U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

Scientific Name:

Anthus spragueii

Common Name:

Sprague's Pipit

Lead region:

Region 6 (Mountain-Prairie Region)

Information current as of:

08/29/2014

Status/Action

___ Funding provided for a proposed rule. Assessment not updated.

___ Species Assessment - determined species did not meet the definition of the endangered or threatened under the Act and, therefore, was not elevated to the Candidate status.

___ New Candidate

_X_ Continuing Candidate

Listing Priority Number (LPN) Change
Former LPN: 8
New LPN: 11

___ Candidate Removal

___ Taxon is more abundant or widespread than previously believed or not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status

___ Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species

___ Range is no longer a U.S. territory

___ Insufficient information exists on biological vulnerability and threats to support listing

___ Taxon mistakenly included in past notice of review

___ Taxon does not meet the definition of "species"

___ Taxon believed to be extinct

___ Conservation efforts have removed or reduced threats

___ More abundant than believed, diminished threats, or threats eliminated.

Petition Information

___ Non-Petitioned

_X_ Petitioned - Date petition received: 10/10/2008

90-Day Positive:12/03/2009

12 Month Positive:09/15/2010

Did the Petition request a reclassification? **No**

For Petitioned Candidate species:

Is the listing warranted(if yes, see summary threats below) **Yes**

To Date, has publication of the proposal to list been precluded by other higher priority listing? **Yes**

Explanation of why precluded:

Higher priority listing actions, including court-approved settlements, court-ordered and statutory deadlines for petition findings and listing determinations, emergency listing determinations, and responses to litigation, continue to preclude the proposed and final listing rules for this species. We continue to monitor populations and will change its status or implement an emergency listing if necessary. The Progress on Revising the Lists section of the current CNOR (http://endangered.fws.gov/) provides information on listing actions taken during the last 12 months.

Historical States/Territories/Countries of Occurrence:

- **States/US Territories**: Arizona, Arkansas, Colorado, Kansas, Louisiana, Minnesota, Mississippi, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Wyoming
- **US Counties**: Campbell, WY, Crook, WY, Park, WY
- **Countries**: Canada, Mexico, United States

Current States/Counties/Territories/Countries of Occurrence:

- **States/US Territories**: Arizona, Arkansas, Colorado, Kansas, Louisiana, Minnesota, Mississippi, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas
- **US Counties**: Franklin, AR, Lafayette, AR, Little River, AR, Miller, AR, Cochise, AZ, La Paz, AZ, Maricopa, AZ, Santa Cruz, AZ, Yuma, AZ, Acadia, LA, Allen, LA, Avoyelles, LA, Bienville, LA, Bossier, LA, Caddo, LA, Calcasieu, LA, Cameron, LA, Catahoula, LA, DeSoto, LA, East Baton Rouge, LA, East Carroll, LA, Iberia, LA, Iberville, LA, Jackson, LA, Jefferson Davis, LA, Lafayette, LA, La Salle, LA, Natchitoches, LA, Orleans, LA, Plaquemines, LA, Rapides, LA, Red River, LA, Richland, LA, St. Bernard, LA, St. Charles, LA, St. John the Baptist, LA, St. Martin, LA, St.

Tammany, LA, Tensas, LA, Terrebonne, LA, Vermilion, LA, West Baton Rouge, LA, West Feliciana, LA, Clay, MN, Polk, MN, Roseau, MN, Big Horn, MT, Blaine, MT, Broadwater, MT, Carbon, MT, Carter, MT, Cascade, MT, Chouteau, MT, Custer, MT, Daniels, MT, Dawson, MT, Fallon, MT, Fergus, MT, Gallatin, MT, Garfield, MT, Glacier, MT, Golden Valley, MT, Hill, MT, Jefferson, MT, Judith Basin, MT, Lewis and Clark, MT, Liberty, MT, Madison, MT, McCone, MT, Meagher, MT, Musselshell, MT, Park, MT, Petroleum, MT, Phillips, MT, Pondera, MT, Powder River, MT, Powell, MT, Prairie, MT, Richland, MT, Roosevelt, MT, Rosebud, MT, Sheridan, MT, Stillwater, MT, Sweet Grass, MT, Teton, MT, Toole, MT, Treasure, MT, Valley, MT, Wheatland, MT, Wibaux, MT, Yellowstone, MT, Adams, ND, Barnes, ND, Benson, ND, Billings, ND, Bottineau, ND, Bowman, ND, Burke, ND, Burleigh, ND, Cavalier, ND, Dickey, ND, Divide, ND, Dunn, ND, Eddy, ND, Emmons, ND, Golden Valley, ND, Grand Forks, ND, Grant, ND, Hettinger, ND, Kidder, ND, LaMoure, ND, Logan, ND, McHenry, ND, McIntosh, ND, McKenzie, ND, McLean, ND, Mercer, ND, Morton, ND, Mountrail, ND, Oliver, ND, Pembina, ND, Pierce, ND, Ramsey, ND, Ransom, ND, Renville, ND, Rolette, ND, Sargent, ND, Sheridan, ND, Sioux, ND, Slope, ND, Stark, ND, Stutsman, ND, Towner, ND, Walsh, ND, Ward, ND, Wells, ND, Williams, ND, Bernalillo, NM, Chaves, NM, Curry, NM, DeBaca, NM, Dona Ana, NM, Eddy, NM, Grant, NM, Guadalupe, NM, Hidalgo, NM, Lea, NM, Luna, NM, Otero, NM, Roosevelt, NM, San Juan, NM, San Miguel, NM, Sierra, NM, Socorro, NM, Union, NM, Canadian, OK, Cleveland, OK, Grady, OK, Jefferson, OK, Kiowa, OK, Latimer, OK, Mayes, OK, McClain, OK, Murray, OK, Payne, OK, Pittsburg, OK, Butte, SD, Campbell, SD, Corson, SD, Custer, SD, Dewey, SD, Fall River, SD, Haakon, SD, Hand, SD, Harding, SD, Hyde, SD, Jackson, SD, Jones, SD, Lawrence, SD, Lyman, SD, McPherson, SD, Meade, SD, Pennington, SD, Perkins, SD, Shannon, SD, Stanley, SD, Ziebach, SD, Aransas, TX, Atascosa, TX, Bee, TX, Brazoria, TX, Brazos, TX, Calhoun, TX, Cameron, TX, Chambers, TX, Galveston, TX, Grimes, TX, Harris, TX, Hidalgo, TX, Jim Wells, TX, Kenedy, TX, Kleberg, TX, Matagorda, TX, Maverick, TX, Nueces, TX, Refugio, TX, San Patricio, TX, Starr, TX, Victoria, TX, Willacy, TX, Wilson, TX, Zavala, TX

- **Countries**: Canada, Mexico, United States

Land Ownership:

Table 1 shows the land ownership for the Sprague's pipit range for the U.S. and Canada. As the table shows, most of the range in both the U.S. and Canada is in private ownership.

Table 1: Percent land ownership in the breeding range of the Sprague's pipit (Lipsey *in litt*. 2014a, pp. 16-17).

	United States	**Canada**
Private	66.9%	72.9%
Tribal/First Nations	13.6%	1.4%
Federal	12.8%	6.0%
State/Provincial	6.4%	19.3%
Private Conservation	0.3%	0.4%

Lead Region Contact:

OFC OF THE RGNL DIR, Justin Shoemaker, 303 236-4214, Justin_Shoemaker@fws.gov

Lead Field Office Contact:

ND ESFO, Carol Aron, 605-773-2745, carol_aron@fws.gov

Biological Information

Species Description:

The Sprague's pipit is a small prairie bird 10 to 15 cm (3.9 to 5.9 in) in length, and 22 to 26 g (0.8 to 0.9 oz) in weight, with buff and blackish streaking on the crown, nape, and underparts. Males and females are similar in appearance. The Sprague's pipit has a plain buffy face with a large eye-ring. The bill is relatively short, slender, and straight, with a blackish upper mandible. The lower mandible is pale with a blackish tip. The wings and tail have two indistinct wing-bars, and the outer retrices (tail feathers) are mostly white (Robbins and Dale 1999, p. 3-4). Juveniles are slightly smaller, but similar to adults, with black spotting rather than streaking (Robbins and Dale 1999, p. 3). Male Sprague's pipits have a territorial flight display that takes place high in the air and that can last up to 3 hours (Robbins 1998, pp. 435-436).

Taxonomy:

The Sprague's pipit is a small passerine of the family Motacillidae, genus Anthus, native to the Northern Great Plains (Robbins and Dale 1999, p. 1). It was first described by Audubon (1844, pp. 334-336). It is one of the few bird species endemic to the North American prairie. The closest living relative is believed to be the yellowish pipit (A. *lutescens*) of South America (Robbins and Dale 1999, p. 9).

Habitat/Life History:

Sprague's pipits are strongly tied to native prairie (land which has never been plowed) on both the breeding and wintering grounds (Davis 2004, pp. 1138-1139; Dechant *et al*. 1998, pp. 1-2; McMaster *et al*. 2005, p. 219; Levandoski *in litt*. 2014, pp. 1-2; Owens and Myres 1973, pp. 705, 708; Ruvalcaba-Ortega *et al*. 2012; p. 15). In migration and on the wintering grounds, there are also reports of pipits occurring in a variety of non-native grass habitat (Arizona Game and Fish Department 2010, p. 4; Desmond 2006, p. 1; Dieni *et al*. 2003a, p. 31; Igl and Ballard 1999, p. 776; Imhof 1958, p. 355; James 1960, pp. 11-12; James and Neal 1986, p. 278; McCaskie 1975, pp. 29-30; Arizona Game and Fish Department 2010, p. 4; Stephens 2011, pp. 13, 25). They are rarely observed in cropland (Koper *et al*. 2009, p. 1987; Owens and Myres 1973, pp. 697, 707; Igl *et al*. 2008, pp. 280, 284) or land in the Conservation Reserve Program (a federal program whereby marginal farmland is planted primarily with grasses), presumably because the vegetation is too dense (Higgins *et al*. 2002, pp. 46-47). Sprague's pipits will use nonnative planted grassland when the vegetative structure is appropriate (Higgins *et al*. 2002, pp. 46-47; Dechant *et al*. 1998, p. 3; Dohms 2009, pp. 77-78, 88). Vegetation structure may be a better predictor of Sprague's pipit occurrence than plant species composition throughout the range (Davis 2004, pp. 1135, 1137). Preferred grass height has varied between studies, but is estimated to be between 10 and 30 cm (4 and 12 in.) on both the breeding and wintering ground (Dieni and Jones 2003b, p. 390; Madden *et al*. 2000, p. 382; Pool *et al*. 2012, pp. 55-56; Sutter 1997, pp. 464-466). The species prefers to breed in well-drained, open grasslands and avoids grasslands with excessive shrubs throughout the range (Desmond *et al*. 2005, p. 442; Grant *et al*. 2004, p. 812; Pool *et al*. 2012, pp. 55-56; Sutter 1997, p. 464).

During the breeding season, Sprague's pipits prefer to nest in native grassland, defined as areas with at least 75 percent cover in native species and without a history of cultivation in most of the plot (Davis *et al*. 2013, p. 909). A minimum size requirement has been suggested to be approximately 145 hectares (ha) (358.3 ac) (range 69 to 314 ha (170 to 776 ac)) of native grassland (Davis 2004, p. 1134), with individuals not observed in areas smaller than 29 ha (71.6 ac) (Davis 2004, p. 1134). The best predictor of Sprague's pipit presence is the amount of native grassland within 400 m (1,312 ft) of the breeding parcel (Davis *et al*. 2013). Sprague's pipits will nest in planted grassland (Dechant *et al*. 1998, pp. 1, 4; Dohms 2009, pp. 41-81), although

fledgling success in non-native prairie is lower than nests in native prairie (Fisher and Davis 2011, pp. 263, 269). Sprague's pipits are up to five times more likely to occur in native compared with planted parcels (Davis *et al*. 2013, p. 7).

Sprague's pipits can be found in lightly to moderately grazed areas (Dechant *et al*. 1998, p. 4), but in North Dakota, a greater abundance of Sprague's pipits have been reported from moderately to heavily grazed areas (Kantrud 1981, p. 414). However, these descriptions are relative; vegetation described as lightly grazed in one study may be called heavily grazed in another (Madden *et al*. 2000, p. 388).

Sprague's pipits winter use of an area on an annual basis is highly dependent on current habitat conditions, which in turn are closely related to the previous summer's rainfall (Dieni *et al*. 2003a, p. 31; MacÃ-as-Duarte *et al*. 2009, p. 901; MacÃ-as-Duarte*et al*. 2011, p. 38). Sprague's pipits preferred grassland habitat in the Chihuahuan Desert consists of 80 percent grass cover, with average grass height of 28 cm (11 in) and less than 5 percent shrub cover (Pool et al. 2012a, pp. 55-56). It is not clear whether converted habitat can be restored (Pool and Panjabi 2011, p. 4), but removing shrubs would likely increase Sprague's pipit use (Pool and Panjabi 2011, p. 4; Pool *et al*. 2012a, p. 56).

While most sightings of Sprague's pipits on the wintering grounds are on native prairie (Pool *et al*. 2012, p. 55), they may not be so tightly tied to native prairie in winter or migration as they are on the breeding grounds (Igl and Ballard 1999, p. 776; Stephens 2011, pp. 13, 25).

Historical Range/Distribution:

The historical breeding range is described as throughout North Dakota, except for the southeastern-most counties; northern and central Montana east of the Rocky Mountains; northern portions of South Dakota, northwestern Minnesota, and possibly some small patches in extreme northcentral and northwest Wyoming (Sauer *et al*. 2012, p.6). In Canada, Sprague's historical breeding range included southeastern Alberta, the southern half of Saskatchewan, and in southwest Manitoba (Robbins and Dale 1999, p. 5, Sauer *et al*. 2012, p. 6).

There is no detailed information regarding the historical winter range (Jones 2010, p. viii).

Current Range Distribution:

The most recent Breeding Bird Survey (BBS) analysis of the Sprague's pipits range, which includes an estimate of the species distribution based on surveys conducted from 2006-2012, shows a reduction of the species range compared with the previous range from 1994-2003 (Sauer *et al*. 2012, p. 6). The edges of the range have been reduced to exclude Minnesota and Wyoming, most of eastern North Dakota, much of South Dakota, and parts of southern and western Montana. In Canada, the updated species distribution excludes eastern and northern Manitoba, and portions of Saskatchewan and Alberta. Especially in the eastern portion of the range, very little grassland breeding habitat remains (Lipsey *et al*. 2014, p. 10).

Recent analysis of survey data on breeding range collected from a number of sources from 2007-2012 revealed that the species has a highly clumped distribution (Lipsey *et al*. 2014, p. 7). Seventy-five percent of the population uses approximately 29 percent of the breeding range (hereafter referred to as the Core area) (Lipsey *in litt*. 2014b, p. 3) (Figure 1).

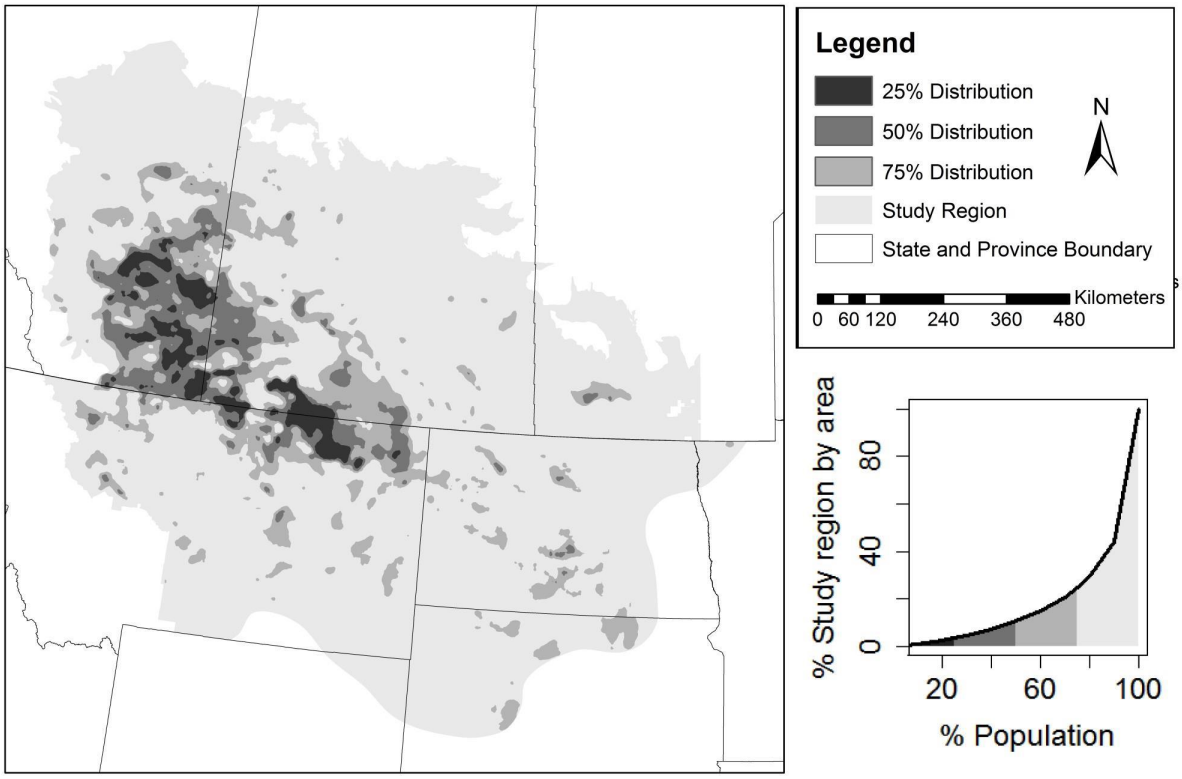

Figure 1: The range of the Sprague's pipit (light gray) from the BBS data with areas of higher occupancy shaded darker. As the graph on the lower right shows, 75 percent of the population is concentrated in approximately 29 percent of the range.
Source: Lipsey *et al*. 2014, p. 7.

The Sprague's pipits current wintering range includes south-central and southeast Arizona, Texas, southern Oklahoma, southern Arkansas, northwest Mississippi, southern Louisiana, and northeastern Mexico, to Michoacan, Puebla, and Veracruz (Robbins and Dale 1999, p. 6). Most of the winter range, and we assume most of the population, winters in Mexico (Robbins and Dale 1999, pp. 5-6). The vast majority of the winter sightings in the U.S. have been in Texas (Figure 2) (From National Audubon Society 2012, p. 1). There have been migration sightings in Michigan, western Ontario, Ohio, Massachusetts, and Gulf and Atlantic States from Mississippi east and north to South Carolina. Sprague's pipits also have been sighted in California during fall migration (Robbins and Dale 1999, p. 6; From National Audubon Society 2012, p. 1).

In the U.S., most of the Sprague's pipit winter range sightings are in the coastal prairie of Texas and Louisiana (Figure 2). However, the majority of the population likely resides in Mexico during the winter, which is not shown on the figure below.

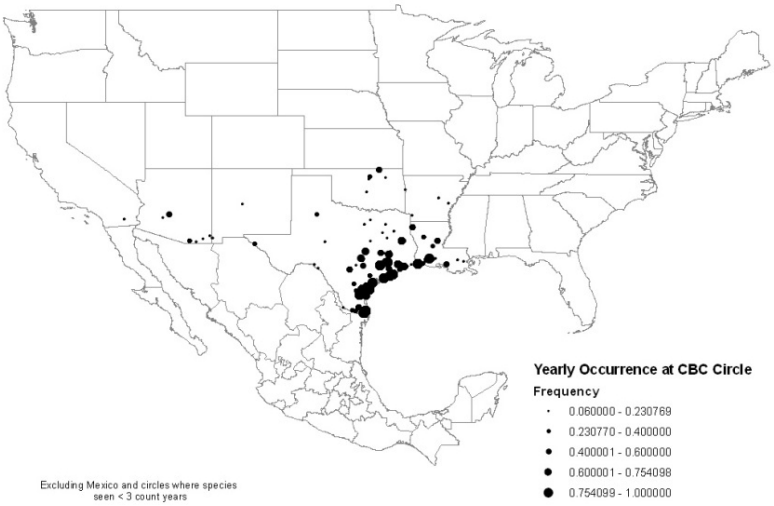

Figure 2: The relative frequency of Sprague's pipits reported at Christmas Bird Count Circles in the U.S. from 1951 through 2011 when the species was observed in more than three count years during the period of the count. Note that most of the observations are along the coastal prairie of Texas and Louisiana. Source: Audubon's Annual Christmas Bird Count 2012 (pages not available)

A study in seven Chihuahuan Desert Grassland Priority Conservation Areas (GPCA) in Northern Mexico, southeastern Arizona, southern New Mexico and west Texas provided information about Sprague's pipit presence and density in those areas of the winter range (Macias-Duarte *et al.* 2011, entire; Pool *et al*. 2012a, p. 52). Sprague's pipits were broadly distributed across the region (Figure 3, Table 2), with Cuchillas de la Zarca, El Tokio, Valle Colombia in the southeastern part of the Chihuahuan Desert having the highest density for the survey period between 2007-2011 (Macias-Durarte *et al*. 2011, pp. 151-152; Pool *et al*. 2012a, p. 52). Presence and density varied dramatically between years and areas. For example, in Cuchillas de la Zarca, no Sprague's pipits were observed in 2007, while a mean of 7.05 (CI 4.96 to 9.77) individuals were observed along survey transects in 2010 (Macias-Durarte *et al*. 2011, p. 151). This suggests that having large areas of extant grassland spread throughout the winter range is important for species viability so that birds can winter in areas where the grassland conditions are good in that year (Macias-Duarte *et al*. 2011, p. 38).

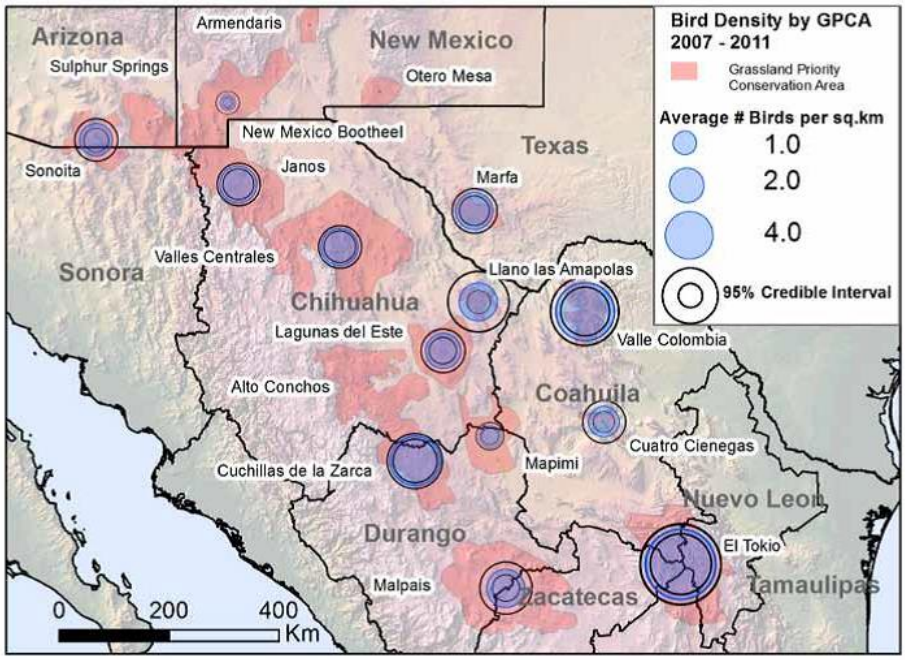

Figure 3: The estimated mean density (in Sprague's pipits per km^2) across years in the surveyed Grassland Priority Conservation Areas. The size of the circle is proportional to the density in the area. The blue circle shows the mean density, while the concentric black circles show the 95% credible intervals. Source: Macias-Durarte *et al*. 2011, p. 153

Table 2: The mean density of Sprague's pipits observed in each Grassland Priority Conservation Areas and the number of years that the survey occurred in that area. The Sprague's pipit is fairly well distributed across the Grassland Priority Conservation Areas. Source: Macias-Durarte *et al*. 2011, pp. 151-152

Grassland Priority Area	**Mean Birds Observed expressed as individuals/km^2 (CI)**	**Years Area Surveyed**
Armendaris	0	2011
Cuatro Ciénegas	1.67 (0.81-3.16)	2007-2010
Cuchillas de la Zarca	4.27 (0.49-5.28)	2007-2011
El Tokio	8.65 (1.29-11.29)	2007-2011
Janos	2.37 (0.38-3.18)	2007-2011
Lagunas del Este	2.13 (0.52-3.26)	2009-2011
Llano Las Amapolas	2.61 (1.34-6.33)	2009-2011
Malpaís	2.57 (0.85-4.73)	2010-2011
Mapimí	0.84 (0.21-1.31)	2007-2011
Marfa	2.34 (0.52-3.54)	2009-2011
NM Bootheel	0.45 (0.21-0.99)	2011
Otero Mesa	0	2011
Sonoita	1.90 (0.56-3.21)	2008-2011
Sulphur Springs	0	2011
Valles Centrales	2.43 (0.34-3.15)	2007-2011
Valle Colombia	6.04 (0.98-8.12)	2007-2011

Population Estimates/Status:

The best available information we currently have regarding the estimated size of the Sprague's pipit population is approximately 900,000 individuals rangewide, based on an analysis of BBS data (Partners in Flight 2013, p. 6). The BBS is a standardized survey performed annually across the continental U.S. and Canada since 1966. Surveyors travel along the same routes at the same time of year annually and count bird seen or heard during three-minute stops every half-mile (Sauer *et al.* 1997, entire). However, the 900,000 population estimate is considered conservative because the BBS routes in the U.S. used to generate this number were largely from a portion of the range where the species occurs in low breeding densities (Sauer *in litt.* 2013, p. 9; Lipsey *et al*. 2014, p. 7). In the U.S., only five routes of 54 total routes run in the U.S. portion of the range were surveyed in the species Core area (Sauer *in litt*. 2014b, p. 3). While the routes to be included in the BBS were randomly selected, we found in our evaluation that many routes, especially in the Core area of Montana and the Dakotas, are not run, presumably due to their locations in sparsely populated areas that are time consuming to access. For routes within the U.S. Core area, the annual index of route abundance was 15.18 individuals (CI 7.6 to 31.7), while outside of the U.S. Core area, the annual index of route abundance was 0.57 individuals (CI 0.36 to 0.91) (Sauer *in litt*. 2014b, p. 3). Thus, the population estimate from the U.S. portion of the breeding range is likely an underestimate, because the part of the range where the species is concentrated is under-represented in the survey routes. Note that this is not an issue in Canada, where habitat is well represented across the Sprague's pipit range (Sauer *in litt*. 2014, p. 5).

Nevertheless, we conservatively use the published population estimate of 900,000 individuals as the starting point to forecast the extinction risk for the future population. The Endangered Species Act (16 U.S.C. 1531 *et seq*.) defines a Threatened species as one that is likely to become endangered within the foreseeable future. We use 40 years as a reasonably foreseeable future for this analysis. This time period represents modeling that was the least speculative and encompasses a minimum of 10 to 20 generations, assuming a generation time of 2 to 4 years (COSEWIC 2010, p. V).

Because the Sprague's pipit population is highly clumped, with most of the remaining population concentrated in areas with relatively large, intact, grassland (Lipsey *et al*. 2014, p. 7) (see further discussion in the *Current Range Distribution* section), the Service elected to evaluate population trends both inside and outside of the Core area. The annual population trend in the Core area (both U.S. and Canada) from 2003-2012 was -1.61 (CI -5.7 to 3.6) (Figure 4) (Sauer *in litt*. 2014a, excel spreadsheet). While the mean estimate is negative, note that the credible intervals encompass zero. When the credible intervals include zero, this indicates that there is no strong trend in any direction and suggests a stable population that cannot reliably be predicted to either increase or decrease in the foreseeable future. Therefore, we cannot determine with any certainty whether the trend in the Core area is increasing, decreasing, or stable. By contrast, outside of the Core area, the trend shows a downward trend for the same period in both the overall estimate and in the credible intervals; -9.84 (-14.11 to -5.67) (Sauer *in litt*. 2014a, excel spreadsheet). As stated above, 75 percent of the population is concentrated in approximately 29 percent of the range.

To determine how these trends might affect the species distribution and abundance into the foreseeable future, we evaluated the change in abundance both inside and outside of the Core area using the most recent trend reported above. The Service estimates that 675,000 individuals currently breed in the Core area (75 percent of 900,000). Therefore, if the most recent ten-year trend continues in the Core area (-1.61 [CI -5.7 to 3.6]), there would be an estimated 356,000 (CI 65,000 to 2,800,000) individuals remaining in 2054 within the Core area. Outside of the Core area, where an estimated 225,000 individuals currently reside (25 percent of 900,000), the projected estimate for 2054 is 3,600 (CI 500 to 22,000) with the steeper decline outside of the Core area -9.84 (-14.11 to -5.67) (Sauer in litt. 2014a, excel spreadsheet). Assuming the vital rates and the species response to existing threats remains unchanged from current conditions, the reasonable worse-case response of the species indicates the area of occupancy associated with the current distribution of the species would be expected to exhibit a strong decrease, largely due to the expected decline in abundance of the species in non-core breeding habitat. In total, the species would have a population size of 356,000 individuals (CI 65,000 to 2,800,000) in the year 2054.

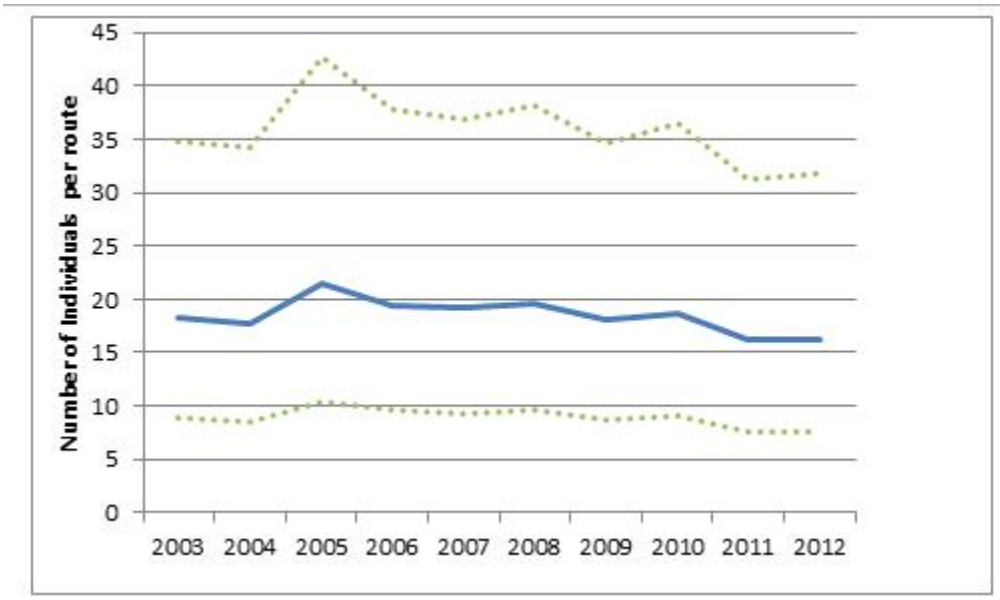

Figure 4: The Sprague's pipit population trend from 2003 through 2012 in the Core area (U.S. and Canada

breeding range) from the BBS analysis. Note that while the mean trend estimate is -1.61 (solid line), the credible intervals encompass zero (-5.7 to 3.6) (dotted lines).

The Christmas Bird Count (CBC) is a long-term survey effort performed in the few weeks around Christmas in which observers attempt to count all birds observed in 15 mile count circles (Dunn *et al*. 2005, p. 338). For this analysis, count circles from 1966 through 2013 were used. The CBC data is long-term and widespread, making it a valuable source of data (Dunn *et al*. 2005, p. 1). However, the CBC has some limitations in design, reducing the ability to perform rigorous statistics (Dunn *et al*. 2005, entire). Locations are non-random, and they are generally surveyed by volunteers with variable birding experience (Dunn *et al*. 2005, pp. 1-2). This can be problematic for observing relatively nondescript, secretive species like the Sprague's pipit, which are difficult to observe and are easily misidentified. Data from the CBC in the U.S. show an uncertain to stable trend for the Sprague's pipit from both the period of the survey from 1966-2013 (-0.49; CI -2.16 to 0.9) and for the past ten years from 2003-2012 (0.59; CI -2.88 to 4.04) (Soykan *in litt*. 2014, excel spreadsheet). Note that the previous analysis for the period from 1966 through 2010 showed a declining trend (-4.2; CI -2.6 to -6.0) (Niven *in litt*. 2012, entire), so the population trend may have stabilized in recent years.

While we acknowledge that both the BBS and the CBC have limitations in their design and implementation (the large number of unsurveyed BBS routes in the Core area of the U.S. portion of the breeding range and the non-random location selection and potential observer inexperience with the CBC), we conclude that these efforts provide reliable information about population trends because of their wide-spread nature and long-term datasets. Even though the surveys take place in different parts of the species range (breeding and wintering) and use different methodologies, both the BBS and CBC analyses independently come to a similar conclusion that the long-term population decline has ceased and the population shows no clear trend either increasing or decreasing.

Distinct Population Segment(DPS):

We have determined that the entire species is warranted for listing under the ESA as threatened or endangered, but that listing has been precluded by higher priorities, so no DPS analysis is necessary.

Threats

A. The present or threatened destruction, modification, or curtailment of its habitat or range:

Grassland Conversion on the Breeding Grounds

Approximately 25 to 30 percent of prairie habitat in the Great Plains and Canada remains from pre-colonial times (Gauthier and Wiken 2005, p. 343; Samson *et al*. 2004, p. 7). Land conversion is ongoing as native prairie is converted to agricultural uses (Hoekstra *et al*. 2005, p. 25; Stephens *et al*. 2008, pp. 1326-1327). Conversion of native prairie to cropland continues, particularly in the Northern Plains of Montana, North Dakota, and South Dakota (Government Accountability Office 2007, pp. 4, 12, 15). A number of factors encourage farmers to convert native prairie, including; higher crop prices, especially for corn; farm payment programs that increase expected cropland profitability without increasing risk; the advent of herbicide-ready crops; and no-till farming methods, which allow farmers to plant directly into native prairie (Government Accountability Office 2007, pp. 4). One study estimated that there was an approximately 3.2 percent loss of native grassland in the Missouri River coteau (a large plateau along the eastern and northern side of the Missouri River) in North Dakota and South Dakota during an 11-year period from 1992 to 2002 (Stephens *et al*. 2008, pp. 1322, 1325). However, this number cannot be reliably extrapolated across the range because a number of factors including climate, soil suitability, precipitation, land ownership, and growing season, among others, make conversion less likely in north-central Montana and much of the Canadian portion of the Sprague's pipit range (Lipsey *in litt*. 2014b, p. 1; Lipsey *et al*. 2014, p. 5). While conversion is ongoing, the

best available information indicates that most conversion will occur outside of the Core area for Sprague's pipit (Lipsey *et al*. 2014, pp. 12-14). The highest risk of cropland conversion is near areas that are already extensively cropped and where there are already few Sprague's pipits: along the Missouri River coteau and in the wheat producing regions of southwest North Dakota and northern Montana (Rashford *et al*. 2013, pp. 14-16; Lipsey *et al*. 2014, pp. 10-13).

Lipsey *et al*. 2014 (entire) developed a model to evaluate the risk of habitat conversion to cropland in the U.S. portion of the Sprague's pipit breeding range (a similar evaluation is underway for the Canadian portion of the range, but results are not yet available). The model evaluated a number of factors to determine likelihood of conversion on the remaining grassland areas. Factors included in the analysis were: risk of drought, annual precipitation (both snowfall and rain), summer precipitation, frost-free days, annual temperature, land ownership, and federal, state, and conservation easements held by non-profit entities (Lipsey *in litt.* 2014b, p. 1; Lipsey *et al*. 2014, p. 5). Three scenarios were evaluated that spanned the reasonable future potential risk of conversion within the Sprague's pipit range. Under the Background Growth scenario, the best 2 percent of habitat would be converted. Under the Constrained Growth scenario, the best 30 percent of habitat would be converted, and for unconstrained growth scenario, the best 70 percent of habitat would be converted. The map of which areas were predicted to be converted under the various conversion scenarios were then overlaid with the model results of where the Sprague's pipit population is concentrated to predict how the various conversion scenarios would impact the Sprague's pipit population. Table 3 shows the three conversion scenarios considered and the resulting effects that the model predicts would occur on the amount of cropland and on the Sprague's pipit population.

In February of 2014, the Service invited a number of Sprague's pipit experts to an expert elicitation meeting to facilitate information exchange and elicit individual expert opinion on issues regarding the species biological status. We did not seek consensus among experts. Instead, we focused on fully probing and understanding the basis for, and extent of, differences of opinion or interpretation. Discussions focused on scientific and technical information; experts were not asked to provide, nor did they voluntarily discuss or recommend, management decisions related to the ESA. The information gathered and analyses conducted during the expert elicitation meeting was considered along with the published literature and other information in our records to inform our decision. At the meeting, results of the model predicting habitat loss on the U.S. breeding grounds were presented under various conversion scenarios (Table 3, Figure 5) (USFWS 2014, Appendix E, pp. 11-13).

Table 3: Three conversion risk models of the Sprague's pipit U.S. Breeding range. These models predict the population effects of these levels of conversion on the Sprague's pipit.

Scenario	**Tillage Risk Cutoff**	**Tillage Risk Cutoff**	**Predicted Population Loss**
Background Growth	0.98	1.2 million	~1-2%
Constrained Growth	0.7	1.2 million	~10-15%
Unconstrained Growth	0.3	30.9 million	~30%

Source: Lipsey *et al*. 2014, p. 14

The Service concludes that the Constrained Growth scenario (Figure 5) is the best approximation of the future for the following reasons. With the availability of crop insurance, increased crop prices, market demand, and tile drainage, areas that have been unsuitable for cropping will become more likely to be converted to row-crop agriculture (Government Accountability Office 2007, pp. 4-5; Classen *et al*. 2011, pp.

i, 1). Even so, factors such as soil quality, dry conditions, cooler temperatures, and relatively short growing season are likely to limit row-crop agriculture in north-central Montana. Therefore, the Constrained Growth scenario, which predicts a mid-level amount of conversion, most likely represents a reasonable future scenario. As shown in Table 3, the model predicts a 10-15 percent population loss under the Constrained Growth scenario. The current Sprague's pipit population is conservatively estimated to be 900,000 individuals (see discussion in the Population Estimates/Trend section), with approximately 170,000 individuals in the U.S. (Partners in Flight 2013, p. 11). Therefore, a loss of 10-15 percent of the population would result in approximately 145,000 to 153,000 individuals remaining in the U.S. portion of the range after the most vulnerable 30 percent of prairie in the U.S. range has been converted.

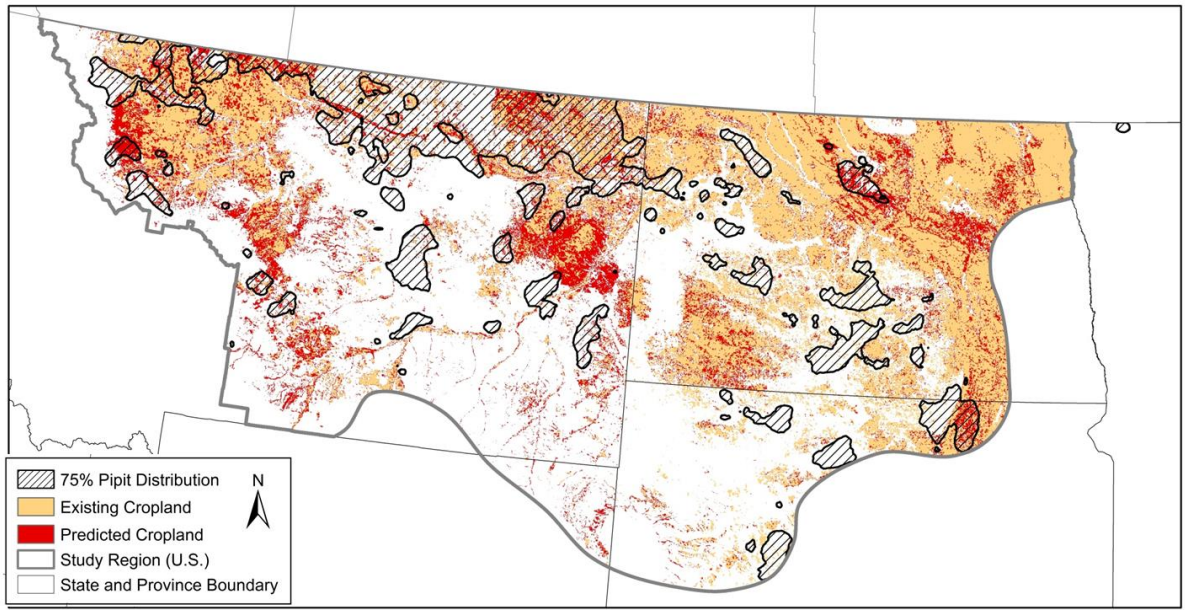

Figure 5: The Sprague's pipit range showing the Core area (hatched) and the predicted conversion to cropland (red) under the Constrained Growth scenario, which we consider the most likely to occur. Under this scenario, the model predicts a 10 to 15 percent decline in the U.S. population.

The model does not include a time element. It predicts how much grassland would likely be converted and in what areas, but not when. Stephens *et al*. (2008, p. 1325) estimated that there was a 3.2 percent conversion of prairie to cropland along the Missouri River coteau in North and South Dakota during the 11-year period from 1992 through 2002, or approximately a 0.3 percent annualized rate. Assuming that this conversion rate is similar to the future conversion rate throughout the Sprague's pipit Core area, it would take approximately 97 years for the conversion predicted in the Constrained Growth model to occur. However, for the reasons discussed above, the conversion rate in the Missouri Coteau region is probably higher than the conversion risk in north-central Montana that has much more Sprague's pipit Core area habitat. Therefore, even though we anticipate continued grassland conversion in parts of the Sprague's pipit breeding range, it is likely to be at a much lower rate than modeled here (i.e. the ending population would be higher) and is unlikely to be at a scale that would threaten the species.

In Canada, an estimated 25 to 30 percent of native grassland remains, although much of that is fragmented or otherwise unsuitable for Sprague's pipit nesting (Gauthier and Wiken 2005, pp. 343, 348; Dale *in litt*. 2010, entire; Roch and Jaeger 2014, pp. 1, 11-14). Approximately 94 percent of the species range has been lost in Canada (Dale *in litt*. 2010, entire). Of the approximately 20 million ha (49.4 million ac) remaining as grassland in the Sprague's pipits range in Canada, 15 to 20 percent (3 to 4 million ha (7.4 to 9.9 million ac)) remains in patches large enough to support breeding territories (Dale *in litt*. 2010).

While prairie conversion is still occurring, modelling of the conversion risk in the U.S. suggests it will only impact an estimated 10-15 percent of the U.S. population, leaving 145,000 to 153,000 individuals in the U.S.

after the most at-risk 30 percent of the remaining grassland is converted. Because the habitat in the Canadian portion of the range is drier and cooler, conversion risk may be lower, and thus impact less of the approximately 80 percent of the population that breeds in Canada. Evaluating a reasonable worst-case-scenario, if future conversion impacts 10-15 percent of the Canadian population as well, the remaining total population would be 765,500 to 810,000 individuals.

Grazing on the Breeding Grounds

Grazing is a major influence in maintaining the prairie ecosystem. An appropriate level of grazing can help to maintain the prairie habitat, while too much or too little may make the habitat unsuitable for Sprague's pipits (Dechant *et al*. 1998, pp. 2-5). However, Sprague's pipits avoid idle areas with deep litter (Prescott 1997, p. 1). Much of the prairie is now grazed more uniformly than it was in pre-colonial times and in some areas may be overgrazed (Sliwinski 2011, p. 21; Walker *et al*. 1981, p. 473), leading to a decline in species diversity and an increase in woody structure (since cattle do not eat woody vegetation, it has a competitive advantage over grass if some other mechanism is not used to remove trees and shrubs) (Walker *et al*. 1981, pp. 478-481; Towne *et al*. 2005, pp. 1550-1558). While improperly timed or overly heavy or light grazing negatively impacts Sprague's pipits ability to use an area, prairie is a disturbance-dependent habitat, and grazing is an effective management method. Some areas are undoubtedly grazed at an intensity incompatible with Sprague's pipit (USFWS 2014, pp. 4-5), but this appears to be a local rather than a rangewide problem, and overgrazed areas recover quickly with sufficient moisture (USFWS 2014, pp. 4-5). There is insufficient information to conclude the change in the grazing regime since European settlement throughout much of the range impacts the Sprague's pipit, but from the available information, we conclude that grazing on the breeding grounds is not a threat to the species. More impactful to Sprague's pipit are those circumstances where ranching/grazing lands are converted to cropland.

Fire Suppression

Like grazing, fire is a major driver on the prairie ecosystem. While there are still some controlled and wild prairie burns, fire is no longer a widespread regular phenomenon as it was in pre-colonial times. Fire suppression has allowed suites of plants, especially woody species and non-natives, to flourish (Knopf 1994, p. 251; Samson *et al*. 1998, p. 438). Fire suppression since European settlement throughout the Sprague's pipits range has impacted the composition and structure of native prairie, favoring the incursion of trees and shrubs in areas that were previously grassland on both the breeding and wintering grounds (Knopf 1994, p. 251; Pool *et al*. 2012a, p. 52). This change in structure negatively impacts Sprague's pipits, which avoid trees and are negatively associated with shrub cover throughout the range (Desmond *et al*. 2005, p. 442; Grant *et al* . 2004; p. 812; Sutter 1997, p. 464).

Eliminating fire from the landscape has likely changed the overall composition of the prairie (Towne *et al*. 2005, pp. 1557-1558). Trees and shrubs can be controlled to some extent through grazing or eliminated by regular mowing, although these management practices may result in selection for yet another suite of grassland plant species (Owens and Myres 1973, pp. 700-701). Some form of disturbance is necessary to maintain the grassland ecosystem, and grazing and mowing are generally used today instead of fire. While the lack of widespread fires as a management technique has led to changes in the grassland ecosystem, other methods of habitat maintenance are substituting for the role that fire historically played, albeit other management techniques may result in a different suite of grassland species (Sampson *et al*. 1998, p. 444; Valone and Kelt 1999, pp. 15, 18-26). While returning the pre-colonial fire frequency and intensity would likely benefit the Sprague's pipit, especially by removing trees and shrubs, grazing and mowing also maintain native prairie habitat, so fire suppression does not represent a threat to the species.

Mowing

Like grazing and fire, mowing is a management technique that can be used as a source of disturbance to prevent woody species from invading into grassland habitat. However, mowing (i.e., haying) in the breeding range could negatively impact Sprague's pipits by directly destroying nests, eggs, nestlings, and young fledglings, and by reducing the amount of nesting habitat available in the short term. Nest success of ground-nesting birds is already low, with an estimated 70 percent of nests destroyed by predators (Davis

2003, p. 119). While Sprague's pipits occasionally will renest if the first nest fails or if nestlings from the first clutch fledge early enough in the season, long intervals between nesting attempts suggest that renesting is relatively uncommon (Sutter *et al*. 1996, p. 694). Thus, early mowing can negatively impact reproductive success for the year. Even mowing done later in the season after chicks have fledged may impact the availability of breeding habitat the following year because Sprague's pipits will not use areas with short grass until later in the season when the grass has grown, possibly due to dense revegetation and the lack of litter (Dechant *et al*. 1998, p. 3; Owens and Myres 1973, p. 708; Kantrud 1981, p. 414). On the other hand, as noted above, mowing can improve Sprague's pipit habitat in the long term by removing trees and shrubs and maintaining prairie habitat (Owens and Myres 1973, p. 700).

The information available about the extent, timing, and frequency of mowing throughout the species range is insufficient to conclude that mowing poses a threat to the species. Since mowing can play both a positive and negative role in the maintenance of Sprague's pipit habitat, the impacts of mowing are mixed. In some parts of the range where large portions of the remaining grasslands are mowed annually or grass growth is slow or both, mowing may be negatively impacting the population, but this management technique is likely local rather than regional in scale. From the available information, we conclude that mowing is not a threat to the species.

Energy Development

Oil and Gas

At the time of the 12-month finding in 2010, the available information suggested that oil and gas development was impacting a large percentage of the breeding birds and that Sprague's pipits showed a large and consistent avoidance of oil and gas development, including associated roads (see Roads section for a discussion of species response to roads). Since that time, we received new information on the distribution of the Sprague's pipit, allowing us to focus our analysis on the portion of the range that supports the majority of the population, as well as new information regarding the potential effects of oil and gas development on the Sprague's pipit as discussed below.

Much of the oil and gas development in the U.S. breeding range has occurred in northwestern North Dakota and northeastern Montana, while the U.S. portion of the population is centered in north-central Montana as shown in Figure 1. Therefore, the impacts from the Bakken oil field development are somewhat limited in scope. Energy development is occurring in Canada, but research has suggested that the birds may show less avoidance than previous studies suggested as described below.

New information collected since our 12-month finding in 2010 indicates that the response of Sprague's pipits to oil and gas development and associated infrastructure varies based upon the type of feature and location across the range (Hamilton 2010, pp. 4, 35; Sliwinski and Koper 2010, p. 7; Hamilton *et al*. 2011, p. 1; Kalyn Bogard 2011, pp, 24, 26; Jones *in litt*. 2013, entire; Jones and White 2012, pp. 310-311; Thompson *et al*. 2013, p. 1; USFWS 2014, Appendix J, pp. 16-20). In Alberta, Sprague's pipit abundance decreased as well density increased from 4 to 8 or 16 wells per square mile (1 mi^2 equals 2.59 km^2) (Dale *et al*. 2009, pp. 194, 200; Hamilton 2010, p. 35; Hamilton *et al*. 2011, p. 9). Other studies have shown decreased use within 75-300 m (246-984 ft) of a traditional oil well (USFWS 2014, Appendix J, p. 18; Linnen 2008, pp. 1, 10; Thompson *et al*. 2013, pp. 1, 6-7). However, Sprague's pipits were not affected by natural gas wells in Saskatchewan (Kalyn Bogard and Davis 2014, p. 479). Natural gas wells have a much smaller footprint than oil wells, and because gas is typically transported via pipeline, the nearby roads have less traffic, so overall disturbance is much lower (ND Pipeline Authority 2014, pp 1-3). Where avoidance is observed, it may be a response to other factors associated with the oil and gas development such as a change in vegetation near the well site, roads, development configuration, industrial noise, vehicular traffic, context within the landscape, presence of drilling infrastructure, or regional variation in population (Kalyn Bogard and Davis 2014, p. 479).

The variation in species response observed between studies may represent the disturbance associated with the different types of facilities common in different parts of the range, rather than avoidance of the oil and/or gas

feature itself. For example, new oil wells have a much larger pad, often accommodating multiple wells and higher traffic associated with them than older oil pads or shallow-gas extraction wells. While each well may create more disturbance, siting multiple wells onto a single pad can result in larger spacing between wells, lowering fragmentation and overall impacts (BIA 2014, p.3).

In North Dakota, the number of drilling rigs has increased dramatically in recent years, from 39 rigs in 2006 to an average of 185 in 2012 (North Dakota Petroleum Council 2013, p. 1). The number of rigs is a good indicator of the number of wells drilled (North Dakota Petroleum Council 2013, p. 1). This upward trend is expected to continue. The North Dakota Department of Mineral Resources estimates that an average of 2,000 wells will be constructed annually in North Dakota for the next 20 years, with up to 70,000 wells constructed total (Department of Mineral Resources 2014, p. 18). In Montana, the amount of oil and gas produced has remained fairly stable with only minor fluctuations since 1986 (DrillingEdge 2014, p. 2). Much of the oil activity is occurring in areas of native prairie (Loesch 2010, pers. comm), a trend that we expect to continue given the amount of native prairie overlaying the Bakken formation, an area of high oil and gas potential in western North Dakota, eastern Montana, and southern Alberta and Saskatchewan (Chelsey-Preston 2013b, entire).

Drilling a well requires an estimated 1,360 truck trips over 80 days (50 trucks per day) (BIA 2014, p. 15). Once the well is in production, the amount of truck traffic drops considerably, with only 0.5 to 3 trucks per day if the oil is transported by truck, and less than that if the oil is piped (North Dakota Department of Mineral Resources 2014, p. 7). Thus, traffic decreases somewhat once the wells in an area are complete, especially if pipelines are constructed. If Sprague's pipits do show avoidance of busy roads, then their avoidance of areas with oil and gas development should decrease as the field matures.

However, when oil production drops at a particular well, companies perform a workover, during which they re-frack the well to increase production. Wells are worked over every one-to-two years, in a process that takes from three to ten days (BIA 2014, p. B14). We assume that the amount of traffic associated with a workover is similar to initial construction, so during a workover, each well has approximately 50 truck trips a day. With many wells on each pad or in each lease (oil companies typically lease an area in which they have the right to drill), the workovers may be more-or-less continuous in an area. If traffic causes avoidance behavior in Sprague's pipits, the effect of oil and gas extraction is likely to continue for the life of the field, estimated at least 40 years; 20 years to complete drilling, and at least 20 years of production (North Dakota Department of Mineral Resources 2014, p. 11).

The Bakken formation lies entirely within the U.S. and Canadian breeding range in northeastern Montana, much of western North Dakota, southeastern Alberta, southern Saskatchewan, and the southwest corner of Manitoba. The Williston formation overlies much of the range in eastern Montana, western North Dakota, northeastern South Dakota, much of southern Saskatchewan, and the southwest corner of Manitoba (Chelsey-Preston 2013a, p. 3; Chelsey-Preston 2013b, p. 4; Sauer *et al*. 2008, pp. 17-19; Robbins and Dale 1999, p. 5; USGS 2008, p. 1). We estimate that each well pad directly impacts approximately 1.1 ha (2.75 acres), and requires approximately 472 m (1,549 ft) of new road, which is approximately 20 m (66 ft) wide (Loesch 2010, pers. comm). Therefore, approximately 2 ha (5 ac) of habitat is directly impacted by each well and associated road (Loesch 2010, pers. comm.). As discussed above, Sprague's pipits may avoid oil wells, staying from 75 to 350 meters (m) (246 to 1148 ft) away, magnifying the effect of the well feature itself (Linnen 2008, pp. 1, 9-11; Thompson et al. 2013, pp. 1, 6-7; USFWS 2014, Appendix J, p. 18). If we include the avoidance distance, each well and associated road can impact from 9 to 71 ha (22 to 175 ac). In 2010, there were 1,421 wells drilled within the Sprague's pipit U.S. breeding range. Of these we estimated that approximately 570 were on potentially suitable habitat, potentially impacting up to approximately 4,900 to 40,000 ha (12,500 to 100,000 ac), including the area avoided if each well had its own well pad rather than being clumped (Loesch 2010, pers. comm.). Additionally, as discussed in the Current Range Distribution section, the Sprague's pipit population is concentrated in north-central Montana, southern Alberta, and southern Saskatchewan, so the ongoing oil development in western North Dakota does not impact most of the breeding population.

Depending on the degree of avoidance Spragues pipits show to these features, oil and gas development could result in a reduction of use across the south-eastern portion of the range. However, Spragues pipits show variable avoidance of different features across the range and to date, most of the oil and gas development in the U.S. has been outside of the Core area where the population is concentrated. While oil and gas development is expected to impact the population, the impacts are not anticipated to impact most of the population; therefore, we do not foresee oil and gas development resulting in future declines larger than those factored into our existing model predicting decline as a result of habitat conversion.

From the available information, we conclude that oil and gas development is not a threat to the species. Spragues pipits show a more variable response to oil and gas development than the available information indicated at the time we completed the 12-month finding, making the overall impact less than previously believed. Where avoidance does occur, the species may be avoiding the disturbance associated with construction rather than the feature itself, so avoidance can be expected to decline to some degree as the construction phase of oil and gas development is complete. Additionally, new information shows that the Spragues pipit has a clumped distribution, with the majority of the population centered west of the Bakken oil field in North Dakota and north eastern Montana, and thus not exposed to that development activity.

Wind

There is very little information specific to Spragues pipit regarding their response to wind turbines. One study in Texas found no avoidance of wind turbines by Spragues pipits on wintering grounds (Stephens 2011, p. 27). On the breeding grounds, we could not find any studies that included the Spragues pipit, but there is information that wind farms adversely affect some grassland bird species, while others show no avoidance (Casey 2005, p. 4; Manville 2009, p. 1; Shaffer and Johnson 2008, p. 51). Spragues pipits avoid trees at the territory scale, although they will nest with some trees at the landscape scale (defined as a 500 m radius or approximately 160 ac) (Winter undated, pp. 6, 8; Grant *et al*. 2004, pp. 810, 812), so it is not clear whether or not they would avoid tall, structures like wind turbines. With their high flight display (Robbins 1998, pp. 435-436), Spragues pipits that form territories near wind turbines may be at risk of collision. However, Spragues pipits avoid trees at the territory scale (Grant *et al*. 2004, p. 812), so they may avoid nesting or displaying near turbines, reducing their risk of a direct turbine strike.

Major wind development could occur in the remaining suitable Spragues pipit habitat because the entire U.S. range of the Spragues pipit is within an area with high potential for wind development (Pacific Northwest Laboratory 1991, p. 1; U.S. Department of Energy 2010, p. 1). Wind energy development has increased rapidly since the early 2000s, from an estimated 4,147 MegaWatts (MW) in 2001 to 61,327 MW at the end of the first quarter of 2014 (AWEA 2014, pp. 1-2). Wind development is also increasing throughout the Canadian range of the Spragues pipit (Canadian Wind Energy Association 2010, entire; Canadian Environmental Assessment Agency Canadian Environmental Assessment Registry 2010, entire). Like oil development, wind projects built in native grassland fragment the habitat with turbines, towers, roads, transmission infrastructure, and associated facilities. Approximately 88 percent of Core area is in the fair or higher class of potential wind development (Juliusson *in litt*. 2014, excel spreadsheet).

Thirty-three States and the District of Columbia have requirements or voluntary goals for renewable energy to make up a percentage of their energy needs, including North Dakota, South Dakota, Minnesota, and Montana (U.S. Department of Energy 2009, entire). Mandates for green energy in States without Spragues pipits are likely to fuel increases in wind development in the Spragues pipits range (e.g. Great River Energy 2010, p. 1). We anticipate the number of turbines throughout the Spragues pipit range to continue to increase. The location of future wind farms will determine whether wind development ultimately impacts the Spragues pipit population. Impacts to habitat and nesting birds could be high if wind development occurs in the Core part of the range in northcentral Montana, Alberta, and Saskatchewan. Therefore, we anticipate that most of the development will occur in the eastern part of the range, which is nearer the large Minnesota market in an area with existing transmission lines. If most of the development occurs in the eastern part of the range, the impacts on the Spragues pipit population should be minimal, especially since much of the eastern part of the range has already been converted from native prairie.

While the potential for wind development throughout the Sprague's pipit range is high, to date, actual construction has been limited. Through 2011, only 957 wind turbines were documented within the Sprague's pipit range, many of them in crop fields where impacts to the species would not be expected (Federal Aviation Association [FAA] 2009; FAA Obstruction Evaluation 2012, p. 1; Loesch, pers. comm. 2010).

In conclusion, wind energy development has the potential to impact Sprague's pipit habitat, especially on the breeding grounds, but how Sprague's pipits respond to wind development is not known. Even if we assume that the Sprague's pipit would be negatively impacted by wind development, to date, the amount of wind development within the range has been relatively low. We do not have information regarding where and how likely wind development would occur throughout the range. If development occurs outside of the areas where the population is concentrated, or if it occurs primarily in cropland, the impacts on the species would be limited. If wind development occurs in native prairie that Sprague's pipits use, it may impact the local population, if they avoid the area surrounding the turbines or by strike risk. However, at this time we do not have sufficient information to determine that wind energy is a threat to the species.

Roads

The literature is mixed regarding Sprague's pipits response to roads on the breeding grounds, with some studies suggesting that they avoid roads, and others finding no avoidance (Linnen 2008, pp. 1, 9-11; Dale *et al*. 2009, p. 200, Koper et al. 2009, p. 1287; Jones and White 2012, pp. 311, 313-315). One study found that of 46 mapped Sprague's pipit territories, only 5 (11 percent) crossed a trail or pipeline (*in* Dale *et al*. 2009, p. 200). However, other studies found that Sprague's pipits avoid roads but not trails, presumably because of the difference in structure in the road right-of-way (Sutter *et al*. 2000, p. 110), and some studies did not document avoidance of roads at all (Koper *et al*. 2009, p 1287; Jones and White 2012, pp. 310-311; Sliwinski and Koper 2012, p. 7). Jones and White (2012, pp. 312-315) found no avoidance of roads and no difference in daily survival rate of nests based on their distance from roads or other linear features (trails, agricultural field, railroad, shoreline) (Jones *in litt*. 2013, p. 1). The differences in behavior observed between studies may reflect different responses across the range, or a response to aspects of the roads themselves, such as the amount of traffic, or the amount of non-native vegetation along the roadway (Dale *et al*. 2009, p. 200; Jones and White 2012, p. 314).

Roadside edges are often planted with non-native species, which Sprague's pipits avoid (Dale *et al*. 2009, pp. 195, 200; Davis *et al*. 1999, p. 393). Exotics have a tendency to spread into nearby prairie, and vehicles also transport invasive species, increasing the footprint of the disturbance (Gelbard and Belnap 2003, p. 420; Dale *et al*. 2009, p. 195; Simmers 2006, p. 7; Trombulak and Frissell 2000, p. 24). Furthermore, the dust and chemical runoff from roads allows only tolerant plant species to grow nearby, changing the plant composition even if the right-of-way is not actually disturbed and reseeded (Trombulak and Frissell 2000, p. 23). Even 20 years after reclamation, the nonnative seeds used on reclaimed roadbeds can still dominate the area (Simmers 2006, p. 24). These nonnative species spread into the nearby prairie, expanding the long-term impacts of road construction beyond the original footprint of the roadway (Simmers 2006, p. 24). Even if vehicles are cleaned before entering an area, they pick up nonnative seeds when visiting infested sites, and carry them to newly disturbed areas, transporting nonnative species throughout the landscape (Dale *et al*. 2009, p. 195). When road avoidance is observed, it may be due to lack of suitable habitat near road edges rather than the physical road. In addition, as discussed under Factor C, roads serve as pathways for predators (Pitman *et al*. 2005, p. 1267). Thus, a secondary impact of habitat fragmentation may be an increase in predation. Predation rates on grassland birds are generally high, but the rates of predation on the Sprague's pipit are generally in line with other grassland birds (Jones and Dieni 2007, p. 122). We do not think that the predation rates on Sprague's pipits are sufficiently high to be impacting the population above background levels.

Sprague's pipits do not appear to avoid road edges in migration or on the wintering grounds (Freeman 1999, p. 51).

Oil and gas development doubles the density of roads on range lands (Naugle *et al*. 2009, pp. 11, 46). In areas with ranching, tillage agriculture, and oil and gas development, 70 percent of the land was within 100 m (109

yards (yd)), and 85 percent of the land was within 200 m (218 yd), of a human feature (Naugle *et al*. 2009, p. 11). In those areas, every square km (0.39 square miles) of land may be both bounded by a road and bisected by a powerline (Naugle *et al*. 2009, p. 11). Assuming that the same percentage of roads was on potentially suitable habitat as the oil wells themselves (see Oil and Gas section above), there would be an additional 271 km (168 miles) of new roads on potentially suitable habitat from the wells drilled in 2010. As discussed above, studies show varied findings about how much Sprague pipits avoid roads, but where road avoidance has been documented in Sprague pipits and other grassland birds, there is a decrease in density at least out to 100 m (328 ft) (Ingelfinger and Anderson 2004, pp. 385-386; Linnen 2008, p. 10; Thompson *et al*. 2013, p. 1). Therefore, in 2010, approximately 5,400 ha (13,000ac) of habitat would have reduced use due to roads and potential avoidance in the U.S., a very small percentage of the range.

The increase in roads throughout the Sprague pipits range represents a potential, albeit not well understood, threat to the species. Because every new energy feature requires at least some new road construction, the impacts of energy development on the species are closely tied to the impacts of road development. Roads can negatively affect the structure and species composition of prairies, and also make grassland habitat more accessible to predators, which may decrease Sprague pipits reproductive success. However, studies have found a mixed response to roads, so rangewide, the effects of roads on the Sprague pipit are not clear.

Where avoidance has been observed, Sprague pipits show some (not complete) avoidance (Linnen 2008, p. 9; Thompson *et al*. 2013, p. 8) up to 250 to 350 m (820 to 1148 ft). Individuals may show more avoidance of roads that are busier, or with a more pronounced habitat difference between the road ditch and the surrounding prairie. While roads may have some localized impacts on the individuals in an area, we do not anticipate that they will have a significant effect on the population because of the limited and incomplete avoidance of road features and similar nesting success in areas adjacent to and away from roadways. From the best available information, we conclude that roads are not a threat to the species.

Impacts to Migration and Wintering Habitat

As on the breeding grounds, Sprague pipits primarily use prairie habitat during the winter (Desmond *et al*. 2005, p. 442; Emlin 1972, p. 324; Levandoski *in litt*. 2014, p. 1; Ruvalcaba-Ortega *et al*. 2012, p. 40). However, they are sighted in other habitat types, especially during migration (Maher 1973, p. 20; Robbins and Dale 1999, pp. 13-14). On the wintering grounds, Sprague pipits are widely and relatively evenly distributed (Audubons Christmas Bird Count 2012, pages not available; Macias-Durarte *et al.* 2011, p. 153). Surveys have found widely varying numbers from year-to-year, suggesting that the birds move annually in response to local habitat conditions (Macias-Duarte *et al*. 2011, p. 901).

Several researchers have noted the rapid conversion rate to cropland and extremely limited area protected in the Chihuahuan desert region along the border between the United States and Mexico (Desmond *et al*. 2005; pp. 448-449; MacÃ-as-Duarte*et al*. 2009, p. 902; Manzano-Fischer *et al*. 2006, p. 3820). An estimated 7 percent of land in the Chihuahuan Desert Region (United States and Mexico), an area of approximately 45,000 ha (175 square miles), is grassland (Desmond *et al*. 2005, pp. 439, 448; New Mexico State University 2013, p. 1). We do not have information about habitat conditions east of the Chihuahuan Desert in Mexico, where a large percentage of the population may winter (Pool *et al*. 2012b, p. 64; Robbins and Dale 1999, p. 6).

There is ongoing, presumably widespread conversion to agriculture in the Chihuahuan Desert on the wintering range (Macias-Duarte *et al*. 2009, p. 902; Pool *et al*. 2014, entire). In many places where native grassland remains, a variety of factors have led to shrub encroachment, including overgrazing, elimination of prairie dogs, changes in stream flow and the water table due to irrigation, and changes in climate patterns (Desmond *et al*. 2005, p. 448; Manzano-Fischer *et al*. 2006, p. 3820; Walker *et al*. 1981, p. 493). Reversing the pattern of woody species invasion is very difficult because once established, woody species tend to be stable in the landscape (Whitford *et al*. 2001, p. 9).

Because Sprague pipits annual presence on the wintering grounds in a particular area is related to rainfall the

previous year (Dieni *et al*. 2003a, p. 31; MacÃ-as-Duarte 2009, p. 901), pipits use different parts of the range annually, with densities dependent on local conditions. Therefore, it is likely valuable for sufficient suitable habitat to be available across the wintering range so that the birds can use different regions annually depending on conditions that year. With conversion of grassland habitat on the wintering grounds, the amount of suitable habitat available to Spragues pipits is shrinking (MacÃ-as-Duarte 2009, p. 896; Manzano-Fischer *et al*. 2006, p. 3820). Even grassland that is not actively converted may become unsuitable for Spragues pipits due to widespread changes in grassland management and resulting changes in grassland structure. These changes are caused by overgrazing, shrub encroachment, and an increase in the biomass of annual grasses, among other causes (Drilling 2010, pp. 9-10; Manzano-Fischer *et al*. 2006, pp. 3819-3821; Walker *et al*. 1981, pp. 473-474).

The Spragues pipits wintering habitat has undergone widespread conversion to farmland and degradation from management changes since pre-colonial times, with conversion and degradation continuing. These changes in habitat are not reflected in the population trend, which, as discussed in the Population Estimates/Status section, no longer shows a clear decline in recent years. We recommend continued monitoring both of native prairie loss on the wintering grounds and of the Spragues pipit population as a whole to ensure that there is not a time lag between habitat loss on the wintering grounds and population response. At this time, there is a large population (900,000) remaining, which has been relatively stable (or at least has shown no clear increasing or decreasing trend) over the past ten years on both breeding and wintering ground surveys. However, in recognition of the acceleration of habitat loss on the wintering grounds, we will be assessing whether these losses represent a present and future threat to the species.

Habitat Fragmentation on the Breeding Grounds

The effect of a non-grassland feature (e.g., shrubs, trees, cropland, human-made structures) in the landscape can be much larger than its actual footprint. Spragues pipits are sensitive to patch size (i.e., the amount of contiguous native grassland available) (Davis 2004, pp. 1134, 1135-1137; Davis *et al*. 2006, pp. 812-814; Greer 2009, p. 65), and they avoid edges between grassland and a number of habitat features that are structurally different than grassland (Davis 2004, p. 1134; Koper *et al*. 2009, pp. 1287, 1293-1296). Spragues pipits have been shown to avoid wetlands, cropland, trees and shrubs, and burned or mowed areas (until the grass has grown back) (Askins *et al*. 2007, p. 21; Koper *et al*. 2009, p. 1287; Sliwinski and Koper 2012, pp. 1, 6-7, 11).

Size of the grassland patch is important, with a patch size of 145 ha (358.3 ac) (range 69 to 314 ha (170 to 776 ac)) suggested to be the minimum patch required for breeding. Singing males have not been observed in patches smaller than 29 ha (71.7 ac) (Davis 2004, p. 1134), with even larger patches preferred (Davis 2004, pp. 1134-1135, 1138; Greer 2009, p. 65). While large, intact grasslands are important, the amount of grassland within a 400 m (1,312 ft) radius may be a better predictor of Spragues pipit use than patch size (Davis *et al*. 2013).

Because Spragues pipits have been shown to avoid edges, the shape of the patch also is important (Linnen 2008, pp. 1, 9-11, 15). Grassland areas with a low edge-to-area ratio provide optimal habitat (Davis 2004, pp. 1139-1140). Thus, a linear patch may not be suitable for a Spragues pipits territory, even if it is sufficiently large. Koper *et al*. (2009, p. 1295) noted that conversion of one quarter section (64 ha (158 ac)) in the middle of a grassland patch reduced the utility of an additional 612 ha (1,512 ac) of grassland.

Spragues pipits strong preference for large, intact, grasslands on the breeding grounds and avoidance of non-prairie structures make them vulnerable to changes on the landscape that may reduce the usability of nearby prairie. However, as discussed in the previous sections, while some human-caused changes will occur within the range of the species, most of these will occur outside of the areas where most of the Spragues pipit population is concentrated. Therefore, we do not consider that habitat fragmentation on the breeding grounds is a threat to the species.

Summary of Factor A

At this time, based on the best available information, grassland conversion on the breeding grounds, and grazing, energy development, roads, and habitat fragmentation throughout the range, do not appear to threaten the Sprague's pipit. While habitat changes on the breeding grounds have resulted in a reduction in range from pre-colonial levels, there is a large remaining population at an estimated 900,000 individuals. The population trend in the Core areas where the species is concentrated is relatively stable, and even in our reasonable worst-case analysis of continued entire population decline at the rates seen from 2003-2012, after 40-years, the population would remain relatively high at approximately 356,000 individuals (CI 65,500 to 2,800,000). The species is widely distributed and mobile during winter, but grassland conversion is ongoing and apparently widespread on the wintering grounds. Despite the fact that our analysis seems to indicate that the population is no longer declining, especially in the Core areas on the breeding grounds, we will be gathering additional information to determine whether the acceleration of habitat losses on the wintering grounds is a threat to the species.

B. Overutilization for commercial, recreational, scientific, or educational purposes:

We are not aware of any commercial, recreational, or educational uses of the species. Sprague's pipit has not been extensively studied for scientific purposes (e.g., Robbins and Dale 1999, p. 1; Davis 2009, p. 265). A limited number of studies have involved close observation or handling of Sprague's pipit adults, nests, or young (e.g., Sutter *et al*. 1996, pp. 694-696; Davis 2003, pp. 119-128; Dieni and Jones 2003b, pp. 388 389; Jones *et al.* 2007, pp. 90-91; Dohms and Davis 2009, pp. 826-830). Work involving radio-transmitter attachment on Sprague's pipit nestlings found no evidence that the devices impacted survival, although the transmitter may temporarily impact the birds balance and mobility (Davis and Fischer 2009, p. 199; Fischer *et al.* 2010, pp. 1, 3-5). In any event, all studies are on a very small scale compared to the overall population size and range of the species.

Most research on Sprague's pipit relies on passive sampling (e.g., point counts) rather than active handling. The studies that involve active handling of adults, nestlings, or nests may impact the individuals involved, but are small enough in scale that they are unlikely to affect the population as a whole. Passive sampling techniques are unlikely to have negative impacts on Sprague's pipits. We do not have any evidence of risks to Sprague's pipits from overutilization for commercial, recreational, scientific, or educational purposes, and we have no reason to believe this factor will become a threat to the species in the future.

C. Disease or predation:

Disease

We are not aware of any information to indicate that disease poses a significant threat to Sprague's pipits at this time. The Intergovernmental Panel on Climate Change (IPCC) (2007, p. 51) suggests that the distribution of some disease vectors may change as a result of climate change. However, the Service currently has no information to suggest that any specific disease may become problematic to Sprague's pipit. More than 300 species of birds have been documented to be killed by West Nile virus (CDC 2009, entire), but to date there have been no documented Sprague's pipit mortalities due to West Nile.

Predation

Grassland birds have evolved with high levels of predation: predation is thought to destroy up to 70 percent of grassland bird nests (Davis 2003, p. 119). The predation rate on Sprague's pipits may be lower than other grassland bird species due to their well-concealed nests and secretive behavior (Davis 2003, pp. 124; Davis and Sealy 2000, p. 223; Jones and Dieni 2007, pp. 117-122). The species tendency to choose taller vegetation and to build covered nests with a runway is presumably at least in part an attempt to avoid being seen by predators (Sutter 1997, p. 467), although a covered nest may not reduce predation (Jones and Dieni 2007, p. 123). Predation has been documented to be the main cause of mortality of nestling and fledgling Sprague's pipits (Davis and Fisher 2009, entire), with a wide variety of predators implicated (Davis *et al*. 2012, entire).

The available evidence does not suggest that predation presents a threat to the species. It is possible that the predation risk for the Spragues pipit may be unnaturally increased by the fragmentation of habitat discussed above under Factor A. Songbird predators tend to travel along habitat edges, avoiding prairie areas where escape is more difficult (Johnson and Temple 1990, p. 110). Birds that may nest near a habitat edge, such as a road, could experience lower nest success because they may be more likely to be parasitized by cowbirds (*Molothrus ater*) (Davis 1994, p. i) and because roads may serve as travel routes for predators (Pitman *et al*. 2005, p. 1267). Despite these theoretical possibilities, Spragues pipits have evolved with a number of grassland predators, and we have no indication that predation rates have increased due to anthropomorphic or other factors. The Spragues pipits preference for larger patches of unfragmented prairie may reduce their susceptibility to predation.

Cowbird Parasitism

Cowbird parasitism leads to Spragues pipit nest failures, because the cowbirds may remove or damage host eggs and cowbird young out-compete the hosts for resources (Davis 2003, pp. 119, 127). Both nest predation and cowbird parasitism generally are higher in small remnant grassland plots near habitat edges (Johnson and Temple 1990, pp. 106, 108; Davis 1994, p. i; Davis and Sealy 2000, p. 226). A study in Manitoba, Canada found no cowbird parasitism on Spragues pipit nests on two 64 ha (158 ac) sites, while five nests were parasitized in a 22 ha (54 ac) site (Davis and Sealy 2000, p. 221), reinforcing the theory that nests in small grassland patches are more likely to be parasitized than those in larger patches. As with predation, the continued loss and fragmentation of native grassland (see discussion under Factor A) means that the remaining habitat is more fragmented, likely leading to increased levels of cowbird parasitism and predation. However, the Spragues pipits preference for larger tracts of grassland, when these are available, likely reduces their susceptibility to cowbird predation (Jones *et al*. 2010, p. 462).

Summary of Factor C
We have no information regarding disease impacts on the Spragues pipit. There have been no documented large die-offs, so at this time we conclude that disease is not a threat to the species now and is not likely to become so in the future. Predation is generally high for grassland birds, and we assume that the Spragues pipit also experiences high levels of predation, especially at the nest and juvenile stage. However, the Spragues pipits secretive behavior at the nest and preference for large patches of prairie may decrease their likelihood of predation to some extent. Similarly, while cowbirds have been documented to parasitize Spragues pipit nests (Davis and Sealy 2000, p. 226; Jones *et al*. 2010, p. 462), their preference for large habitat patches away from trees and shrubs may limit their susceptibility to parasitism. At this time, based on the available information we conclude that disease or predation is a not threat to the species now and is not likely to become so in the future.

D. The inadequacy of existing regulatory mechanisms:

In Canada, Spragues pipits are listed as threatened under the Species at Risk Act (COSEWIC 2010, p. V). This designation provides some protection on Crown, or federal lands, although only approximately six percent of the range is on federal land (Table 1). As in the U.S., the Spragues pipit is protected as a migratory bird under the Migratory Bird Treaty Act (16 U.S.C. 703 *et seq*.) in both Canada and Mexico. The Migratory Bird Treaty Act protects the Spragues pipit from direct take, but it does not protect habitat from conversion.

As discussed under Factor A, habitat in both the breeding and wintering range is being converted and fragmented to some extent. While most of the States in the Spragues pipits range have identified the Spragues pipit as a species of conservation concern, this designation only protects the bird, it does not result in protection of remaining habitat. However, as discussed in the *Habitat Conversion* section of Factor A, most conversion on the breeding grounds is likely to occur outside of the Core part of the range where most of the species breeds. Therefore, we have determined that the lack of regulatory mechanisms protecting native grassland on the breeding grounds is not a threat to the species at this time.

Sprague's pipits nest on federal public land administered by the Bureau of Land Management (BLM), which is subject to the Federal Land Policy and Management Act (FLPMA) (Pub.L. 94579), a law that requires the BLM to manage land for multiple use, including protecting and preserving land for fish and wildlife resources (Bureau of Land Management 2011, p. 1). Under FLPMA, the BLM is required to develop resource management plans (RMPs) to ensure compliance with FLPMA (Bureau of Land Management 2011, p. 1). BLM lands in the Sprague's pipit range are generally managed for grazing, which is compatible with nesting activities.

National Wildlife Refuges in North Dakota, South Dakota, and Montana developed a guidance document for refuge lands (USFWS 2011, entire). This document identifies the key areas that support the Sprague's pipit and describes the management approach that the Service will take to actively manage prairie habitat to benefit Sprague's pipit in the long term. There are approximately 304,000 ha (751,000 ac) of grassland in perpetual easement within the Sprague's pipit range (Loesch *in litt*. 2014, p. 1). These acres are in private ownership, but are protected from conversion, and activities such as mowing, haying, and grass seed harvesting must be delayed until after July 15 of each year (USFWS 2010, p.1). These protections would benefit the Sprague's pipit by keeping the land in grass, and ensuring that most nests are protected from impacts associated with cutting the grass.

Other than some limited protected areas, we are not aware of any regulatory mechanisms protecting Sprague's pipits habitat in Mexico. A large portion of the wintering range is in Mexico, and the literature suggests that habitat is rapidly being converted without regulatory oversight (Desmond et al. 2005, pp. 448-449; MacÃ-as-Duarte*et al*. 2009, p. 902; Manzano-Fischer *et al*. 2006, p. 3820; Pool 2014, entire). While the population has been relatively stable for the past ten years, there may be a lag period between conversion and population response. In recognition of the accelerated losses of habitat in the wintering grounds, we will be assessing whether these losses constitute a threat to the species now or in the future.

E. Other natural or manmade factors affecting its continued existence:

Climate change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms climate and climate change are defined by the Intergovernmental Panel on Climate Change (IPCC). Climate refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term climate change thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 814, 1819). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

The temperature throughout the Great Plains (an area extending from North Dakota and Montana south to Texas) and Prairie Pothole region has increased significantly over the 20th century (Millett *et al*. 2006 p. 243; Kunkel *et al*. 2013, p. 22). Climate models predict that the Great Plains temperatures will continue to increase relatively uniformly across the region, except in Coastal Texas, where the temperature increase is projected to be smaller (Kunkel *et al*. 2013, p. 36). The models predict a slight increase in precipitation in the northern part of the region, and a slight decrease in the southern portion, but at least through 2035, the changes will be less than current annual variation (Kunkel *et al*. 2013, pp. 53-54). However, by 2085, the models predict that the changes in precipitation will be larger than normal annual variation (Kunkel *et al*. 2013, pp. 53-54). The

western portion of the regions are predicted to become drier, while the eastern portion will become wetter (Millett *et al*. 2006 p. 243; Shaffer *et al*., 2014, p. 443) and the southern areas will generally be drier than the northern portions (Kunkel *et al*. 2013, p. 53).

Grassland bird nesting success has been shown to be related to local weather conditions during the breeding season (George *et al*. 1992, entire). While some grassland bird populations can probably withstand a few bad years, long-term climate change may have much larger implications on the populations ability to rebound, and some species may be much more resilient to several years of poor reproductive success than others (George *et al*. 1992, pp. 275, 281).

On the wintering range, rainfall is highly correlated with mean grass height, and as discussed in the *Winter habitat condition* section above, Sprague's pipits are highly sensitive to factors relating to precipitation the previous season (Dieni *et al*. 2003a, p. 31; MacÃ-as-Duarte*et al*. 2009, p. 901; Macias-Duarte *et al*. 2011, p. 38). A decline in mean annual rainfall, as predicted by the climate models, would result in a decrease in grassland passerines in the Chihuahuan Desert grasslands (Kunkel *et al*. 2013, p. 53; MacÃ-as-Duarte*et al*. 2009, p. 896). Thus, climate change, especially due to precipitation declines on the wintering grounds, may negatively impact the Sprague's pipit.

With their wide distribution on both the breeding and wintering grounds, the Sprague's pipit population may shift in response to climate change if sufficient grassland habitat remains in those parts of the range where climate conditions promote suitable conditions. The population is highly mobile, so as long as there is suitable habitat available, the population should be able to shift in response to climate change. However, as discussed in the *Impacts to Migration and Wintering Habitat* section, there is widespread conversion occurring in the remaining grasslands in the Chihuahuan Desert.

While climate change may affect the habitat where the Sprague's pipit breeds and winters, these changes are predicted to be similar to year-to-year variation for precipitation, at least until sometime after 2035, when the effects may be larger. The species mobility and wide range may reduce the effect of climate change somewhat since birds select breeding and wintering conditions annually based on habitat conditions in that area. Because of the predicted reduction in rainfall on the wintering grounds, leading to unsuitable grassland conditions, climate change may be a threat to the Sprague's pipit.

Conservation Measures Planned or Implemented :

The Natural Resources Conservation Services (NRCS) national policy directs agents to recommend only actions that will avoid adverse effects, and to the extent practicable, provide long-term benefits to the species (NRCS 2014, p. 25). The NRCS estimates that approximately 10 percent, or 73,000 ha (180,000 ac) of land that came out of the Conservation Reserve Program (CRP) remains in grass in North Dakota (Schwagler, *in litt*. 2014, p. 2). We do not have information for the other states in the range. Because CRP land is comprised of only a few species of grass and forbs, it probably does not provide optimal habitat for the Sprague's pipit, but if it is grazed, it may provide the appropriate structure in some areas to support nesting or feeding.

Conservation efforts to benefit the federally endangered Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*) such as restoring coastal prairie in Texas should also benefit the Sprague's pipit. The Coastal Prairie Conservation Initiative associated with Texas Parks & Wildlife Department, the Service, The Nature Conservancy, NRCS, Grazing Land Conservation Initiative, and many private landowners have spent hundreds of thousands of dollars on brush control on at least 24,281 ha (60,000 ac) of grasslands in Victoria, Goliad, and Refugio counties since 2000. The high-quality prairie habitat conserved should also benefit the Sprague's pipit in Texas (Ortego 2011, pers. comm.).

The Service developed a Conservation Plan for the Sprague's pipit (Jones 2010, entire). This plan identifies a number of actions to benefit Sprague's pipit as well as research questions that would help land managers throughout the range make better decisions for the species. The Service is currently working with partners to

develop a grassland conservation plan on the breeding grounds that will likely include tasks identified in the Jones (2010) Conservation Plan. Since this plan is still in development, we have not considered the benefits that may be accrued from its implementation in evaluating whether the species is meets the criteria of federally threatened or endangered.

The Service is currently working with a number of partners to develop a conservation plan to protect native prairie on the U.S. breeding grounds. This plan is still in development, but it will focus on efforts to conserve grassland in the area identified as having a high percentage of the breeding population.

Summary of Threats :

Native prairie is one of the most imperiled habitats worldwide, with loss rates approximating 70 percent in the United States and Canada, and prairie loss is continuing. While conversion to agriculture is still occurring, our analysis suggests conversion risk in the Core parts of the breeding range where 75 percent of the population occurs is relatively low, with future conversion potentially impacting approximately 10 to 15 percent of the population. The population has experienced a sharp decline since historic levels, but independent surveys (BBS and CBC) suggest that in recent years, the population trend can be described as uncertain to stable on the winter range and in the Core part of the breeding range rather than showing a clear declining trend as analysis of the previous period did. The remaining population is conservatively estimated at 900,000 individuals. If the 2003-2012 BBS trend estimate continues, there would be an estimated 356,000 individuals (CI 65,000 to 2,800,000) remaining in 40 years.

In the 12-month finding, we identified energy development (oil, gas, and wind) and associated infrastructure as a threat to the species. New information since that time has found that the species shows a variable response to these stressors, suggesting that the impacts on the species from energy development are not as strong as previously believed.

Prairie habitat on the wintering grounds is also being degraded and converted. Surveys suggest that Sprague's pipits are widely distributed throughout the wintering grounds, so that habitat conversion in one region may affect only a portion of the population. Further surveys and analysis of habitat conditions on the wintering grounds should help to determine how winter habitat is affecting the species.

The best available information at this time suggests that while grazing, mowing, overutilization, predation, cowbird parasitism, harassment, and chemical use may have some impacts on Sprague's pipits, these effects are unlikely to be influencing the population as a whole. On the breeding grounds, the risk of continued conversion of native prairie in the part of the range where the species is concentrated is relatively low, but on the wintering grounds, habitat conversion is ongoing and has likely accelerated in recent years. The effects of climate change may lead to large-scale population-level impacts if it causes changes in the remaining suitable habitat. The available information strongly suggests that changes in the global climate system are likely to impact rainfall and temperature throughout the Sprague's pipits range. In particular, the models predict decreased precipitation in the wintering part of the range, especially after 2035. Annual local use on the winter range is dependent on habitat conditions, which in turn depends on precipitation in the previous growing season. Therefore, reduced precipitation may impact the amount of available habitat on the wintering grounds, where widespread habitat loss is already occurring.

This status review identified potential threats to the Sprague's pipit attributable to Factors A and possibly E. The primary factor affecting the species is habitat conversion (Factor A), especially due to native prairie conversion on the wintering grounds. Climate change (Factor E) is predicted to increase drought, especially on the wintering grounds, increasing the potential that the remaining grassland conditions are unsuitable.

For species that are being removed from candidate status:

_____ Is the removal based in whole or in part on one or more individual conservation efforts that you

determined met the standards in the Policy for Evaluation of Conservation Efforts When Making Listing Decisions(PECE)?

Recommended Conservation Measures :

Continued monitoring and actions on both the breeding and wintering grounds to conserve native grasslands.

The Service has had preliminary discussions with partner agencies on potential actions to conserve Sprague's pipit; however, these are as yet preliminary, and demonstrable conservation has not yet occurred:

- Work with public and private landowners to conserve and improve existing Sprague's pipit habitat on the breeding grounds, especially in the Core area.
- Adopt conservation and research measures identified in the Sprague's Pipit (Anthus spragueii) Conservation Plan (Jones 2010, pp. 24-33)
- Continue to monitor the population and habitat on the wintering grounds so that changes affecting the population can be identified early and conservation measures implemented.
- Work throughout the wintering range to prevent the continued loss of native prairie. Once converted, this habitat would be difficult to reclaim. Protecting grasslands on the wintering grounds would also benefit a number of other grassland birds and wildlife.

Priority Table

Magnitude	Immediacy	Taxonomy	Priority
High	Imminent	Monotypic genus	1
		Species	2
		Subspecies/Population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/Population	6
Moderate to Low	Imminent	Monotype genus	7
		Species	8
		Subspecies/Population	9
	Non-imminent	Monotypic genus	10
		Species	**11**
		Subspecies/Population	12

Rationale for Change in Listing Priority Number:

We are changing the Priority Number from 8 to 11, indicating a moderate and nonimminent threat risk, based on new information gathered since the 2013 CNOR as summarized below.

Magnitude:

The major potential threat facing the species is habitat conversion on both the breeding and wintering grounds. On the breeding grounds, modeling has suggested that most of the population (75 percent) is concentrated in approximately 29 percent of the range, primarily centered on Montana, Alberta, and Saskatchewan. Information about the risk of conversion in Canada is not available, but in the U.S., modeling

projected that the risk of large-scale conversion is limited (Lipsey *et al.* 2014, p. 10). The most likely future scenario predicts that conversion may affect 10 to 15 percent of the U.S. population. A similar analysis is still ongoing in Canada, but many of the same factors that limit the likelihood of conversion in the U.S., such as moisture, soil quality, frost-free days, and growing season probably also limit conversion risk in Canada.

Additionally, in the 12-month finding and previous CNORs, we identified oil and gas development and associated infrastructure, specifically roads, as a major threat to the species on the breeding grounds, especially from the Bakken oil field in North Dakota. However, as discussed above, the population is concentrated in central Montana, Alberta, and Saskatchewan, reducing the potential population impacts from oil and gas development and associated infrastructure from the Bakken oil field development. New information suggests that Spragues pipits response to oil and gas development, including roads, is more nuanced than previous literature suggested, with varying avoidance behavior across the range.

There has been recent, widespread conversion of native prairie in the Chihuahuan Desert of Mexico, which may affect populations of grassland birds, including the Spragues pipit (Pool *et al*. 2014, entire). Ongoing population monitoring should help determine what effect this habitat conversion is having on the population as a whole.

Given the above, we consider the magnitude of threats affecting Spragues pipit to be moderate to low.

Imminence :

While the Spragues pipit population has experienced a large decline from historical times, when it was described as one of the most common birds in the Northern Great Plains (Coues 1874, p. 42), the population estimated at 900,000, is still relatively large (Partners in Flight 2013, p. 6). Due to poor BBS coverage in the U.S. range, this estimate is likely low (Sauer *in litt*. 2013, p. 9; Lipsey *et al*. 2014, p. 7). Life history parameters (e.g. annual survival) are not well described, but surveys on both the breeding Core area and on the wintering range suggest that the population trend is stable to increasing in the past ten years (Sauer *in litt*. 2014a, excel spreadsheet; Soykan *in litt*. 2014, excel spreadsheet). Because of the relatively large population remaining and the stable-to-uncertain (i.e. not showing a clear decline) trends by independent surveys on both the breeding and wintering grounds, the immediacy of the threats and potential decline is nonimminent.

__Yes__ Have you promptly reviewed all of the information received regarding the species for the purpose of determination whether emergency listing is needed?

Emergency Listing Review

__No__ Is Emergency Listing Warranted?

We determined that issuing an emergency regulation temporarily listing the species is not warranted for this species at this time, because while the population has shown a decline since the BBS monitoring began approximately 40-years ago, this decline has stabilized in the past ten years. On the breeding grounds, the portion of the range where the population is concentrated has a relatively low risk of large-scale conversion. On the wintering grounds, prairie conversion is ongoing, but the species may be more flexible in habitat use during winter.

Additionally, while we believe that both the U.S. and Canadian portions of the breeding range are necessary for the long-term survival of the species, the protections afforded in Canada under SARA should somewhat buffer the species' decline. However, if at any time we determine that issuing an emergency regulation temporarily listing the Sprague's pipit is warranted, we will initiate the action at that time.

Description of Monitoring:

Refuges in North Dakota, South Dakota, and Montana are currently developing guidelines to ensure that their actions benefit the Sprague's pipit. Because the species may not use an area for several years, depending on local conditions, and because the survey window for the species is limited to the few weeks when the male is displaying, they plan to primarily monitor the species using habitat evaluation as a proxy for species use.

The Nature Conservancy in Texas conducted Sprague's pipit surveys at Fort Hood, Texas during the winters of 2010/2011 and 2012/2013, including vegetation sampling in the areas where Sprague's pipits were flushed. Results are still being analyzed.

The Rocky Mountain Bird Observatory has done a survey of grassland birds, including the Sprague's pipit, in the Chihuahuan Desert of Texas and Mexico from 2009-2011 (Poole *et al*. 2012, entire).

Sprague's pipit was reported to be a rare but regular visitor to Stuttgart Airport in Arkansas (Brian *in litt*. 2011, p. 4).

Both the BBS and CBC are continuing, which should provide trend information into the future. BBS routes will be added in the U.S. Core area starting in 2015, to better track the population in those areas where the species is concentrated.

Indicate which State(s) (within the range of the species) provided information or comments on the species or latest species assessment:

Texas

Indicate which State(s) did not provide any information or comment:

Arkansas,Kansas,Minnesota,Mississippi,South Dakota

State Coordination:

Information was provided from the states mentioned above as well as the Tonkawa Tribe of Oklahoma. No information was provided from Mexico.

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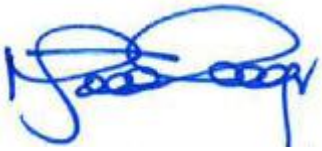
Approval/Concurrence:

Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes, including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve:  09/10/2014
Date

Concur: 11/18/2014
Date

Did not concur: _____ _____
Date

Director's Remarks:

U.S. Fish & Wildlife Service

Sprague's Pipit (*Anthus spragueii*) Conservation Plan

Doug Backlund, Wild Photos Photography ©

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U.S. Fish & Wildlife Service

Sprague's Pipit (*Anthus spragueii*) Conservation Plan

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Cover Image: Sprague's Pipit
Photo Credit: Doug Backlund, Wild Photos Photography ©

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Table 1. Status and trends of Sprague's Pipits throughout their range. "Status" definitions from NatureServe Explorer (2009). BCC=Birds of Conservation Concern-2008 (U. S. Fish and Wildlife Service 2008c); COSEWIC= Committee on the Status of Endangered Wildlife in Canada (2002); ESA=Endangered Species Act (U. S. Fish and Wildlife Service 2008b); BBS=Breeding Bird Survey (Sauer et al. 2008); IUCN=International Union for Conservation of Nature. 3

Table 2. Prioritized conservation plan and actions for Sprague's Pipit (SPPI). "Lead for current work" represents groups and individuals currently working on this aspect of SPPI biology in each of the three countries; "Potential" refers to partners with the knowledge and potential to collaborate in this area. "Critical" habitat is used for Canada under the SARA listing as threatened; for the United States and México, it is used in the non-legal sense, meaning important habitat types and areas. Organization abbreviations: CRT = Canada Recovery Team; CWS = Canadian Wildlife Service; FWS = U.S. Fish and Wildlife Service; FWS-ES = FWS Bismarck Ecological Services Office; FWS-MBNG = FWS Migratory Birds, Nongame, Region 6; FWS-HAPET: FWS HAPET Office, Regions 6 and 3; USGS = U. S. Geological Survey, Biological Research Division; USFS = U. S. Forest Service; USBLM = U. S. Bureau of Land Management; USDOD = U. S. Department of Defense; TNC = The Nature Conservancy; CEC = Commission for Environmental Cooperation; RMBO = Rocky Mountain Bird Observatory; NCC = Nature Conservancy of Canada; INEGI = Instituto Nacional de Estadística y Geografía; CONANP = Comisión Nacional de Áreas Naturales Protegidas; WWF = World Wildlife Fund; PLJV = Playa Lakes Joint Venture; PPJV = Prairie Potholes Joint Venture; PPP-LCC = Prairie Landscape Conservation Cooperative; JV-LCC = Joint Ventures and Landscape Conservation Cooperatives. Individuals abbreviations: NK = Nicola Koper, University of Alberta, Edmonton; SKD = Stephen K. Davis, University of Regina, Saskatchewan; MD = Martha Desmond, New Mexico State University; SLJ = Stephanie L. Jones, FWS.) 25

Executive Summary

Apparently widespread during early European settlement, Sprague's Pipits breeding distribution has contracted sharply from its historical range. Sprague's Pipits were recorded as abundant during early European exploration; currently, they are common only in remnant large grassland patches in the northern mixed-grass native prairie of North America. Much of the decline of Sprague's Pipits occurred in the late 19th and early 20th centuries as the short- and mixed-grass prairies were converted to agriculture. Since ca. 1900, approximately 75% of native Canadian prairie and 80% of aspen parkland have been converted from native grassland; in the United States, approximately 60% of native mixed-grass prairie has been converted to cropland.

Sprague's Pipits are short distance migrants, moving from breeding grounds in the northern prairies of southern Canada and northern United States to the wintering grounds in southern United States and northern México. The breeding range in Canada has contracted from the eastern and northern portions of the historic range in Alberta and Manitoba. Similarly, the breeding range in the United States has contracted to the north and west in North Dakota and Minnesota, and north in Montana. There are no details on the historical distribution of Sprague's Pipits on the wintering range in the southern United States and México.

In 1999, Sprague's Pipits were listed as "Threatened" in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); the status was re-examined and confirmed in May 2000. Sprague's Pipits were officially listed under the Canadian Species at Risk Act (SARA) as "Threatened" on 5 June 2003. They are also protected under provincial Wildlife Acts in British Columbia, Alberta, Saskatchewan, and Manitoba. In the United States, Sprague's Pipits were petitioned for listing under the Endangered Species Act in 2008. On 14 September 2010 the U.S. Fish and Wildlife Service determined that this petition presented substantial information that listing Sprague's Pipits as "Endangered" or "Threatened" was warranted but precluded by higher listing priorities. Sprague's Pipits are listed as a "Species of Conservation Concern" by the U.S. Fish and Wildlife Service's Division of Migratory Bird Management and classified as "Endangered" by the state of Minnesota. Sprague's Pipits are a protected migratory bird species in México; they have no other official or legal designation there.

The principal causes for the declines in Sprague's Pipit populations are habitat conversion to seeded pasture, hayfield, and cropland, as well as overgrazing by livestock. Moreover, management favoring intensive cattle grazing and reduced fire frequency may lead to the degradation of remaining suitable grassland tracts over much of their range. Without proper fire intervals, shrubs and excessive vegetative litter may reduce habitat quality; in addition, grasslands may even eventually succeed to shrubland or savannah. Energy development, introduced plant species, nest predation and parasitism, drought, and fragmentation of grasslands are all threats that currently impact Sprague's Pipits populations throughout their present range.

Management for Sprague's Pipits consists of protecting, maintaining, and restoring native mixed-grass prairie in suitably large expanses. Converting cultivated land adjacent to native prairie to perennial cover, including seeding with a native grass mix, or one that includes a prostrate (versus erect) form of legume, could make smaller land tracts attractive to Sprague's Pipits. Management through fire, grazing, or mowing may assist in maintaining native grasslands in many areas; however, the intensity and frequency of disturbance is dependent upon soil productivity and climate factors, and thus the geographic area. Therefore, recommendations on fire, grazing and haying frequency and intensity should be area-specific.

The goals for the conservation of Sprague's Pipit populations are to maintain or increase the current population size, distribution and viability. This can be achieved by simply preventing further loss and degradation of native prairie within their historic range. To achieve this goal, management strategies and recommendations must be researched and developed that are specific to particular geographic regions. To this end, this Conservation Plan includes a prioritized list of actions and needs that will begin to achieve long-term range-wide conservation of Sprague's Pipits. In addition, several states and provinces have developed objectives and actions designed to address state-wide conservation of Sprague's Pipits. Updated information on life history and population status are included here in support of this goal. Implementing effective conservation measures will require the cooperation of a coalition of local, regional, national, and international partners.

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Taxonomy

Class: Aves

Order: Passeriformes

Family: Motacillidae

Scientific Name: *Anthus spragueii* Audubon 1844

Common Name: Sprague's Pipit

French: Pipit des Prairies; Pipit de Sprague

Spanish: Bisbita Ilamera

There are no unsettled taxonomic issues. There are no subspecies designated (American Ornithologists' Union 1957, Pyle 1997a). Sprague's Pipits were named *Alauda spragueii* by Audubon after Isaac Sprague. The first (type) specimen was documented as collected near Fort Union, North Dakota in 1843 by Audubon, although the location that John Bell and Edward Harris shot the first bird could have been in or near Montana (J. Marks, pers. comm.).

Molecular data indicate that the closest living relatives to the Sprague's Pipit are the Yellowish Pipit (*A. lutescens*) and the Short-billed Pipit (*A. furcatus*) of South America; these species form a clade to the other South American pipits. Thus, the Sprague's Pipit may only be distantly related to the American Pipit (*A. rubescens*) and other Old World pipits (Robbins and Dale 1999).

Legal Status

Global

Sprague's Pipits (pipits) are federally protected in the United States, Canada, and México under the Migratory Bird Treaty Act of 1918 as amended (16 U.S.C. 703-711: 40 Stat. 755; U. S. Fish and Wildlife Service 2008a). They are listed on the International Union for the Conservation of Nature (IUCN) Red List as Vulnerable (Hilton-Taylor 2000), but are not listed on the Convention on International Trade in Endangered Species list (Inskipp and Gillett 2005; Table 1).

The species' conservation status includes "Species of Special Concern/Watch List Species" by Partner's in Flight and National Audubon Society (Rich et al. 2004, Butcher et al. 2007). The Nature Conservancy has assigned it a global rank of "apparently secure", and rare (Table 1; NatureServe Explorer 2009). Sprague's Pipit is also considered a Species of Highest Tri-National Concern by Partners in Flight (Berlanga et al. 2010).

Canada

Sprague's Pipits were listed in 1999 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Threatened"; the status was re-examined and confirmed in May 2000 (Committee on the Status of Endangered Wildlife in Canada 2002), based on status reports (Prescott 1997, Prescott and Davis 1998). Sprague's Pipits were officially listed under the Species at Risk Act (SARA) as "Threatened" on 5 June 2003 (Environment Canada 2008). Although this species remains relatively common in suitable habitat, numbers have declined significantly and there is evidence of a contraction of its range on the periphery (Prescott and Davis 1998, Environment Canada 2008).

Sprague's Pipits are protected under provincial Wildlife Acts in British Columbia, Alberta, Saskatchewan, and Manitoba (Table 1). In Alberta, Sprague's Pipits are a "Species of Special Concern": a species that without human intervention may soon become threatened with extinction in the province. This designation was made on the basis of rapidly declining populations and a lack of research into the biology and management of the species (Prescott and Davis 1998). Sprague's Pipits have no legal designation in Saskatchewan and are listed as "Threatened" in Manitoba. Pipits are included on the "Red List" of species considered to be candidates for designation as "Threatened" or "Endangered" in British Columbia. However, the very small number of reports for Sprague's Pipits in British Columbia suggests that its occurrence there is accidental or casual, and it may be removed from the "Red" list in the future (Prescott 1997).

United States

Sprague's Pipits are a Candidate for listing as "Endangered" or "Threatened" under the Endangered Species Act of 1973 as amended (16 U.S.C. 1531 *et seq.*; U. S. Fish and Wildlife Service 2008b, 2010). After being been petitioned for listing in 2008 (WildEarth Guardians 2008), the U. S. Fish and Wildlife Service (USFWS) determined that the petition presented substantial information indicating that listing the Sprague's Pipit is warranted but precluded by higher listing priorities (U. S. Fish and Wildlife Service 2010). Sprague's Pipits were listed as a "Species of Conservation Concern" by the USFWS Migratory Bird Management Office in 2008 (U. S. Fish and Wildlife Service 2008c). Sprague's Pipits are classified as "Endangered" in Minnesota (Table 1). They are considered a "Sensitive Species" in Region 1 (Northern Region) of the U. S. Forest Service (U. S. Forest Service 2005).

México

Sprague's Pipits are a protected migratory bird species in México; they have no other official or legal designation (Secretaría de Medio Ambiente y Recursos Naturales 2002).

Table 1 is a summary of the legal status of Sprague's Pipit in the states and provinces where it occurs.

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Table 1. Status and trends of Sprague's Pipits throughout their range. "Status" definitions from NatureServe Explorer (2009). BCC=Birds of Conservation Concern-2008 (U.S. Fish and Wildlife Service 2008c); COSEWIC=Committee on the Status of Endangered Wildlife in Canada (2002); ESA=Endangered Species Act (U.S. Fish and Wildlife Service 2008b); BBS=Breeding Bird Survey (Sauer et al. 2008); IUCN=International Union for Conservation of Nature.

Area	Status	State or Province Status	BBS Trend (1966-2007)	BBS Trend (1980-2007)	Species Status
United States	N4B, N4N	Candidate 1 (ESA), BCC National Concern	-2.4 (p=0.35; n=49)	-3.1 (p=0.47; n=45)	Regular breeder, migrant and winter resident
Montana	S2B	Species of Greatest Conservation Need[1]	-0.6 (p=0.85; n=21)	-0.3 (p=0.90; n=20)	Regular breeder and migrant
North Dakota	S3B	Species of Conservation Priority	-2.0 (p=0.62; n=25)	-2.4 (p=0.75; n=23)	Regular breeder and migrant
South Dakota	S2B	Species of Greatest Conservation Need[1]	-12.7 (p=0.36; n=3)[2]	-3.5 (p=0.75; n=2)[2]	Regular breeder and migrant
Minnesota	S1B	Endangered[3]			Rare breeder
Wyoming	S4N	None			Rare migrant
Kansas	SNA	None			Uncommon to rare migrant and casual winter resident
Nebraska	SNRN	None			Uncommon spring and fall migrant
USFWS Region 6	n/a	BCC Regional Concern	-2.4 (p=0.35; n=49)	-3.1 (p=0.46; n=45)	Regular breeder and migrant
Arizona	S2N	None			Regular winter resident and migrant
New Mexico	S2N	Species of Greatest Conservation Need[1]			Regular winter resident and migrant
Texas	S3N	None			Regular winter resident
Oklahoma	SNRN	Species of Greatest Conservation Need[1]			Uncommon to rare migrant and casual winter resident
USFWS Region 2	n/a	BCC Regional Concern			Regular winter resident and migrant
Canada	N4B	Threatened (COSEWIC)	-4.3 (p=0.00; n=120)	+3.2 (p=0.05; n=111)	Regular breeder
Alberta	S4B	Species of Special Concern[4]	-4.1 (p=0.01; n=61)	-3.1 (p=0.23; n=58)	Regular breeder
Saskatchewan	S4B	None	-4.2 (p=0.05; n=45)	-3.0 (p=0.13; n=40)	Regular breeder
Manitoba	S2B	Threatened	-4.6 (p=0.31; n=14)	-10.2 (p=0.18; n=13)	Regular breeder
BBS survey-wide	G4	Vulnerable (IUCN)[5]	-3.9 (p=0.00; n=169)	-3.7 (p=0.03; n=156)	Regular breeder
México	n/a	None	n/a	n/a	Regular winter resident

Other records: State/province (NatureServe Explorer 2009): Alabama (SNR), Arkansas (SNA), British Columbia (none), California (none), Colorado (SNA), Georgia (S3), Louisiana (S3S4N), Mississippi (SNA), Missouri (SNA)

[1]State Wildlife Action Plan
[2]Reflects data with an important deficiency
[3]Minnesota Department of Natural Resources (http://www.dnr.state.mn.us/ets/birds.html)
[4]Alberta Species at Risk (http://www.srd.alberta.ca/BioDiversityStewardship/WildSpecies/Birds/Songbirds/SpraguesPipit.aspx)
[5]IUCN Red List (Hilton-Taylor 2000)

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Description

Sprague's Pipits are grassland specialists endemic to the mixed-grass prairie in the northern Great Plains of North America (Robbins and Dale 1999). Sprague's Pipits are a passerine about 14 cm in length (range: 10-18 cm). The wings and tail are dark brown with two pale indistinct wing-bars and mostly white outer retrices, the crown, nape and upperparts are buffy with blackish streaking and the face is buffy with a pale eye-ring creating a large-eyed appearance. The underparts are whitish, the breast has fine blackish streaks, and the breast and flanks are often faintly washed with buff. The bill is relatively slender, short, and straight, with a blackish upper mandible and a pale lower mandible with a blackish tip. The tarsi are yellow to pale pinkish brown and are relatively long with an elongated hind claw (Pyle 1997a, 1997b).

Molt and Juvenile Plumage.—Hatching year individuals may be separated from adults by the primary coverts which appear tapered and worn compared with the broader, less worn basic primary coverts of adults (Pyle et al. 2008). Knowledge of the molts of this species is preliminary and based on a small number of specimens (Pyle 1997a, 1997b; Pyle et al. 2008).

Range

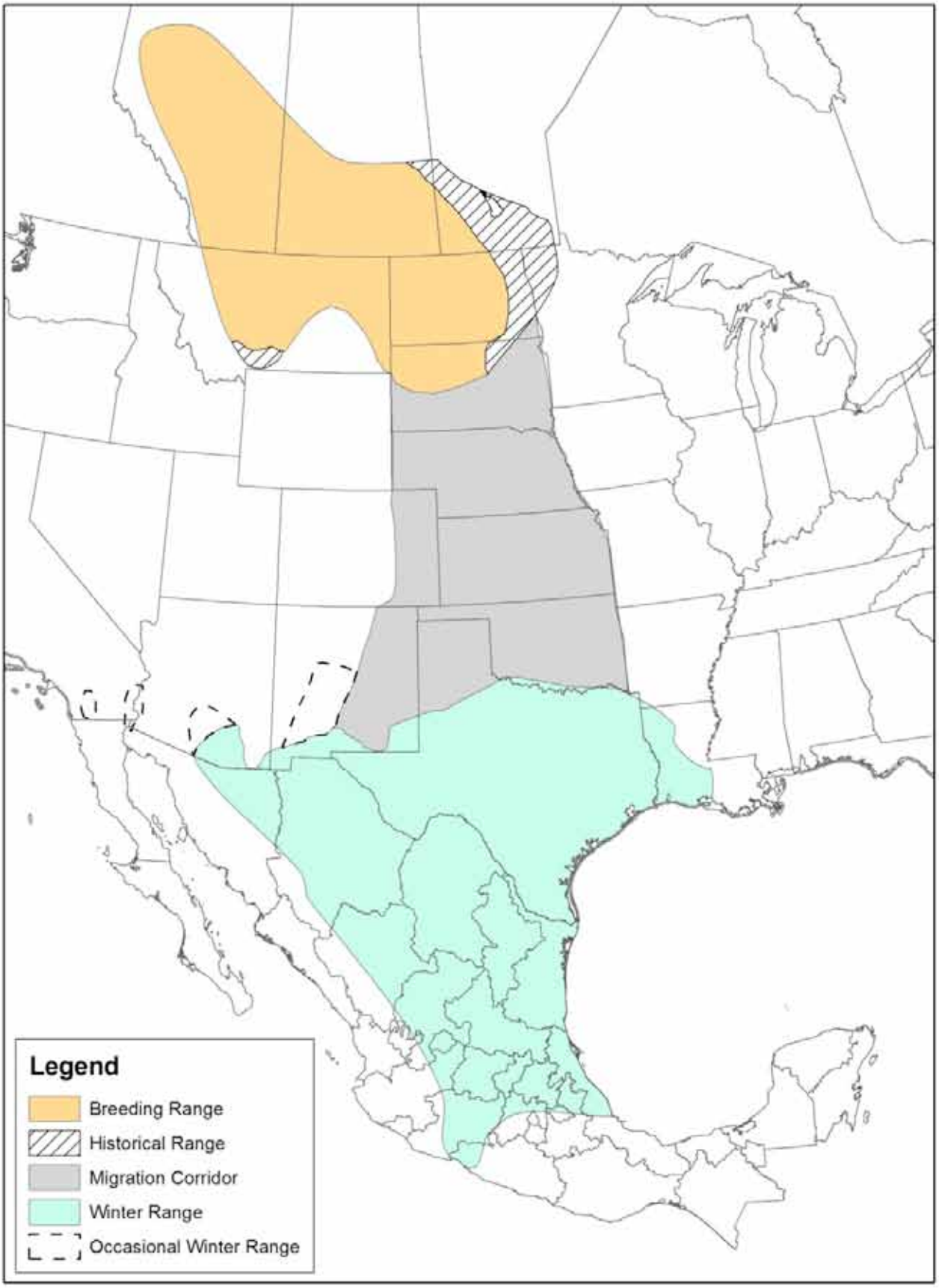

Figure 1. Current and potential historical range for Sprague's Pipit.

Sprague's Pipits are short to medium distance migrants, moving from breeding grounds in the northern prairies of southern Canada and northern United States to the wintering grounds in southern United States and northern México (Fig. 1; Robbins and Dale 1999). Sprague's Pipits migrate through the Great Plains states of the United States (Fig. 1).

Canada

Breeding.—Sprague's Pipits are largely confined to the grassland and aspen parkland regions of the prairie provinces (Fig. 1; Godfrey 1986, Prescott and Davis 1998) and breed in southeast Alberta west to the Rocky Mountain foothills, throughout southern Saskatchewan (Robbins and Dale 1999) and west-central (Prescott and Davis 1998) and southwestern Manitoba (Robbins and Dale 1999). Historically common in Manitoba (Coues 1874, Carey et al. 2003), their range has contracted and Sprague's Pipits are now rare, though locally they may be numerous (Carey et al. 2003). In south-central British Columbia a single breeding record was recorded in 1991, the first breeding record in that province; no subsequent breeding has been documented, although pipits have occasionally been observed (Prescott and Davis 1998). Historically, they probably bred near Kimberly, British Columbia in 1959 (Prescott and Davis 1998).

Migration.—Sprague's Pipits generally arrive in Canada in the spring in mid-Apr and depart in the fall by mid-Oct.

Winter.—Sprague's Pipits do not winter in Canada.

United States

Breeding.—Sprague's Pipits breed in the northern Great Plains, with their highest numbers occurring in the central mixed-grass prairie (Fig. 2). Their breeding range is primarily in north-central and eastern Montana, to North Dakota through to northwestern and north-central South Dakota (Fig. 1). They occur casually in northwestern Minnesota and locally in southern South Dakota (Stewart 1975, South Dakota Ornithologists' Union 1991, American Ornithologists Union 1998, Robbins and Dale 1999, Tallman et al. 2002).

Migration.—Spring migration primarily occurs through the central Great Plains in Apr and May (Johnsgard 1979, Thompson and Ely 1992), with two early Nebraska reports from 17 Mar (Sharpe et al. 2001). The latest date they were observed in Texas is 14 May (B. Freeman, pers. comm.). Fall migration primarily occurs through the Great Plains from late Sep through early Nov, with a few sightings from 30 Aug (Sharpe et al. 2001), and extending in some

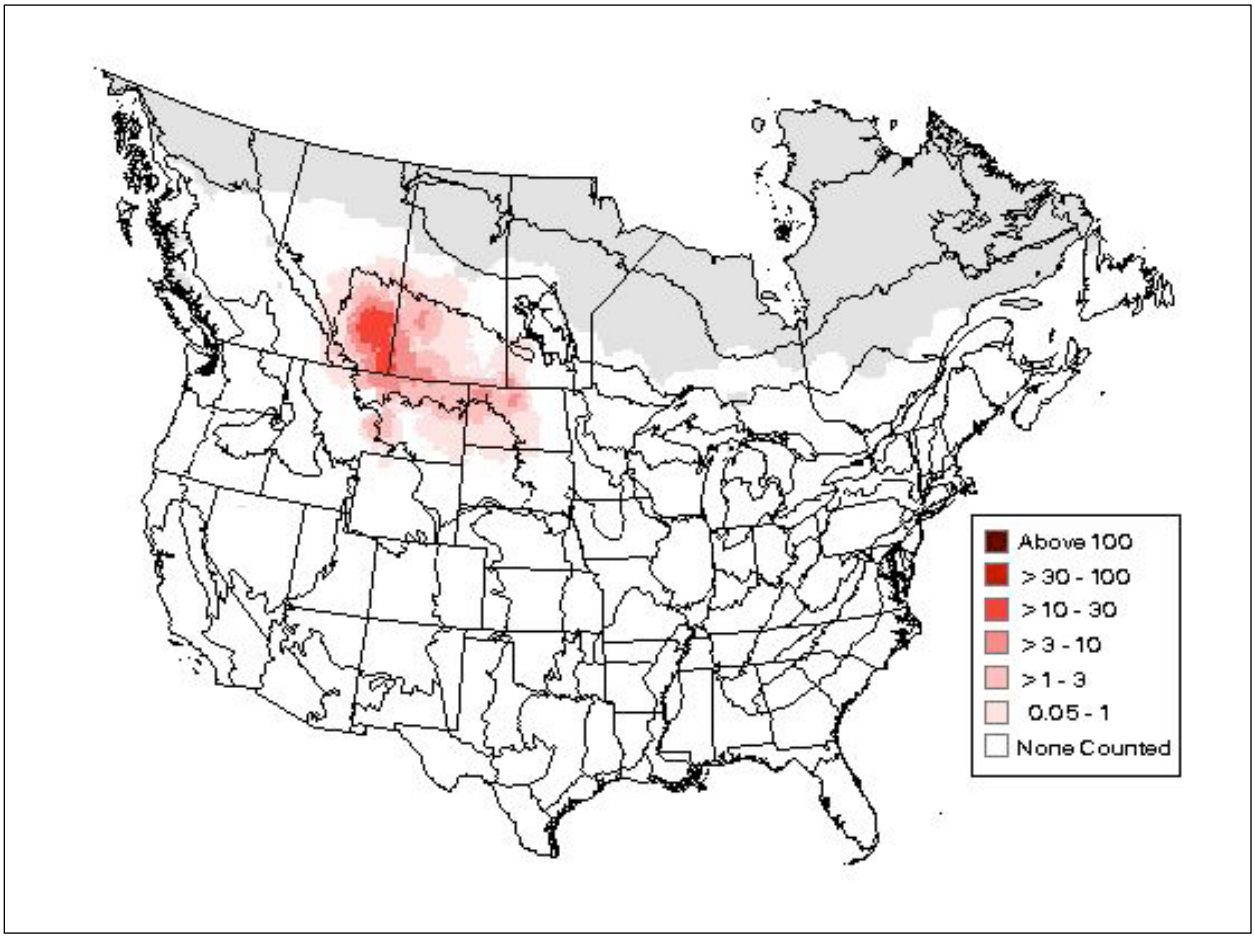

Figure 2. Relative abundances of Sprague's Pipits in their breeding range; data from the Breeding Bird Survey for 1996-2007 (Sauer et al. 2008).

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years through the first week of Dec in New Mexico (W. H. Howe, pers. comm.). Sprague's Pipits are rarely seen on migration, which has been attributed to a number of reasons, including: 1) many short-distance grassland species migrate high and at night without using stopover sites, potentially including Sprague's Pipits (Thompson and Ely 1992; SLJ), however, it is uncertain whether their night flight calls that were recorded in Nebraska and Kansas came from migrants or from birds flushed from the ground (W. Evans, pers. comm.); 2) they have solitary and cryptic behavior during the non-breeding season (Prescott and Davis 1998); 3) many observers are largely unfamiliar with the flight call notes (Seyffert 2001; W. H. Howe, pers. comm.); and 4) there are few migration studies in grasslands (J. M. Ruth, pers. comm.) or few observers in remote grassland areas (M. Howery, pers. comm.).

Sprague's Pipits are generally described as being an uncommon migrant immediately south of the breeding range (Fig 1). They are described as "accidental" in Iowa, "a rare migrant" in Wyoming and Illinois, and generally uncommon in Oklahoma. They are occasionally found from late Sep through Nov in eastern New Mexico, but the later records are probably late migrants (W. H. Howe and J. M. Ruth, pers. comm.). In Oklahoma, Sprague's Pipits have been documented in the central and western two-thirds of the main body of the state, and in the southern portion of the panhandle. They are undocumented in the eastern third of Oklahoma (M. Howery, pers. comm.). Sprague's Pipits are found in all months except Jun through Aug in Texas; those seen inland and north of the primary wintering areas are probably migrants, although some individuals may linger into the winter there (Freeman 1999). Sprague's Pipits are a rare migrant in California and a casual fall migrant in the eastern United States (Robbins and Dale 1999).

Winter.—Sprague's Pipits winter in the United States from the southeast corner of Arizona, southern New Mexico, central and southern coastal prairies in Texas, through southern Oklahoma. There are regular sightings in southern Louisiana and Arkansas (Root 1988) and occasional sightings in southern Kansas and Missouri, Tennessee, northwestern Mississippi, and other portions of Texas (Fig. 1; American Ornithologists' Union 1998). Winter distribution data show highest densities in Texas (National Audubon Society 2009).

México

Breeding.—There are no breeding occurrences in México.

Migration.—There is no migration information from México.

Winter.—Sprague's Pipits winter in northern México from northeastern Sonora, Chihuahua, Coahuila, and Nuevo León south to northern Michoacán, Puebla, central Veracruz, and perhaps Guerrero (Fig. 1; Howell and Wilson 1990, Howell and Webb 1995, American Ornithologists' Union 1998). Christmas Bird Count (CBC; National Audubon Society 2009) data show Sprague's Pipits occur every year in northern Chihuahua and some years in Coahuila. There is very limited data from México documenting the status and distribution of Sprague's Pipits.

Historical Changes

Canada.—The eastern and northern portions of the historical breeding range of Sprague's Pipits has contracted in Alberta, Manitoba, and Saskatchewan (Committee on the Status of Endangered Wildlife in Canada 2002). Range contractions may occur temporarily due to climatic conditions, however; there are suspected long-term range contractions for Sprague's Pipits in the Canadian provinces that are their primary range. In the 1980s and 1990s, Pipits were not recorded from the Peace parkland of northwestern Alberta; this may not represent a "dramatic" reduction in the breeding range as they were probably never widespread here (Prescott and Davis 1998). In Saskatchewan, Sprague's Pipits were described in the 1930s as "not uncommon", by the 1950s, the species was described as being "rather rare" (Prescott and Davis 1998). In Manitoba, Sprague's Pipits have declined dramatically. Sprague's Pipits were once one of the commonest prairie birds in the western portion of the province (Carey et al. 2003). Their range has contracted several hundred kilometers south from areas north and east of Winnipeg in Manitoba; they are now considered "fairly rare" or "virtually absent" from areas where they were once a regular, but uncommon summer resident. Pipits are still fairly numerous, although localized, in parts of southwest Manitoba (Carey et al. 2003).

United States.—The range for Sprague's Pipits in the United States has contracted notably on its periphery. Changes and declines in abundance have contracted the range west and north in North Dakota and Minnesota and to the north in Montana. Data on South Dakota are inconclusive.

As he traveled near present-day Lostwood National Wildlife Refuge (NWR) in northwestern North Dakota in 1873, Elliot Coues remarked on the "...trio of the commonest birds…" encountered: Baird's Sparrow (*Ammodramus bairdii*), Sprague's Pipits, and Chestnut-collared Longspur (*Calcarius ornatus*), stating "…Sprague's Pipits were sometimes so numerous that the air seemed full of them..." (Coues 1878, Madden et al. 1999). After fewer than 100 years of settlement and agricultural development, Sprague's Pipits in North Dakota have declined to the point that they are no longer among the 15 most common birds and are currently absent in the easternmost counties (Stewart 1975). In Montana, there have been no breeding records in the southern and south-central counties since

1991 or earlier (Lenard et al. 2003), although some singing males have been noted in Jun (C. Wightman, pers. comm.). In South Dakota, pipits are absent in the eastern portion of the state and considered a rare and local summer resident (South Dakota Ornithologists' Union 1991, Tallman et al. 2002). The only breeding records are a nest found in 1907 and fledglings in 1996 (Tallman et al. 2002). The species was recorded in the summer months during the first South Dakota Breeding Bird Atlas (1988-1993) in McPherson, Dewey, Corson, Perkins and Pennington counties. There are also summer records in Edmunds and Harding counties in the 2000's (R.P. Russell, pers. comm.). Sprague's Pipits may always have been local and uncommon breeders in South Dakota, but historical data is lacking.

In Minnesota, Sprague's Pipits range has contracted substantially since European settlement and since the 1920s there has been a steady decline in numbers and breeding numbers and occurrence in the state. Currently, it is only a casual visitor and unknown as a breeding species (R. P. Russell, pers. comm.). Prior to 1890, the species could be found throughout the southwestern and south-central parts of Minnesota, breeding as far south as Pipestone and adjacent counties and as far east as Ottertail County (Roberts 1932). It was a common breeder in Kittson County in the northwest corner of the state in 1898, then no other data until 1928 when a dedicated trip to the Red River Valley found that it was only a casual summer resident on virgin prairie areas of the northwest valley (Roberts 1932). In recent years, a few birds have been observed on fall migration with Sep records from Dakota County in the southeast and Duluth in the northeast and Oct records from Cottonwood and Wilkin counties in the west. Likely these are birds straying eastward from breeding populations to the west or northwest of Minnesota (R. P. Russell, pers. comm.). The Minnesota County Biological Survey recorded a few birds at one site in Roseau County in 1991 and a single bird at another site in the same county in 2009 (S. Stucker, pers. comm.).

México.--There is no information on historical range in México.

Biology

Breeding

Arrival.—Sprague's Pipits arrive on the breeding grounds from the third week of Apr to mid-May (Maher 1973, Stewart 1975, SLJ); some individuals linger on the wintering grounds into early May. Pair formation begins shortly after arrival on the breeding grounds and eggs are laid between the second week of May through early Aug (Sutter 1996, Davis 2003, Jones et al. 2010). In Montana, the median nest initiation date was 25 May; the earliest date a nest was initiated was 7 May, while the latest date a nest was initiated was 31 Jul (Jones et al. 2010). Nest initiation dates tended to differ among years, and did not appear to be influenced by arrival dates (Davis 2003, SLJ).

Breeding Display.—Sprague's Pipits are unique in being so easy to hear yet so difficult to see with their "…prolonged and unique aerial display…" (Robbins 1998). The male's flight song is delivered high above the prairie in a series of high-pitched jingling notes that are audible>300 m. Males often hurry from view immediately after returning to the ground at the end of the display. Sprague's Pipit display bouts are prolonged, and persistent male display occurs from the time of arrival (approximately the third week of Apr) through the third week of May at Lostwood NWR in North Dakota (Robbins 1998). This was followed by a period of two to three weeks where display rates were reduced, followed by another period of elevated display rates (Robbins 1998) with some display into mid-Aug (Robbins and Dale 1999). This bimodal display regime is probably related to the breeding cycle, with display rates decreasing once a first clutch of eggs is laid and copulation opportunities decrease (Robbins 1998, Robbins and Dale 1999). This display is also observed, although rarely, during early migration in late Apr or very early May in Texas (Freeman 1999).

Territoriality.—Sprague's Pipit breeding territories are used for both nesting and feeding. These territories are presumably established and maintained through the aerial display. Occasionally, territorial males interrupt aerial displays and give chase to other presumed males that pass through the territory (Robbins and Dale 1999). Mapping of territory boundaries in 2007 indicated pipit territories rarely crossed trails (Dale et al 2009); territories were reported as 2.5±0.5 (SD) ha (n=30; Davis and Fisher 2009). In North Dakota, males were not uniformly distributed; all territories were located in elevated areas with short grass and relatively low sedge and forb densities (Robbins 1998).

Foraging Behavior.--Sprague's Pipits typically forage alone throughout the day in all seasons. They walk or run while gleaning food from the ground surface or grasses, typically in grass that is several centimeters tall (Robbins and Dale 1999).

Diet.—The diet of Sprague's Pipits during the breeding season is almost entirely comprised of arthropods with a small amount of vegetable matter (Robbins and Dale 1999). Sprague's Pipits feed primarily on arthropods during migration and on wintering grounds, with the addition of seeds during the later part of the winter (Emlen 1972, Robbins and Dale 1999).

Nest Characteristics.—Sprague's Pipits build ground nests in grasslands primarily with native grasses of intermediate height and density, with little bare ground and few shrubs; many times the nest is at the base of a dense tussock of grass (Sutter 1997, Dieni and Jones 2003). Coarse and fine dried grasses (about 5-15 cm in length) were woven into a cup; long grass growing adjacent to the nest is sometimes interwoven with loose grass forming a dome (Sutter 1997). This canopy can range from almost a complete dome to almost full exposure (Harris 1933, Sutter 1997). Nest entrances frequently have runways that extend up to 15 cm in length (Harris 1933, Sutter 1997). Nests were usually <100 m from roads and far (mean 20.7 m) from the nearest perch (shrubs and rocks) (Sutter 1996, 1997).

Nesting Behavior.—The female remains on the nest until an approaching observer is close. Once flushed, she flies low for a few meters then lands in the grass or climbs in an undulating flight to circle the area. When undisturbed, she approaches the nest by flying low to within a few meters and then walks to the nest. Incubation and brooding is primarily by females; although males will incubate and brood at an unknown rate (SLJ). Adult pipits responded aggressively to researcher presence if nestlings or dependent young were nearby (Davis and Fisher 2009), and during late incubation or with taped call playback (SLJ).

Incubation.—In Montana, the mean incubation time was 12.2±0.12 days (range: 7-15 days, n=85; Jongsomjit et al. 2007, Jones et al. 2010). In Saskatchewan from 1996-2000 the incubation period was 13 days (Davis 2003); mean incubation from Manitoba and Saskatchewan combined was 13.4±0.3 days (n=9; Davis 2009).

Clutches per Year.—The hatching rate for Sprague's Pipits in Montana was 85% (Jones et al. 2010). Re-nesting and second broods have been occasionally

documented for Sprague's Pipit (n=4; Sutter 1996; n=1; Davis 2009), as has polygyny (n=1; Dohms and Davis 2009).

Clutch Size.—Mean clutch size was 4.6±0.17 eggs (n=123; Jongsomjit et al. 2007, Jones et al. 2010) in Montana; 4.4 eggs (n=49; Maher 1973), 4.6 eggs (n=51; Sutter 1996), and 4.8 eggs (n=57; Davis 2003) in Saskatchewan. Sprague's Pipits clutch size generally increased during the first month of the breeding season (Davis 2003, Jones et al. 2010).

Nestling Stage.—In Montana, the mean nestling period was 13.1 days (range: 9 17 days, n=17; Jongsomjit et al. 2007, Jones et al. 2010). In Saskatchewan, Sprague's Pipit young left the nest 11-13 days after hatching (Robbins and Dale 1999); mean nestling period was 11 days (Davis 2003). The average nesting period for Manitoba and Saskatchewan combined was 12.1±0.2 days (n=43; Davis 2009). In Montana, the mean number of nestlings per all nests initiated was 4.0±0.26 nestlings (n=97; Jones et al. 2010).

Fledging.—Fledging dates ranged from 13 Jun through the last week of Aug, with 50% of pipits fledging between late Jun and mid-Jul at Matador, Saskatchewan (Maher 1973). Fledging ranged from 11 Jun to 19 Aug with 50% of fledging dates after mid-Jul at Last Mountain Lake and other sites in Saskatchewan (Dale 1983). A brood fledged as late as 31 Aug near Winnipeg, Manitoba (Harris 1933). At Bowdoin NWR in northcentral Montana, the earliest date for fledging was 6 Jun and the latest 24 Aug (Jones et al. 2010, SLJ).

Fledglings spent the first two days sitting in relatively tall (20-30 cm high) grasses and remained motionless when approached; by day 9, fledglings flew at least 25 m when approached, and by day 11, young pipits were able to make longer distance flights of 50-60 m (Davis and Fisher 2009). In Saskatchewan from 1996 - 2000, the mean number of young fledged per successful nest was 3.4±0.32 (n=20; Davis 2003). In Montana from 1997–2007, the mean number fledged per successful nest was 3.4±0.35 (n=49) and the mean number fledged per pair was 1.3±1.07 (Jones et al. 2010).

Nest Success.—Mayfield nest success (Mayfield 1975) was reported to be 24% (n=65) in Saskatchewan (Davis 2003) and 27.7% (n=120) in Montana (Jones et al. 2010). Predation was the primary cause of nest failure in Saskatchewan from 1996-2000 (Davis 2003) and from 1997-2007 in Montana (Jones and Dieni 2007, Jones et al. 2010). Nest predation was highest during the nestling stage with daily survival rates typically lower than those of the incubation period (Davis 2003, Jones et al. 2010). Predation may influence nest site choice, but nest age appears to be a stronger predictor of nest survival than nest site (Davis 2005, Davis et al. 2006; SLJ).

Predation.—Documented and suspected nest predators are diverse and include: mammals, such as Richardson's ground squirrel (*Spermophilus richarsonii*), American badger (*Taxidea taxus*), long-tailed weasel (*Mustela frenata*), red fox (*Vulpes vulpes*), and coyote (*Canis latrans*); mice and voles (*Zapus, Reithrodontomys, Peromyscus,* and *Microtus* spp.); and snakes, such as bull snake (P*ituophis melanoleucus*), garter snakes (*Thamnophis* spp.), and western rattlesnake (*Crotalus viridis*). Potential avian predators, such as Merlin (*Falco columbarius*), gulls (*Larus* spp.), Short-eared Owl (*Asio flammeus*), Loggerhead Shrike (*Lanius ludovicianus*), Black-billed Magpie (*Pica hudsonia*) and American Crow (*Corvus brachyrhynchos*) have been observed within the immediate vicinity of pipit nests (Jones and Dieni 2007). Documented nest predators from camera data in Saskatchewan and Montana are Northern Harrier (*Circus cyaneus*), Black-billed Magpie, Western Meadowlark (*Sturnella neglecta*), garter snakes, mice, 13-lined ground squirrel (*Spermophilus tridecemlineatus*), deer (*Cervidae*), striped skunk (*Mephitis mephitis*) and coyote (Davis et al. *in prep.*).

Nest Parasitism.—Brown-headed Cowbirds (*Molothrus ater*; cowbirds) parasitize Sprague's Pipit nests; pipits accept cowbird eggs and their nesting season largely overlaps with that of cowbirds (Davis 2003). Parasitism of Sprague Pipit nests by cowbirds is low compared with other grassland species (Davis 2003, Jones et al. 2010) and appears to be lower in more extensive prairies than in fragmented ones (Dechant et al. 2003). The rate of cowbird parasitism on pipit nests varied regionally: 18% (southwestern Manitoba: n=17; Davis and Sealy 2000), 15.4% (Saskatchewan: n=54; Davis 2003), and 2.4% (Montana: n=128; Jones et al. 2010). Sprague's Pipits failed to fledge cowbird young in Montana (Jones et al. 2010) and Saskatchewan (Davis 2003); in Manitoba, one cowbird young was fledged (Davis 2003), suggesting Sprague's Pipits are a poor quality cowbird host. However, in Manitoba and Saskatchewan, the presence of cowbird eggs/nestlings resulted in reducing clutch size and hatching success of Sprague's Pipits, with an overall cost of 1.3–1.6 young per parasitized nest (Davis and Sealy 2000, Davis 2003).

Mortality Other Than Predation.—High mortality rates in nestlings occurred due to prolonged periods of cold wet weather, flooding, trampling by cattle (*Bos* spp.), exposure, and desertion (Davis and Fisher 2009; SLJ). During the 2004–2006 breeding seasons at Last Mountain Lake, Saskatchewan, over 90% of active nests failed during periods of cool wet weather, due to flooding and exposure or starvation (Environment Canada 2008).

Return Rates.—Sprague's Pipits have low return rates (2.1%, n=48; Jones et al. 2007). Low site fidelity rates are typical of many passerines breeding in northern grasslands where habitat suitability varies with annual weather patterns, but may also be in response to fire frequency and grazing intensity (Andersson 1980, Jones et al. 2007). Sprague's Pipits respond to their unpredictable environment by settling in the most suitable habitats they encounter each spring (Andersson 1980, Jones et al. 2007).

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Habitat

Breeding

Sprague's Pipits are closely associated with native grassland throughout their range (Sutter 1996, 1997; Sutter and Brigham 1998; Madden et al. 2000; Grant et al. 2004) and are less abundant (or absent) in areas of introduced grasses than in areas of native prairie (Kantrud 1981, Johnson and Schwartz 1993, Dale et al. 1997, Madden et al. 2000, Grant et al. 2004). Generally, pipits prefer to breed in well-drained native grasslands with high plant species richness and diversity. They prefer higher grass and sedge cover, less bare ground, and an intermediate average grass height when compared to the surrounding landscape, <5-20% shrub and brush cover, no trees at the territory scale, and litter cover <12 cm (Sutter 1996, Madden et al. 2000, Dechant et al. 2003, Dieni and Jones 2003, Grant et al. 2004). The amount of residual vegetation remaining from the previous years' growth also appears to be a strong positive predictor of Sprague's Pipits occurrence (Madden 1996, Sutter 1996, Prescott and Davis 1998, Sutter and Brigham 1998) and where they put their nests (Dieni and Jones 2003, Davis 2005).

Sprague's Pipits prefer breeding sites in grasslands with a range of vegetative structure, which may vary geographically. In Saskatchewan, in native pastureland, Sprague's Pipits occurred more frequently in areas with <10% bare soil and <10% clubmoss (*Selaginella densa*; Davis et al. 1999). In Montana, nest abundance was positively associated in sites with ≤ 22% clubmoss cover and dominated by native grass (*Stipa*, *Bouteloua*, *Koeleria*, and *Schizachyrium* spp.); abundance was negatively associated with prickly pear cactus (*Opuntia* spp.) cover, and density of low-growing shrubs (Dieni and Jones 2003). In North Dakota, Sprague's Pipits were negatively impacted by increasing tall shrub (>1 m) and brush (<1 m) cover and increasing litter depth >12 cm (Grant et al. 2004). They had a negative reaction to tall shrub cover in the landscape and, with other grassland endemics, preferred areas with <20% shrubs; however, they were not woodland-sensitive at the landscape scale but were negatively associated with trees at the territory scale (Grant et al. 2004).

Sprague's Pipits rarely occur in cultivated lands, and are uncommon on non-native planted pasturelands (Owens and Myres 1973, Sutter 1996, Davis et al. 1999, McMaster and Davis 2001). They have not been documented to nest in cropland (Owens and Myres 1973, Koper et al. 2009), in land in the Conservation Reserve Program (Higgins et al. 2002) or in dense nesting cover planted for waterfowl habitat (Prescott 1997). However, territorial displays have been recorded in non-native grasslands where the structure of the vegetation was similar to that of native vegetation (Dale et al. 1997, Sutter and Brigham 1998, Davis et al. 1999, Higgins et al. 2002, Dohms 2009). In Saskatchewan, Sprague's Pipits have been documented nesting in non-native hayfields at Last Mountain Lake National Wildlife Area (Dale 1983); conversely, they were not associated with hayfields in the Missouri Coteau (Dechant et al. 2003).

Nests and Nest Sites.—In Montana, Sprague's Pipit nest sites were in grasslands primarily with native grasses of intermediate height and density, with little bare ground or clubmoss and few shrubs, and in nest patches with greater litter cover and depth, while avoiding areas with prickly pear cactus cover (Dieni and Jones 2003). They tended to nest in patches that had little or no clubmoss cover, nor was clubmoss ever used as a nesting substrate (Dieni and Jones 2003). These nest site data were consistent with findings reported from Saskatchewan (Sutter 1997), except there was no evidence of selection against forb cover (Dieni and Jones 2003). Selection for vertical habitat characteristics by this species appears to be occurring at the scale of the nest site rather than the nest (Dieni and Jones 2003, Grant et al. 2004). In Saskatchewan, Sprague's Pipits nest sites were most abundant in areas with intermediate cover values, higher grass and sedge cover, higher maximum height, lower forb and shrub cover, lower bare ground cover, and lower forb density than random sites; average vegetation characteristics at nest sites were: 52.7% grass and sedge cover, 10.5% forb and shrub cover, 15.2% litter cover, 16.8% bare ground cover, 55.6 forb contacts per m^2, 27.7 cm maximum vegetation height, 2.4 cm litter depth, and vegetation density of 1.1 contacts above 10 cm and 3 contacts below 10 cm (Davis et al. 1999).

Patch Size.—Sprague's Pipits are likely influenced by the size of grassland patches and the amount of grassland in the landscape (Davis 2004). In southern Saskatchewan, Davis (2004) found that Sprague's Pipits abundance was influenced by the size and configuration of suitable grassland patches and the amount of grassland in the landscape. Pipits also had a 50% probability of occurring on patches ≥ 145 ha (95% CI=69-314 ha); pipits were absent from grassland patches <29 ha (Davis 2004). A smaller edge:area ratio had higher pipit abundances, and was an important predictor of their occurrence (Davis 2004). No consistent effect of patch size was found on nest success (Winter et al. 2006; SLJ).

Management.—Grazing, fire, and mowing are the most common management techniques used in grasslands to

create or restore suitable habitat for Sprague's Pipits or to prevent further degradation. The effects will vary with intensity and frequency, as well as environmental conditions, such as moisture, soil type, plant species composition and geography (see Threats, below; Maher 1973, Owens and Myres 1973, Karasiuk et al 1977, Kantrud 1981, George et al. 1992).

Migration

No data. Migration habitats are poorly known. Where pipits have been seen during migration, the habitats used are similar to those documented on the breeding and wintering grounds, including pastures, prairie-dog (*Cynomys* spp.) towns, fallow cropland, and short-, mixed- and heavily grazed tall-grass prairies (Thompson and Ely 1992).

Winter

United States.—Winter habitats are similar to breeding habitats; i.e., large grasslands areas that may or may not primarily consist of native grass (Dieni et al. 2003, Desmond et al. 2005). In southern Texas, Sprague's Pipits were located almost exclusively in grass-forb prairie (27 individuals/km^2), and rarely in shrub grassland (2 individuals/km^2; Emlen 1972). Sprague's Pipits southern distribution is coincident with the occurrence of *Andropogon* spp. grasses (Root 1988), although this may be due to limited sample sizes. In Arizona and New Mexico they are found in extensive areas of well developed desert grasslands (Merola-Zwartjes 2005).

In Texas, Sprague's Pipits winter in heavily grazed grasslands dominated by little bluestem (*Schizachyrium scoparium*) and *Andropogon* spp, and in large, over-grazed pastures (Grzybowski 1982); they are often found in patches where the grass is very short (Freeman 1999). Large numbers were also found on approximately 2000 ha (~5000 acres) of former rice fields, that had been re-planted to Bermuda grass (*Cynodon* spp.) a decade or more earlier and heavily grazed; in these fields, pipits occurred most frequently on the saline outcroppings where there was little vegetation (B. Ortego, pers. comm.). The 2nd highest densities of wintering pipits in Texas were observed on grasslands at the Attwater Prairie Chicken NWR in Colorado County and the Mad Island complex in Matagorda County These areas each consists of > 4000 ha (~10,000 acres) of native grasslands with moderate grazing and with the dominant grasses being normally about 0.2 m high. Pipits were also found frequently on turf grass farms, golf courses, heavily gazed Bermuda grass (Freeman 1999; B. Ortego, pers. comm.) and areas of burned pasture (Freeman 1999).

In both Texas and México, Sprague's Pipits are often observed using roads through appropriate habitat (Freeman 1999; B. Ortego, pers. comm.). These are typically either paved or unpaved secondary or tertiary roads with grass shoulders in agricultural settings without much traffic (Freeman 1999; B. Ortego, pers. comm.).

México.—In northwestern Chihuahua, Sprague's Pipits showed strong association with open grasslands, both densely and sparsely vegetated, and were not found in grassy agricultural borders or overgrazed *ejido* lands, and they were negatively associated with shrub abundance (Desmond et al. 2005). Comparisons of avian species assemblages on *ejido* land and an adjacent private ranch found that overgrazed *ejido* land did not support Sprague's Pipits (Desmond et al. 2005). A seasonal study of bird distribution in Cuatro Ciénegas, Coahuila, México (Contreras-Balderas et al. 1997) noted that Sprague's Pipits were found in three vegetation types: 1) scrub dominated by creosote bush (*Larrea tridentata*); 2) mesquite dominated by catclaw acacia (*Acacia greggi*); and 3) alkali scrub dominated by *Atriplex* sp., salt-tolerant grasses (*Sporobolus, Distichlis*, and *Monanthochloe* spp.) and mesquite (*Prosopis laevigata*).

In north-central México (Sonora, Chihuahua, Durango, Coahuila, and portions of Nuevo León and San Luis Potosí), Sprague's Pipits were a widespread winter resident in Chihuahuan desert grasslands (Panjabi et al. 2010). Densities have some annual variation, however, estimates of global densities were similar across years (2007–2009; Panjabi et al. 2010). Shrub cover had a strong negative influence on pipit abundance, with grass and other cover variables important positive predictors (Panjabi et al. 2010).

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Population Trends and Estimates

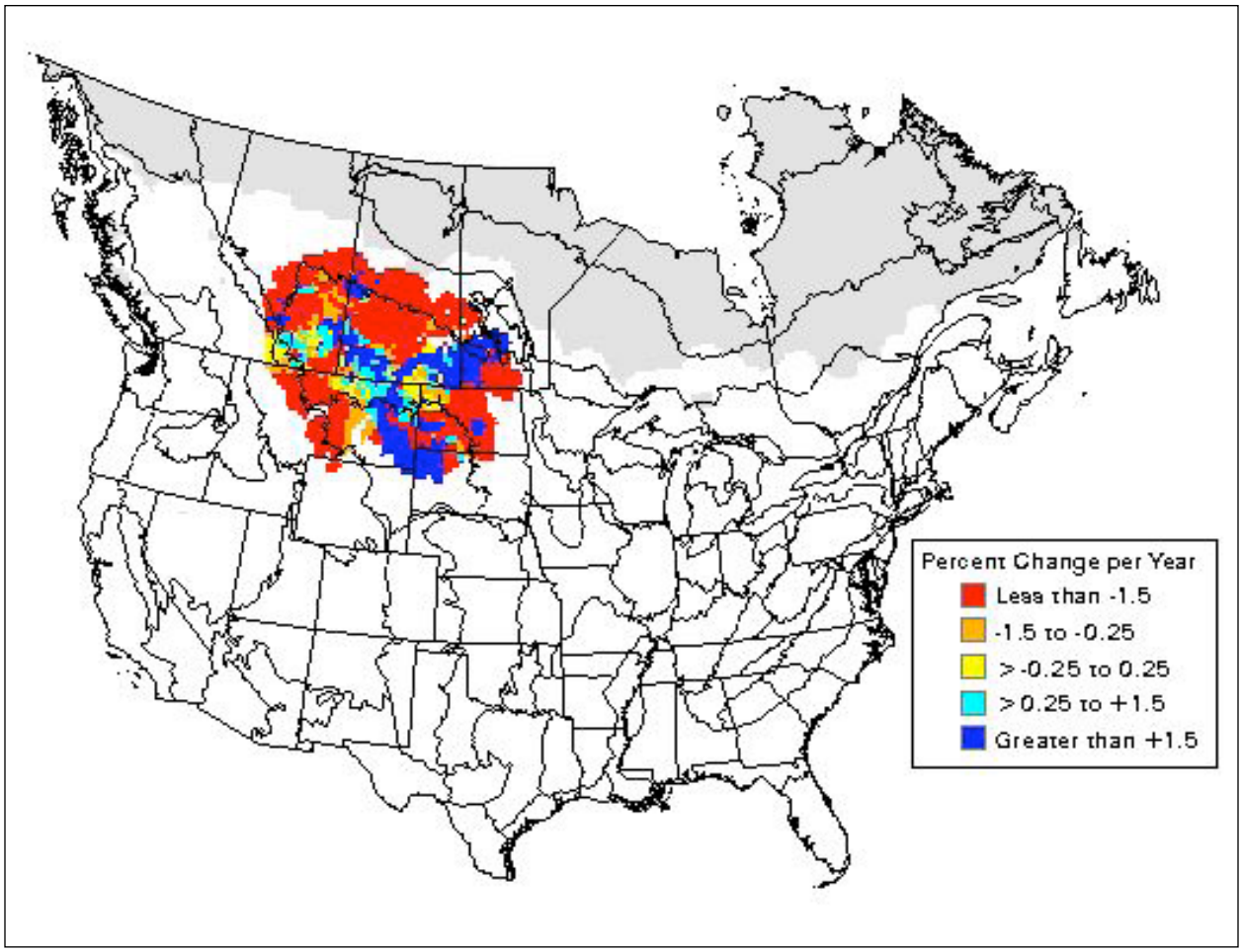

Figure 3. Trends for Sprague's Pipit, percent change per year; data from the Breeding Bird Survey for 1996-2007 (Sauer et al. 2008). These trends do not necessarily reflect statistical significance (see Table 1)

Trends

Breeding Bird Survey

Rangewide.—Breeding Bird Survey (BBS) data show Sprague's Pipit populations experiencing a statistically significant rangewide decline of 3.9% per year (1967-2007, n=169, p=0.00; Table 1; Sauer et al. 2008). The most dramatic population decreases occurred in Canada (6.0% per year between 1966 and 1996; n=37, p=0.09; Sauer et al. 2008). On a continental scale, most areas show declining populations over the past 30 years, with non-significant increases occurring only in the southwestern portion of the breeding range (Fig. 3; Sauer et al. 2008). Population monitoring in Sprague's Pipits is complicated by their nomadic behavior in response to annual weather conditions (Fig. 4; Root 1988, Jones et al. 2007).

Canada.—Sprague's Pipit experienced a 4.8% annual decline between 1966 and 2005; pipit populations in all jurisdictions and physiographic strata experienced their largest declines between 1966 and 1979 (Environment Canada 2008). A recent analysis of BBS routes within the Prairie Habitat Joint Venture indicates a 4.5% annual decline between 1970 and 2005; 2.8% annual decline in the prairie region compared with a 6.4% decline in the northern parkland region (Environment Canada 2008). Trend results for Grassland Bird Monitoring-Canada (1996–2004) show a decline of 10.5% annually in the prairie region compared with a 1.8% annual decline measured by the BBS in Bird Conservation Region (BCR) 11 for the same period (B. Dale and B. Collins, pers. comm.).

Declines in Alberta, where the species reaches its highest continental abundance, have been more rapid (10% per year) over the same period (Environment Canada 2008). Declines are also steep in Saskatchewan,

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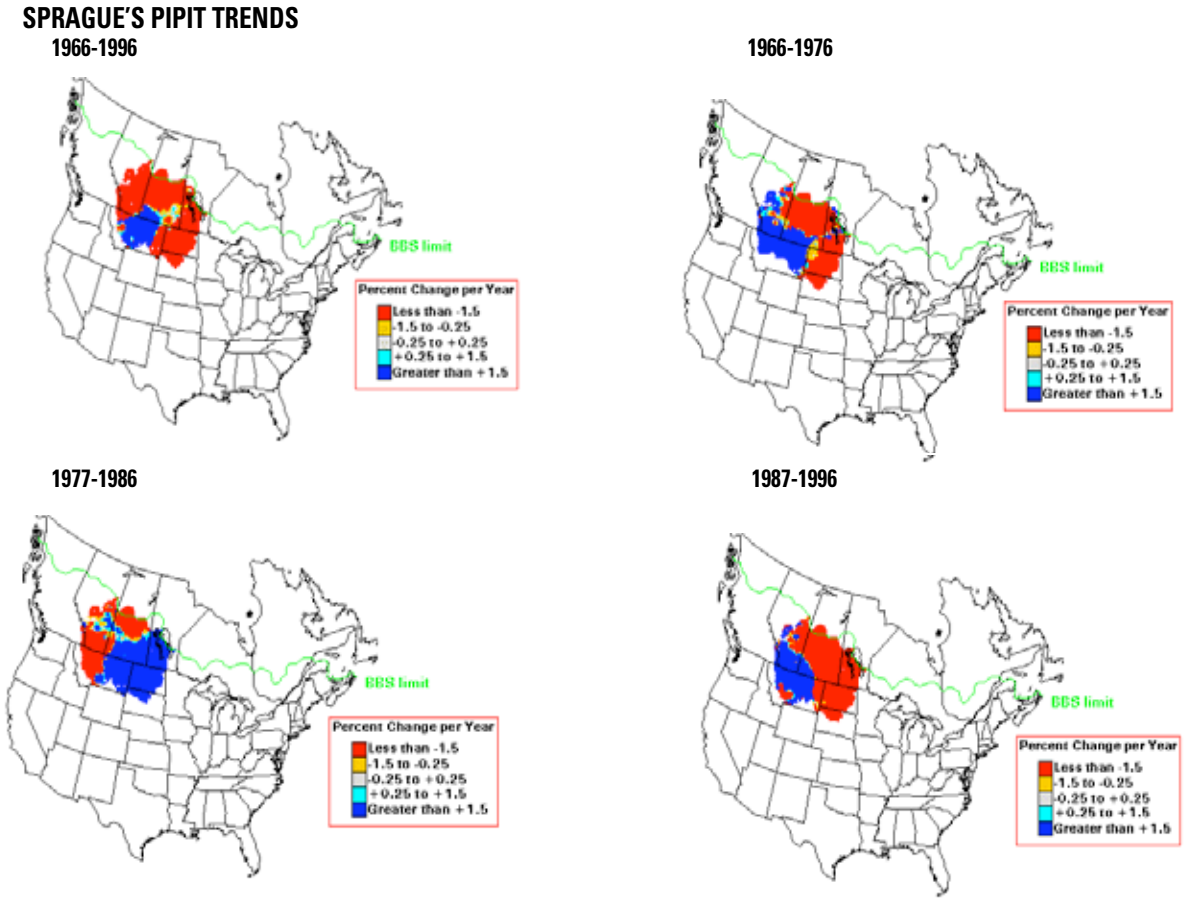

Figure 4. Trends for Sprague's Pipit for different time periods, data from the Breeding Bird Survey (J. R. Sauer, pers. comm.). Trends do not reflect statistical significance (see Sauer et al. 2008).

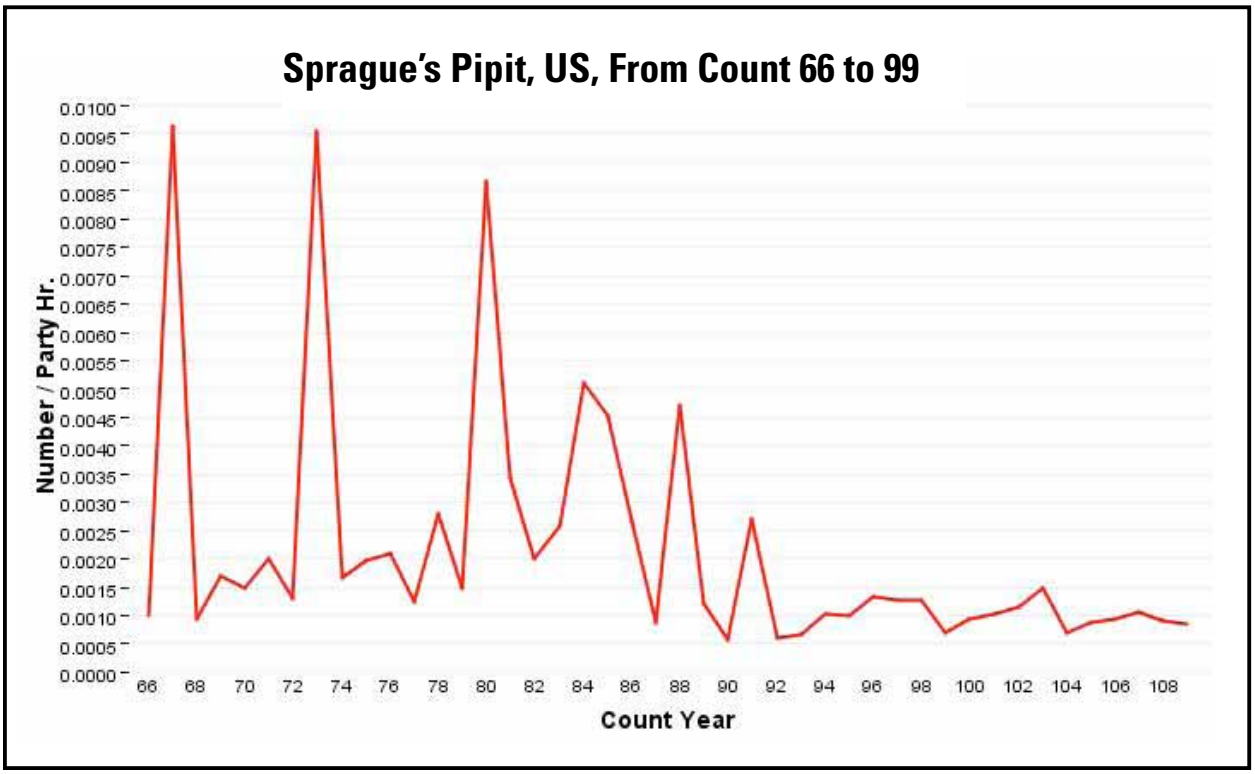

Figure 5. Christmas Bird Count data showing yearly variation in Sprague's Pipit densities for the U.S. (National Audubon Society 2009).

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4.2% per year (n=45, p=0.05) for the survey period (1966–2007; Environment Canada 2008). Sprague's Pipits populations in Saskatchewan have declined 4.8% per year since 1966, and 7.9% per year since 1980 (Prescott 1997).

United States.—In the United States trends are largely non-significant (Table 1; Sauer et al. 2008). There was no change in the population size of Sprague's Pipits in North Dakota between 1967 and 1993 (Igl and Johnson 1997).

Christmas Bird Count

United States.—CBC data show large yearly swings in numbers (Fig. 5; National Audubon Society 2009), and in general, the abundance of pipits was too low and sporadic for CBC data to yield meaningful information (Root 1988). Some of this variation may be due to measurement error, or to Sprague's Pipits nomadic behavior in response to annual weather conditions (Root 1988). There is also some annual variation in the areas of the highest winter densities; however, while poorer quality sites are inconsistent in the number of pipits from year to year, the higher quality sites consistently have high numbers of pipits each winter (B. Ortego, pers. comm.).

In another analysis of CBC data (National Audubon Society 2009), the 40-year (winters of 1996 through 2005) trend data for Sprague's Pipits showed a decline for Texas (2.54%), Louisiana (6.21%), Mississippi (10.2%), and Arkansas (9.27%), although abundances were very low and variable (U. S. Fish and Wildlife Service 2010). Overall, the 40-year trend showed a median declining population of approximately 3.23% annually; however, no tests of statistical significance were given (U. S. Fish and Wildlife Service 2010).

México.—CBC data (National Audubon Society 2009) data show Sprague's Pipits occurring every year in northern Chihuahua (Ejido San Pedro) and some years in Coahuila. Few individuals have been observed, with only one pipit documented in 1979, 1980, and 1986. Beginning in 1989, pipits were observed in northern México in all years. The highest number of individuals was in 1996, with 54 reported on one circle, and in 2004, with 48 individuals reported on five circles (National Audubon Society 2009). Generally, there is limited CBC data from México and therefore, CBC data could be misleading in the relative importance of México to wintering populations (J. M. Ruth, pers. comm.).

Historic

Anecdotal accounts from early naturalists suggest that Sprague's Pipits were one of the most common grassland songbirds in the northern Great Plains. Since its discovery, the Sprague's Pipit has suffered greatly throughout its breeding range from conversion of short- and mid-grass prairie to agriculture by Euro-Americans. There have been dramatic declines in pipits as prairie has disappeared through cultivation, overgrazing, and invasion by exotic plants (see Historical Changes, above; Prescott and Davis 1998).

Population estimates

Breeding.—Using BBS data, a global population estimate of 870,000 birds was derived (Sauer et al. 2003, Rich et al. 2004); however, this was calculated using a standard set of assumptions and calculations (Rosenberg 2004) that are unverified with the existing data and is a rough estimate with unknown, but potentially large, error. Similarly, populations have been estimated for the sub-regions of the U.S. states and Canadian provinces (Blancher et al. 2007). These estimates range from 400,000 (47.9% of the global population) in Alberta to 3000 (0.3% of the global population) in South Dakota (Blancher et al. 2007).

Wintering.—CBC data show that the highest wintering densities of Sprague's Pipits are recorded in north-central Texas (Prescott and Davis 1998, Sauer et al. 2008); however, this data has noteworthy biases (B. Ortego, pers. comm.). Grzybowski (1982) described the highest numbers in the central coastal prairie region of Texas and the highest numbers reported on a CBC route was 196 individuals at Corpus Christi in the winter of 1966-1967; currently, either Matagorda or Attwater Prairie Chicken CBC routes have the highest tallies with ca. 36 individuals (B. Ortego, pers. comm.). The small numbers of individual pipits on the CBC in southern Oklahoma and northern Texas may be due in part to the sometimes slow migration these birds exhibit during the dates of the CBC period; in mid to late Jan, the Sprague's Pipits are difficult to locate north of the coastal plain and become more common in southern Texas (B. Freeman, pers. comm.). The largest wintering populations in the Unites States were in coastal short-grass prairie in southern Texas, where "…many hundreds…" were observed in a single day in a 154 km^2 (60 sq. mile) area; the numbers of individuals peaked in Mar and early Apr (B. Freeman, pers. comm.). However, since abundance data is largely lacking from México, it is unknown how much of the population generally winters in México.

Densities

Breeding.—Densities of 21.5-41.2 pairs/100 ha were reported on native prairie in Saskatchewan (Maher 1973). A partially randomized survey of Saskatchewan grasslands found Sprague's Pipits on 18% of 1858 half-circles in native pasture (Antsey et al. 1995). In 1996-1997, a BBS-type study reported Sprague's Pipits on 32.5% of 1650 point counts in southwest Saskatchewan and southeast Alberta (Dale et al. 1997). In Alberta in 1994 and 1995, Sprague's Pipits were encountered on 54.1% of 741 point counts (Robbins and Dale 1999). In Montana, from 2001-2007, 49.8–71.3% of point counts (n=1410 points) detected Sprague's Pipits (C. Wightman, pers. comm.).

Wintering.—Densities of wintering pipits in the coastal prairies of Texas were 64 to 90 birds/100 ha (Grzybowski

1982) and 4.4 individuals/km² in southern Texas (n=23; Emlen 1972). The highest concentrations were in southwest Texas, where the maximum abundance was 0.68 individual/party hour (n=56 circles; Root 1988). In portions of northern México adjacent to Texas, Sprague's Pipits were recorded on 11.2% of survey points (Prescott and Davis 1998). Densities of Sprague's Pipits from 1 to 11 birds per km² were documented throughout northern México (Chihuahua, Sonora, Coahuila, Durango, and Nuevo León). Densities of 10 individuals/km² were found at Cuchillas de la Zarca in Durango and Valle Colombia in Coahuila; densities of 5-10 individuals/km² were found in El Tokio in Coahuila/Nuevo León and Sonorita in Sonora. Sprague's Pipits were also regularly found at lower densities at Janos and Valle Centrales in Chihuahua (A. O. Panjabi, unpubl. data). The Janos Valley in Chihuahua may represent a northern limit of regular wintering by large numbers of Sprague's Pipits (Dieni et al. 2003).

Monitoring Activities

Grassland Bird Monitoring-Canada.—Grassland Bird Monitoring-Canada (GBM-Canada) started in 1996 in prairie Canada (Dale et al. 2003). GBM-Canada uses the same methodology as the BBS but additional random routes were added to the regular BBS routes to target grassland cover within the mixed-grass prairie region. Originally 30 routes were selected in Canada, and the Canadian Wildlife Service continues to run about 15 per year. GBM-Canada results in a higher number of grassland birds per route compared to BBS routes within grasslands. Population trends differ between GBM-Canada and BBS as well, both positively and negatively – the combined trends are probably the most accurate (Dale et al. 2003).

Other-Canada.—Priority grassland bird surveys on Canadian federal lands (e.g., National Wildlife Areas, Prairie Farm Rehabilitation Administration (PFRA) pastures, and Grasslands National Park) in Saskatchewan and Alberta are conducted to monitor local populations and refine the status, distribution, and abundance of pipits in these areas (Environment Canada 2008). The Manitoba Conservation Data Centre has collected and collated Sprague's Pipit occurrence data from 1987 to 2006. A federal database has been established to manage and distribute Sprague's Pipit data collected by various agencies across the prairie region in Canada and the United States (Environment Canada 2008). Pipit populations are monitored by staff at Suffield National Wildlife Area in southeast Alberta (Dale et al. 2003). Demographic monitoring was initiated at Last Mountain Lake National Wildlife Area in central Saskatchewan in 2004 and has recently expanded to nearby PFRA pastures (Environment Canada 2008).

Grassland Bird Monitoring-United States.—In 2009, USFWS Region 6 started a GBM-US program in southwestern North Dakota, northwestern South Dakota, and eastern Montana expanding the GBM-Canada in the mixed-grass prairie regions of the United States (Jones and Niemuth 2009). GBM-US will add new BBS routes in degree blocks with >50% grass in Montana. These new routes will be selected in conjunction with the methods established by GBM-Canada program. Additionally, GBM-US will target running all BBS routes in the priority GBM-US area and habitat (Jones and Niemuth 2009).

Other-United States.—Priority areas and species are the focus of state agency projects. These include the second South Dakota Breeding Bird Atlas (2008-2012; E. Dowd-Stukel, pers. comm.) and monitoring projects in Montana, one ongoing from 2001, and the other started in 2009 (C. Wightman, pers. comm.). The Bureau of Land Management and Montana Natural Heritage Program have conducted surveys of breeding birds, including Sprague's Pipits, from 2001 - 2007 in northern Valley County, Montana (C. Wightman, pers. comm.).

Mexican Plateau Monitoring-México—In January 2007, the Rocky Mountain Bird Observatory initiated a study to inventory, research, and monitor wintering birds in Chihuahuan Desert Grassland Priority Conservation Areas (GPCA) in México (Levandoski et al. 2008, Panjabi et. al 2010). The project assessed key vegetation and habitat parameters at selected sites considered important in determining grassland bird use, including use by Sprague's Pipits. Variation in densities and richness of wintering grassland birds across GPCAs and changes in regional distribution between 2007 and 2008, suggested plasticity in wintering range for pipits (Levandoski et al. 2008, Panjabi et al. 2010).

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Threats

Habitat loss, degradation, and fragmentation, inappropriate management, nest predation and parasitism, energy development, climate change, and drought are threats that currently or potentially effect Sprague's Pipits populations throughout their range.

Breeding

Regulatory Protection.—Current regulations appear to provide Sprague's Pipit individuals with adequate protection throughout its breeding range. Sprague's Pipits are federally protected in Canada and the United States under the Migratory Bird Treaty Act of 1918 as amended (16 U.S.C. 703-711: 40 Stat. 755; U.S. Fish and Wildlife Service 2008a).

Sprague's Pipits are protected as "Threatened" in Canada (Committee on the Status of Endangered Wildlife in Canada 2002). In Canada, a national recovery strategy for Sprague's Pipits has been prepared with guidance on recovery efforts required to mitigate threats (Environment Canada 2008); this recovery strategy provides some protection for their habitat.

Sprague's Pipits are proposed for listing as "Endangered" or "Threatened" in the United States, but further action is precluded by higher listing priorities (U.S. Fish and Wildlife Service 2010). No current protection for Sprague's Pipit habitat exists in the United States, except on public lands, and lands under grassland easements; many tribal lands have lower rates of conservation. Incentive programs such as the U.S. Farm Bill Grassland Reserve Program and the Farm and Ranchland Protection Program offer some breeding habitat protection in upland easements that are held in perpetuity. Most native grassland habitat suitable for Sprague's Pipit is owned primarily by private landowners and is afforded little or no protection from alteration and disturbance from human activities. There are currently no specific requirements in state agency regulatory systems that protect Sprague's Pipits habitat (U. S. Fish and Wildlife Service 2010), although many state and provicial lands are protected from cropland conversion. Although not protected specifically for pipits, large grassland tracts are protected by the National Wildlife Refuge System, National Parks, Bureau of Land Management, and Forest Service lands in the United States and the Grasslands National Park in Canada; however, these areas would not be enough to sustain pipit populations throughout their lifecycle.

Habitat.—The conversion, degradation, fragmentation, and loss of native prairie are the primary threats to Sprague's Pipit populations. The once abundant grasslands of the Great Plains have been drastically reduced, altered, and fragmented by intensive agriculture, roads, tree plantings, encroachment by woody vegetation, invasion of exotic plants, and other human activities, including the removal of native grazers and a change in the natural fire regime (Igl and Johnson 1997, Dechant et al. 2003, U. S. Fish and Wildlife Service 2010). It has been estimated that at least 75% of native grasslands in the Canadian prairies have been lost primarily to cultivation, succession, road construction, gravel extraction, petroleum exploration and extraction, and settlement (i.e., urban and rural expansion) (Environment Canada 2008). Mixed-grass prairie has declined 60 - 99% in acreage in the prairie provinces of Canada with over 90% of the converted grasslands in Canada being used for agriculture (Robbins and Dale 1999). In the United States, about 60% of native mixed-grass prairies in Montana, North Dakota, and South Dakota have been converted to cropland (Higgins et al. 2002). Data from South Dakota indicate that 1.4 million hectares (3.5 million acres) of rangelands (a 14% decrease) were converted to cropland and other developments from 1977 to 1997 (Higgins et al. 2002).

Grassland conversion has greatly reduced the quality and availability of suitable habitat for Sprague's Pipits. Land cover images of the Great Plains in Canada and the United States indicate that only 30% of native prairie remains from pre-colonial times (Samson and Knopf 1994). However, due to expected demographic change in human populations and subsequent landowner changes, it is likely that more grassland will be lost in the near future (Prescott and Davis 1998, Environment Canada 2008). Since pipits rarely use land enrolled in the Permanent Cover Program in Canada or the Conservation Reserve Program in the United States or seeded cover planted for waterfowl production (Johnson and Schwartz 1993, Prescott and Davis 1998) these programs will not mitigate the effects of prairie conversion for Sprague's Pipits.

Although Sprague's Pipits will use non-native replanted grasslands, their abundance is lower than in native grasslands (Dale et al. 1997, Sutter and Brigham 1998, Davis et al. 1999), and they are generally associated with native prairie (Sutter 1996, Madden et al. 2000, Davis 2004, Grant et al. 2004, McMaster et al. 2005). Pipits may nest in non-native grassland sites that were previously cultivated if the vegetation structure is appropriate (Dale et al. 1997, Sutter and Brigham 1998, Davis et al. 1999). Abundances are lower in these

habitats than in native grasslands (McMaster and Davis 2001); however, nest survival is similar (Dohms 2009).

Since most native grasslands in the mixed-grass prairie in both Canada and the United States are grazed by livestock, Sprague's Pipits are susceptible to habitat degradation as a result of high-intensity grazing (see Grazing, below; Prescott and Davis 1998, Madden et al. 2000). Other grassland changes can alter the structure of vegetation so that it is no longer attractive to pipits. These changes include increased woody vegetation in the form of tree plantings and shrub encroachment, and invasive grasses and forbs (Johnson and Igl 1995, Dechant et al. 2003, Environment Canada 2008).

Sprague's Pipits nested in patches that had little or no clubmoss cover, nor was clubmoss ever used as a nesting substrate (Dieni and Jones 2003) although at the territory scale, pipits were positively correlated with ≤22% clubmoss cover (Dieni and Jones 2003). The potential for clubmoss to increase during drought sometimes makes it a management target; generally accepted methods of clubmoss removal, e.g., burning, grazing, mechanical and chemical treatments (Crane 1990), may themselves alter grassland conditions making the area unsuitable for nesting Sprague's Pipits, particularly in the short-term.

Burning.—Sprague's Pipits have evolved with periodic fires on the prairies, and may be limited by reduced fire frequencies that have accompanied human settlement. Reduced fire frequency allows encroachment by woody vegetation and invasive grasses and forbs, excessive growth of vegetation, and excessive accumulation of litter (Madden 1996, Environment Canada 2008), degrading breeding habitat in many geographic areas (Environment Canada 2008).

Large increases in Sprague's Pipit populations were recorded two years after a burn in Saskatchewan (Environment Canada 2008). Sprague's Pipits did not occur on North Dakota grasslands that had not been burned for over eight years; breeding abundances were highest two to seven years after a fire (Madden 1996). In more arid regions, Sprague's Pipits were common on native pastures that had not been burned for more than 15 years (Sutter 1996, Dale et al. 1997) and 26 years (Dieni and Jones 2003, Jones et al. 2010). Thus, the effects of burning likely vary with frequency, soil type, and moisture regimes, and land productivity. In the arid regions of the mixed-grass prairie, fire frequency recommendations are 8-20 years (Askins et al. 2007). Burning can have adverse short-term effects on Sprague's Pipits abundance and occurrence; however, it may have long-term benefits through improved habitat quality, if it occurs in an appropriate periodicity (Prescott and Davis 1998, Environment Canada 2008).

Grazing.—Livestock grazing can greatly influence vegetation structure, and, therefore, influence Sprague's Pipits occurrence and abundance (Prescott and Davis 1998). The effects of cattle grazing on Sprague's Pipits distribution depend on a variety of factors, including grazing intensity and frequency, as well as environmental conditions, such as moisture, soil type, and plant species composition (Maher 1973, Owens and Myres 1973, Karasiuk et al. 1977, Kantrud 1981, George et al. 1992). Therefore, the response of Sprague's Pipits to grazing intensity and frequency likely varies with geography.

While Sprague's Pipits generally avoid heavily-grazed pastures (Maher 1973, Owens and Myres 1973, Prescott and Wagner 1996, Sutter 1996, Davis et al. 1999), lightly- to moderately-grazed pastures have been identified as optimal habitat for pipits throughout much of their breeding range (Owens and Myres 1973, Davis et al. 1999, Robbins and Dale 1999, Dechant et al. 2003). In North Dakota, a greater abundance of Sprague's Pipits was reported from moderately to heavily grazed pastures (Kantrud 1981). Intensive grazing, however, may render some grassland habitat unsuitable, both indirectly through impacts to vegetation structure and directly through reproductive failure due to disturbance and trampling of nests (Environment Canada 2008).

In the eastern portion of Sprague's Pipits range, in the mesic mixed-grass prairie, disturbance (primarily fire at appropriate intervals, and secondarily grazing, at appropriate rates) can be used to create and maintain healthy pipit habitat (Kantrud 1981, Madden et al. 1999). In the drier, less densely-vegetated mixed-grass prairie particularly in the southwestern portions of Sprague's Pipits range, it has been documented that the number of Sprague's Pipits decreased significantly with increased grazing intensity (Maher 1973, Dale 1983, Robbins and Dale 1999). During 1994-2007, a small but consistent breeding population was documented at Bowdoin NWR in north-central Montana in idle mixed-grass prairie (Dieni and Jones 2003, Jones and Dieni 2007, Jones et al. 2007, Jones et al. 2010).

The effects of grazing must also take into account vegetation potential in the form of structure (i.e., vertical and horizontal density) as well as plant species composition, which varies within and across geographic locales. Cattle presence can also result in increased abundances of cowbirds (Duffy 2000, Danley et al. 2004).

Fire and Grazing, Combined.—In units that were burned, and then grazed, pipit numbers were similar to those in units that were only burned; Sprague's Pipits had lower abundances the first year after treatment, and increased in the second and third year, whether grazing was added or not (Danley et al. 2004). However, cowbirds occurred 2.4 times more frequently on burned and grazed units then those only burned (Danley et al. 2004). The implications of increased cowbird abundance on pipit populations are currently unmeasured.

Mowing.—Haying in native prairie may have negative impacts on Sprague's Pipits populations (Prescott and Davis 1998, Robbins and Dale 1999, McMaster et al. 2005). Sprague's Pipits are not common on planted hayfields, and haying native prairie during the nesting season may substantially lower reproductive

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success through mechanical destruction of nests and adults, or by reducing vegetative cover and exposing nests to predators and inclement weather (Dale et al. 1997, Davis 2005). Mowing has been found to destroy approximately 50% of ground nests and the productivity of breeding birds in hayfields is below that required to maintain stable populations (Dale et al. 1997, Prescott and Davis 1998). In Manitoba, native hayland was more attractive to Sprague's Pipits than brome/alfalfa hayland or idle native grassland, but it was less attractive than non-native pasture. In Alberta, hayed native fescue was less attractive to Sprague's Pipits than idle fescue, but more attractive than grazed fescue (Robbins and Dale 1999). In Saskatchewan, Sprague's Pipits were significantly more common in idle native grassland than in either annually or periodically hayed exotic grasses (Robbins and Dale 1999, McMaster et al. 2005).

Introduced Vegetation.—Sprague's Pipits have a strong negative response to exotic grasses (Sutter 1996, Madden et al. 2000, Grant et al. 2004). Consequently, the introduction of Eurasian plant species has had a negative effect on Sprague's Pipit populations. In Manitoba, Sprague's Pipits were significantly more abundant in native prairie than in introduced vegetation (Wilson and Belcher 1989). Singing males were two to three times more abundant in native grass than in crested wheatgrass (*Agropyron cristatum*) and four to 25 times more abundant in native grass than in brome-dominated grassland in south-central Saskatchewan (Prescott and Wagner 1996). They were more than twice as abundant in native grass than crested wheatgrass or absent from crested wheatgrass in southern Alberta sites (Prescott and Wagner 1996). Greater Sprague's Pipit densities were significantly correlated with native grasses at Lostwood NWR in North Dakota (Madden 1996). Exotic plant species planted for the Conservation Reserve Program and for nesting cover for waterfowl are generally not used by Sprague's Pipits (see Threats, Breeding, Habitat, above; Robbins and Dale 1999).

Pesticides.—Use of pesticides to control grasshoppers may impact Sprague's Pipit populations, since grasshoppers are an important food item for the adults and nestlings during the breeding season (George et al. 1992, Environment Canada 2008). Anecdotal observations suggest that Sprague's Pipits may occasionally forage in cropland and thus could be exposed to pesticides (Environment Canada 2008). The amount of time pipits could be exposed to pesticides during the breeding and non-breeding season is unknown.

Fragmentation.—Fragmentation of native prairie has likely contributed to the decline of Sprague's Pipit populations through a reduction in average patch size, increased isolation of habitat patches, an increase in the ratio of edge:area to interior habitat (Davis 2004, Davis et al. 2006) and potentially, an increase in parasitism (Davis and Sealy 2000). In fragmented landscapes, habitat interior species such as Sprague's Pipits (Davis 2004) may experience lower reproductive success when nesting near habitat edges, where they are more susceptible to nest predators and brood parasites (Prescott and Davis 1998, Davis et al. 2006). Sprague's Pipit abundance was inversely correlated with distance to cropland and to water (Koper and Schmiegelow 2006a, 2006b; Koper et al. 2009). Pipits had higher densities by at least 0.3 individuals per point count per km away from cropland, and the average number of individuals per point count increased by at least 0.4 per km away from water, with distance to road having no effect (Koper and Schmiegelow 2006b).

Roads.—Sprague's Pipits may avoid roads and trails during the breeding season (Sutter et al. 2000) and the increased roads densities associated with energy development effects Sprague's Pipits habitat (Dale et al. 2009, Linnen 2008). The type of road (e.g., secondary or tertiary, the presence of deep ditches on the sides, heavily graveled) and the level of traffic are the potential issues in determining the degree of effect roads and trails have on Sprague's Pipit populations (N. Koper, pers. comm.; SLJ; see Winter, below).

In Saskatchewan, Sprague's Pipits were significantly more abundant along trails (wheel ruts visually indistinct from surroundings) than along roadsides (fenced surfaced roads with adjacent ditches), which may be attributed to the 20 - 30% reduction of suitable habitat associated with the road right-of-way (Sutter et al. 2000). Sprague's Pipits avoidance of roads in this study may be due to the roadside habitat which also tended to have non-native vegetation, dominated by smooth brome (*Bromus inermis*) (Sutter et al. 2000). Other data found that there was no significant effect of roads (Koper et al. 2009); there was no effect of trails on pipit nest survivorship in Montana (SLJ).

Linnen (2008) examined the effects of oil and gas disturbances, including road establishment and suggested that Sprague's Pipits tended to occur in lower numbers and at fewer sites near natural gas wells and trails than in interior habitat patches; however, the relationship was not statistically significant (Linnen 2008). Dale et al. (2009) documented that pipit territories rarely crossed trails. However, the method used to map the breeding territories was not detailed and no tests of statistical significance were reported (Dale et al. 2009), thus sampling error was never eliminated as a possible explanation.

Depredation.—Predation is the primary factor influencing nest survival throughout the species' range (Davis and Sealy 2000, Davis 2003, Jones and Dieni 2007, Jones et al. 2010) and in some years, predation can result in near complete nesting failures (Davis 2005). It is difficult to determine whether current predation rates are higher than historic levels; changes in predator communities, habitat structure, and composition and configuration of current grassland habitat could increase the risk of predation; however, little data are available.

Nest Parasitism.—Cowbird parasitism rates on Sprague's Pipit nests vary throughout their range. Habitat fragmentation potentially increases the rate of cowbird parasitism, and the degree of impact from parasitism on nest survival (Davis and Sealy 2000). However, pipits do not seem to be a good host for cowbirds; the cost of parasitism to pipit populations overall is unknown (see Parasitism, above; Davis 2003, Jones et al. 2010).

Climate Change.—Sprague's Pipits are susceptible to climate change (Price 1995). Modeling and predictions of climate change indicate that pipits will become extirpated as a breeding species in the United States and the lower third of Canada due to increasing temperature (Price 1995). It is also predicted that Sprague's Pipits may shift their range north, as southern areas become too warm (Price 1995). The impact of climate change at a population level is unknown. Prolonged periods of cool and wet weather may impact local Sprague's Pipit populations by reducing productivity (Environment Canada 2008). In addition, predictions for harsher, drier temperatures in México, changes in frequency and intensity of drought could impact wintering Sprague's Pipit populations further. These predictions may also affect migration areas (C. M. Rustay, pers. comm.).

Drought.—Drought can be a significant factor affecting Sprague's Pipits nesting habitat and possibly food supply at the local level (Environment Canada 2008) and also affecting wintering habitats (Dieni et al. 2003, J. M. Ruth, pers. comm.). Sprague's Pipits disappeared or declined from many transects in North Dakota during a severe drought in 1988 (George et al. 1992, Niemuth et al. 2008); pipits rebounded once the drought cycle was reversed (George et al. 1992). The effects of drought could be exacerbated by the impact of grazing and fire, particularly in the xeric areas of their range (Askins et al. 2007).

Energy Development.—Energy exploration and extraction are expected to continue to be a threat to Sprague's Pipits habitat and populations into the future as demands for resources increase globally (Environment Canada 2008). Sprague's Pipits abundance decreases within 300 m of oil wells (Linnen 2008). A substantial amount of new oil and gas production is predicted to occur throughout Sprague's Pipits' breeding range, particularly in Alberta (Environment Canada 2008). Currently, no regulatory mechanisms exist for many of these activities to ensure that drilling and associated activities avoid nesting habitat. In the United States, much of the Sprague's Pipit's breeding range overlaps major areas of oil production in eastern Montana, western North Dakota and northwestern South Dakota. Areas with a high density of oil production may also decrease migration and wintering habitats available.

Wind energy has been increasing in recent years; more than 45% in 2007 and more than 50% in 2008 (A. Manville, pers. comm.). Area and patch size (Davis 2004) are important habitat attributes for Sprague's Pipits, and habitat fragmentation a threat to their populations. Wind projects can fragment native prairie habitat through the construction of roads, turbines, electrical grids, and associated facilities; several of the states where Sprague's Pipits breed or winter are the top states potential for wind energy development (Elliott et al. 1991). Sprague's Pipits negatively respond to shrub and tree densities, and it is likely that they exhibit negative responses to other vertical structures in their habitat (e.g., wind turbines, telecommunication towers, power line towers), although specific data are limited.

The effects of increased biofuel production (converting native prairie to agriculture) would likely further decrease breeding habitat.

Industrial Noise.—Industrial noise caused reduced pairing success and influenced age structure in some breeding bird species (Environment Canada 2008, Barber et al. 2009). Expanding energy development (wind energy and oil and gas) in grassland regions may result in increased noise levels and subsequently interfere with male song in Sprague's Pipits. The effect of anthropogenic noise on Sprague's Pipit breeding success is unmeasured.

Winter

Sprague's Pipits are federally protected on their winter range in the United States and México under the Migratory Bird Treaty Act (U.S. Fish and Wildlife Service 2008a). Enforcement of regulatory mechanisms are inadequate to protect individuals in México; no regulatory mechanism currently protects Sprague's Pipit habitats on their winter range.

Specific threats on the winter range in the United Sates or México are many of the same issues identified as threats on the breeding range, (e.g., over-grazing, fragmentation, degrading, and conversion of grasslands, invasive species, and climate change) although the level of each threat may be different.

Protected Sprague's Pipit habitat exists in the United States largely on public lands. Although not protected specifically for pipits, large grassland tracts are protected by the National Wildlife Refuge System, National Parks, Bureau of Land Management and Forest Service lands in the southern United States. Smaller areas of grassland are protected by The Nature Conservancy and other private land owners committed to managing lands for conservation. In México, few truly protected areas of grassland exist. A few private reserves containing pipit habitat (e.g., the Reserva Ecológíca El Uno in northern Chihuahua) have been established. Few national or state-level protected areas exist in México for Sprague's Pipits and those that do, such as the Janos Biosphere Reserve, offer limited protection against landscape-level disturbance. These protected areas would not be enough to sustain pipit populations throughout their winter cycle.

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Although large numbers of Sprague's Pipits frequent heavily grazed pastures on the Texas coast during winter (Freeman 1999), this is in contrast to observations in México that heavy grazing is a threat to pipits (Desmond 2004; below). This apparent conflict may be due to a number of causes, including the level of grazing, as "heavy" is largely undefined; differences in the environmental conditions, such as moisture, soil type, and plant species composition, or to lack of data, as most information from the wintering range is limited in scope.

United States

In general, there are few data from the wintering range in the United States, and little is known about the level of the threats here. Sprague's Pipits occur on the largest patches of grasslands in Texas, but are also found on turf-grass farms, grassy roadsides, and other areas with short grass, and on heavily grazed areas (Freeman 1999). They will also use areas with introduced Bermuda grass, with high concentrations of pipits found in saline openings in a large exotic grassland that were heavily grazed (B. Ortego, pers. comm.). Overgrazing, conversion of grasslands, drought, climate change, energy development, and fire suppression are all potential threats to grasslands in the southern United States, but the relative levels are unknown.

Sprague's Pipits appear to use roads frequently on the wintering grounds (Freeman 1999; B. Ortego, pers. comm., SLJ) and during migration (SLJ). The loss of native coastal prairie in Texas is extensive; however, Sprague's Pipit do use introduced grasses at some level during the winter period.

México

Overgrazing by domestic livestock and agricultural practices are the most extensive land uses thought to threaten habitat for Sprague's Pipits in Chihuahua, México (Desmond 2004). In addition, large-scale habitat alterations are occurring throughout the Chihuahua Desert (Desmond 2004). These include conversion of grasslands to agriculture and the large-scale conversion of desert grasslands to shrub dominated systems. These changes are occurring from current and historic overgrazing by domestic livestock, loss of native herbivores, fire suppression, drought, and climate change (Desmond 2004). Shrub encroachment into areas of extensive grasslands is also occurring and may have contributed to reduced numbers of grassland obligate passerines, including Sprague's Pipits (Desmond 2004). Sprague's Pipits were found in significant numbers after a wet year in Chihuahua, but were local and rare in dry years (Dieni et al. 2003). The relative levels of the threats to Sprague's Pipits on the winter range are unknown.

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Management

Management for Sprague's Pipit consists primarily of protecting, maintaining, and restoring native mixed-grass prairie in large expanses (Stewart 1975; Sutter 1996, 1997; Davis 2004). In general, Sprague's Pipit abundances are higher in native grass then in non-native fields. The breeding habitat attributes important to Sprague's Pipits abundance include prairie dominated by native grass, with a particular structure, and area size (see Habitat above; Sutter 1996, 1997, Davis et al. 1999, Table *in* Dechant et al. 2003, Dieni and Jones 2003). Converting cultivated land adjacent to native prairie to perennial cover, including seeding with a native grass mix or one that includes a prostrate (versus erect) form of legume could make smaller tracts attractive to pipits (Winter et al. 2006). The conservation value of large prairie tracts is obvious, but several small habitat patches surrounded by treeless landscape might offer similar conservation value for grassland passerines as a single large prairie patch (Davis 2004, Winter et al. 2006).

Successful management of many grassland habitats often requires some form of disturbance. In many cases, management through fire, grazing, mowing or herbicides can assist in maintaining native grasslands appropriate for Sprague's Pipits; however, the intensity and frequency of disturbance is dependent upon soil productivity, geographic area, and climate. Idling grassland habitat can reduce its suitability for Sprague's Pipits in the mesic portions of their range (e.g., moist mixed grasslands and aspen parkland regions), while disturbance can reduce habitat suitability if the timing, frequency, intensity, or duration of disturbance is inappropriate, particularly in the drier portions of their range (Askins et al. 2007). The following discussion is primarily for the breeding range, unless otherwise mentioned; there is little data on migration or wintering habitat and their management.

Patch Size.—Large native prairie grasslands are needed for Sprague's Pipit conservation. Native grassland tracts of ≥145 ha should be retained for breeding (Davis 2004, Anonymous 2007) although some high quality smaller patches (≤ 29 ha) could provide conservation value, if the landscape is neutral (e.g., no trees or other vertical structure) for Sprague's Pipits, rather than hostile (e.g., development) (Winter et al. 2006).

Preclude Woody Vegetation.—Optimal breeding habitat for Sprague's Pipits will require the removal of woody vegetation from the interior of grassland patches (Grant et al. 2004). In native and planted grasslands this can be accomplished through burning, grazing, mowing, herbicides, or manual removal, as long as the treatment does not result in long-term damage to the grassland (Anonymous 2007) or cause excessive vegetation disturbance, increases in small mammal predators due to leaving slash piles, or excess removal of litter. Avoid planting trees and/or shrubs within 100 m of native grasslands (Anonymous 2007).

Invasive Grass and Forb Species.—Removing exotic plant species, especially smooth brome, sweet clover (*Melilotus* sp.), and alfalfa (*Medicago* sp.) in native grasslands will improve habitat for pipits. Monitor roadsides for invasive species, and remove these species before they move into native prairie (Anonymous 2007).

Mowing.—Mow haylands on a rotational schedule of every other year. Although hayfields are limited in their use by pipits, mowed hayfields can provide better habitat than those idled (Denchant et al. 2003, Anonymous 2007). Delaying mowing until after 15 Aug, should allow >70% of Sprague's Pipit nests to fledge. Minimum dates for mowing of hayfields are after 15 Jul in the dry mixed-grass prairie, after 21 Jul in the xeric mixed-grass prairie, and southern aspen parkland and after 31 Jul in the northern aspen parklands (Anonymous 2007).

Prescribed Fire.—In general, prescribed burning reduces shrub encroachment as well as residual grass cover and may reduce or restrict invasion of exotic plants (Robbins and Dale 1999). Fire is important to maintain Sprague's Pipits' breeding habitat, especially in the eastern portion of the species' range. In Saskatchewan, Sprague's Pipits were most abundant two to three years, and sometimes up to seven years, post-fire; none were present on native prairie that had not been burned or grazed for more than eight years (Anonymous 2007). In North Dakota, burning grasslands every two to four years over a 15-year period resulted in the highest abundance when compared to unburned areas or areas burned only once or twice in 15 years (Madden et al. 1999). Recommendations for timing of burns in the aspen parklands in Canada are 5-10 year intervals, 10 - 15 year intervals in moist mixed-grass regions, and as much as 20-26 year intervals in the mesic mixed-grass prairies or not at all if the vegetation structure can be maintained (Anonymous 2007, Askins et al. 2007). Optimal burning intervals will vary with local and climatic conditions, such as during a drought (where the interval may be significantly longer).

On the wintering grounds, in the coastal prairie of Texas, herbicides are used to control invading mesquite

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(*Prosopis* spp.) and huisache (*Acacia smallii*) in the prairie. The burn intensity and frequency needed to control mature brush is generally not practical in Texas and burning tends to only control the small brush at lower intensities (B. Ortego, pers. comm.).

Grazing.—Grazing reduces residual grass cover and may stimulate growth of native plants and prevent or slow invasion by exotic plants (Robbins and Dale 1999). Grazing during the breeding season should be light to moderate (Dechant et al. 2003), although intensity varies geographically. Moderate intensity grazing should be used in the aspen parklands, low to moderate grazing intensities in the mesic mixed-grass prairie, and low grazing intensities or no grazing in the xeric or semi-arid mixed-grass prairie, where disturbance is rarely needed to make the habitat attractive to Sprague's Pipits (Anonymous 2007). However, these terms are relative and difficult to quantify. Local focus should be on getting absolute, rather than relative, measures of vegetation as inherent problems exist in defining, for example, "heavy" or "moderate" or "low" grazing levels (Madden et al. 2000).

There is little data on optimum grazing levels on the wintering grounds, and some conflicting information from the United States and México. It seems likely that different grazing management prescriptions would be needed for Sprague's Pipits in the desert grasslands of the arid southwestern United States and northern México then in areas of Texas coastal prairie. However, information is so limited it is difficult to make recommendations.

Both fire and grazing should be conducted on smaller habitat patches rather than over large areas to achieve an increased vegetation mosaic and to provide a mix of native habitats (Fuhlendorf et al. 2006). Grazing, fire and herbicides could be used together, in conjunction, and in rotation, to achieve the desired conditions (Fuhlendorf et al. 2006).

Restoration.—Restoration programs can be used to enhance the attractiveness and reproductive potential of irregular shaped grassland patches by focusing efforts on increasing patch size and minimizing the amount of edge habitat (Davis 2004). Seed with finer grasses in forage mixes, and seed herbaceous species that grow well in a stand with other species. Do not seed with coarse, tall, or dense growing grasses like smooth brome, or with aggressive competitors, like crested wheatgrass, where litter levels are too low and bare ground coverage is too high (Anonymous 2007).

Roads.—Construction of built-up roads (e.g., dikes) in native or planted grasslands should be avoided. Use native grasses and forbs to re-vegetate pipelines, roads, and other linear development (Anonymous 2007).

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Conservation

This Conservation Plan (Plan) is designed to highlight actions needed to achieve conservation for Sprague's Pipits. This Plan includes a prioritized list of actions and needs that will begin to address the requirements to achieve the long-term rangewide conservation of Sprague's Pipits; actions are prioritized within each major group (Table 2).

The goals for the conservation of Sprague's Pipits are to increase and maintain population size and distribution throughout the pipit's historic range and to prevent further loss and degradation, including fragmentation, of native prairie within its historic range. In addition, the restoration of currently unsuitable habitat is a conservation priority.

No current recovery strategy exists for Sprague's Pipits in United States or México. Implementing these strategies will encompass different issues in each of the three countries. Canada currently has a recovery plan (Environment Canada 2008) and the United States has completed a status review (U. S. Fish and Wildlife Service 2010). In México, implementation will be primarily dependent on NGOs and will require gathering basic baseline data and developing educational programs.

Other Species Covered

Other species that could benefit by habitat management, modification and protection for Sprague's Pipits, in the portions of their breeding and wintering ranges that overlap, include Northern Bobwhite (*Colinus virginianus*), Marbled Godwit (*Limosa fedoa*), Upland Sandpiper (*Bartramia longicauda*), Common Nighthawk (*Chordeiles minor*), Grasshopper (*Ammodramus savannarum*), Baird's, LeConte's (*A. leconteii*), and Savannah (*Passerculus sandwichensis*) sparrows, Dickcissel (*Spiza americana*) and Western and Eastern (*Sturnella magna*) meadowlarks.

Species that could be negatively affected by proposed Sprague's Pipit habitat management include species that use tree and brush vegetation in a grassland savannah, including Loggerhead Shrikes (*Lanius ludociianus*) and Clay-colored Sparrows (*Spizella pallida*). Grassland species requiring tall and dense or short and sparse grass, including Mountain Plovers (*Charadrius montanus*) and McCown's Longspurs (*Rhynchophanes mccownii*), may be negatively affected locally by habitat management for Sprague's Pipits.

Canada

In Canada, conservation goals will be accomplished through grassland conservation initiatives, such as stewardship and management agreements, conservation easements, policy reform, and tax incentives (Environment Canada 2008). Voluntary stewardship agreements have been widely used by conservation groups as a means of establishing and building relationships with producers, and this will be one of Canada's main tools (Environment Canada 2008). Management agreements are typically short-term (10–15 years) formal agreements that are legally binding and represent an agreement between a producer and conservation organization. Incentives are provided (e.g., watering system development, fencing materials, forage seed, etc.) to encourage landowners to alter current management regimes for species at risk, including Sprague's Pipits (Environment Canada 2008).

The Canadian recovery strategy lists the primary actions required to effectively recover Sprague's Pipit populations (Environment Canada 2008). Action plans are scheduled for development by 31 Mar 2011, to cover jurisdictions within the range of Sprague's Pipits in Canada (Environment Canada 2008). Critical habitat determinations in Canada are scheduled for development in 2010 (Environment Canada 2008).

United States and México

Knowledge of the response of breeding Sprague's Pipits to invasive species, and the effects of both timing and method of eradication actions are needed to make informed management recommendations. Grazing, haying, and prescribed burning are all recommended management tools for maintaining native prairie grasslands for breeding Sprague's Pipits (Hagen et al. 2005). Determining the best timing and intensity of these management tools are important to maximize benefits and reduce disturbance both to breeding pipits and their habitat. However, recommendations can vary across the pipit's range, and management of other high priority wildlife species (e.g., prairie-dogs or Mountain Plovers) could conflict with recommendations developed for Sprague's Pipits. This reinforces the need for local evaluation of management actions that can then be integrated into a rangewide perspective.

Although data is available on timing and breeding distribution, identifying all of the important sites used by wintering Sprague's Pipits, particularly in México, has not been completed. As a general strategy, conservation will initially require identifying important migration and wintering areas, assessing their functional ability to support Sprague's Pipits, and then, if warranted, developing conservation actions and evaluation measures for these areas. The effects of energy development

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Table 2. Prioritized conservation plan and actions for Sprague's Pipit (SPPI). "Lead for current work" represents groups and individuals currently working on this aspect of SPPI biology in each of the three countries; "Potential" refers to partners with the knowledge and potential to collaborate in this area. "Critical" habitat is used for Canada under the SARA listing as threatened; for the United States and México, it is used in the non-legal sense, meaning important habitat types and areas. Organization abbreviations: CRT = Canada Recovery Team; CWS = Canadian Wildlife Service; FWS = U.S. Fish and Wildlife Service; FWS-ES = FWS Bismarck Ecological Services Office; FWS-MBNG = FWS Migratory Birds, Nongame, Region 6; FWS-HAPET: FWS HAPET Office, Regions 6 and 3; USGS = U. S. Geological Survey, Biological Research Division; USFS = U. S. Forest Service; USBLM = U. S. Bureau of Land Management; USDOD = U. S. Department of Defense; TNC = The Nature Conservancy; CEC = Commission for Environmental Cooperation; RMBO = Rocky Mountain Bird Observatory; NCC = Nature Conservancy of Canada; INEGI = Instituto Nacional de Estadística y Geografía; CONANP = Comisión Nacional de Áreas Naturales Protegidas; WWF = World Wildlife Fund; PLJV = Playa Lakes Joint Venture; PPJV = Prairie Potholes Joint Venture; PPP-LCC = Prairie Landscape Conservation Cooperative; JV-LCC = Joint Ventures and Landscape Conservation Cooperatives. Individuals abbreviations: NK = Nicola Koper, University of Alberta, Edmonton; SKD = Stephen K. Davis, University of Regina, Saskatchewan; MD = Martha Desmond, New Mexico State University; SLJ = Stephanie L. Jones, FWS.

					Lead for current work				
Priority	**Sub-priority**	**Section**	**Sub-section**	**Description**	**Canada**	**United States**	**México**	**Potential**	**Comments**
1		**Habitat**							
	1.A		*Protect and restore larger tracts of native grasslands.*						
		1		Use conservation easements (voluntary and paid) or purchase of larger tracts of land with native grassland protecting large tracts of existing native grasslands from conversion and fragmentation.	NCC	TNC, FWS	TNC, ProNatura	USBLM, USFS, State Agencies, USDOD, WWF	No specific easement programs have yet been planned for SPPI; existing grassland easement programs can be used.
		2		Identify priority areas to target habitat conservation activities.	CRT, NCC	FWS-ES, FWS-HAPET	TNC, WWF	TNC, CEC	Evaluate the potential to convene regional groups to establish priorities, maybe through TNC.
		3		Convert non-native uplands, including hay and pasture, to native vegetation; join tracts of restored and native grasslands to form larger tracts.				FWS, TNC	
		4		Establish protected natural areas.	Parks Canada	FWS, FS, USBLM	CONANP		Janos Biosphere Reserve recently declared in Chihuahua, México.
	1.B		*Identify important (critical) habitat*						
		1		Use current technology and other data to document and map the existing grassland habitat critical for SPPI.	CRT	FWS-HAPET, PPJV	TNC, WWF	PPP-LCC	TNC, states, and others may have information from México.
		2		Update land cover data with ground-truthing to verify current and future model predictions, and to confirm habitat suitability and SPPI use.	CRT	PLJV	INEGI	States, FWS, JV-LCC	Texas & other states will be completing a land cover classification in the next couple of years.

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Table 2, continued

Priority	Sub-priority	Section	Sub-section	Description	Lead for current work: Canada	Lead for current work: United States	Lead for current work: México	Potential	Comments
	3			Develop and refine predictive models of occurrence and abundance using existing data to identify potential source breeding areas. Produce geographic information system (GIS) maps to delineate regions of high probability of occurrence and abundance, in all seasons.	CRT	FWS-HAPET, PPJV		PPP-LCC	Study ongoing on landscapes and spatial analysis linking populations to habitat (Montana).
	4			Conduct field surveys to verify predictive models and collect SPPI location and abundance data on the breeding range. High-ranking sites confirmed to have high densities of SPPI should be identified.					
	5			Assess wintering areas in s. U S and n. México to identify and protect areas with high value for SPPI populations.			RMBO, TNC	JV-LCC	
	1.C		*Identify important habitat components*						
	1.C.b		*Breeding*						
	1			Determine influence of exotic vegetation and confirm whether suitable habitat includes only native vegetation on the breeding range.	SKD				
	2			Determine influence of wetlands and topography on density and reproductive success. Determine whether high-density wetland landscapes are source SPPI habitat.	NK				
	1.C.w		*Wintering and Migration*						
	1			Determine the extent of SPPI use of grazed rangelands on the wintering range, and how SPPI respond to various grazing regimes.				MD	
	2			Determine habitat needs on wintering range, including influence of non-native vegetation, precipitation, and diet and seed resources.				MD	SPPI seem to use non-native quite readily in some locations, on the wintering range.
	3			Determine influence of exotic vegetation and confirm suitable habitat types on the wintering range.					
2		**Management**							
	1			Implement best management practices, and determine whether current recommendations are valid, for different geographic areas and seasons.				FWS, USFS, USBLM	

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Table 2, continued

Priority	Sub-priority	Section	Sub-section	Description	Lead for current work: Canada	Lead for current work: United States	Lead for current work: México	Potential	Comments
	2			Identify and implement appropriate restoration and management tools to improve and maintain the quality of habitat used by SPPI in all seasons.				FWS, USFS, USBLM	
	3			Determine how various habitat management practices for grasslands in different regions of the range effect this species. Test and monitor a variety of existing grassland restoration projects within the range of this species for its benefits to SPPI.	NK			FWS, USFS, USBLM	
	4			Implement techniques to recover SPPI populations in areas that have experienced declines and range contractions.				CWS, FWS, JV-LCC	
	5			Remove woody vegetation from existing open grasslands. Identify geographic regions where woody vegetation encroachment is prevalent and the relative importance of woody vegetation to SPPI during breeding.	NK				
	6			Convert shrub-encroached grasslands back to more open grasslands (e.g., removal of mesquite) on the wintering grounds.				JV-LCC, USBLM, TNC, ProNatura	
	7			Identify areas where haying of SPPI habitat is common; establish and implement guidelines for haying during the breeding season. Determine whether incentives are required to offset costs to producers.	NK				Probably an issue in sw. Manitoba more than the other areas of Canada; not known to be an big issue in other portions of the range.
3		**Inventory, Monitoring and Assessment**							
	1			Increase grassland bird monitoring using the Grassland Bird Monitoring programs in Canada and the U.S.	CWS	FWS-MBNG, FWS-HAPET			
	2			Encourage and solicit increased participation in the BBS and increase the number of trained observers and routes in grassland habitat.	CWS	FWS-MBNG, FWS-HAPET	USGS	USGS	
	3			Evaluate the existing inventory and monitoring data for both populations and habitat to identify data gaps, particularly on the wintering range.				USGS	

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Table 2, continued

Priority	Sub-priority	Section	Sub-section	Description	Lead for current work: Canada	Lead for current work: United States	Lead for current work: México	Potential	Comments
	4			Determine the quantity and quality of grassland habitat, and monitor changes in quantity and quality over time.	CWS	FWS-HAPET, FWS-ES, PPJV		PPP-LCC, TNC, JV-LCC	Targeting grassland conservation: an estimate of land–use conversion risk in the Northern Great Plains (parts of ND, SD, and MT).
	5			Inventory and monitor the distribution and habitat use for SPPI on the wintering grounds.		FWS-R2	RMBO,TNC		
	6			Collect location and abundance information and establish a database with this data. Create maps showing locations of SPPI and areas of high density and persistence.	CRT	RMBO			
	7			Use existing programs (e.g., avian checklist, bird atlas, e-Bird, Natural Heritage programs), and collated sightings from bird enthusiasts, to refining the extent distribution in all seasons, particularly on the winter range and during migration.					
	8			Establish long-term study plots throughout the breeding range to monitor demographic parameters.	NK, SKD	SLJ			
4		**Research**							
	4.A		*Demographics*						
	1			Increase demographic information for SPPI throughout different geographic areas; conduct studies to target unknown aspects of basic biology for SPPI.	NK, SKD	SLJ			
	2			Conduct analysis on the extent and direction of road bias in surveys and on nest survival for SPPI.		SLJ			
	3			Conduct an analysis on changes in arrival dates due to changes in weather on survivorship.		SLJ			
	4			Develop and assess techniques to recover SPPI populations in areas that have experienced declines and range contractions.					
	5			Do a population viability analysis.		SLJ			

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Table 2, continued

Priority	Sub-priority	Section	Sub-section	Description	Lead for current work: Canada	United States	México	Potential	Comments
	2			Conduct analysis on the extent and direction of road bias in surveys and on nest survival for SPPI.		SLJ			
	3			Conduct an analysis on changes in arrival dates due to changes in weather on survivorship.		SLJ			
	4			Develop and assess techniques to recover SPPI populations in areas that have experienced declines and range contractions.					
	5			Do a population viability analysis.		SLJ			
	6			Conduct research to determine site fidelity, return rates and survivorship.					
	4.B		*Habitat and Management*						
	1			Increase basic knowledge on the effects of haying, grazing, burning and brush control, and other management actions on demographic parameters, e.g., parasitism rates, survivorship. Make recommendations for management.	NK				
	2			Determine the fire regimes that create suitable SPPI habitat in different geographic areas. Determine at what levels fire may be a threat to SPPI habitat, if any.	NK				
	3			Determine the grazing levels and seasons that create suitable SPPI habitat in different geographic areas and seasons. Determine what levels grazing becomes a threat to SPPI habitat.					
	4			Determine the impact of cattle grazing on Brown-headed Cowbird parasitism rates.					
	5			Determine the relative effects of threats, including habitat loss and degradation, pesticide exposure, predation, etc. on continuing declines.	NK				

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Table 2, continued

Priority	Sub-priority	Section	Sub-section	Description	Lead for current work: Canada	Lead for current work: United States	Lead for current work: México	Potential	Comments
	6			Determine whether non-native grassland habitats act as ecological sources or sinks and whether management (and if so, what type of management) improves habitat suitability, reproductive success, and survival of SPPI, in all seasons.	SKD				
	4.C		*Wintering and Migration*						
	1			Describe migration and wintering distribution, habitats, and abundance.					
	2			Conduct research to determine wintering habitat components that are important, including distribution, amount, and protection status of nonbreeding habitat.					
	3			Determine degree of wintering habitat threats, and limiting factors.					
	4			Determine site fidelity on wintering range.					
	4.D.		*Threats*						
	1			Determine the relative level of the threats identified, on both breeding and wintering ranges, and their relative importance to continuing declines and range contractions.	NK		WWF, TNC		
	2			Effects of tall structures (e.g., buildings, towers, wind developments) on both habitat components (e.g., invasive plant species, fragmentation) and on mortality and survivorship rates.					
	3			Energy Development. Determine the direct and indirect effects oil and gas, solar, and wind energy development have on presence, abundance, survival, and productivity of SPPI. Establish appropriate guidelines to mitigate these effects. These issues will apply to all geographic area in SPPI's range, and to all seasons.					

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Table 2, continued

Priority	Sub-priority	Section	Sub-section	Description	Lead for current work: Canada	Lead for current work: United States	Lead for current work: México	Potential	Comments
	4			Climate Change. Gain an understanding of the consequences of changing weather patterns, including annual variation in population size and resiliency of SPPI to climate change. Use existing climate change models to evaluate possible changes in grassland habitats.		SLJ			
	4.E		*Area-sensitive*						
	1			Determine the suitability of small grassland patches as SPPI breeding habitat, including variability of SPPI responses temporally and spatially.	NK, SKD	USGS			
	2			Determine the functionality of small grassland patches, and the effects of the surrounding landscape.	SKD				
5		**Education and Outreach**							
	1			Publish and distribute land use guidelines and practices that benefit SPPI, in different geographic areas. Where BMPs for SPPI already exist, make them readily available.	NK	FWS-MBNG			
	2			Outreach to Mexican NGOs and government agencies to work on SPPI populations and habitats.		TNC, ProNatura, JV-LCC			
	3			Develop of education and outreach tools for SPPI to for public and landowner education and outreach on the value of conserving intact native prairie. Develop education and communication programs targeted at youth, land managers, and the general public increasing awareness of SPPI and their habitat requirements.					
	4			Integrate Sprague's Pipit recovery needs into land management programs and grassland conservation initiatives.		JVs			
	5			Produce outreach documents to inform and influence land use decisions and policies that affect grassland habitat.		JVs			

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on Sprague's Pipits are not fully understood, but any prairie conversion and fragmentation of suitable habitats will further decrease their breeding populations. Pre-project investigations should be made a priority in areas suggested for wind power or oil and gas development.

Recommended conservation actions are prioritized as follows:

1. Identify essential habitat throughout Sprague's Pipits' range.

2. Identify essential winter areas and Sprague's Pipits distributions throughout their wintering range.

3. Identify the types and intensity of current threats during the breeding, migration, and wintering seasons.

4. Determine factors limiting Sprague's Pipit populations, and the causes of breeding range contractions. Identify the relative importance of factors during the breeding, and wintering seasons to limit populations. Assess which environmental factors could be limiting Sprague's Pipits population growth, during all seasons.

5. Determine if Sprague's Pipits are positively responding to management actions designed for their conservation in local areas.

Conservation Strategies

The conservation action plan is divided into major sections, addressing priority actions that contribute and enhance this Plan. The specific actions are prioritized and described in Table 2.

1. Habitat Protection and Restoration

The primary cause of Sprague's Pipits historical declines are the loss, conversion, degradation, and fragmentation of native grasslands.

1A. *Protect and restore larger tracts of native grasslands.*—The 1st priority action to stem these declines is to protect and restore the remaining native prairie and grasslands.

1B. *Identify important source habitat.*—Identify geographic areas that are important as source habitat for pipit populations. Identify those priority areas and essential habitats to preserve.

2. Management

Recommendations for management actions should be primarily designed to improve and restore grasslands for Sprague's Pipit nesting and wintering populations. These recommendations should be evaluated and refined to create habitat in specific geographic area.

3. Monitoring, Surveys and Assessment

Monitoring and assessment will play important roles in the adaptive management process by ensuring that critical information gaps are filled and enabling recovery activities and goals to be evaluated. On the breeding grounds, Sprague's Pipit populations seem to be adequately monitored for trends by the BBS, but no large-scale program monitors native grassland habitat. Determining the quantity and quality of grassland habitat and monitoring changes in quantity and quality over time are required to assess whether recovery efforts are successful.

4. Research

Sprague's Pipits are one of the least studied avian species (Robbins and Dale 1999), and past research has focused primarily on distribution, habitat use, area requirements, demographics, and productivity. Currently, ongoing research is focusing on demographics and management.

4A. *Demographics.*—The primary factors causing population declines and range contractions in different regions are unknown. Demographic data throughout the range and across the full annual cycle are necessary to determine potential source and sinks areas. Complete a population viability assessment across the range of breeding demographic data

4B. *Habitat.*—Although pipits are most abundant on native grassland, they will breed in planted pastures in some regions; however, the conditions under which this occurs are unknown. Further work is needed on whether these anthropogenic habitats act as an ecological source or sink or whether management can improve habitat suitability, reproductive success, and survival of pipits.

4C. *Wintering and Migration.*—The current status of migration and wintering distribution and habitats are unknown, along with the factors that threaten the quantity and quality of these habitats.

4D. *Threats.*—A priority is to identify of degree and intensity of current threats on breeding, migration, and wintering grounds. It will be necessary to identify exactly where and what level of risk perceived threats pose to Sprague's Pipit populations.

5. Education and Outreach

Development of education and outreach tools were recurring themes in every category of the recommended conservation actions. Sprague's Pipit conservation will require public and landowner education and outreach on the value of conserving intact native prairie. In addition, education and communication programs targeted at youth, land managers, and the general public are needed to increase awareness of pipits and their habitat requirements. Education and outreach activities will enhance, and explain many of the actions above. Integrating Sprague's Pipit recovery needs into land management programs, and getting recommendations included in local, state, provincial, NGO and federal agency plans is crucial to success.

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Completed and Ongoing Conservation Actions

Completed actions

• Completion of conservation action plan by the Region 6 Migratory Bird Office, Nongame (this document).

• Publication of results of demographic studies in Saskatchewan (Davis 2003, 2004, 2005, 2009; Davis et al. 2006; Davis and Fisher 2009; Dohms and Davis 2010) and Montana (Dieni and Jones 2003, Jones and Dieni 2007, Jones et al. 2007, Jones et al. 2010).

• Publication of the results of management studies in Canada (Koper and Schmiegelow 2006a, 2006b; Koper et al. 2009).

• Increased monitoring and evaluation of Sprague's Pipits using the GBM-Canada (Dale et al. 2003) and GBM-US (Jones and Niemuth 2009) programs.

• Evaluation of Sprague's Pipits populations and habitats for current listing actions from Canada (Environment Canada 2008) and the United States (U. S. Fish and Wildlife Service 2010).

Current and Ongoing Actions

Current and ongoing actions are focusing on landscape composition, habitat, and population densities for Sprague's Pipit in all three countries. However, much research is still needed. Some of the ongoing programs include:

• Demographic information, including nesting success, juvenile and adult survival, and other parameters are being conducted on native (Davis et al. in prep., SLJ) and non-native grasslands, along with effects of management actions on demographic parameters.

• Identification of predators over a larger geographic area using camera data (Davis et al. in prep.), along with demographic parameters from cameras (SLJ).

• Research using stable isotope analyses is being conducted to identify connectivity to Sprague's Pipit wintering grounds, determine its molting patterns, and assess levels of dispersal and recruitment in grassland- and cropland-dominated landscapes in central Saskatchewan (Crawford et al. 2009).

• Research in Grasslands National Park, Saskatchewan is determining the effect of grazing on pipit abundance and reproductive success (Koper et al. 2009; Koper et al. *in prep.*).

• Surveys in northern México are ongoing, determining distribution, habitat and densities (Levandoski et al. 2008, Panjabi et al. 2010).

• The Bureau of Land Management and Montana Natural Heritage Program have been conducting surveys of breeding birds in north Valley County, Montana from 2001-2007 (n=1410 point counts) and these are continuing (C. Wightman, pers. comm.).

• Montana Fish, Wildlife and Parks are funding a monitoring program in the Montana portions of Sprague's Pipit's range. The program began in 2009, and involves point count and vegetation surveys. Surveys are continuing (C. Wightman, pers. comm.).

Conclusion

Developing a specific Action Plan by a coalition of partners is necessary to implement the conservation strategies recommended here. The Action Plan should relate to a sub-portion of each strategy and should include the identification of the partners that might undertake each sub-strategy. However, there are currently no specific funding sources available for Sprague's Pipit conservation in the United States and México. Therefore, implementing effective conservation measures will require the cooperation of a coalition of local, regional, national, and international partners. In addition to this Action Plan, several states and provinces have developed objectives and actions designed to address conservation of Sprague's Pipits, and many states and provinces have developed actions as part of their wildlife programs (e. g., Hagen et al. 2005, Environment Canada 2008). The conservation of Sprague's Pipits will be an action for a wide group of partners, and will require implementation in three countries, three provinces, many U. S. and Mexican states, and by public and private organizations.

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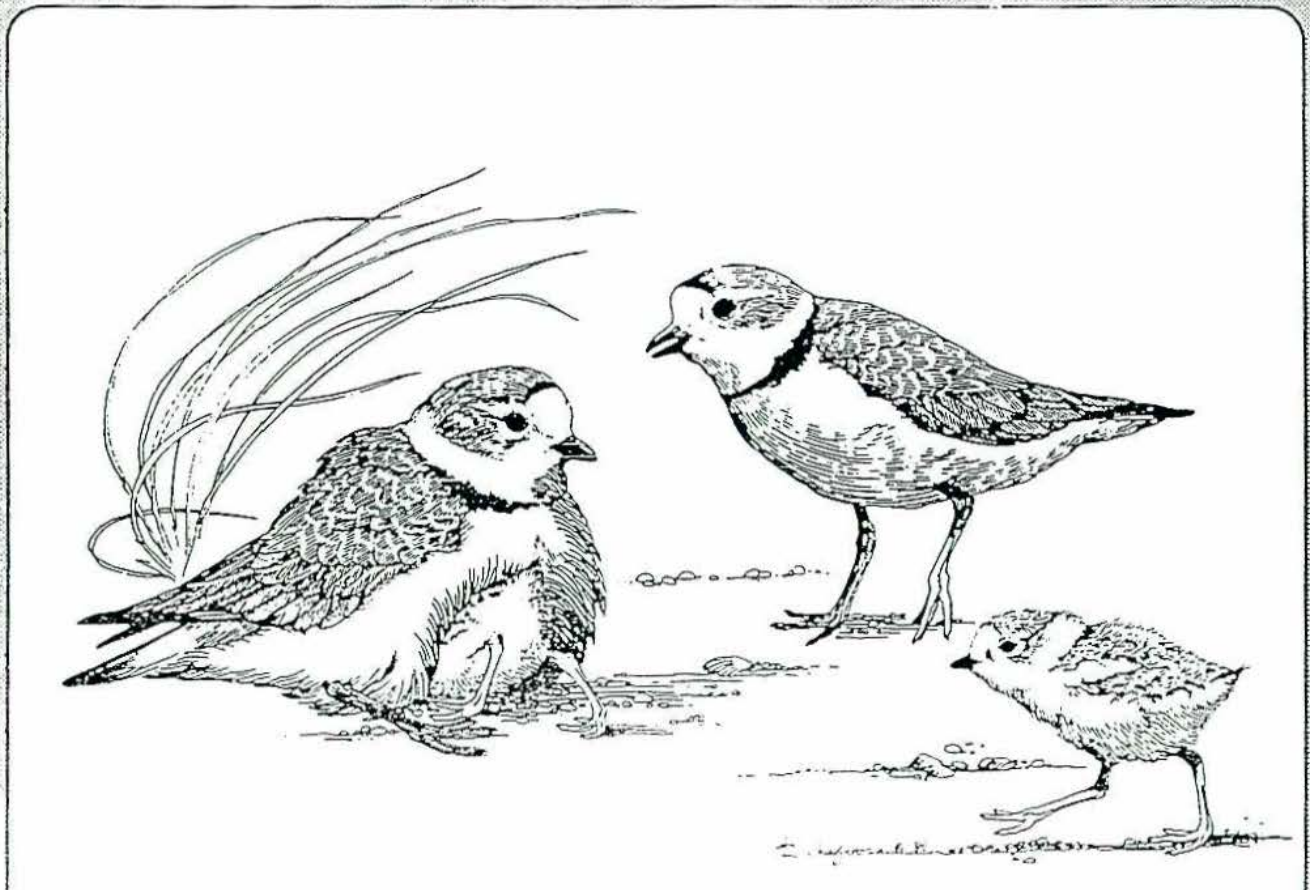
October 2010

Great Lakes & Northern Great Plains Piping Plover

Recovery Plan



DEPARTMENT OF THE INTERIOR • U.S. FISH & WILDLIFE SERVICE

007606

RECOVERY PLAN FOR PIPING PLOVERS

Charadrius melodus

OF THE GREAT LAKES AND NORTHERN GREAT PLAINS

Prepared by the Great Lakes / Northern Great Plains

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SUMMARY

CURRENT STATUS: The Piping Plover (Charadrius melodus), one of six North American species of belted plovers, was added to the Federal Endangered Species list in January 1986 (50 Federal Register 50726-34). Piping plovers breed in three regions of North America; the Atlantic coast from Newfoundland to South Carolina, the beaches throughout the Great Lakes, and river systems and lakes of the Northern Great Plains. Inland piping plovers occupy breeding habitat on the Great Lakes and Northern Great plains from March until August; they spend the remainder of the year along the Gulf Coast from Florida to northern Mexico. Threats to the survival of the species include the loss of beach habitat, vehicular and human traffic on beach nesting areas, and channelization and modification of river flows that have led to the elimination of sandbar nesting habitat. Breeding pair estimates for 1986-87 reveal 17 pairs on the Great lakes (all in Michigan), and 680 pairs in the Northern Great Plains of the U.S.. This plan outlines recovery strategies for the inland birds that winter along the Gulf coast. Another plan presents recovery actions for the Atlantic coast piping plovers.

RECOVERY GOAL: Assure that piping plovers attain the following stable population levels which will insure long term stability and survival leading to their removal from the endangered species list:

1. Birds in the Northern Great plains (U.S.) increase to 1300 pairs and remain stable for 15 years, distributed as follows:

    Montana -----60 pairs
    North Dakota-650 " "
    South Dakota-350 " "
    Nebraska-----465 " "
    Minnesota----25 " "

2. Great Lakes piping plover population increase to 150 pairs and remain stable for 15 years distributed as follows:

    Michigan----------100 pairs
    Wisconsin----------15 " "
    Other Great Lakes states-35 " "

RECOMMENDED RECOVERY ACTIONS: Determine population trends and habitat requirements; protect, enhance, and increase populations during breeding, migration, and wintering periods; develop management plans for use and protection of various habitat types; and develop public awareness and implementement educational programs about the piping plover.

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DISCLAIMER

This is the completed Great Lakes/Northern Great Plains Piping Plover recovery plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies and does not necessarily represent the views of all (recovery team members/individuals) who played a role in preparing this plan. This plan is subject to modification as dictated by new findings, changes in the species status, and completion of tasks in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities and other constraints.

Literature Citation should read as follows:

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I. INTRODUCTION

The Piping Plover (Charadrius melodus Ord) has been a species of concern throughout North America since the early 1900's. At the turn of the century, as now, Piping Plovers bred along prairie rivers and on alkali wetlands of the Northern Great Plains, on sandy beaches along Great Lakes shorelines, and on vast Atlantic coast beaches. Recently, numbers of birds and breeding sites have declined (Haig and Oring 1985, U.S. Fish and Wildlife Service 1985). Furthermore, a gap has formed in the species' distribution due to decreasing breeding activity on the Great Lakes (Haig and Oring 1985).

Only recently have specific measures been initiated to examine factors limiting the species. In December 1982, the U.S. Fish and Wildlife Service took action by identifying the Piping Plover as a candidate species for addition to the list of threatened and endangered wildlife (47 Federal Register 58454). In January 1986, the Piping Plover was listed as threatened and endangered under the provisions of the Endangered Species Act of 1973 (50 Federal Register 50726-34). Piping Plovers on the Great Lakes were listed as endangered, while the remaining Atlantic and Northern Great Plains birds were listed as threatened. Piping Plovers on migration and in wintering areas were classified as threatened.

In 1986, the U.S. Fish and Wildlife Service appointed the Atlantic Coast and Great Lakes/Northern Great Plains recovery teams to develop recovery plans for the conservation and survival

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of Piping Plovers (Section 4 of the Endangered Species Act). Information presented in this plan outlines a strategy for recovery of inland breeding Piping Plovers in the U.S. that winter along the Gulf of Mexico.

Description

The Piping Plover, whose name describes its melodic mating call, is one of six North American species of belted plovers. Piping Plovers have a body length of 17 cm (Palmer 1967) and weigh between 46 and 64 g ($\bar{x}$ = 55 g) (Wilcox 1959; S. Haig, National Zoo). Wing lengths span 11.0-12.7 cm, tarsi range from 2.1-2.4 cm, and culmen lengths vary from 1.0 to 1.4 cm (Wilcox 1959; Prater et al. 1977; S. Haig, National Zoo). Throughout the year, adults have a sand-colored upper body, white undersides, and orange legs. A white wing stripe and white rump are also visible in flight. During the breeding season, adults acquire single black forehead and breast bands, and orange bills. In general, males have more complete bands than females, and inland birds have more complete bands than Atlantic coast birds (Wilcox 1959, Prater et al. 1977, Haig and Oring 1988a). Nonbreeding birds lose the bands and orange on their bill, but are easily distinguished from Snowy Plovers (Charadrius alexandrinus) and Collared Plovers (Charadrius collaris) by their slightly larger size and orange legs (Haig and Oring 1987a). Juvenile plumage is similar to adult nonbreeding plumage. Juveniles acquire adult plumage the spring after they fledge (Prater et al. 1977).

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Taxonomy

Originally described as a race of Charadrius hiaticula (Wilson and Bonaparte, no date), the taxonomy of Piping Plovers has undergone a number of revisions. Ord (1824) was the first to consider the Piping Plover a separate species, but it was not until the fourth edition of the American Ornithologists' Union (AOU) Checklist that the original binomial, Aegialitis meloda, was changed to Charadrius melodus (AOU 1931). In addition to changes in the binomial, ornithologists have argued for over 100 years about designation of two subspecies: C. m. melodus (Atlantic birds) and C. m. circumcinctus (inland birds). Moser (1942) argued that the extent and brightness of breast bands differed between inland and coastal birds. This facilitated acceptance of the two subspecific designations (AOU 1945). Wilcox (1959) reported a variety of breast band forms on birds from Long Island, NY. Subsequent morphological measurements of Atlantic and inland birds did not indicate a significant difference between birds from different regions (Wilcox 1959). Recently, electrophoretic analyses did not indicate a genetic difference among local or regional populations in Saskatchewan, Manitoba, North Dakota, Minnesota, and New Brunswick (Haig and Oring 1988b). Nevertheless, the subspecies designation is currently maintained by the AOU (1957), but is under review for the next edition (R. Banks, U.S. Fish and Wildlife Service).

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Distribution

Historically, Piping Plovers bred across three geographic regions: 1) U.S. and Canadian Northern Great Plains from Alberta to Manitoba, and south to Nebraska; 2) Great Lakes beaches; and 3) Atlantic coastal beaches from Newfoundland to North Carolina. Winter sites were not well described, although Piping Plovers were generally seen along the Gulf of Mexico, on southern U.S. Atlantic coastal beaches from North Carolina to Florida, in eastern Mexico, and on scattered Caribbean Islands (Haig and Oring 1985).

Currently, the species' range remains similar to historic range accounts except that Piping Plovers breeding in the Great Lakes have almost disappeared (Figure 1, Table 1, Haig and Oring 1988b). In 1986, northern Michigan had the only viable breeding population of Piping Plovers in the Great Lakes area. Data on wintering birds are so sparse it is difficult to determine if loss of nonbreeding sites has occurred. Migratory routes have not been described.

Historic Distribution

Historic distribution and census data are sporadic in some regions or altogether lacking for others. Comprehensive censusing efforts began after 1980. The information presented here represents a summary of museum records and historic accounts for the distribution of the species prior to 1980 (documented in Haig 1986a).

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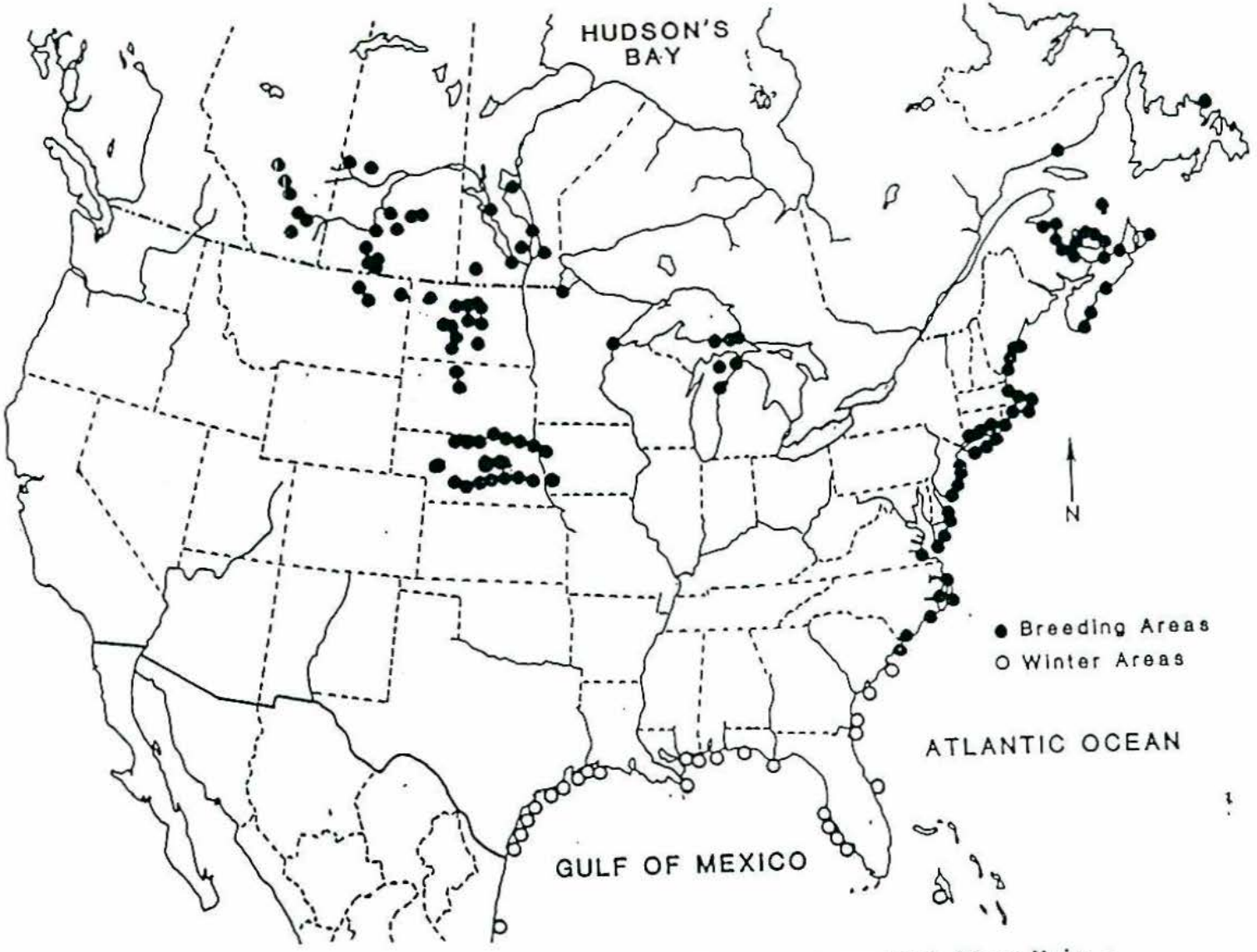

Figure 1. Breeding and winter distribution of Piping Plovers since 1986 (from Haig and Oring 1988c).

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Table 1. Breeding and winter areas for Piping Plovers in the Great Lakes/Northern Great Plains of the United States in 1987.

State	County	Locations
Breeding		
Minnesota	Lake of the Woods	Pine and Curry Island, Morris Point, Rocky Point, Zippel Bay
	St. Louis	Duluth Port Terminal
Michigan	Emmet	Wilderness State Park
	Charlevoix	High Island
	Leelanau	Sleeping Bear Dunes NLS
	Alger	Grand Marais
	Chippewa	Vermillion Station, Weatherhog area
	Luce	Deer Park, Crisp Point
Montana	Valley	Fort Peck Dam (west end)
	Sheridan	Saline wetlands near Dagmar and Medicine Lake NWR
	Garfield	Big Dry Arm of Fort Peck Reservoir
	McCone	Fort Peck Reservoir
North Dakota(a)	McLean	Missouri River sandbars
	Burleigh	"
	Oliver	"
	Morton	"
	Mercer	"
	Kidder	Alkali Wetlands on Missouri Coteau
	Stutsman	"
	McLean	"
	Sheridan	"
	Ward	"
	Mountrail	"
	McHenry	"
	Pierce	"
	Emmons	"
	Sioux	"
	McKenzie	Yellowstone River sandbars

aBreeds in 25 counties in North Dakota; only primary counties are listed above.
bBreeds in 31 counties in Nebraska; only primary counties are listed above.

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Table 1 continued

State	County	Locations
Breeding Areas		
South Dakota	Charles Mix	Sandbars along Missouri River
	Bon Homme	"
	Yankton	"
	Clay	"
	Union	"
	Sully	Lake Oahe
	Hughes	"
	Stanley	"
	Day	Saline wetlands
	Potter	"
	Codington	"
Nebraska (b)	Dixon	Missouri River sandbars
	Cedar	"
	Knox	"
	Howard	Loup River sandbars
	Nance	"
	Platte	"
	Keith	Lake McConaughy
	Boyd	Niobrara River sandbars
	Holt	"
	Keya Paha	"
	Brown	"
	Rock	"
	Cass	Platte River sandbars
	Sarpy	"
	Saunders	"
	Douglas	"
	Dodge	"
	Colfax	"
	Butler	"
	Platte	"
	Polk	"
	Merrick	"
	Hall	"
	Buffalo	"
	Kearney	"
	Phelps	"
	Dawson	"
Iowa	Woodbury	Iowa Public Service ash ponds
	Pottawattamie	Iowa Power and Light ash ponds

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Table 1 continued

State	County	Locations
Wintering Areas		
Texas	Jefferson	Sea Rim State Park
	Chambers	Galveston Bay and Coast
	Galveston	Galveston, San Luis Pass, Gilchrist, Bolivar Flats
	Brazoria	Freeport, San Bernard NWR
	Matagorda	Matagorda peninsula and Bay
	Calhoun	Matagorda
	Aransas	Aransas NWR, San Jose Island
	Nueces	Padre Island National Seashore Mustang Island State Park, Corpus Christi Bays
	San Patricio	Corpus Christi area mud & sandflats
	Kleberg	Padre Island
	Willacy	Padre Island Laguna Atascosa NWR
	Cameron	South Padre Island, Brownsville Brazos Island State Park
Louisiana	Cameron	Rutherford Beach, Holly Beach, East Jetty Beach, Johnson's Bayou
	Jefferson	Grand Terre Island, Grand Isle beach
Mississippi	Jackson	Gulf Island National Seashore
	Harrison	"
	Hancock	Gulf coast beaches
Alabama	Mobile	Dauphin Island
	Baldwin	Gulf coast
Florida	Santa Rosa	Gulf coast
	Franklin	St. George Island
	Pinellas	Clearwater Beach
	---	Atlantic beaches from Jacksonville to Fort Pierce

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Northern Great Plains: Past inland breeding records are available for Piping Plovers in Montana, Wyoming, New Mexico, North Dakota, South Dakota, Nebraska, and Iowa. In Montana, records include the following counties: Phillips, Sheridan, and McCone (Carlson and Skaar 1976). Wyoming records are limited to Laramie County (Cheyenne), Lincoln County (LaBarge, Fontanelle), and Oneida Lake (county unknown). Likewise, Piping Plovers have been irregular summer residents and migrants in Adams, Yuma, Washington, and Boulder counties in Colorado. One record exists for Eddy County, New Mexico (Bailey and Niedrach 1965).

Piping Plovers have bred in the following North Dakota counties: McLean, Benson, Bottineau, Burke, Burleigh, Cass, Emmons, Sioux, Mercer, Oliver, Kidder, Divide, Eddy, Grand Forks, Ward, Logan, McHenry, McIntosh, McKenzie, Mountrail, Morton, Nelson, Pierce, Ramsey, Renville, Sheridan, Stutsman, and Williams (Stewart 1975, Haig 1986a). Breeding in South Dakota occurred in the Missouri Trench counties of: Clay, Hughes, Stanley, Sully, Union, and Yankton, with additional records from Codington, Day, and Miner counties in the Missouri coteau (Visher 1915, Whitney et al. 1978). Nebraska records exist for counties along the Missouri, Loup, Niobrara, and Platte rivers (Bruner et al. 1904, Bent 1929, Tout 1947, Moser 1940, Heinemann 1944). In Iowa, Piping Plovers were regular migrants and summer residents.

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Channelization of the Missouri River below Sioux City eliminated use of all riverine sandbar habitat and resulted in loss of nest sites in Pottawattamie and Harrison counties, the only known nesting habitat in the state (Dinsmore et al. 1984).

Great Lakes: Over the past 50 years, viable breeding of Piping Plovers on the Great Lakes has diminished from eight states (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York) to only one state: Michigan. In Minnesota, Piping Plovers have consistently nested in only two counties: Lake of the Woods (Green and Janssen 1975, Wiens and Cuthbert 1984, Davis 1985, Wiens 1986) and St. Louis (Lakela 1940, Niemi and Davis 1979). Records from Wisconsin do not indicate that Piping Plovers occurred in large numbers anywhere in the state. Nesting occurred on the south shore of Lake Superior (Douglas and Ashland counties), sporadically on Lake Michigan (Door, Kenosha, Oconto, Ozaukee, and Sheboygan counties), and on Lake Koshkonong (Jefferson County) (Matteson 1987; unpub. Milwaukee Public Museum records). Further south in Illinois, Piping Plovers bred in two counties (Lake and Cook) adjacent to Lake Michigan (Nelson 1876, Russell 1973, Russell 1983). Similarly, Piping Plovers in Indiana nested along Lake Michigan in Porter, Lake, and LaPorte counties (Russell 1973, 1983).

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At one time Piping Plovers nested on all four Great Lakes beaches surrounding Michigan. Past breeding records include the following counties: Alger, Delta, Emmet, Cheboygan, Charlevoix, Benzie, Mackinac, Chippewa, Muskegon, Leelanau, Berrien, Monroe, Macomb, Tuscola, Huron, Alcona, Presque Isle, Schoolcraft, and St. Clair (Cotrille 1957, Lambert and Ratcliff 1981, Russell 1983). Piping Plovers have not nested in Ohio since 1942. Prior to that, breeding birds were found along the shore of Lake Erie in Lucas, Ottawa, Cuyohoga, Erie, Lorain, Lake, and Ashtabula counties (Hicks 1933, Trautman 1977, Russell 1983). Similarly, nesting in Pennsylvania only occurred on Presque Isle (Erie County) (Todd 1940, Genoways and Brenner 1983). Birds nested in two counties (Oswego and Cayuga) along Lake Ontario in New York (Bull 1974) and in Penn Yan (Yates County)(Wilcox 1959).

Gulf of Mexico: A review of past Christmas Bird Counts (CBC's) indicated Piping Plovers used most Texas coastal beaches during the winter. Further support comes from birds collected in Aransas, Cameron, Nueces, San Patricio, and Matagorda counties. In addition, Piping Plovers have been reported at Hagerman National Wildlife Refuge (Grayson County) for more than 20 years. Museum records indicated that birds wintered in the following coastal Louisiana parishes: Calcasieu, Cameron, East Baton Rouge, Jefferson, LaFourche, and Orleans. In Mississippi, Piping Plovers wintered along coastal beaches in Jackson, Harrison, and Hancock counties, and the Gulf Shore Islands (Burleigh 1944, Gandy and Turcotte 1970). Piping Plovers have consistently used

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inland habitat at Wheeler National Wildlife Refuge, Alabama, since at least 1955. Other records from Alabama indicate winter use of coastal areas in Baldwin and Mobile counties (Howell 1928, Imhoff 1975).

Florida is one of the few states where Piping Plovers winter that has experienced loss of wintering Piping Plovers from entire counties over the past 50 years. Numerous museum records and CBC's indicate Piping Plovers regularly wintered in the following counties: Bay, Brevard, Broward, Collier, Dade, Duval, Franklin, Gulf, Hillsborough, Indian River, Lee, Monroe, Nassau, Orange, Pinellas, St. John's, St. Lucie, Sarasota, Volusia, and Wakulla. There is no evidence to suggest that birds still use winter sites in Broward, Indian River, Nassau, and Orange counties.

Current Distribution

Northern Great Plains: Currently, the most westerly breeding Piping Plovers in the U.S. occur in Montana on sandflats above the west end of Fort Peck Dam (Valley County), on the shorelines of the Big Dry Arm of Fort Peck Reservoir (Garfield and McCone counties), and on the saline wetlands near Dagmar and Medicine Lake National Wildlife Refuge (Sheridan County).

In North Dakota, Piping Plovers breed in 25 counties along the Missouri River and on alkali wetlands in the central region of the state (R. Kreil, North Dakota Game and Fish Department).

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Approximately 15% of breeding pairs occur on the free-flowing stretch of the Missouri River and the north end of Lake Oahe. This encompasses habitat from below the Garrison Dam south to the mouth of the Cannonball River in McLean, Burleigh, Oliver, Morton, Emmons, Sioux, and Mercer counties. Recently, birds were found nesting on the Yellowstone River in McKenzie County (R. Kreil, North Dakota Game and Fish). The remaining 85% breed in alkali wetlands on the Missouri Coteau, principally in Kidder, McLean, Sheridan, Ward, Mountrail, McHenry, and Pierce Counties.

Most breeding activity in South Dakota occurs on sandbars along the Missouri River from the Fort Randall Dam to Springfield, and from Yankton to Ponca, Nebraska. Breeding also occurs on silty flats, sandy beaches and gravel parking lots of Lake Oahe from Whitlocks Crossing south. Other isolated nesting locations include sandbars and causeways directly below Oahe Dam, and occasionally on saline wetlands in northeast South Dakota. Breeding season sightings (no documented nesting) have been reported for Campbell, Fall River, Harding, Hyde, and Walworth counties (G. Vandel, South Dakota Game, Fish, and Parks).

Currently, birds breeding in Nebraska are found on sandbars and sand and gravel spoil piles on three major rivers. In the northeastern corner of the state, nesting occurs along approximately 64 km of the upper Missouri River and along 153 km of the lower Niobrara River. Further south, Piping Plovers are found along approximately 386 km of mid- and lower Platte River habitat from near Plattsmouth west to Lexington. Breeding occurs

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at Lake McConaughy in western Nebraska (Rosche and Johnsgaard 1984) and on the Middle Loup and Loup rivers in central and eastern Nebraska (R. Lock, Nebraska Game and Parks Commission).

Breeding activity in Iowa has occurred during the past five years on ash ponds owned by Iowa Public Service in Woodbury County and by Iowa Power and Light in Pottawattamie County along the Missouri River (Wilson et al. 1983; D. Howell, Iowa Natural Areas Inventory). Potential breeding habitat has been created at DeSoto National Wildlife Refuge (Harrison County) but birds have not yet nested there (G. Gage, De Soto National Wildlife Refuge).

Birds nesting at Lake of the Woods in Minnesota use habitat similar to both prairie and Great Lakes areas. Currently, Piping Plovers breed on state-owned sites on Pine and Curry Island, Morris Point, Rocky Point, and Zippel Bay (Wiens and Cuthbert 1984, Wiens 1986, Haig and Oring 1987b).

Great Lakes Region: In Minnesota, a few pairs have been known to breed annually at the Duluth Port Terminal in St. Louis County (Niemi and Davis 1979, Davis 1985). Breeding activity in Wisconsin is confined to Long Island in Lake Superior's Chequamegon Bay (Ashland County) (Matteson 1978, 1979, 1980, 1981, 1987). Here, success has been poor, and breeding have come to an end due to vegetation encroachment and human disturbance (Matteson 1987). During the 1985 field season, only one lone adult was present. The only productive breeding populations remaining on the Great Lakes are in northern Michigan. In 1986, Michigan Department of Natural Resources surveys found breeding

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birds in six counties: Emmet (Wilderness State Park), Charlevoix (High Island), Leelanau (Sleeping Bear Dunes National Lakeshore), Alger (Grand Marais), Chippewa (Vermillion Station and Weather Hog area), and Luce (Deer Park) (E. Pike, Michigan Department of Natural Resources). Other Great Lakes Piping Plover activity is restricted to a 1986 sighting at a Cleveland, Ohio confined waste disposal site and a 1984 nest record for Sandy Pond (Oswego County) on Lake Ontario, New York (Petersen, in press). Recent surveys in Indiana did not result in discovery of any Piping Plovers (Cable 1987).

Gulf of Mexico: The complete winter distribution of Piping Plovers remains to be determined, yet specific U.S. Gulf of Mexico and Atlantic coast sites are becoming better recognized for their importance to nonbreeding birds (Haig and Oring 1985, Haig 1987b). Band returns indicate that most inland Piping Plovers winter along the Gulf of Mexico, although a few inland birds have been sighted wintering on the Atlantic Coast (Haig 1987a). Unless otherwise specified, winter sites discussed below are currently used by Piping Plovers and have been verified for ten years or more by CBC's. All known Gulf of Mexico sites were censused from 1983-85 (Haig and Oring 1985, Haig 1987b).

Piping Plovers use Texas beaches and sandflats along the entire Gulf coast from Brownsville to Sea Rim State Park. Concentrations are found in the following counties: Jefferson, Chambers, Galveston, Brazoria, Matagorda, Calhoun, Aransas, Nueces, San Patricio, Kleberg, Willacy, and Cameron.

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In Louisiana, Piping Plovers winter along the Gulf in Cameron Parish and Jefferson Parish. Occasionally, birds are seen in New Orleans Parish and Union Parish (Upper Quachita National Wildlife Refuge). Birds winter along the coast of Mississippi in Harrison, Hancock, and Jackson counties, and on Gulf Island National Seashore. Use of sites in Alabama is restricted to Mobile and Baldwin counties and principally occurs on Dauphin Island.

The number of Piping Plovers recorded in a single year on Florida CBC's is less than 100, yet there are a number of sites where birds are regularly seen. Color-banded inland birds have been seen most frequently along the Florida panhandle from Santa Rosa County east to St. George Island (Franklin County), and further south from Clearwater Beach (Pinellas County) to the Florida Keys (Haig 1987a). Atlantic birds use northeastern Florida beaches from Jacksonville south to Fort Pierce.

Winter use of sites in Caribbean, Central American, and other southern areas is poorly documented. The low number of Piping Plovers observed on Gulf of Mexico censuses indicate that Piping Plovers must be using more areas than are currently known (Haig and Oring 1985). Sporadic sightings of Piping Plovers have been reported in the Bahamas, Barbados, Bermuda, Cuba, Jamaica, Mexico, and Virgin Islands (Haig and Oring 1985).

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Life History

Breeding chronology and behavior: Piping Plovers are migratory shorebirds that spend approximately 3-4 months on northern U.S. and southern Canadian breeding sites. In North Dakota, birds begin arriving on breeding grounds in mid-April (Prindiville 1986); by mid-May, most Piping Plovers have returned to North Dakota, Minnesota, Manitoba, and other inland sites (Prindiville 1986, Wiens 1986, Haig 1985). Courtship behavior includes aerial flights, digging of several nest scrapes and a ritualized stone-tossing behavior (Cairns 1977, 1982; S. Haig, National Zoo). Finished nest cups, frequently lined with small pebbles or shell fragments are shallow depressions approximately two cm deep and six cm in diameter. Territories are actively defended by both adults. Egg laying commences the second or third week of May. Females lay an egg every other day until a four-egg clutch is complete. Both sexes share incubation duties which last for 25-31 days (Wilcox 1959, Cairns 1977, Prindiville 1986, Wiens 1986, Haig and Oring 1988a). In Manitoba, incubation began with the laying of the first egg (Haig 1987a) while Cairns (1977) did not report the onset of incubation in Nova Scotia until the third egg was laid. Cairns reported equal division of incubation duties between the sexes, but males in Manitoba assumed more diurnal incubation duties during laying and just prior to hatch than females (S. Haig, National Zoo).

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In the Midwest, eggs begin to hatch from late May to mid-June. The precocial chicks hatch within one half to one day of each other and are able to feed themselves within hours. Brooding duties are shared by males and females, although females in Manitoba deserted broods as early as the first week after hatch (Haig 1987a). Broods generally remain on nesting territories but may expand their movements as they mature or are disturbed. Fledging time varies from 21 days in Manitoba (Haig and Oring 1988a) and North Dakota (Prindiville 1986) to 30-35 days on Long Island, New York (Wilcox 1959). In Minnesota, breeding adults were observed departing the nesting grounds as early as mid-July and the majority had left by early August (Wiens 1986). Juveniles depart a few weeks later and have largely disappeared by late August (Wiens 1986). Adult males in Manitoba were observed to remain with broods until after fledging and were frequently seen moving into nonbreeding flocks with their chicks (Haig 1987a).

Mating System: Piping Plovers exhibit a predominantly monogamous mating system, although, mate-switching may occur during the breeding season (Haig and Oring 1988a) and between years (Wilcox 1959, Wiens 1986, Haig and Oring 1988a). Apparently, mate-switching between years occurs regardless of previous reproductive success (Wiens 1986, Haig and Oring 1988a). In Manitoba, most former mates were present in nesting areas in subsequent years, thus making it possible for pair bonds to persist if birds chose to do so (Haig 1987a).

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Population biology: Between 1986-1987, total pair counts for Piping Plovers throughout North America ranged between 2,020 - 2,088 (Table 2). Seventeen pairs bred on the Great Lakes, while 1,258-1,326 pairs bred on the Northern Great Plains (Table 3). There are no comprehensive historic numbers to compare with these figures, although major sites and regions (i.e. the Great Lakes) have suffered a decline in plover numbers (Haig and Oring 1985, U.S. Fish and Wildlife Service 1985). Increased censusing efforts over the past three years may account for some discrepancies in population estimates cited in 1985 (Haig and Oring 1985, U.S. Fish and Wildlife Service 1985).

Electrophoretic analysis of Piping Plover populations across North America did not indicate a quantifiable genetic difference between major breeding regions (Haig and Oring 1988b). Furthermore, local populations appeared to be in Hardy-Weinberg equilibrium. Lack of variability occurred for some populations at some loci, but coefficients of inbreeding were not significant.

At the individual level, Wilcox (1959) reported that 13% of females and 28% of male Piping Plovers lived to be five years or older, and implied they were still reproductively active at an advanced age. Data on adult mortality, population sex ratios, and turnover rates scarce. During a single year, most adults raise only one brood of up to four chicks, although one pair in Nebraska raised two broods (G. Lingle, Platte River Whooping Crane Habitat Maintenance Trust). When nests are destroyed,

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Table 2. North American breeding pair estimate for Piping Plovers 1986-87.

Geographic Region	Pairs	Source
Atlantic Coast	745	
United States	522	Atlantic Recovery Team
Canada	223	Canadian Wildlife Service
Great Lakes	17	
United States	17	Table 3
Canada	0	Table 3
Northern Great Plains	1258-1326	
United States	682	Table 3
Canada	576-644	Table 3
TOTAL	2020-2088	
United States	1221	
Canada	799-867	

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Table 3. Breeding pair estimate for Great Lakes/Northern Great Plains Piping Plovers 1986-87 (Canadian estimates from 1986).

Location	Pairs	Source
GREAT LAKES:		
Duluth, Minnesota	0	L. Pfannmuller, Minnesota DNR
Michigan	17	E. Pike, Michigan DNR
New York	0	R. Miller, New York Conserv. Dept.
Wisconsin	0	S. Matteson, Wisconsin DNR
NORTHERN GREAT PLAINS:		
Iowa	6	D. Howell, Iowa Nat. Areas Inventory
Lake of the Woods, MN	7	Haig and Oring 1987b
Montana	36	A. Dude, Montana Fish and Game
Nebraska*	167	R. Lock, Nebraska Game & Parks
North Dakota	352	R. Kreil, ND Natural Heritage Program
South Dakota*	97	G. Vandel, SD Game, Fish, & Parks
Alberta	150	C. Wershler
Manitoba	66-90	Haig 1987c.
Lake of the Woods, ON	4	B. Darby, Ontario MNR
Saskatchewan	356-400	D. Hjertaas, Saskatchewan MNR
TOTAL INLAND POPULATION	1376-1444	

*Missouri River numbers for Nebraska and South Dakota are presented as South Dakota pairs.

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adults may renest up to four times (Dyer et al. 1987). On average, pairs fledge 0.3-2.1 chicks per year (Haig and Oring 1985). Flemming (1984) observed that pairs on undisturbed beaches fledged more chicks than those nesting on beaches with intense recreational activity. Young plovers are able to breed the year after fledging.

Dispersal patterns: Breeding site fidelity for Piping Plovers ranges from 15% in Nova Scotia (Cairns 1977) to 92.3% in Minnesota (Haig and Oring 1987b). Return patterns do not differ significantly between males and females (Haig and Oring 1988a). Furthermore, return patterns to specific breeding sites do not seem influenced by previous reproductive success (Wiens 1986, Haig and Oring 1988a). In Manitoba, adults exhibited two patterns: those that hatched chicks the year before, returned to the same breeding site but changed territories; but adults that experienced nest failure the year before generally changed sites (Haig and Oring 1988a). Adults have been known to disperse as far as from Lake of the Woods, Minnesota to northern Lake Winnipeg (546 km) in consecutive years (Haig 1987a).

The percentage of chicks returning to fledging sites ranges from 4.7% in New York to 20.2% in Minnesota (Wilcox 1959, Wiens 1986). In Manitoba, first year males and females return in equal numbers (Haig 1987a). Chick dispersal is difficult to characterize, although, long range dispersal distances have been documented. For example, a chick from southern Manitoba was

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found at Long Point, Ontario a year after hatch (Haig 1987a). Wilcox (1959) reported a chick from Long Island, New York, bred as an adult at Penn Yan (Yates County), New York.

Home range: The Piping Plover's home range during the breeding season is usually limited to the wetland, lakeshore, or section of beach on which its nest is located. In Manitoba, however, birds whose nests were destroyed often changed territories and breeding sites prior to renesting. Males that changed territories generally changed breeding sites. Females generally changed territories on the same site. Distances between sites varied from 3-100 km (Haig and Oring 1988a). Investigation into movements of individual birds between beaches and spoil islands at Dauphin Island, Alabama, and on the Upper Texas Coast are beginning to provide better information about home ranges of wintering birds (Johnson 1987, T. Eubanks).

Territoriality: Piping Plovers defend territories during the breeding season (i.e., throughout courtship, laying, incubation, and brood care) and at some winter sites. During the breeding season, both members of the pair defend a nesting territory which may or may not contain their foraging area. Piping Plovers in Nova Scotia had separate nesting and feeding territories (Cairns 1977), whereas birds in Saskatchewan had combined territories (Whyte 1985). Piping Plovers in Manitoba exhibited both patterns in some areas (S. Haig, National Zoo).

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Spacing of territories varies from one pair per beach to a semi-colonial situation where 30 or more pairs place nests less than 25 m apart. (Haig 1986b).

Defense of feeding areas varies with habitat and stage of the annual cycle. New arrivals to breeding grounds and nonbreeding birds tend to forage on undefended areas (Cairns 1977, Haig 1986b). During courtship, incubation, and early brood-rearing, most Piping Plovers forage on their territories (Cairns 1977, Whyte 1985, Haig 1986b). Haig (1987b) and Eubanks (pers. comm.) observed Piping Plovers feeding on territories on some Texas beaches, but did not observe territory defense on adjacent sandflat feeding areas. Studies underway in Alabama may provide information on defense of feeding areas by nonbreeding birds in winter (Johnson 1987).

Diet: Little is known about the diet of Piping Plovers or their foraging behavior during any phase of the annual cycle. The species' sensitivity to human disturbance and its status requires the use of nondisruptive techniques to sample food while birds are present. Low population numbers rule out collection of birds for stomach content analysis. Cairns (1977) was unsuccessful in her attempt to develop an emetic that would have forced chicks to regurgitate their food. Nevertheless, Bent (1929) reported the stomach contents of four Piping Plovers from Alabama as containing marine worms, insects (fly larvae and beetles), crustaceans, molluscs, and other small marine animals (and their eggs). Similarly, in Nova Scotia, Cairns (1977)

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observed Piping Plovers feeding on marine worms averaging 2.5-7.5 cm in length. She suggested their diet consisted of marine worms, minute worms, and crustaceans.

Whyte (1985) carried out invertebrate sampling on Piping Plover territories at Big Quill Lake in Saskatchewan, and found the following families present (percents represent % of species found in all samples): Coleoptera: Carabidae (26.9%), Dytiscidae (15.3%); Hemiptera: Corixidae (19.2%) and Saldidae (2.3%); and Diptera: Chironomidae (9.5%) and Ephidridae (2.6%). Dytiscid adults and larvae, corixids, and chironomid larvae were collected in water sweeps one meter from the water's edge. He found ephidrids to be more common further upland, and collected carabids and dytiscids from the shoreline to the edge of the grassland cover. Whyte's sampling was carried out in August, possibly biasing the results.

Piping Plovers have been observed eating grasshoppers and spiders in the grass near nest sites in Manitoba and Nebraska (S. Haig, National Zoo; G. Lingle, Whooping Crane Habitat Maintenance Trust). Food studies underway in North Dakota, Wisconsin, and Michigan (M. Ryan, University of Missouri) will provide better information about Piping Plover diets and food abundance on nesting territories. Furthermore, studies underway on the Upper Texas Coast (T. Eubanks) are beginning to identify important food elements for wintering Piping Plovers. Finally, captive birds have done well on a diet of commercial feed, chopped egg yolks, and mealworms (Quinn and Walden 1966).

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Interspecific interactions: Piping Plovers nest in Least Tern (Sterna antillarum) colonies at a number of sites on Great Plains river sandbars, sand pits, and Atlantic Coast beaches (Nebraska Game and Parks Commission 1978-86, Faanes 1983, Master and French 1984, U.S. Fish and Wildlife Service 1985). Threats to success are similar for both species, compounding problems associated with destruction of their habitat. In Nova Scotia, Piping Plovers nested within colonies of Arctic Terns (Sterna paradisaea) and Common Terns (Sterna hirundo) (Cairns 1977). Similarly, Piping Plovers at Lake of the Woods, Minnesota, nested in the midst of a Common Tern colony (Wiens 1986). In central North Dakota, Piping Plovers commonly nest in association with American Avocets (Recurvirostra americana). Circumstantial evidence suggests that Piping Plovers nesting near Avocets had higher nest success than those nesting in the absence of Avocets (Prindiville 1986).

Habitat Requirements

Piping Plovers, like most members of the genus Charadrius, breed in open, sparsely vegetated habitats. In north-central North America, Piping Plovers nest on barren sand and gravel Great Lakes shorelines, and along sand and gravel shores of rivers and lakes in the Great Plains.

Inland Lakes: This habitat type includes the large inland lakes of the Great Lakes states (e.g., Lake Michigan, Lake Superior, and Lake of the Woods, MN) and Northern Great Plains

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(e.g., Lake McConaughy, NE; Lake Oahe, SD). Also included are the much smaller prairie sloughs and saline wetlands. Along large inland lakes, plovers nest on open, sand and gravel beaches on islands or the mainland. Beaches may be adjacent to dunes and are surrounded by prairie parkland (Lake of the Woods) or northern hardwood/coniferous forest (Great Lakes). In the northern Great Plains, permanent to seasonally flooded, palustrine wetlands are used by breeding birds. Typical nests are placed on dry salt flats, or gravel beaches. Surrounding habitat may include pasture or rangeland composed of short or mixed grass prairie. Although the preference of Piping Plovers for open beaches has been repeatedly noted in the literature, quantitative data on habitat characteristics, evidence of habitat selection, and information on the relative quality of inland lake habitats remain scarce. Several studies have suggested that beach width and the area from the water's edge to the line of upland vegetation, may affect habitat use by breeding Piping Plovers: in Michigan, beaches were wider in territories of mated pairs ($\bar{x}$ = 31 m) than in territories of unmated males ($\bar{x}$ = 26 m) (Lambert and Ratcliff 1981). Whyte (1985) recorded minimum nest-to-water distances of 40 m at his Saskatchewan study area and suggested that beaches less than 20-30 m in width were not likely to be used by Piping Plovers. In Alberta, however, Weseloh and Weseloh (1983) calculated a mean beach width of only 11.7 m at nest sites. But they noted that these seemed to be the widest beaches available. Prindiville (1986) reported mean beach width

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to be larger in occupied territories ($\bar{x}$ = 33 m) than in unoccupied beaches ($\bar{x}$ = 13.6 m) at her North Dakota study sites. Narrow beaches may be low quality Piping Plover breeding sites because predators may be more successful at locating nests along narrow strips (< 20 m) of beach than on wider areas (Prindiville 1986). Nests on narrow, gently sloping beaches also are likely to be destroyed by increasing water levels or wave action during storms (Haig and Oring 1985).

The amount and distribution of beach vegetation affects Piping Plover habitat selection and reproductive success. Niemi and Davis (1979) searched nine beaches along Lake Superior and found six of ten Piping Plover nests on beaches with the least vegetative cover (5%). They also reported that occupied beaches with the greatest percent cover (42%) had vegetation clumped in bands. Prindiville (1986) found no difference in vegetative cover between territories ($\bar{x}$ = 3.4%) and unoccupied sites ($\bar{x}$ = 3.8%). However, vegetation was more clumped in territories than in unoccupied areas. Furthermore, territories in which Piping Plover nests were successful had either less vegetation or more clumped vegetation than territories with unsuccessful nests (Prindiville 1986).

Substrate composition may also affect habitat selection by Piping Plovers and influence nest success. Cairns (1977) found 31 of 38 nests in Nova Scotia on mixed sand and gravel and stated that those nests were less conspicuous than those on sand alone. Whyte (1985) reported that Piping Plovers were more likely to

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establish nests on gravel than was expected by chance alone. In North Dakota, gravel was generally more evenly distributed and in greater concentration on Piping Plover territories than at unoccupied sites (Prindiville 1986). Prindiville (1986) also reported greater nest success (59%) for nests placed on gravel versus those on alkaline substrate (15%).

In summary, evidence from wetland and deep water habitats in the Northern Great Plains and Great Lakes suggests that beach width as well as abundance and distribution of vegetation and gravel are important factors affecting Piping Plover habitat selection and reproductive success. Wide beaches (> 20 m) with less than 5% vegetative cover, with highly clumped vegetation and/or with extensive gravel create large blocks of homogeneous substrate that provide a suitable habitat for breeding Piping Plovers.

Prairie Rivers: Piping Plovers nesting on the Missouri, Platte, Niobrara, and other rivers use beaches and dry, barren sandbars located midstream in wide, open channel beds. Vegetative cover on nesting islands is usually less than 25% (Faanes 1983, Nebraska Game and Parks Commission 1978-86). Although plover density is high in these areas, there are insufficient quantitative data that relate habitat characteristics to reproductive success in riverine habitats.

Twenty-eight Platte River sandbars, occupied by nesting Piping Plovers, averaged 286 m in length and 55 m in width (Faanes 1983). Vegetative cover on those sandbars averaged

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25.4%. Piping Plover nests averaged 16 m (n = 39) from the water's edge, but the mean height above river level was only 0.2 m (n = 14) (Faanes 1983). The mean nest-to-water distance for eight nests on Lake Sakakawea, North Dakota, was 46.2 m and the mean height above water level was 1.0 m (North 1986). All eight nests were successful in 1985 but if the water level of this Missouri River reservoir had been manipulated as it was in 1984, five of the eight nests would have been inundated (North 1986). Measurements of size and elevation on nesting sandbars have been recorded on the Missouri River by Schwalbach et al. (1986) and on the Platte River by the Nebraska Game and Parks Commission (1982-86).

Artificial Nesting Habitat: Recent evidence suggests that plovers may nest on sites created by various artificial manipulations (Table 4). Piping Plovers using artificial off-river sites, however, have experienced severe reproductive failure due to predation and human disturbance (G. Lingle, Whooping Crane Habitat Maintenance Trust). In Nebraska, 18% of nests in artificial sites were successful compared with 40% success in natural areas (Nebraska Game & Parks Commission 1986).

Feeding Habitat: Piping Plovers feed primarily on exposed beach substrates by pecking for invertebrates at or less than one centimeter below the surface (Cairns 1977, Whyte 1985). In Saskatchewan, Whyte (1985) noted that adults concentrated foraging efforts within five meters of the water's edge. He found broods also fed most often near the shore, but their use of

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Table 4. Use of newly-created and artificial habitat by Piping Plovers (adopted from Haig 1985).

Location	Habitat description/ management attempted	Result	Source
Island Wildlife Area, IA Sioux City (Woodury Co.), Council Bluffs (Pottawattamie Co.)	Two fly ash disposal ponds on Missouri River.	Eleven pairs used the areas.	Howe, Iowa Natural Areas Inventory
Lake Manitoba, MB	Dike road adjacent to lake.	Pair nested.	Sealy, Univ. of Manitoba
Oak Hammock Marsh, MB	Gravel road and parking lot.	Four nests in 1974, 1 nest in 1975, 2 nests in 1976.	Gardner, Oak Hammock Marsh
Erie Pier, Duluth Harbor, MN	Active dredge disposal site.	One-two pairs attempted to nest in 1983, 1984 and 1985. Only one pair has been successful (1984).	Davis, 1985
Public access parking lot, Lake McConaughy, NE	Gravel parking lot.	One unsuccessful nest.	Nebraska Game and Parks Comm.
Platte River, Elkhorn River, NE	Sand and gravel pit excavations.	Young produced annually, but success is low due to predation and human disturbance.	Nebraska Game and Parks Comm.
Loup River, NE	Irrigation canal dredge disposal area.	Success unknown.	Nebraska Game and Parks Comm.
Duluth Port Terminal	Old dredge disposal site.	1-5 pairs used site from 1977-1985.	Davis 1983, 1984 1985

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Table 4 continued

Location	Habitat description/ management attempted	Result	Source
Hearding Island, Duluth Harbor, MN	Old dredge disposal island; 5.7 ha cleared in spring of 1983.	Individuals observed on the island in 1983; no nesting.	Davis 1985,
Interstate Island, Duluth-Superior Harbor, MN, WI	Old dredge disposal island; vegetation removed between 1984-1986.	No Piping Plover use.	Davis 1985
Lake Oahe (Missouri River), ND	Construction of 5 acre dredge spoil island in 1981.	5 pairs present in 1983, 4 in 1984, 2 in 1985, 3 in 1986.	Dryer, U.S. Fish and Wildlife Service
Northwestern North Dakota	Creation of waterfowl nesting islands by Ducks Unlimited.	Rapid habitation and nesting by Piping Plovers.	Kreil, North Dakota Game and Fish Dept.
Prince Edward Is. National Park, PEI	Parking lot adjacent to Brackley beach.	One pair nested.	Cairns, pers. comm.
Estevan, SK	Highway Department ash lagoon.	One pair nested successfully.	Switzer 1979
Public Access Parking Lot, Missouri R., SD	Gravel Parking Lot.	One-three pairs nested; some young produced.	Schwalbach et al. 1986

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upland beach habitats was greater than that of adults. Cairns (1977) reported that chicks tended to feed on firmer sand at greater distances from the shoreline than adults. At Lake of the Woods, Minnesota, and on Long Island-Chequamegon Point, Wisconsin, adult Piping Plovers seemed to prefer shoreline or beach pool edges (wet sand) over open beach (dry sand) as feeding sites (Wiens 1986; S. Matteson, Wisconsin Department of Natural Resources). Additional data are needed to determine whether food abundance or quality at breeding, migratory, or wintering sites are limiting Piping Plovers.

Gulf of Mexico Winter Sites: During the winter, Piping Plovers use beaches, sandflats, and dunes along Gulf of Mexico coastal beaches and adjacent off-shore islands (Haig and Oring 1985). Spoil islands in the Intercoastal Waterway are also used. Research has not yet been conducted to further describe or quantify nonbreeding habitat.

Reasons for Decline

The Piping Plover is a species with highly variable annual reproductive success that use freshwater and saline wetland habitats throughout the annual cycle. These ephemeral habitats render birds susceptible to frequent nest destruction, and consequently, drastic population fluctuations. Early 20th century accounts report that shorebird hunting caused the first known major decline of the species (Bent 1929, Hall 1960). There are no comprehensive population estimates for the entire species

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prior to 1980 (Cairns and McLaren 1980), although Haig and Oring (1985) outlined specific sites or regions where substantial declines occurred. Since then, factors discussed below have further contributed to the decline of Piping Plovers.

Habitat alteration and destruction: Loss of sandy beaches and other littoral habitats due to recreational/ commercial developments and dune stabilization on the Great Lakes, Atlantic Coast, and Gulf of Mexico are partially responsible for the decline of the species (Bent 1929, Cairns 1977, Flemming 1984, Haig 1985, Haig and Oring 1985, U.S. Fish and Wildlife Service 1985, and others). Also in the Great Lakes, historical nesting sites have been destroyed by high water levels, flooding, or eroding beaches (Russell 1983). Where breeding does occur on Great Lakes and Atlantic Coast sites, reproductive success can be curtailed by human disturbance. Vehicular and foot traffic destroys chicks and eggs. The presence of people on beaches inhibits incubation and other breeding behavior, further decreasing reproductive success (e.g., Cairns 1977, Flemming 1984).

Reservoirs, channelization of rivers, and modification of river flows have eliminated sandbar nesting habitat along hundreds of kilometers of the Missouri and Platte rivers in the Dakotas, Iowa, and Nebraska. Before regulation of river flows, summer flow patterns were relatively predictable. Peak flows occurred in May and June and then declined during the rest of the summer. Spring flows covered some sandbars, but Piping Plovers

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were able to nest as water levels dropped and sandbars became available. Currently, regulated flows can be unpredictable and may fluctuate greatly. High flow periods are now more common long into the normal nesting period, thus reducing the potential for optimum nest sites, and forcing Piping Plovers to nest in less desirable locations, or not at all. Diversion of peak flows responsible for scouring river sandbars has resulted in the encroachment of vegetation (Currier et al. 1985). Consequently, Piping Plovers are often faced with finding a nest site outside the channel or not nesting at all (Nebraska Game and Parks Commission 1978-86, U.S. Fish and Wildlife Service 1981). In addition, river mainstem reservoirs now trap much of the sediment load resulting in less aggradation and more degradation of the river bed and subsequently less sandbar nesting habitat.

Commercial sand and gravel mining operations along river banks have created sandy spoil piles that may be used for nest sites. Piping Plovers initiate nesting on spoil piles early in the breeding season when river flows are inundating sandbars. Eggs and young are vulnerable to predation and human disturbance from pit operations or adjacent housing projects. Eventually, nesting habitat is lost to vegetation encroachment and/or housing and recreational development.

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Although some saline wetlands in the northern Great Plains have been drained or modified, the impact of this activity has not been specifically investigated. Freshening of water on saline wetlands in central North Dakota decreased their quality as nesting habitat (Prindiville 1986).

Winter habitats are threatened by industrial or urban expansion that could result in wholesale destruction of sites. The quality of sites may be threatened by increased human use of beaches for recreational purposes. Habitat quality may be substantially lowered, at least on a short-term basis, by oil spills (T. Amos, Marine Science Institute). Wintering sites near existing oil trans-shipment facilities, and oil tanker shipping lanes should be identified and regularly monitored. The stabilization of barrier island sand flats also has been identified as a potential threat to Piping Plover habitat. Stabilization may result in encroachment of vegetation that reduces the quality of, or eliminates altogether, wintering sites (Currier et al. 1985).

Overutilization by humans: As mentioned above, early 20th century hunting may have severely reduced numbers of Piping Plovers. Currently, illegal shooting may be a problem in Newfoundland (Diechmann and Burrows 1983) and the West Indies (I. Price, Canadian Wildlife Service), but it is not evident in the U.S. In North America, care will have to be taken to insure that collecting permits are not issued without significant justification for the action. Also, as more research is carried

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out, biologists are becoming increasingly aware of Piping Plovers' sensitivity to humans (including researchers) on their territories (Haig and Oring 1987a). In the future, research activities will have to be carefully monitored.

Disease or predation: Disease is not known to be a problem for Piping Plovers. Predation, however, is a problem along Atlantic and Great Lakes beaches, on saline wetlands in the prairies, and at sand and gravel pits along the Platte River in Nebraska. Increased urbanization and use of beaches has brought an increase in the number of unleashed pets, unnaturally high densities of gulls and other predators such as skunks and foxes (Vulpes spp.) (Drury and Kadlec 1974, Haig 1985). Cattle trampling nesting habitat may also affect nest success and chick survival (Prindiville 1986, Nebraska Game and Parks Commission 1978-86).

Inadequate regulatory mechanisms: Even though the species may have been declining for many years, past regulatory mechanisms were inadequate to provide the plover with protection necessary to prevent future decline. Recent federal recognition of the species' status by the U.S. and Canada has improved the outlook for the plover's future (U.S. Fish and Wildlife Service 1985, Haig 1985). Implementation of recovery plans by both countries will further assure protection of habitat for the species.

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Other natural or human factors affecting its continued existence: An oil spill along the Texas coast killed a few Piping Plovers, but the incident was short-lived (T. Amos, Marine Science Institute). Dinsmore (1983) reviewed the impact of surface mining on Piping Plovers and concluded that there was potential for habitat destruction as well as enhancement in mining areas. Currently, mining practices are not known to be threatening the birds.

Future threats: Many future threats are similar to current problems, e.g., increased recreational/commercial development of beaches, wetland drainage, water level manipulation on rivers, increased predation, lack of undisturbed nesting habitat, and stabilization of winter sites. Natural increases in water levels that historically may have had minor impact when populations were larger may now cause birds to shift away from traditional sites and experience repeated reproductive failure.

Past research (Flemming 1984, Burger 1987) and work underway (E. Straus, Tufts University) indicate human presence on beaches may reduce Piping Plover reproductive success. Little recognition, however, has been given to disturbance caused by researchers or managers during the course of their work (Haig and Oring 1987a). Given this situation, initiation of new studies will be undertaken only if specific issues, necessary for species recovery, are being addressed.

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Finally, the impact of agricultural runoff into wetlands, pesticide drift, botulism (Haig 1986c), and environmental contaminants has not been carefully investigated, but may prove detrimental in the future. However, two eggs tested in Michigan for PCB, PBB, chlorinated hydrocarbons, and pesticides, did not indicate the presence of contaminants (Pike 1985).

Conservation Efforts

During the past decade, there has been an explosion of interest in the Piping Plover at the state and federal level, as well as among private conservation organizations. Conservation efforts were underway by the late 1970's in the Great Lakes, but began only recently on the Great Plains. Proposed federal listing of both the Piping Plover and the Interior Least Tern, prompted much of the interest in the Plains states in the early 1980's. Today, extensive survey work is underway in both regions, as are a variety of other investigations. Innovative approaches to habitat protection and management are also being implemented. Specific conservation actions in states that have recently supported one or more nesting pairs of plovers are discussed below and summarized in Table 5.

New York: Since New York's Piping Plover population is concentrated almost entirely on the Atlantic Coast, the few birds that occasionally reside along the shoreline of Lake Ontario have received little attention. Current survey work for terns and posting of known tern nesting areas may provide better

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Table 5. Summary of state actions for conservation of Piping Plovers[a]

	SURVEY		RESEARCH							HABITAT MANAGEMENT							OTHER	
	Survey work	Additional Survey Work Planned	State-listed	Population Studies: Banding	Population Studies: Color-Banding	Habitat Studies	Predation Studies	Feeding Ecology	Posting and Signing	Psychological Fencing	Patrols	Management Plans	Predator Mgmt.	Creating and/or Enhancing Habitat	Control of River Flow	Habitat Acquisition	State Recovery or mgmt. plan	Information and Education
GREAT LAKES																		
New York		●	T															
Michigan	●	●	E	●	●	●	●	●	●	●	●	●	●	●		●	●	●
Wisconsin	●	●	E						●			●		●		●		●
Minnesota	●	●	E	●	●	●	●	●	●			●	●	●		●		●
GREAT PLAINS																		
Montana	●	●							●									
South Dakota	●	●	T	●		●	●	●	●						●			●
North Dakota	●	●	T[b]	●	●	●	●	●	●	●		●	●	●		●		●
Iowa	●		E						●			●		●				
Minnesota	●	●	E	●	●				●			●	●			●		●
Nebraska	●	●	T	●	●	●	●		●	●	●	●		●	●	●		●

a Appendix 1 lists state contacts.
b Listed by The Wildlife Society; state has no official list.
● Indicates participation in activity by the state.

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information about plovers but no specific conservation actions have been undertaken (B. Miller, New York Department of Environmental Conservation). Since federal listing of the Great Lakes population, interest has been renewed regarding the potential of New York's Lake Ontario shoreline to support Piping Plovers. The state, however, does not plan surveys in the near future.

Michigan: Michigan has surveyed Piping Plover breeding areas annually since 1979. Potential breeding areas that were identified and surveyed in 1979 by Lambert and Ratcliff (1981) were recently surveyed again by the Michigan Natural Features Inventory. Although no new nesting pairs were found, the survey was successful in locating a few solitary birds and will be continued if funding is available. Other research activities include a study comparing breeding biology of Piping Plovers and Spotted Sandpipers (Actitis macularia) (Brown 1987), and an investigation of Piping Plover food abundance (M. Ryan, University of Missouri).

Management actions in Michigan include a closure order that now prohibits trespassing on all occupied nesting areas on state land. The order was written to include all historical breeding areas, but only occupied sites are closed for the nesting season. To insure that regulations are enforced, signs are posted or psychological fencing (i.e., two strands of twine) is erected near nesting areas subject to frequent off-road vehicles or foot

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traffic. One popular recreational spot that supports several nesting pairs is regularly patrolled to remind visitors of the regulations in effect.

Habitat enhancement work has begun along the Lake Superior shoreline. Small patches of gravel were recently added to several sand beaches in an effort to make them more attractive to breeding pairs (T. Allan, Lake Superior State College).

Other conservation measures include efforts to incorporate management recommendations for plovers into all existing plans of appropriate state management units and preparation of a state recovery plan for the plover. Finally, to increase public awareness and appreciation of the species, numerous educational efforts are underway. In 1986, the Piping Plover was selected as the Department of Natural Resource's bird of the year. Embroidered arm patches and prints of an original painting of plovers were used to generate public support.

Wisconsin: Recent nesting in Wisconsin has been limited to Long Island-Chequamegon Point on Lake Superior. Previously a separate island, Long Island has been connected to the mainland (Chequamegon Point) since 1976. In that time, dunes have stabilized and herbaceous cover is now considered a potential impediment to the plovers. Methods of vegetation control are under consideration (S. Matteson, Wisconsin Department of Natural Resources).

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Currently, Long Island is owned by the Bureau of Land Management, Ashland County, and private individuals. In the past, Ashland County owned part of northeastern Chequamegon Point where Piping Plovers nested. Recently, the statutory boundary of the Apostle Islands National Lakeshore was changed to include this area and all of Long Island.

Elsewhere in Wisconsin, annual survey work is being conducted along the Lake Michigan shoreline to check sites that historically supported plovers and to survey sites that could be managed for plovers. In the Duluth-Superior harbor, efforts are underway to create secure and suitable habitat that may attract birds. Details of this project are provided below.

Duluth-Superior Harbor (Minnesota and Wisconsin): The Duluth-Superior harbor is located in a heavily industrialized metropolitan area. Historically, the area may have supported 10-15 breeding pairs of Piping Plovers. Today, the birds are absent from Wisconsin's portion of the harbor and up to two pairs are present in Minnesota (T. Davis, pers. comm.). In recent years, Minnesota's primary nesting sites in the Duluth area have been the industrialized Port Terminal and an active dredge disposal site at the Erie Pier. The harbor's major Common Tern colony is also located at the Port Terminal. Although biologists have worked closely with federal agencies whose activities directly impact the plovers, the species' future is in immediate jeopardy at both of these highly disturbed sites.

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In an effort to enhance natural resources throughout the Duluth-Superior harbor, a local planning agency, the Metropolitan Interstate Committee, prepared a management plan for the area in 1985. The primary focus of the harbor work has been two-fold. First, complete protection is provided to all known Piping Plover nesting attempts, regardless of their location. At the same time, work is underway to create and secure potential nesting habitat elsewhere in the harbor on two old dredge spoil islands: Hearding (Minnesota) and Interstate (Minnesota and Wisconsin), and on Wisconsin Point in Allouez Bay. Both Hearding and Interstate Islands are wildlife management areas. Woody vegetation on all or portions of each site has been removed to create an open, sandy, substrate that is preferred by both plovers and terns. Trespassing is prohibited on both sites during the nesting season. Because plovers invariably nest with Common Terns in the harbor, many management strategies specifically target terns. For example, Common Terns are now actively discouraged (e.g., by intentional disturbance by researchers and their dogs) from nesting at the Port Terminal and are encouraged (e.g., by using decoys and taped calls) to nest on dredge-spoil islands. If terns relocate, biologists believe plovers will follow.

Thus far, the program has met with some success. During the 1985 field season, 41 of the harbor's 280 nesting pairs of terns established themselves on Interstate Island (none nested in 1986); in 1986, 31 pairs moved to Hearding Island (Davis 1985,

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1986). In neither case, however, were nesting attempts successful. Nevertheless, management will continue on both islands for several more years. Investigation of predation problems and the need for vegetation control, particularly on Hearding Island, will also be initiated.

Habitat management work had been underway on a third island, Barker's Island (Wisconsin), since 1981, but terns and plovers were not attracted to the site. Because pressure for development on the island has been high, it has been traded for two hectares on Wisconsin Point where scattered amounts of woody vegetation will be removed to expose a sandy nesting substrate suitable to plovers.

Minnesota: Over 90% of Minnesota's Piping Plovers (approximately 20-25 adult birds) nest on Pine and Curry Island at Lake of the Woods. Individually marked Piping Plovers have been monitored at the site since 1982 (Wiens and Cuthbert 1984, Wiens 1986, Haig and Oring 1987b). Acquisition efforts by the State of Minnesota and the Minnesota Chapter of The Nature Conservancy have protected the island and an adjacent peninsula where a few pairs have nested each year. The site has been designated a State Scientific and Natural Area (SNA), the most protective land classification available in Minnesota. A detailed management plan that places protection and perpetuation of the plover population as the foremost priority was completed in 1986. All three nesting areas on the SNA are posted during the breeding season and no trespass is allowed.

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Recent threats to the birds' long-term survival at Lake of the Woods have prompted increased management activities. After three consecutive nesting seasons with poor reproductive success (1984, 1985, and 1986), efforts to remove all potential predators (fox and mink) from Pine and Curry Island were begun in 1987. Similarly, since Ring-billed Gulls (Larus delawarensis) attempted to establish a colony on the island in 1985, biologists have systematically destroyed nests and removed eggs.

Because the SNA is located in one of Minnesota's major recreational areas, public awareness is an important aspect of Minnesota's conservation program. A brochure on the island's significance to the Piping Plover has been prepared and distributed to local resort owners. Signs that alert boaters to areas of the island that are off limits, as well as public areas where use is allowed, have been posted at many of the resort boat ramps. Public meetings regarding the island's designation as an SNA and its subsequent management also have been held in the nearby town of Baudette.

On a statewide basis, many public relations efforts have been directed at the plover. Numerous magazine and newspaper articles have been written, a slide-tape show has been prepared and distributed throughout Minnesota and neighboring states, and the bird was featured on the 1987 state park sticker.

Montana: Conservation work in Montana has been directed at survey efforts in the eastern plains as well as at Fort Peck Reservoir and Medicine Lake. In 1986, field surveys by several

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independent parties were successful in documenting the presence of approximately 20 plover nests plus several non-nesting birds at three different sites (D. Flath, Montana Fish and Game Department). More extensive surveys are planned for the entire stretch of the Missouri River and shorelines of large reservoirs and saline wetlands. In addition, efforts have been undertaken to secure plover sites at Fort Peck Reservoir and Medicine Lake.

North Dakota: Widespread in both riverine and prairie wetland habitats, North Dakota's Piping Plover population is one of the largest in North America. Its distribution, however, has made it difficult to conduct intensive statewide surveys of breeding pairs. Nevertheless, the first statewide census was undertaken in 1967 (Stewart and Kantrud 1972). Since then, two extensive surveys have been conducted. The first, in 1984, was conducted by the Natural Heritage Inventory. Two years later, field personnel from state and federal agencies worked together to document approximately 325 pairs statewide (R. Kreil, North Dakota Game and Fish Department). A similar effort will continue in future years. In addition to surveys, research coordinated by the University of Missouri-Columbia is underway at the Chain of Lakes. One master's degree project on habitat selection was completed in 1986 (Prindiville 1986) and another on predation is underway (Mayer and Ryan 1986).

Management actions in North Dakota have focused primarily on the riverine habitat. Some nesting areas that are most prone to human disturbance have been posted. Development of a river

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management plan, sensitive to the needs of both plovers and terns, will be undertaken in cooperation with the Army Corps of Engineers. The managers at Lostwood and Audubon National Wildlife Refuges have initiated habitat management practices to increase the suitability of nest sites. In the state's Missouri Coteau region, the Nature Conservancy has recently acquired the Chain of Lakes area and two other Piping Plover nest sites were entered into the Natural Areas Registry Program (M. Dryer, USFWS Bismarck ND).

The Piping Plover has been the focus of several public relations efforts in North Dakota, particularly along the Missouri River. T-shirts featuring the plover have been popular and, in 1986, the species was chosen to be highlighted on North Dakota's state park sticker.

South Dakota: In the past, Piping Plover surveys in South Dakota were incomplete; only the larger well-known sites were monitored. In 1986, funding from USFWS and Army Corps of Engineers allowed for a survey to determine distribution, production, and population densities of Piping Plovers along the Missouri River (Schwalbach et al. 1986). Although the Missouri River is thought to provide the primary habitat for Piping Plovers in South Dakota, scattered sightings are available from saline wetlands in the northcentral and northeastern regions of the state. Nevertheless, these regions have not been systematically surveyed and no future work is planned.

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In addition to monitoring the plover's distribution and status, the South Dakota Department of Game, Fish, and Parks plans to prepare specific management recommendations for the Army Corps (Schwalbach et al. 1986). Staff at the federal agency have already cooperated with South Dakota biologists. During the 1986 field season, water was intentionally held back at one dam in order to protect a single nest located immediately downstream. Elsewhere along the river, water levels were so high that a few isolated pairs of birds chose to nest in parking lots adjacent to Lake Oahe. Each nest was protected with wooden barricades, large rocks, or a twine fence, but only one pair remained throughout the nesting season and was successful at fledging young. Currently, there is a major need to evaluate main stem dam operations on the Missouri River in the Dakotas and Nebraska. U.S. Fish and Wildlife Service is currently attempting to consult wiith the Army Corps of Engineers.

Future management activities include plans to post informational signs at boat ramps and no trespassing signs on sandbars used for nesting. A slide show on both Piping Plovers and Least Terns will also be prepared and shown to public groups using the river.

Nebraska: Like North Dakota, Nebraska's rivers support one of the largest Piping Plover breeding populations in North America. Annual surveys by the Nebraska Game and Parks Commission began on the Missouri River in 1980, on the Niobrara River in 1978, and on the Platte River in 1979. Portions of

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these rivers support 95% of Nebraska's total Piping Plover breeding population. Since 90% of Nebraska's plovers nest in association with Least Terns, aerial surveys of tern colonies also provide the location of plover nesting areas. Ground surveys are then made to pinpoint colony locations, census the breeding population, describe habitat characteristics, determine reproductive success, and identify mortality factors.

Efforts are being made to quantify available nesting habitat on the Platte and Niobrara rivers at various discharges through the use of airborne television and photography. Intensive research on habitat selection and productivity is being conducted by the Platte River Whooping Crane Habitat Maintenance Trust along the central Platte River and by the Nebraska Game and Parks Commission on the lower Platte, Loup, and Niobrara rivers. The Nebraska Game and Parks Commission is funding a color banding study on the lower Platte River is investigating nesting, population, and foraging ecology. The Platte River is located in the midst of several controversial water development projects.

Numerous management efforts are underway in Nebraska, particularly along the Missouri and Platte rivers, where development pressure is intense. State biologists have prepared a Missouri River flow management plan. Included are recommendations to the Corps of Engineers for scheduling discharges from reservoirs at times that will minimize impacts on both plovers and terns. During the summer of 1986, the Corps of Engineers temporarily retained water in upstream reservoirs to

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prevent inundation of plover nests and young on the Missouri River. Now that both species are federally listed, more effort will be exerted to insure that daily operations along the river are not detrimental to either species.

State biologists have posted nesting areas and patrol areas subject to human disturbance. Because such sites are more likely to be located in areas with development, an effort has been made to contact local landowners to discuss the importance of nesting areas. Biologists from the Fish and Wildlife Service, Platte River Whooping Crane Habitat Maintenance Trust, National Audubon Society, and the Game and Parks Commission are involved in an application of the instream flow methodology in an effort to identify Platte River flow regimes necessary for the protection and enhancement of nesting habitat. Efforts to restore historic breeding habitats are also underway along the Platte River. Some sandbars that have become stabilized and overgrown with woody vegetation as a result of water development projects are now being cleared.

Finally, Nebraska law requires state agencies to consult with the Nebraska Game and Parks Commission on any action authorized, funded, or carried out by them. This insures that such actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of habitat. The Game and Parks

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Commission reviews state sponsored or authorized projects that may impact endangered or threatened species and issues biological opinions to the state agencies.

Iowa: Largely devoid of natural Piping Plover habitat, Iowa's conservation efforts have focused almost entirely on monitoring and protecting the few nest sites located on fly-ash disposal sites of two power generating stations along the Missouri River at Council Bluffs and Sioux City (D. Reeves, Iowa Department of Natural Resources). Both sites are monitored to document the number of nesting pairs and reproductive success. The Council Bluffs nesting habitat is also protected by a written management plan in cooperation with the power plant operator. The plan specifies that both people and heavy equipment will be kept out of the nesting area during the breeding season. To further minimize disturbance, no banding is done at either site.

Although Piping Plovers are not currently using natural habitats in Iowa, work was initiated at the DeSoto National Wildlife Refuge, approximately 35 km north of Council Bluffs, to attract both Piping Plovers and Least Terns. Piping Plovers nested on the refuge sandbars in the 1960's and early 1970's. Woody vegetation was recently cleared and the sandbars are now disced twice each season to maintain open habitat. Decoys of both plovers and terns have been set out, but Piping Plovers have not been attracted to the area.

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II. RECOVERY

Recovery Objective

The purpose of this plan is to describe actions necessary to achieve recovery of Piping Plovers breeding in the Great Lakes and Northern Great Plains states. The first step in this approach is to set a quantifiable goal (i.e. the Recovery Objective) that, when reached, will assure populations remain stable. The remainder of this plan outlines steps necessary to achieve the Recovery Objective.

Recognizing that the Piping Plover has a broad distribution and occupies a variety of habitat types and sizes across the Great Lakes and Northern Great Plains, the Recovery Objective was set taking into account: 1) current data on distribution and abundance of Piping Plovers in each state; 2) knowledge of how thoroughly each state has been surveyed; 3) historic population data, when available; 4) loss of viable habitat; 5) an assessment of the potential to increase breeding pairs at currently occupied sites; 6) assessment of the potential to establish breeding pairs at unoccupied sites. Models of Minimum Viable Populations were not used to obtain recovery goals because the chance of achieving the resulting population goals were unrealistic given current and potential available habitat restraints.

Technical experts and state and federal resource agencies were consulted to determine the status of current populations and habitats, as well as the potential for population increase. Goals for each state were summed to establish separate population goals for the Northern Great Plains and Great Lakes.

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Therefore, in order to be considered for delisting, Piping Plover populations on the Northern Great Plains will have attained the criteria listed below. Delisting could be considered on a state by state basis once individual state objectives are met.

A. Number of birds in the Northern Great Plains states will increase to 1300 pairs. This represents a 70% increase over 1986 population estimates for the region.

B. Essential breeding and winter habitat (Appendix 2) will be protected.

C. The Canadian Recovery Objective of 2500 birds for the prairie region will be attained.

D. The 1300 pairs will be maintained in the following distribution for 15 years (assuming at least three major censuses will have been conducted during this time):

Montana - 60 pairs

North Dakota - 650 pairs

Missouri River - 100 pairs

Missouri Coteau - 550 pairs

South Dakota - 350 pairs (including 250 pairs shared with Nebraska on Missouri River)

Missouri River below Gavin's Point - 250 pairs (shared with Nebraska)

Other Missouri River sites - 75 pairs

Other sites - 25 pairs

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Nebraska - 465 pairs (including 250 pairs on Missouri River shared with South Dakota)

Platte River - 140 pairs

Niobrara River - 50 pairs

Missouri River - 250 pairs

Loup River system - 25 pairs

Minnesota - 25 pairs (Lake of the Woods)

In order to prevent extirpation of Piping Plovers on the Great Lakes, the following criteria will be attained:

A. Number of birds will increase to 150 pairs.

B. Essential breeding and winter habitat (Appendix 2) will be protected.

C. The Canadian Recovery Objective of restoring Great Lakes populations in Canada will be achieved.

D. The 150 pairs will be maintained in the following distribution for 15 years (assuming at least three censuses will have been conducted during this time).

Duluth/Superior - 5 pairs

Wisconsin - 15 pairs (including Duluth/Superior)

Michigan - 100 pairs

Other Great Lakes sites - 35 pairs

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Step-Down Outline

The step-down outline lists tasks that need to be undertaken in order to meet the recovery objective. Steps (or tasks) are not presented in order of importance. Some steps are underway, while others may take years before they are begun. A detailed explanation of these steps is presented in the Narrative section of this plan. Following the Narrative, the Implementation Schedules will list and prioritize steps that need to be taken in the next three years.

1. Determine current distribution and population trends of the Piping Plover.
    11. Assess status and distribution of breeding populations.
        111. Survey beaches, sandbars, and other suitable habitats to determine breeding distribution.
        112. Census known and potential breeding sites.
        113. Monitor reproductive success.
        114. Assess dispersal patterns and genetic diversity.
        115. Assess mortality.
        116. Determine significance of Piping Plover interactions with other species.
        117. Further identify life history parameters including development of population models.
    12. Assess status and distribution of Piping Plovers for the migration period.
    13. Assess status and distribution of Piping Plovers during the winter.

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131. Survey beaches and other suitable habitat to determine winter distribution.

132. Annually census known wintering areas.

133. Monitor movement of birds between wintering sites and assess mixing of populations on wintering areas.

134. Assess mortality of wintering Piping Plovers.

2. Determine current habitat requirements and status.

21. Determine breeding habitat requirements and status.

211. Assess the characteristics, including prey resources, of plover habitat.

212. Quantify and evaluate available breeding habitat.

213. Eliminate current or potential threats to breeding habitat.

22. Determine current migration habitat requirements and status.

221. Assess the characteristics, including prey resources, of migration habitat.

222. Quantify and evaluate available habitat.

223. Eliminate current or potential threats to migration habitat.

23. Determine current habitat requirements and status on wintering areas.

231. Assess the characteristics, including prey resources, of winter habitat.

232. Quantify and evaluate available winter habitat.

233. Eliminate current/potential threats to habitat.

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3. Protect, enhance and increase Piping Plover populations.

31. Protect, enhance, and increase Piping Plover populations during the breeding season.

311. Increase reproduction and survival at occupied breeding sites.

3111. Evaluate predator impacts on eggs and chicks and identify specific species responsible for the damage.

3112. Evaluate techniques for predator management and implement where appropriate.

3113. Restrict human and vehicular access to nesting areas.

3114. Restrict livestock and domestic animals a nesting sites.

3115. Manage water levels to reduce nest and chick loss.

3116. Modify or eliminate construction activities that adversely impact reproductive success of Piping Plovers.

3117. Assess the need to implement reintroduction techniques to enhance current the breeding population in the Great Lakes.

312. Assess the need to implement techniques for introduction of breeding birds to suitable unoccupied habitats.

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32. Protect, and enhance Piping Plover populations during migration and winter.

321. Manage areas to maximize survival of birds during migration.

322. Manage winter areas to maximize survival of birds during winter.

3221. Investigate the effects of human activities on winter survival.

3222. Investigate the effects of environmental contaminants.

4. Preserve and enhance habitat.

41. Provide protection and management of breeding habitat.

411. Identify areas of essential habitat.

412. Continue to evaluate areas for consideration as essential habitat.

413. Establish liaison with agencies and organizations with land and water management responsibilities.

414. Revise, establish, or utilize land and water laws and regulations to provide protection along lakes, rivers, and prairie wetlands.

415. Develop criteria and priorities for habitat protection.

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416. Develop management plans for riverine habitat.

4161. Determine effects, including direct, indirect, and cumulative, of manipulation of river hydraulics, flow regimes, and sediment discharge on breeding and foraging habitat.

4162. Identify river flow regimes that will protect and enhance breeding and foraging habitat.

4163. Determine the relationship of existing artificial breeding sites to river sites.

4164. Identify need and techniques of improving habitat by management of substrate and by vegetation control through physical and/or non-toxic chemical means.

4165. Study feasibility and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.

417. Develop management plans for lake habitat.

4171. Identify lake and reservoir control policies where existing and potential Piping Plover habitat is threatened.

4172. Identify needs and techniques for suitable substrate and vegetation control.

4173. Identify needs and techniques for managing managing water levels.

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4174. Study feasibility of and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.

418. Develop management plans for prairie wetland habitat.

4181. Identify threats to essential prairie wetland habitats and develop policies or management actions to eliminate those threats (See also 213).

4182. Develop management plans for use of lands adjacent to nesting beaches.

4183. Identify the need for and techniques to maintain and improve nesting habitat along prairie wetlands.

4184. Determine the need for creation of new habitat along prairie wetlands.

419. Modify or eliminate construction activities that that adversely alter breeding habitat.

420. Evaluate success of protection and management techniques.

42. Provide protection and management of migration habitat.

43. Provide protection and management of winter habitat.

431. Identify areas of essential habitat.

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432. Continue to evaluate areas for consideration as essential habitat.

433. Establish liaison with agencies and organizations with land and water management responsibilities.

434. Revise or establish land and water laws and regulations to provide habitat protection.

435. Develop criteria and priorities for habitat protection.

436. Develop management techniques.

437. Modify construction activities that may reduce or negatively alter winter habitat.

438. Evaluate success of protection and management techniques.

5. Develop and implement an education program that publicizes information about the Piping Plover, including its life history, reasons for decline, and options for recovery.

51. Inform and educate the general public.

511. Identify target audiences among the general public.

512. Develop and distribute educational materials appropriate to each audience.

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513. Develop press releases for newspapers, radio, and TV, that highlight specific Piping Plover projects.

514. Provide controlled viewing opportunities if and when appropriate.

52. Inform and educate public resource management agencies.

521. Identify critical resource agency constituents.

522. Develop educational materials appropriate to respective agencies and their management authority.

523. Provide public resource agencies with periodic updates on the plover's status and progress of recovery efforts.

6. Coordinate recovery efforts.

61. Designate a recovery plan coordinator.

62. Coordinate research and management activities with federal, state, local, and private organizations.

63. Coordinate international research and management activities.

64. Coordinate development of a public information program at the national and international level.

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Narrative

The Narrative gives further details and justification for each step listed in the Step-Down Outline. The steps critical for recovery in the next three years are outlined and prioritized in the Implementation Schedule.

1. Determine current distribution and population trends of the Piping Plover.

The effectiveness of current conservation efforts will not be well-understood until comprehensive distribution and census data have been collected. Future plans for recovery also will be stalled until a more accurate picture of the species' status is defined. To enhance our knowledge of the species distribution, U.S. and Canadian recovery teams will sponsor an international census of Piping Plovers in 1991.

11. Assess status and distribution of breeding populations.

Most Piping Plover censusing has been carried out during the breeding season. Results indicate inland Piping Plovers are widely distributed as scattered pairs or in high concentrations at breeding areas. Furthermore, plovers are capable of dispersing great distances during or between years (Haig 1987a). Continued search for new sites and evaluation of known sites is necessary to fill the gap in our current knowledge of the birds' status. Standardization of census techniques will be desirable although the

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tremendous diversity in Piping Plover habitat types prevents setting stringent guidelines. See Appendices 3, 4, 5 for further details.

111. Survey beaches, sandbars, and other suitable habitats to determine breeding distribution. Currently, Great Lakes sites (with the exception of New York) are largely well-known and monitored, although beaches in New York should be surveyed. On the Northern Great Plains, however, many potential sites remain to be surveyed. Missouri River sandbar, large reservoir, and National Wildlife Refuge surveys have been undertaken in Montana, North Dakota, South Dakota, and Nebraska, but additional sandbar and shoreline habitat needs to be searched from eastern Montana to Nebraska. Surveys of the Loup and Platte River shorelines in Nebraska need to be intensified until the distribution is better identified. Prairie wetlands need to be surveyed throughout the range in North Dakota, South Dakota, and Montana. The status of potential sites should be monitored and updated at least once every five years.

112. Census known and potential breeding sites. Once sites are identified as containing breeding pairs, annual censuses of breeding and non-breeding adults should be carried out at essential sites (Appendix 2) for several years until

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permanence of the population is established. Following this establishment period, censusing should continue at least once every three years.

113. Monitor reproductive success.

Census data provide an indication of an area's population density, but estimates of reproductive success are also necessary. In Manitoba and North Dakota, many more adults were present in nesting areas than actually bred (Haig 1985, Prindiville 1986). Frequent nest destruction further lowers productivity of a site, rendering simple counts of breeding pairs less meaningful than censuses of adults and fledged chicks. Reproductive success (measured in terms of number of chicks fledged per pair whenever possible) should be monitored annually at essential sites and at least every three years, on a rotating basis, at other sites. Causes of reproductive failure should be identified whenever possible.

114. Assess dispersal patterns and genetic diversity.

Site fidelity has been assessed for local populations in New York (Wilcox 1959), Manitoba (Haig 1987a), Minnesota (Wiens 1986, Haig and Oring 1987b), Nebraska (G. Lingle, Platte River Whooping Crane Habitat Maintenance Trust), and Michigan (Pike 1985), yet little is known about site fidelity along rivers on the Northern Great

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Plains. Band returns are beginning to outline directions and distances dispersed by adults and chicks not returning to former nest sites (Haig 1987a). Continued monitoring of movements of banded birds in major breeding areas will fill the gap in our understanding of dispersal. Knowledge of how new nest sites are colonized, and where new birds originated will be useful in developing comprehensive population management plans and models.

115. Assess mortality.

Factors such as human disturbance, predation, and water level regulation have reduced success of Piping Plover eggs and chicks. Factors affecting adult mortality, however, have never been directly addressed for any part of the annual cycle. During the breeding season, predation by mink (Haig and Oring 1987b) and coyote (Canis latrans) (G. Lingle, Platte River Whooping Crane Habitat Maintenance Trust) has been inferred, but evidence for predation by other species has not been well-documented. In the future, it will be important to determine the extent and cause of adult and juvenile mortality during the breeding season.

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116. Determine significance of Piping Plover interactions with other species.

Evaluation of costs and benefits to Piping Plovers nesting near Least Terns, Common Terns, American Avocets, and other species may indicate better ways of establishing new populations and improve methods of securing current sites.

117. Further identify life history parameters including development of population models.

Much of the basic life history information pertaining to breeding Piping Plovers has been clarified through studies of birds in New York (Wilcox 1959), Nova Scotia (Cairns 1982), Manitoba (Haig 1987a), Saskatchewan (Whyte 1985), North Dakota (Prindiville 1986, Mayer and Ryan 1986), and Minnesota (Wiens 1986, Haig and Oring 1987b). These studies have shown that Piping Plovers are fairly variable in their mating system, dispersal abilities, and reproductive success. Recent research also has pointed out that Piping Plovers may be negatively affected by regular, constant, or sporadic human activity on or near their territories (Cairns 1977, Flemming 1984 and others). This makes it critical for researchers to carry out intense studies without reducing reproductive success or site tenacity of the Piping Plovers. Future breeding studies should

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only be undertaken after researchers have identified specific critical factors that require resolution in order to rehabilitate the species. Currently, the most positive step forward is to compile all available life history data so that a model can be developed to manage current populations.

12. Assess status and distribution of Piping Plovers for the migration period.

Less is known about the migratory ecology for Piping Plovers than for any other phase of the annual cycle. Migratory routes have not been adequately described for spring or fall. Delineation of diet, habitat use, and behavior of the birds during this time is virtually unknown. Before intensive individual field studies are undertaken, it may be beneficial to coordinate surveys of potential sites with natural resource employees or local birders to determine if Piping Plovers actually are stopping en route to wintering sites. So far, biologists in the most-likely stop-over sites (e.g., Cheyenne Bottoms, Kansas; Great Salt Plains National Wildlife Refuge, Oklahoma) have not reported great numbers of Piping Plovers using their areas. Either the birds are non-stop migrants or else migration stop-over areas have not been fully identified.

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13. Assess status and distribution of Piping Plovers during the winter.

Piping Plovers spend 7-8 months of the year on Gulf of Mexico and Atlantic coast winter sites (Haig and Oring 1985, Haig 1987b), yet most field research has been carried out on breeding birds. Recent studies of other neotropical migrants (Keast and Morton 1980, Myers 1981) have shown that factors limiting nonbreeding birds may be as severe or worse than threats encountered during other times of the year. Extension of the few studies that have addressed these issues should continue and additional research should begin.

131. Survey beaches and other suitable habitat to determine winter distribution.

Winter censuses on the Gulf of Mexico (Haig and Oring 1985, Haig 1987b) provide an outline of the current winter distribution, and identify both beach and sandflat areas as important habitat-types for the species. Currently, less than 35% of the total population can be accounted for during the winter. Further censusing is needed along Laguna Madre in Texas and Mexico, on Caribbean islands, and along the Gulf and Atlantic coasts of the U.S.

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132. Annually census known wintering areas.

Once winter sites are better known, annual censuses of important areas will provide an indication of their continuing importance and status as post-breeding sites. Censusing Piping Plovers during winter (rather than summer) also may prove to be a less disruptive and more efficient method of gathering annual census data for the species.

133. Monitor movement of birds between wintering sites and assess mixing of populations on wintering areas.

Whereas it is known that post-breeding Piping Plovers use a variety of habitat types, it is not yet clear how their use of areas varies on a daily or seasonal basis. Without this information, it will be difficult to develop habitat protection or acquisition plans. Monitoring movements of birds between different sites will provide this information, as well as indicate the degree to which individuals from various breeding populations mix during the winter.

134. Assess mortality of wintering Piping Plovers.

The extent and cause of mortality to post-breeding Piping Plovers has not been addressed. It is not clear if adults and juveniles exhibit differential mortality, or if post-breeding birds face greater

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threats than do breeding birds. Any information leading to further delineation of threats to the species during this time will be important.

2. Determine current habitat requirements and status.

Habitat alteration has been identified as one of the principal causes of the Piping Plover population and range decline. Recovery of the species will be substantially affected by the ability to identify and protect essential breeding habitat and to intensively manage that habitat to maximize productivity and survival. Setting priorities for protection of remaining sites and determining habitat management actions will require detailed knowledge of Piping Plover habitat requirements and the availability and quality of existing sites.

21. Determine breeding habitat requirements and status.

Whereas a general, qualitative understanding of Piping Plover breeding habitat requirements exists, quantitative data are scant. Furthermore, although much is known of the range of habitats used by breeding Piping Plovers, very little information is available to document conditions optimal for reproductive success. Quantitative data on the characteristics of habitat used by Piping Plovers, as well as data on seemingly adequate but unoccupied sites, are needed. Comparison of habitat conditions among used sites along with detailed data on reproductive success will provide the

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information necessary to define high quality habitat, set priorities for protection, and determine site-specific management actions to enhance breeding habitat.

211. Assess the characteristics, including prey resources, of plover habitat.

The characteristics of breeding habitat must be investigated across the entire range occupied by Piping Plovers in the Great Plains and Great Lakes. Specifically, data are needed on riverine habitats in Nebraska, South Dakota, and North Dakota, and lake beaches in Minnesota and Michigan. Data on habitat variables at occupied sites will be of minimal value in the absence of associated data on reproductive success. Habitat information also must be gathered at seemingly adequate, but unoccupied sites.

The habitat variables primarily researched at palustrine and lacustrine sites are beach width; beach area; prey abundance and temporal availability; abundance and distribution of vegetation; substrate type, abundance, and distribution; type and amount of disturbance; and vegetation encroachment rates. At riverine sites, habitat variables should be measured at the time of nest site selection and should include: sandbar area and height above water level, vegetative

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cover and distribution, substrate type, river level fluctuations, and vegetation encroachment rates. Other variables may be of particular interest at local breeding areas. Measurements taken and methods employed at various breeding sites should be standardized to allow comparisons among areas.

Few data are available on food resources at Piping Plover breeding areas. Information on prey species occurrence and abundance are needed, as are estimates of the likelihood of food being a limiting habitat factor. Data should be obtained across the breeding range.

The goals of these investigations should be identification of the range of habitat conditions tolerated by Piping Plovers, determination of habitat factors that affect nest densities, and elucidation of habitat conditions that yield maximum reproductive success rates.

212. Quantify and evaluate available breeding habitat. As habitat assessment is undertaken, efforts to quantify existing Piping Plover habitat should be initiated. The first task should be quantification of known and potential breeding habitat. As habitat-quality data become available, existing sites should be evaluated with respect to habitat adequacy and deficiencies.

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Based on this information, recommendations for site protection or management actions should be prioritized. Development of remote sensing techniques to quantify and, if possible, rate Piping Plover breeding habitat will be an important phase of this task.

213. Eliminate current or potential threats to breeding habitat.

As breeding habitat is pinpointed and ownership identified, current or potential threats to sites should be outlined. First priority should be given to sites used by breeding Piping Plovers. Second priority should be given to sites with potential to support breeding plovers, but currently unoccupied. And finally, sites of insufficient quality to support plovers, but with the potential to be enhanced by available management techniques should be considered. In addition to threats that could destroy Piping Plover breeding habitats, perturbations that could leave sites intact, but reduce the quality of the habitat must be considered. Parcels in state or federal ownership should not be considered immune from future threats to Piping Plovers.

Disturbance due to competing resource use (e.g., recreation, grazing, gas and oil exploration, vegetation encroachment, freshening of water on

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saline wetlands, etc.) or management of other species will have to be evaluated in terms of potential harm to Piping Plovers. In determining breeding habitat quality, consideration must be given to potential predation pressures at the site (e.g., proximity to a gull colony).

22. Determine current migration habitat requirements and status.

Because migration patterns of Piping Plovers are so poorly understood, no information on habitat requirements or status is available. Once stop-over sites, if they exist, are determined, evaluation of habitat requirements should be undertaken.

221. Assess the characteristics, including prey resources, of migration habitat.

If stop-over sites are identified, the habitats used should be described and variables characterizing those habitats quantified. Some habitat variables of interest include: vegetative cover and species composition, other structural features, substrate types, and prey species occurrence and abundance. Quantification (time-activity budgets) of how Piping Plovers use the available habitats and their length of stay at stop-over sites also should be determined.

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222. Quantify and evaluate available habitat.

Once migratory habitats are identified and characterized, the availability of such habitats should be determined. Initially, habitat availability in the vicinity of known stop-over sites should be quantified and its quality assessed. If migratory habitat in the vicinity of current stop-over sites is limited, a larger scale survey of available habitat along suspected migratory corridors should be made.

223. Eliminate current or potential threats to migration habitat.

As stop-over habitats are identified, current and potential threats to those sites should be delineated. On publicly-owned sites (e.g. national wildlife refuges, state wildlife management areas), current use patterns or management actions that could conflict with Piping Plover use of existing habitats should be identified. On privately-owned sites, potential land-use changes that degrade existing habitats should be evaluated. At that point, availability and quality of alternative habitats could be determined. Feasibility of protecting major privately-owned stop-over sites, should be assessed.

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23. Determine current habitat requirements and status on wintering areas.

Few quantitative data are available on Piping Plover winter habitat requirements, although studies underway in Texas (T. Eubanks) and Alabama (Johnson 1987) may provide better information. Further effort is needed to complete this task and determine the extent to which wintering habitats are traditionally used. Information on the role of winter habitat abundance, distribution, and quality in Piping Plover population dynamics is totally lacking. Data relating winter habitat conditions to population status are needed.

231. Assess the characteristics, including prey resources, of winter habitat.

As primary wintering areas are identified, characteristics of the habitats used by Piping Plovers must be quantified and variables affecting quality of those habitats elucidated. Winter habitats should be assessed with regard to Piping Plover prey abundance and distribution, roost site needs, juxtaposition of feeding and roosting habitat, and security from predation. Habitats near occupied sites, but not currently used by Piping Plovers, also should be assessed.

Quantitative data on Piping Plovers use of winter habitats also are needed. Information on movements among wintering areas, movements among

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habitats, time-activity budgets, the use of pre-migration staging areas, etc. may provide important information on habitat quality.

The goal of these studies should be identification of habitat features that affect overwinter survival of Piping Plovers, assure adequate prebreeding condition of plovers, and favor mixing among individuals from local breeding populations.

232. Quantify and evaluate available winter habitat. After baseline information on habitat characteristics and quality is available, the amount and distribution of winter habitat for Piping Plovers should be determined. Additionally, the quality of existing habitat should be rated and deficiencies identified. This effort may involve development of remote sensing techniques to identify and monitor winter habitat. Based on data generated under Steps 231 and 232 the likelihood of winter habitat quantity and/or quality limiting the growth of the Piping Plover population should be evaluated. If winter habitat is found to be limited, further recommendations should be developed on the need for habitat protection or management of specific sites.

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233. Eliminate current or potential threats to winter habitat.

As winter habitat is identified, current and potential threats to each site should be determined. First priority should be given to sites currently used by Piping Plovers, but sites of potential use should not be neglected. Care should be taken not only to identify threats that could destroy winter habitats, but also those that could result in lowering the quality of remaining sites. Ownership of land parcels will have to be taken into consideration when assessing threats to the species.

3. Protect, enhance, and increase Piping Plover populations.

Efforts to provide full protection to all known breeding, migration and wintering areas are essential to insure the Piping Plover's recovery. Legal protection of areas, however, is often not enough to insure perpetuation of breeding populations. Active management actions, including predator control, restricted access, and water level management are critical components of a comprehensive protection plan. In the Great Lakes region, where breeding populations are in immediate jeopardy of extirpation, innovative techniques to enhance and increase local populations may be essential.

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31. Protect, enhance, and increase Piping Plover populations during the breeding season.

To date, breeding activity of Piping Plovers has been more thoroughly investigated than activities at other times of the year. Current surveys have now identified nearly all nesting areas in the U.S. Extensive survey work and intensive research investigations of several major breeding concentrations have helped delineate many factors contributing to the species decline, thus enabling the development of specific recommendations that may enhance the species' survival during the reproductive season.

311. Increase reproduction and survival at occupied breeding sites.

Activities that reduce Piping Plover reproductive success and survival on its breeding grounds are among the principal factors responsible for the species' decline. Actions directed at eliminating or minimizing such impacts are essential to the plover's recovery.

3111. Evaluate predator impacts on eggs and chicks and identify specific species responsible for the damage.

Studies conducted in the Great Lakes and Great Plains have documented a high percentage of egg and chick loss to predation. Wiens (1986) reported that

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predation accounted for 48% to 70% of egg mortality (total egg failure/mortality ranged from 25%-81%) and up to 69% of chick mortality in Minnesota (total chick mortality was approximately 32% each year). In North Dakota, Prindiville (1986) reported that predation was responsible for 89% and 95% of egg failure in two consecutive years of study at Chain of Lakes (total egg failure/ mortality was 54% and 60% respectively). Both avian and mammalian species are among the suspected predators. Similar studies that document such losses should continue. Investigations that focus specifically on identifying predators, and the cues they use in locating nests and/or chicks, determining the time of predation, etc., are necessary if egg and chick mortality are to be curtailed. However, if and when implementation of predator control techniques is considered, it will be essential to have delineated the species responsible for the damage.

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3112. Evaluate techniques for predator management and implement where appropriate.

Lethal and non-lethal methods for controlling mammalian predators have been extensively developed for other wildlife management purposes. They include: eliminating or relocating the animal, erecting electric fences, and developing taste aversions (Schemnitz 1980). The applicability of these and other techniques (e.g., predator exclusion cages) to the Piping Plover should be investigated. Few management efforts have focused on controlling avian predators, such as Common Ravens (Corvus corax) and American Crows (Corvus brachyrhynchos). Some attention recently has been directed at problems posed by exploding populations of Ring-billed Gulls, but many of the control measures do not directly address interspecific problems posed by loafing adults or breeding populations ((See Blokpoel and Tessier (1986) for a thorough review of the Ring-billed Gull and associated management problems)). In the Great Lakes region, these avian predators may be significant in decreasing plover nest success and appropriate methods for controlling or

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minimizing their impact should be investigated. Appropriate control measures should be implemented at plover nest sites that are now experiencing significant and repeated loss due to predation.

3113. Restrict human and vehicular access to nesting areas.

Disturbance caused by foot traffic and recreational vehicles has been well-documented, particularly in the Atlantic coast region where recreational activity is intense (Cairns 1977, Flemming 1984, Haig 1985, Sidle 1985). Losses incurred by these activities can be direct, by destroying eggs and chicks, as well as indirect, by inhibiting territory establishment, feeding behavior, incubation and other reproductive behavior. A variety of techniques that restrict access to nesting areas have been successful in a few states and should be implemented on a wider scale. These include posting, restricted access, and the use of psychological fencing.

Because many plover nesting areas are located in remote areas, strict enforcement of regulations is often impractical. Although the site may receive substantial

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recreational use, budget restrictions rarely allow full-time monitoring by professional staff. It is essential, therefore, that actions to restrict recreational activities always be accompanied by an aggressive public relations effort that will effectively reach all potential visitors to an area and adequately explain the purpose of the regulations. Development of volunteer "Plover Wardens" who patrol beaches to enforce and explain the restrictions, should be considered for particularly important breeding areas. Michigan, for example, has posted a warden on one of its prime nesting beaches. The U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and state wildlife agencies could become involved in public relations efforts and patrols to protect Piping Plover nesting areas on the Missouri and Platte Rivers.

Field research on Piping Plovers should be carefully examined for its effects on the reproductive success of the birds. Research proposals should be scrutinized for their benefit to Piping Plover recovery.

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3114. Restrict livestock and domestic animals at nesting sites.

Pets accompanying visitors to beach areas and sandbars are responsible for direct and indirect losses to plover populations (Flemming 1984). Leash laws and other restrictions that eliminate such disturbance should be developed and strictly enforced.

In the alkaline wetlands of the Great Plains a more difficult problem is caused by livestock (Prindiville 1986). Although direct mortality may occur, indirect impact is more likely. Livestock leave deep tracks in the soft, mucky shoreline around these wetlands. Tracks may remain for a year or more and can trap plover chicks that fall in. In North Dakota, Piping Plovers abandoned nesting beaches in a year when cattle were present but returned the following years when cattle were absent (K. Smith, Lostwood National Wildlife Refuge). Vegetation also is more prone to grow in shoreline areas with surface disturbance. Once established, herbaceous growth can become an effective travel corridor for predators and decrease available nesting

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habitat. Wetlands that provide nesting habitat for plovers should be identified and livestock access restricted where feasible.

3115. Manage water levels to reduce nest and chick loss.

A significant proportion of the Great Plains Piping Plover population resides along the Missouri, Platte, and Niobrara Rivers where much habitat has been destroyed by reservoir construction channelization, water depletion, vegetative encroachment, and modification of flow regimes (Currier et al. 1985, Nebraska Game and Parks Commission 1986, Schwalbach et al. 1986). This riverine habitat is subject to a number of additional threats, including untimely water releases from dams that flood sandbar nesting habitat (Dryer and Dryer 1985, Schwalbach et al. 1986, North 1986).

Maintaining higher water levels early in the spring could help to resolve this problem. Nesting habitat, normally flooded late in the season, should be submerged when plovers begin establishing territories in late April and early May, forcing them to seek higher grounds that would be safe throughout the nesting season. High waters in spring also helps keep sandbars devoid of

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vegetation by reducing sprouting of young herbaceous growth and by increasing deposition of sediments (Faanes 1983).

3116. Modify or eliminate construction activities that adversely impact reproductive success of Piping Plovers.

Recreational, residential, and industrial development along lakeshores and riverfronts should be discouraged in nesting areas. Proposals for maintenance or development activities that do not directly disturb breeding habitat but that occur in the vicinity of nest sites should be closely scrutinized for their potential impact. For example, in Minnesota, channel dredging activities at Lake of the Woods threatened to disturb a pair of plovers nesting nearby and were subsequently modified to insure minimal disturbance during the breeding season.

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3117. Assess the need to implement reintroduction techniques to enhance the current breeding population in the Great Lakes.

The recovery tasks delineated above describe means of enhancing plover reproductive success by managing and/or controlling other aspects of their environment (e.g., predation, livestock, and water levels). Prior to implementation, criteria that clarify when population enhancement techniques should be considered need to be developed. A population's size, historical trends, and annual reproductive success are among factors that should be carefully considered. Equally important are habitat concerns, including whether or not the site can be properly protected and managed in future years. Such management activities should only be considered as a last resort.

312. Assess the need to implement techniques for introduction of breeding birds to suitable unoccupied habitats.

Although one of the principal factors contributing to the Piping Plover's decline has been loss of shoreline and sandbar habitat (Haig 1985, USFWS 1985), suitable but unoccupied habitat still remains or is actively being created (e.g., in

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Nebraska, Iowa, and Minnesota; see Section 1: Conservation Efforts). If long term protection of such areas can be insured, reintroduction of plovers may be considered as a partial means of accomplishing the recovery objective after all attempts to initiate natural settling have failed.

Numbers of Piping Plovers breeding in the Great Lakes Region is at a critically low level. Michigan is now the only state among eight that supports a viable population; even there, the number of breeding pairs is less than 17 (E. Pike, Michigan Department of Natural Resources). Biologists need to assess whether successful recovery of this endangered population may be feasible with implementation of a reintroduction program. Initially efforts should focus on developing criteria to identify areas where such a program would be practical. Sites that were historically occupied by breeding pairs and that can be adequately protected and managed to insure the plover's success should be among the sites that receive priority.

32. Protect and enhance Piping Plover populations during migration and winter.

Each year, 30% or less of the Piping Plover's time is spent on the breeding grounds, indicating a comprehensive protection plan must also focus on the

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species survival during migration and winter. As stated earlier, however, migration is the most poorly understood stage of the plover life cycle and little can be recommended until migratory patterns are determined. Winter research has begun to delineate key areas where plovers spend nonbreeding months (Haig and Oring 1985, Haig 1987b). This is a critical step forward in enabling biologists to extend protection measures necessary for the birds' survival year-round. Further work of this nature is necessary before survival can be increased.

321. Manage areas to maximize survival of birds during migration.

Nothing is currently known about either the extent or causes of mortality that Piping Plovers encounter during migration. Work that focuses on delineating migration routes (Section 12) should be expanded to focus on causes of mortality as well. When appropriate, measures should then be taken to lessen the impact upon the species.

322. Manage winter areas to maximize survival of birds during winter.

During winter, Piping Plovers use habitats similar to those used during the summer. Along the southern Atlantic coast, sand, gravel, and/or cobbled marine beaches are selected, as well as intertidal beach bars and flats. Along the Gulf

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of Mexico, beaches, sandflats, and dunes are use
Plovers, therefore, are prone to the same types
disturbance on wintering grounds as they
experience in their nesting habitats.

3221. Investigate effects of human activities o
winter survival.

Recreational, residential, and industrial developments each pose a potential threat t Piping Plovers by increasing the level of human activity. To date, research studies have focused primarily on describing the impacts of such activities on nesting grounds. Future efforts also should be directed at collecting similar data from wintering areas.

3222. Investigate the effects of environmental contaminants.

A possible concern for Great Lakes and Great Plains plovers on wintering grounds is the potential impacts from oil spills and other contaminants, particularly along the Gulf Coast.

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4. Preserve and enhance habitat.

Because of major habitat losses and increasing demands on available habitat, protecting and enhancing existing and potential Piping Plover habitat is of major concern. Important breeding areas have been identified but enhancement and protection of essential habitat has been limited. Little is known about those areas along the migration route or on the wintering grounds.

41. Provide protection and management of breeding habitat.

Essential breeding habitat (Appendix 2) will need delineation, protection, and enhancement to provide for recovery of the species. Efforts should include increased management activities to provide better use and protection of existing and potential areas. Compatibility of other uses (e.g., grazing, recreation, etc.) for breeding areas should be defined. All essential habitat needs to be provided permanent protection through appropriate fee title aquisition, permanent easement, cooperative agreements, and memorandums of agreement or understanding among federal agencies and private organizations (Appendix 6).

411. Identify areas of essential habitat.

Essential Habitat is listed in Appendix 2 to highlight areas to be protected.

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412. Continue to evaluate areas for consideration as essential habitat.

Recognizing the fragile nature of much of the Piping Plover's breeding habitat, continued evaluation and designation of Essential Habitat in primary breeding areas will protect areas from detrimental development.

413. Establish liaison with agencies and organizations with land and water management responsibilities.

Due to increasing pressure for development and use of land and water resources to meet human's needs, efforts should be made to communicate with agencies, organizations, and individuals whose decisions affect the future of Piping Plover habitat. The purpose would be to resolve conflicts between known development actions and future conflicts through planning of land and water development.

414. Revise, establish, or utilize land and water laws and regulations to provide protection along lakes, rivers, and prairie wetlands.

Increasing demands for agricultural land and urban development, wetland drainage, power generation, water for irrigation, recreational space, and operation of river mainstem reservoirs have threatened or destroyed Piping Plover habitat. Strict enforcement of laws and regulations,

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particularly those involving instream flow protection, 404 permits, and endangered or threatened species habitat protection, is needed to restrict or modify such developments on the remaining essential Piping Plover habitat. All land- and water-use legislation should be scrutinized for potential impact to Piping Plover habitat. Undesirable legislation should be modified and laws enacted that will expand the consideration given wildlife during water and land development planning.

New legislation, or legal interpretation of existing laws and regulations, may need to be developed to address specific problems such as determination of sandbar and island ownership along the Missouri River between South Dakota and Nebraska. Ownership of essential habitat in free-flowing sections of the Missouri River (i.e. areas not contained within Corps of Engineers take lines) is uncertain and no state or federal agency appears to have the authority to take responsibility for protecting and managing these areas.

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415. Develop criteria and priorities for habitat protection.

To provide adequate protection, some habitat wi have to be purchased in fee title, or placed un a protective easement or cooperative landowner agreement. Although permanent protection of essential areas will usually be preferred, in s instances, temporary protection of ephemeral nesting areas may be achieved through agreement with local, state, county, or district authorities. Protection of areas listed as essential habitat (Appendix 2) is based upon tradition of occupancy, number of birds present site productivity, proximity to other protected sites, imminence of habitat destruction, and ephemeral nature of the site.

416. Develop management plans for riverine habitat.

Techniques may vary from site to site depending need and opportunity, but plans should be developed for management of essential riverine habitat (see Section 2).

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4161. Determine effects, including direct, indirect, and cumulative, of manipulation of river hydraulics, flow regimes, and sediment discharge on breeding and foraging habitat.

Manipulation of river flow regimes and river hydraulics through water diversion, storage of flows by mainstream dams, discharge from dams for power generation, navigation and irrigation demands, bank stabilization, and channelization has significantly altered the natural dynamic processes responsible for loss and creation of sandbars used for nesting. As a result, breeding habitat is likely being lost at a higher rate than what is being created. Modifications of river flow regimes through operation of mainstem reservoirs also has caused concern for long-term effects of riverbed degradation on plover habitat. Although many direct effects of human manipulations have been identified, suspected indirect and cumulative impacts of ongoing and future river developments need to be determined.

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4162. Identify river flow regimes that will protect and enhance breeding and foragi habitat.

Control of river flows is desirable to prevent inundation of nests and youn discourage growth of woody vegetation, to maintain a river with a nutrient bas necessary for reproduction of invertebr used as food by Piping Plovers.

4163. Determine the relationship of existing artificial breeding sites to river site Islands, spoil piles, and beaches forme by dredged sand and gravel, and located immediately adjacent to the Platte Rive in Nebraska are used by Piping Plovers. The importance of such habitat to recov of the species, and to what extent such habitat can replace lost natural sandba should be determined.

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4164. Identify need and techniques of improving habitat by management of substrate and by vegetation control through physical and/or non-toxic chemical means.

Existing woody vegetation will have to be removed from certain sandbars to provide suitable nesting habitat through physical or chemical means. Annual control may be necessary. Spreading sand or gravel of particular particle size could improve substrates for nesting and increase the height of sandbars to prevent inundation.

4165. Study feasibility and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.

Creation of artificial habitat may be necessary in areas where manageable habitat is non-existent. This may be particularly important in areas where natural habitat has been lost to channelization.

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417. Develop management plans for lake habitat. Whereas many life history characters and habit parameters are similar across the specie's ran specific plans for management of lake and prai wetland habitat are warranted.

4171. Identify lake and reservoir control policies where existing and potential Piping Plover habitat is threatened. Water levels affect Piping Plover reproductive success by increasing or decreasing the amount of habitat available. Changes in these levels dur: critical periods can delay initiation o: nesting, flood nest sites or feeding areas, or possibly increase the distance from nest sites to the water's edge. Lak and reservoirs with Piping Plover habita must be identified and any policies controlling water levels need to be scrutinized to determine the effect on Piping Plover reproductive success.

4172. Identify needs and techniques for suitabl substrate and vegetation control. Analysis of substrate currently used by Piping Plovers should be conducted. Usin this information, areas with potential habitat can be enhanced. Methods such as

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spreading sand or gravel of a particular particle size on potential nest sites could encourage or improve nesting success. Control of vegetation through various methods such as burning, herbicides, salt water spray, or physical removal should be investigated to determine the best method for each site. On the Great Lakes, creation of ponds adjacent to lakeshores could draw birds into certain areas.

4173. Identify needs and techniques for managing water levels.

Lakes and reservoirs currently supporting nesting plovers or that provide suitable nesting habitat should be evaluated to determine if water level management is feasible. Where feasible, techniques should be developed to manage water levels to improve reproductive success.

4174. Study feasibility of and determine needs for creating new habitat and implement trials to determine success rates of creating new habitat.

Techniques for creation of new habitat discussed in the introduction, Sections 2, and 4165 may be applicable to lake habitat.

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418. Develop management plans for prairie wetland habitat.

The ephemeral alkali wetlands of the Dakotas and Montana represent fragile ecosystems that could easily be lost one at a time until none remained. Threats to these areas include wetland drainage, water freshening, vegetation encroachment, and cattle trampling. Specific management techniques should be developed to address these threats.

4181. Identify threats to essential prairie wetland habitats and develop policies or management actions to eliminate those threats (See also 213).

Threats to prairie wetland nesting habitat may be direct, such as drainage or the freshening of alkali wetlands, or indirect, for example the nearby disruption of underground water flow or volume. There is a need to identify all such threats to essential nesting habitat in North Dakota, Montana, and South Dakota.

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4182. Develop management plans for use of lands adjacent to nesting beaches.

The characteristics and use of upland habitats adjacent to nesting beaches may influence quality of beach habitats. Vegetation type in adjacent uplands could influence food availability at nesting sites, as could use of insecticides on agricultural crops adjacent to beaches. Access to nesting beaches by cattle may be detrimental to plovers. Management plans for uplands adjacent to nesting sites are important to maintain quality nesting habitat.

4183. Identify the need for and techniques to maintain and improve nesting habitat along prairie wetlands.

Analysis of substrate currently utilized by Piping Plovers should be conducted. Using this information, areas with potential habitat can be enhanced. Methods such as spreading sand or gravel of a particular particle size could encourage or improve nesting success.

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Control of vegetation through various methods such as burning, herbicides, salt water spray, or physical removal should be investigated to determine the best method for each site.

4184. Determine the need for creation of new habitat along prairie wetlands.

Techniques for creation of new habitat (see 4165, 4174) may be applicable in developing new nesting habitat along prairie wetlands.

419. Modify or eliminate construction activities that adversely alter breeding habitat.

Development activities that adversely alter breeding sites must be modified or eliminated to protect essential habitat. In some instances these activities may not occur directly on breeding sites, per se, but their effect will be to alter breeding sites.

420. Evaluate success of protection and management techniques.

Adequate assessment of protection and management practices requires that certain predetermined measurements be taken to monitor accomplishments versus desired results. Additional unplanned results may occur and monitoring must be sufficient to detect and measure those effects as

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well as to avoid potentially detrimental impacts on Piping Plover habitat. Daily and seasonal activity patterns of plovers, along with locations of specific nesting areas, will provide key measures of the birds' response to various management practices. Monitoring vegetation to determine where changing habitat conditions exist and monitoring potential predator levels in the area should be considered. All techniques used to improve plover habitat should be evaluated to determine their cost-efficiency.

42. Provide protection and management of migration habitat. If migration sites are identified, their protection and enhancement will be essential. At that point, assessment of further needs of migrating Piping Plovers will be carried out.

43. Provide protection and management of winter habitat. The migratory nature of Piping Plovers requires the species to spend a critical portion of its life cycle along the Gulf of Mexico. Survival and continued existence of the species depends on juveniles and adults being able to occupy suitable winter habitat. Furthermore, reproductive success of adults may partially be a function of their physical condition as they begin spring migration. Consequently, the quality and quantity of winter habitat may limit recovery of the species.

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431. Identify areas of Essential Habitat.

Similar to breeding areas (411), essential winter areas have been identified (Appendix 6)

432. Continue to evaluate areas for consideration as Essential Habitat.

Recognizing that winter areas may be just as important as breeding areas for recovery of Piping Plovers, continued evaluation of winter sites for Essential Habitat designation should pursued.

433. Establish liaison with agencies and organizatic with land and water management responsibilities

Intense development of beaches for recreational use and the Intra-coastal Waterway for shipping pose serious threats to winter habitat. Cooperative efforts among the agencies involved will insure protection of essential habitat.

434. Revise or establish land and water laws and regulations to provide habitat protection.

Applicable regulatory mechanisms such as the National Environmental Policy Act, Migratory Bi Treaty Act, Endangered Species Act (especially sections 7(a)(2) and 10(a)), and state and loca zoning statutes should be invoked to bring publ and private attention to bear upon the need to protect and enhance wintering habitat for Pipin Plovers.

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435. Develop criteria and priorities for habitat protection.

Once further research is carried out in wintering areas, factors will be identified as being essential for winter habitat. At that point, a land protection strategy should be developed. Areas that support the greatest number of wintering plovers, especially those supporting individuals from important subpopulations should be prioritized in a habitat management/protection plan.

436. Develop management techniques.

Once actual and/or potential Piping Plover wintering habitat is identified, methods of managing those habitats should be developed and improved so that wintering habitat is of sufficient quantity and quality to accomodate and promote expansion of Piping Plover populations to more stable levels.

437. Modify construction activities that may reduce or negatively alter winter habitat.

Further construction of Intercoastal Waterway dredging activities on sandflats, and creation of new recreation developments in winter areas should be investigated and modified accordingly so that Piping Plovers suffer no loss of essential winter habitat.

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438. Evaluate success of protection and management techniques.

As discussed in Section 413, an evaluation of protection and management techniques must be carried out throughout their development and implementation. Furthermore, comparison of cost-effectiveness for various techniques is essential to insure rapid recovery of Piping Plovers.

5. Develop and implement an education program that publicizes information about the Piping Plover, including its life history, reasons for decline and options for recovery.

The Piping Plover's successful recovery in the Great Lakes and Northern Great Plains will depend on curtailing and/or redirecting human recreational and development activities. Therefore, resource managers and the general public should be provided with sufficient information to explain and justify changes in previous actions. Current efforts to develop a public information program have made an impressive start in this direction but must be intensified. These efforts could also benefit from better coordination at the national level and from delineation of specific audiences that need to be targeted.

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51. Inform and educate the general public.

The first priority in developing a public information program should be to educate the general public about the significance and value of the Piping Plover. The public's support and cooperation will ultimately be essential to the species full recovery.

511. Identify target audiences among the general public.

Materials prepared to increase public awareness and appreciation of the Piping Plover can be more effective if they are developed to meet specific interests and concerns of a particular audience. Time should be spent delineating which public groups are affected, either directly or indirectly, by plover conservation efforts and how each audience can best be reached. Fishermen, for example, who may use sandbars or islands for picnic spots are one audience that can be targeted by providing information at public access sites. Materials could also be distributed to local resorts, parks, restaurants, and other facilities that provide services to such groups.

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512. Develop and distribute educational materials appropriate to each audience.

Current efforts should be expanded to make greater use of the various media, including newspapers, radio, and TV. The primary focus of this task should be to provide background information describing the plover's life history and habitat requirements. The public should also be made aware of the necessity to enact local regulations to protect the plover. Biologists should be cautious, however, that materials do not increase the potential for observer disturbance to nesting birds.

513. Develop press-releases for newspapers, radio, and TV, that highlight specific Piping Plover projects.

In several states, cooperative projects between state and federal agencies, as well as private organizations and individuals are underway to protect Piping Plovers. Such efforts which generate public support should be applauded and widely publicized, particularly at the local level.

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514. Provide controlled viewing opportunities if and when appropriate.

Guided opportunities for observing Piping Plovers may be one of the best vehicles for generating public support and concern. Led by a qualified biologist under conditions that minimize or prevent disturbance to the birds, such trips can educate visitors first-hand about the need for strong protection and curtailment of some recreational activities.

52. Inform and educate public resource management agencies.

Many Piping Plovers in the region occur on lands that are protected and/or managed by state and federal resource agencies. Recreational activities permitted on these areas (e.g., hiking, ORV use, camping) can reduce the bird's reproductive success. In some areas, particularly in the Great Plains, an agency's own activities may also pose a threat (e.g., control of water levels in lakes and along rivers). Contact with these agencies will facilitate better management of the areas for Piping Plovers.

521. Identify critical resource agency constituents.

Each resource agency (including state, federal, and private organizations such as The Nature Conservancy) whose activities can impact the Piping Plover should be identified.

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522. Develop educational materials appropriate to respective agencies and their management authority.

Resource managers need to be provided with basic life history information about the plover as well as specific management information and recommendations directly pertinent to their area of responsibility.

523. Provide public resource agencies with periodic updates on the plover's status and progress of recovery efforts.

It is important that each public agency responsible for insuring the plover's survival, either directly or indirectly, be kept abreast of the success of their efforts at both the local and national level. Periodic updates not only inform them of progress being made, but also remind them of their responsibilities to the conservation of Piping Plovers.

6. Coordinate recovery efforts.

Development of a recovery plan for Piping Plovers involves coordination of biologists, agencies, and governments so that the most comprehensive, up to date information is collected and disseminated in an efficient way. Proper coordination would also help insure rapid implementation of

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those actions necessary for full recovery. The plan will be less effective, however, if coordination does not continue throughout achievement of the recovery objective.

61. Designate a recovery plan coordinator.

Designation of a coordinator for each team, or for both Atlantic and Great Lakes/Northern Great Plains teams is recommended. Duties of the coordinator would include: coordinating team assignments and meetings; editing and updating recovery plans; encouraging and monitoring execution of the plan's implementation schedule; maintaining collaboration with other recovery teams, state, federal, and international agencies; disseminating critical annual data; and coordinating range-wide research activities for Piping Plovers.

62. Coordinate research and management activities with federal, state, local, and private organizations.

Efficient achievement of recovery goals will be enhanced through coordination of research and management with private and governmental agencies. Of immediate importance is establishment and coordination of an international banding scheme whereby birds can be easily identified throughout the annual cycle. The recovery plan outlines many facets of Piping Plover conservation that require urgent investigation. Repetition of efforts, due to lack of coordination, will slow the recovery process and may cause undue disturbance to the birds.

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63. Coordinate international research and management activities.

Development of population management plans on an international scale will be necessary if the species is to recover throughout its range. Many factors threatening the species are similar for Piping Plovers breeding in Canada and the U.S. Furthermore, breeding birds from both countries use U.S., Mexican, and Caribbean wintering grounds. Currently, only 35% of the breeding population has been accounted for on U.S. wintering areas (Haig and Oring 1985). Central America and Caribbean nations may, therefore, be of great importance to the winter survival of Piping Plovers.

In 1986, the American Ornithologists' Union passed a resolution urging international cooperation in achieving recovery goals. Members of U.S. and Canadian recovery efforts have met and agreed to work together. International cooperation of research activities will allow gaps in information needed by all countries involved to be filled more quickly. Currently, plans are underway for a cooperative international census of Piping Plovers in 1991. Strong collaboration among Canadian and U.S. recovery efforts also may facilitate initiation of more powerful protective measures on Piping Plover wintering grounds.

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64. Coordinate development of a public information program at the national and international level.

Information and educational materials developed in the Great Lakes or Great Plains could be of equal benefit along the Atlantic coast and vice versa. Some materials also may be helpful to states that support wintering populations. Coordination at the federal level will reduce duplication of effort and encourage more efficient use of time and money at the state level. The birds' habitat also faces major threats in both Canada and Mexico. A coordinated approach to raising an awareness of the plover's plight at the international level would insure protection throughout its range.

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III. IMPLEMENTATION

The Implementation Schedule outlines and prioritizes tasks deemed necessary to be undertaken in the next three years in order to maximize recovery of Piping Plovers in the Great Lakes and Northern Great Plains. This process will be reviewed every three years until the recovery objective is met. Therefore, priorities and tasks may change in the future.

The Implementation Schedule is presented in two ways. First, the entire schedule is outlined according to the order tasks are presented in the Step-Down Outline and Narrative (Schedule A). Then, the Implementation Schedule is divided into the two geographic regions (Great Lakes and Northern Great Plains) and tasks are again presented by priority (Schedules B and C).

KEY TO IMPLEMENTATION SCHEDULE
General Category (column 1):

Information Gathering - I or R (Research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management technique
5. Taxonomy
6. Demographic studies
7. Propagation
8. Migration
9. Wintering
10. Predation
11. Competition
12. Disease
13. Environmental contaminant
14. Reintroduction
15. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreeme
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenanc and manipulation
4. Predator and competitor contro
5. Depredation contro
6. Disease control
7. Pollution control
8. Public information
9. Other management

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Priority (column 4):

1. Those actions absolutely necessary to prevent extinction of the species.

2. Those actions necessary to maintain the species' current population status.

3. All other actions necessary to provide for full recovery of the species.

4. GL = Great Lakes, GP = Northern Great Plains

Agency Responsibility (column 6):

USFWS Regional Office
- 2 - Albuquerque
- 3 - Twin Cities
- 4 - Atlanta
- 5 - Boston
- 6 - Denver

SA = State Wildlife Agency
BLM = Bureau of Land Management
BR = Bureau of Reclamation
COE = U.S. Army Corps of Engineers
NPS = National Park Service
TNC = The Nature Conservancy
WCHT = Platte River Whooping Crane Habitat Maintenance Trust

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IMPLEMENTATION SCHEDULE A:
Complete Implementation Schedule for First Three Years of Recovery Effort on the Great Lakes and Northern Great Plains

General Category	Task	Task #	Priority	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3	Comments
I1	Survey, census and monitor reproductive success of breeding populations	111-113	2 (GL) 2 (GP)	Annual Annual	Region 3 Regions 3,6	SA,TNC,NPS,BLM SA,TNC,COE,BLM WCHT	$15 K $30 K	$30 K $45 K	$15 K $30 K	Survey costs for Intnatl. census will occur in Y 2
I6, R6	Assess mortality and identify life history parameters (including population modeling)	115, 117	3 (GL) 3 (GP)	Annual Annual	Region 3 Regions 3,6	SA SA	$10 K	$10 K	$10 K	Task shared by GL & GP
R9, R1, R6	Survey and census winter populations	131-132	1 (GL) 1 (GP)	2 years 2 years	Regions 2,4,5 Regions 2,4,5	SA,TNC,COE,NPS SA,TNC,COE,NPS	$15 K	$30 K		Task shared by GL & GP
I2, R3,	Quantify and evaluate breeding habitat and threats	211-213	2 (GL) 2 (GP)	2 years 2 years	Region 3 Regions 3,6	SA,TNC,NPS,BLM SA,COE,WCHT, TNC,BR,BLM	$20 K	$20 K		
I2, R3, R9	Quantify and evaluate winter habitat	231-233	2 (GL) 2 (GP)	2 years 2 years	Regions 2,4,5 Regions 2,4,5	SA,TNC,NPS COE		$20 K	$20 K	Task shared by GL & GP
M4, R10	Evaluate predator impacts; evaluate predator control techniques and implement	3111-3112	1 (GL) 2 (GP)	Annual Annual	Region 3 Region 3,6	SA,NPS,BLM SA,TNC,BLM	$ 5 K $10 K	$ 5 K $10 K	$ 5 K $10 K	
M8, M9	Restrict human and vehicular access to nests	3113	1 (GL) 2 (GP)	Annual Annual	Region 3 Regions 3,6	SA,NPS SA,COE	$ 8 K $ 5 K	$ 8 K $ 5 K	$ 8 K $ 5 K	

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IMPLEMENTATION SCHEDULE A continued

General Category	Task	Task #	Priority	Task Duration	Responsibility Region (USFWS)	Responsibility Other Agencies	Fiscal Year Costs 1	Fiscal Year Costs 2	Fiscal Year Costs 3	Comments
M3, M9	Manage water levels to reduce nest and chick loss.	3115	1 (GP)	Annual	Region 6	COE,SA,BR				
I14	Assess reintroduction techniques to enhance Great Lakes birds.	3117	3 (GL)	1 year	Region 3	SA		$ 5 K		
A1, A2, A3, A4, A5, A6	Apply protection and and management practices on breeding habitat.	41	1 (GL) 1 (GP)	3 years 3 years	Region 3 Region 3,6	SA,TNC,NPS,BLM SA,BR,COE,WCHT BLM	$ 100K $ 100K	$ 200K $ 500K	 $ 750K	Include easement and acquisition
I2	Identify Essential breeding habitat.	411-412	1 (GL) 1 (GP)	Ongoing Ongoing	Region 3 Region 3,6					
M3	Establish liasion to protect breeding habitat.	413	2 (GP) 2 (GL)	Annual Annual	Region 3,6 Region 3	SA,COE,BR,BLM SA,NPS,BLM				
M9	Revise or establish laws to protect breeding habitat.	414	2 (GP)	Annual	Region 6	SA				
R2, R3, M9	Develop criteria and priorities for habitat protection.	415	2 (GL) 2 (GP)	1 year 1 year	Region 3 Region 3,6	SA,TNC SA,TNC				
R3, M3	Develop river management plans.	416	2 (GP)	3 years	Region 6	SA,COE,WCHT	$ 7 K	$ 7 K	$ 7 K	

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IMPLEMENTATION SCHEDULE A (Continued)

General Category	Task	Task #	Priority	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3	Comments
R1, R2 M3	Determine effects of river hydraulics and sediment discharge on breeding habitat; identify flow regimes to protect habitat	4161-4162	2 (GP)	3 years	Region 6	SA,COE,BR WCHT	$30 K	$30 K	$30 K	See 213
R3	Determine relationship of existing artificial breeding sites to riverine sites	4163	3 (GP)	3 years	Region 6	SA,WCHT	$10 K	$10 K	$10 K	
I2	Identify specific threats to prairie wetland habitat	4181	2 (GP)	2 years	Region 6	SA,TNC,BLM	$ 5 K	$ 5 K		See 213
I2, R2, R3, R4	Identify need and techniques to protect prairie wetland habitats	4163	3 (GP)	2 years	Region 6	SA,TNC,BLM	$18 K	$18 K		
M3	Modify and/or eliminate construction activities that impact breeding habitat	419	2 (GL) 2 (GP)	Annual Annual	Region 3 Region 3,6	SA,COE SA,COE,BR	$ 5 K	$ 5 K $ 5 K	$ 5 K $ 5 K	$ 5 K

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IMPLEMENTATION SCHEDULE A continued

General Category	Task	Task #	Priority	Task Duration	Responsibility Region (USFWS)	Responsibility Other Agencies	Fiscal Year Costs 1	2	3	Comments
M3, M9	Protect and manage winter habitat.	43	1 (GL) 1 (GP)	Annual Annual	Region 2,4,5	SA,COE,TNC,NPS	$ 100K	$ 500K	$ 750K	Task shared by GL & GP
I2,I3 R3,I9	Identify Essential winter habitat.	431-432	1 (GL) 1 (GP)	Ongoing Ongoing	Region 2,4 Region 2,4					
M3	Establish liasions for winter habitat; revise or establish laws; develop priorites for habitat protection.	433-434	3 (GL) 3 (GP)	Ongoing Ongoing	Region 2,4,5	COE,NPS,SA,TNC				Task shared by GL & GP
M3, M8	Modify and/or eliminate construction activities that impact winter habitat.	437	2 (GL) 2 (GP)	Annual Annual	Region 2,4,5	SA,COE,NPS	$ 4 K	$ 4 K	$ 4 K	Task shared by GL & GP
M8	Inform and educate the general public.	511-513	2 (GL) 3 (GP)	Annual Annual	Region 3 Regions 3,6	TNC,NPS,SA,COE TNC,NPS,SA,COE, WCHT	$15 K $15 K	$15 K $15 K	$15 K $15 K	
M8, M9	Inform and educate public resource management agencies.	52	3 (GL) 3 (GP)	Annual Annual	Region 3 Regions 3,6	TNC,NPS,SA,COE BLM TNC,NPS,SA,COE BLM	$ 1 K $ 1 K	$ 1 K $ 1 K	$ 1 K $ 1 K	
M9	Coordinate recovery efforts	61-63	2 (GL) 2 (GP)	Annual Annual	Region 3 Regions 3,6		$60 K	$75 K	$75 K	Task shared by GL & GP

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IMPLEMENTATION SCHEDULE B:

Priority Recovery Tasks for the Great Lakes

Priority # 1 - Actions necessary to prevent extinction of Piping Plovers on the Great Lakes.

Task #	131 - 132	Survey and census winter populations.
	3111 - 3112	Evaluate predator impacts; evaluate predator control techniques and implement.
	3113	Restrict human and vehicular access to protect birds.
	41	Protect and manage breeding habitat, emphasizing habitat acquisition.
	411-412	Identify Essential breeding habitat.
	43	Protect and manage winter habitat.
	431-432	Identify Essential winter habitat.

Priority # 2 - Actions necessary to maintain current Piping Plover population levels on the Great Lakes.

Task #	111 - 113	Survey, census and monitor reproductive success of breeding populations.
	211 - 213	Quantify and evaluate breeding habitat.
	231 - 233	Quantify and evaluate winter habitat.
	413	Establish liason to protect breeding habitat.
	415	Develop criteria and priorities for habitat protection.
	419	Modify and/or eliminate construction activities that impact breeding habitat.
	437	Modify and/or eliminate construction activities that impact winter habitat.
	511 - 513	Inform and educate the general public.
	61 - 63	Coordinate recovery efforts.

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Priority # 3 - Other actions necessary for full recovery of Piping Plovers on the Great Lakes.

Task #	115, 117	Assess mortality and identify life history parameters (including population modeling).
	3117	Assess reintroduction techniques to enhance Great Lakes Piping Plovers.
	433 - 434	Establish liaisons for winter habitat; revise or establish laws; develop priorities for habitat protection.
	52	Inform and educate public management agencies.

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IMPLEMENTATION SCHEDULE C:

Priority Recovery Tasks for the Northern Great Plains

Priority # 1 - Actions necessary to prevent extinction of Piping Plovers on the Northern Great Plains.

Task #	131 - 132	Survey and census winter populations.
	3115	Manage water levels to reduce egg and chick loss
	41	Manage and protect breeding habitat. Acquire breeding areas in North Dakota and on the Platte River, Nebraska.
	411-412	Identify Essential breeding habitat.
	43	Protect and manage winter habitat, emphasizing habitat acquisition of essential areas.
	431-432	Identify Essential winter habitat.

Priority # 2 - Actions necessary to maintain current Piping Plover population levels on the Northern Great Plains.

Task #	111-113	Survey, census, and maintain reproductive succes of breeding populations.
	211-213	Quantify and evaluate breeding habitat.
	231-233	Quantify and evaluate winter habitat.
	3111-3112	Evaluate predator impacts; evaluate predator control techniques and implement.
	3113	Restrict human and vehicular access to protect birds.
	413	Establish laiason to protect breeding habitat.
	414	Revise or establish laws to protect breeding habitat.
	415	Develop criteria and priorities for habitat protection.
	416	Develop management plans for riverine habitat.

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	4161-4162	Determine effects of river hydraulics and sediment discharge on breeding habitat; identify flow regimes to protect habitat.
	4183	Identify specific threats to prairie wetland habitats.
	419	Modify and/or eliminate construction activities that impact breeding habitat.
	437	Modify and/or eliminate construction activities that impact winter habitat.
	61-63	Coordinate recovery activities.

Priority # 3 - Actions necessary to provide full recovery of Piping Plovers in the Northern Great Plains.

Task #	115,117	Assess mortality and identify life history parameters (population modeling).
	413	Establish liaison to protect breeding habitat.
	4163	Determine relationship of existing artificial breeding sites to riverine sites.
	4183	Identify need and techniques to protect wetland habitats.
	433-434	Establish liaisons for winter habitat; revise or establish laws; develop priorities for habitat protection.
	511-513	Inform and educate the general public.
	52	Inform and educate public resource management agencies.

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APPENDIX 1

State Contact People

The following individuals have offered to provide interested parties with information pertaining to Piping Plovers in their state.

Dr. Joe Meyers
Alabama Dept. of Conservation and Natural Resources
64 N. Union Street
Montgomery, Alabama 36130
205/261-3469

Mr. Don A. Wood, Endangered Species Coordinator
Game and Fresh Water Fish Commission
620 South Meridian Street
Tallahassee, Florida 32301
904/488-3831

Mr. Daryl Howell, Chief
Bureau of Preserves & Ecological Services
Iowa Dept. of Natural Resources
Wallace State Office Building
Des Moines, Iowa 50319
515/281-8524

Ms. Nancy J. Craig
Louisiana Dept. of Wildlife & Fisheries
Louisiana Natural Heritage Program
DNR-CMD
PO Box 44124
Baton Rouge, Louisiana 70804
504/342-4602 or -5052

Mr. Tom Weise
Endangered Species Coordinator
Michigan Dept. of Natural Resources
Box 30028
Stevens T. Mason Building
Lansing, Michigan 48909
517/373-1263

Ms. Lee Pfannmuller
Nongame Wildlife Research Supervisor
Minnesota Dept. of Natural Resources
Box 20, 500 Lafayette Road
St. Paul, Minnesota 55155-4007
612/297-2276

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Mr. Ken Gordon
Endangered Species Coordinator
Department of Wildlife Conservation
P.O. Box 451
Jackson, Mississippi 39205-0451
601/961-5300

Mr. Arnold Dood
Montana Dept. of Fish, Wildlife and Parks
P.O. Box 5, Montana State University
Bozeman, Montana 59717
406/994-6433

Mr. Ross Lock, Nongame Specialist
Nebraska Game and Parks Commission
2200 N. 33rd Street
P.O. Box 30370
Lincoln, Nebraska 68503
402/464-0641, Ext. 138

Mr. Robert Miller
New York Department of Environmental Conservation
Wildlife Resources Center
Delmar, NY 12054

Mr. Randy Kreil, Wildlife Biologist
North Dakota Game and Fish Department
100 N. Bismarck Expressway
Bismarck, North Dakota 58501
701/224-9870

Mr. George Vandel, Wildlife Biologist
South Dakota Department of Game, Fish & Parks
Sigurd Anderson Building
Pierre, South Dakota 57501
605/773-4229

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Texas Parks & Wildlife Department
4200 Smith School Road
Austin, Texas 78744
512/389-4800

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Nongame Biologist
Box 7921
Madison, Wisconsin 53707
608/266-1571

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APPENDIX 2

Essential Breeding and Winter Habitat for Piping Plovers Breeding in the Great Lakes and Northern Great Plains.

Alkali wetlands and riverine sandbars in the northern Great Plains, and sandy beaches along the Great Lakes provide essential habitat for the Piping Plover. Gulf coastal areas from Florida to Texas provide essential habitat for the Piping Plover during the wintering period. The Piping Plover is completely dependent on these habitats for food and nesting sites. Therefore, destruction or adverse modification of remaining habitats will cause continued reduction of the species range and eventually a serious reduction in population numbers. The areas described and mapped herein as essential habitat will provide the space necessary for continued existence and growth of Piping Plover populations required to meet the recovery objective. The following areas are essential habitat for the Piping Plover. This list may be modified when better distribution and status information become available:

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AREAS OF ESSENTIAL HABITAT

ALABAMA*	Mobile Co.	- Little Dauphin Island, Bon Secour NWR - Sand Island - Dauphin Island - western 3 km - N. shore west of bridge
FLORIDA*	Bay Co.	- Tyndall Air Force Base
	Gulf Co.	- St. Joseph Peninsula State Park
	Franklin Co.	- Port St. Joe - Phipps Reserve - St. George Island State Park
	Santa Rosa Co.	- Gulf Island National Seashore
LOUISIANA*	Jefferson Parish	- Grand Terre Island
	Cameron Parish	- Johnson's Bayou
MICHIGAN	Emmet Co.	- Wilderness State Park
	Charlevoix Co.	- High Island - Beaver Island
	Leelanau Co.	- Sleeping Bear Dunes National Lakeshore (North Manitou Island) - Cathead Bay
	Alger Co.	- Grand Marais
	Chippewa Co.	- Vermillion Station - Weatherhog area - Whitefish Point
	Luce Co.	- Crisp Point - Deer Park - Point Aux Chien
MINNESOTA	Lake of the Woods Co.	- Pine/Curry Island - Morris Point - Zippel Bay - Rocky Point
	St. Louis Co.	- Hearding Island - Interstate Island
MISSISSIPPI*	Hancock Co.	- Waveland to Biloxi beaches
	Harrison Co.	- Deer Island
	Jackson Co.	- Ship Island
MONTANA	Bowdoin National Wildlife Refuge	
	Medicine Lake National Wildlife Refuge	

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MONTANA

Alkali wetlands with Piping Plover habitat characteristics (Whyte 1985, Prindiville 1986) within the glaciated prairie pothole region of northeastern Montana.

NEBRASKA

All existing and reoccurring sandbars suitable for Piping Plover nesting within the following river reaches.

- Niobrara River from the Highway 183 bridge east to the Niobrara's confluence with the Missouri River
- The mainstem of the Loup River
- The Platte River from the Highway 283 bridge at Lexington to the Platte's confluence with the Missouri River
- Missouri River National Recreational River

NEBRASKA/SOUTH DAKOTA (Common Border)

All existing and reocurring sandbars suitable for Piping Plover nesting on the Missouri River National Recreational River from Gavin's Point Dam to Ponca State Park,Nebraska.

NORTH DAKOTA

All existing and reoccurring Missouri River sandbars suitable for Piping Plover nesting from Garrison Dam to the outflow of the Cannonball River.

Alkali wetlands with Piping Plover habitat characteristics (Whyte 1985, Prindiville 1986) within the two glacial outwash plains of central North Dakota (centered in Kidder and McLean County) including the Chain of Lakes area in McLean County and Lostwood National Wildlife Refuge. The essential habitats are the wetlands and their shorelines.

Boundaries of these areas are:

- Northwest portion of Benson County located west of State Highway 30 and north of State Highway 19.
- The portion of Kidder County located south of State Highway 36
- The portion of McHenry County located south of U.S. Highway 2 and east of State Highways 14 and 53.

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NORTH DAKOTA continued:

- The following townships in McLean County: Lake Williams (T147N R80W), Wise (T147N R79W), McGinnis (T149N R84W), and Rosemont (T150N R84W).
- The portion of Montrail County located north of U.S. Highway 2.
- The portion of Pierce County located south of U.S. Highway 2.
- The portion of Sheridan County located north of State Highway 200.
- Chase Lake National Wildlife Refuge in Stutsman County.
- Linton Township (T153N R86W) in Ward County.

SOUTH DAKOTA	All existing and reoccurring sandbars suitable for Piping Plover nesting within the Missouri River from Fort Randall Dam to Ponca, Nebraska; and beach and island habitats along Oahe Reservoir in Potter, Sully, Stanley, and Dewey County.	
TEXAS*	Jefferson Co.	- Sea Rim State Park
	Galveston Co.	- Galveston Jetty, San Luis Pass, Gilchrist, Bolivar Flats
	Brazoria Co.	- San Bernard NWR
	Calhoun Co.	- Matagorda Island
	Aransas Co.	- Aransas Co. airport flats
	Nueces Co.	- 1850 Pass
		- Packery Channel
		- Flats between Corpus Christi State Univ. & Corpus Christi Naval Air Station
		- Padre Island National Seashore
	Kleberg Co.	- Padre Island National Seashore
	Kenedy Co.	- Padre Island National Seashore
	Willacy Co.	- Padre Island National Seashore
	Cameron Co.	- Padre Island National Seashore
		Brazos Island State Park
WISCONSIN	Ashland Co.	- Chequamegon Point, Long Island
	Superior Co.	- Interstate Island
	Douglas Co.	- Wisconsin Point

* Essential areas are coastal beach, mudflat, and sandflat habitats.

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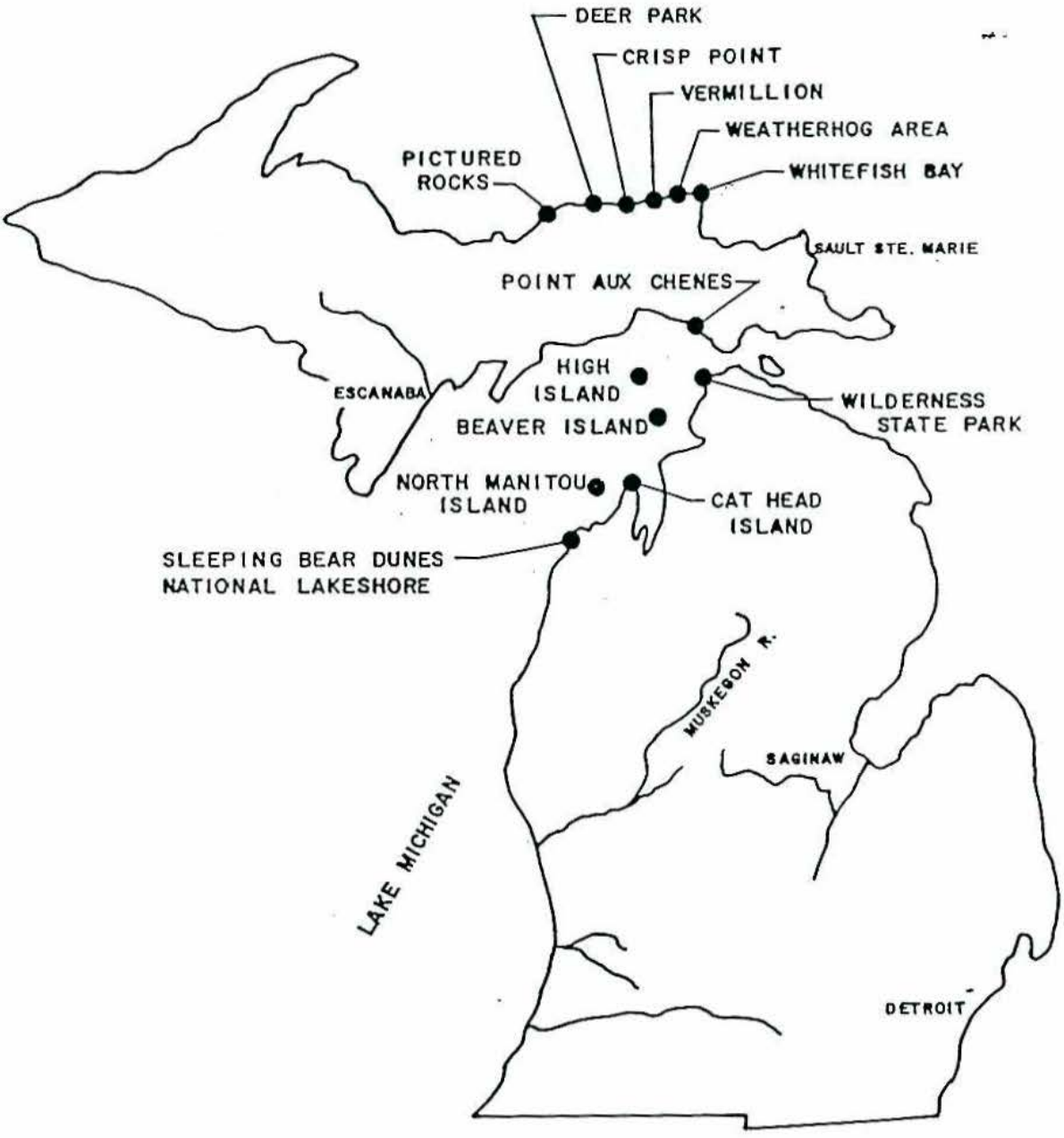

ESSENTIAL PIPING PLOVER HABITAT IN MICHIGAN

(DOTS INDICATE ESSENTIAL AREAS)

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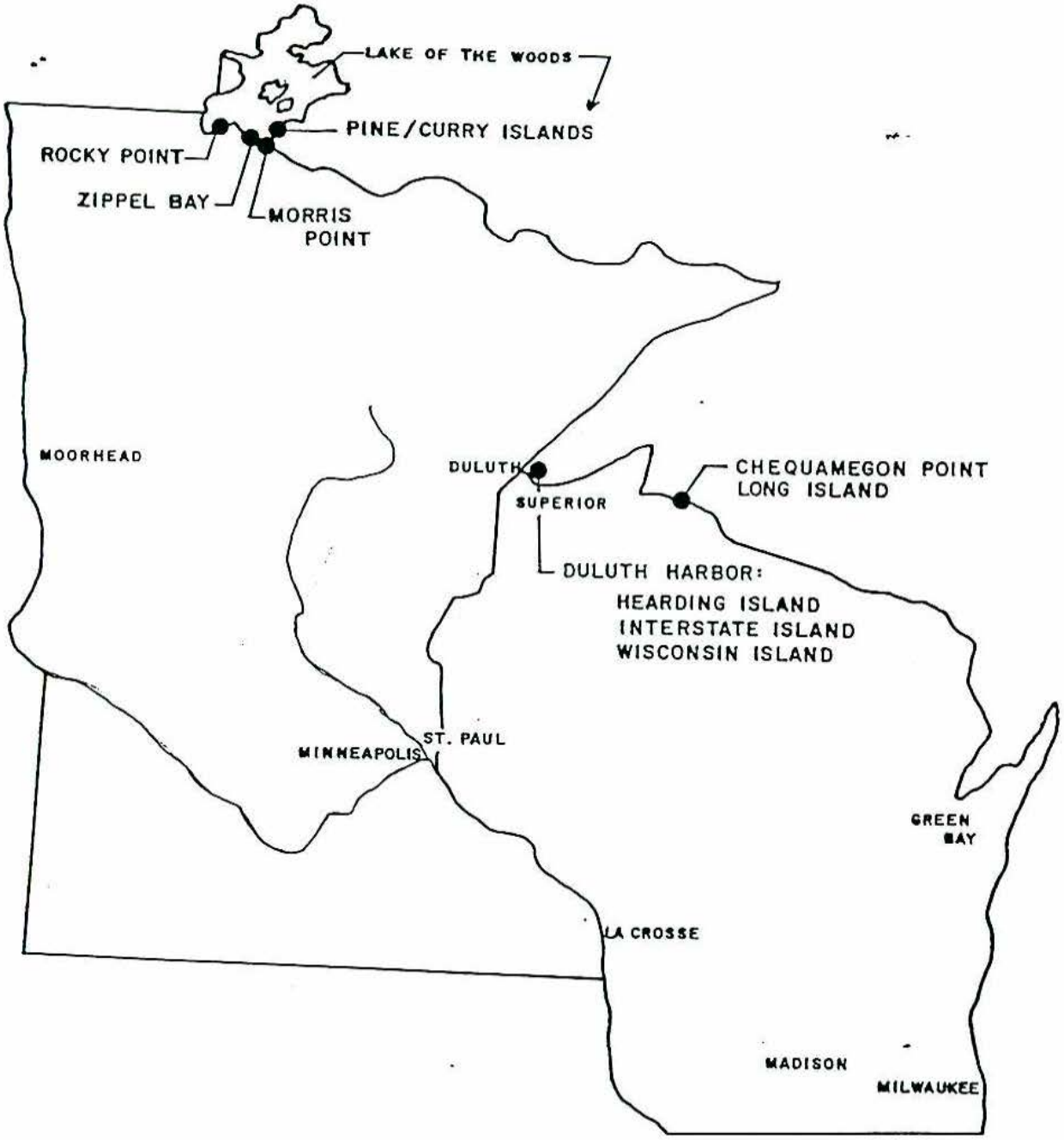

ESSENTIAL PIPING PLOVER HABITAT IN MINNESOTA & WISCONSIN

(DOTS INDICATE ESSENTIAL AREAS)

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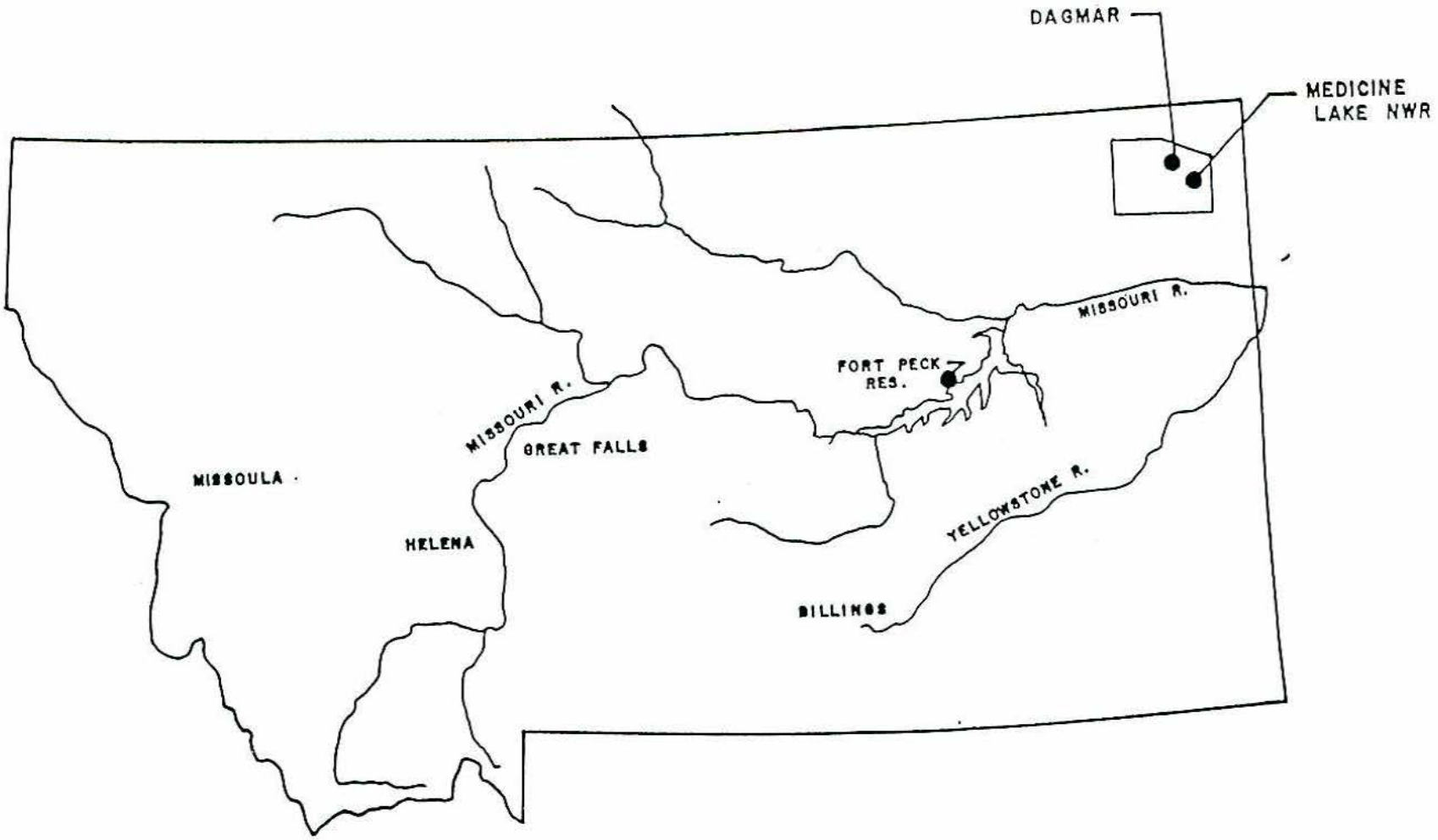

ESSENTIAL PIPING PLOVER HABITAT IN MONTANA
(DOTS INDICATE ESSENTIAL AREAS)

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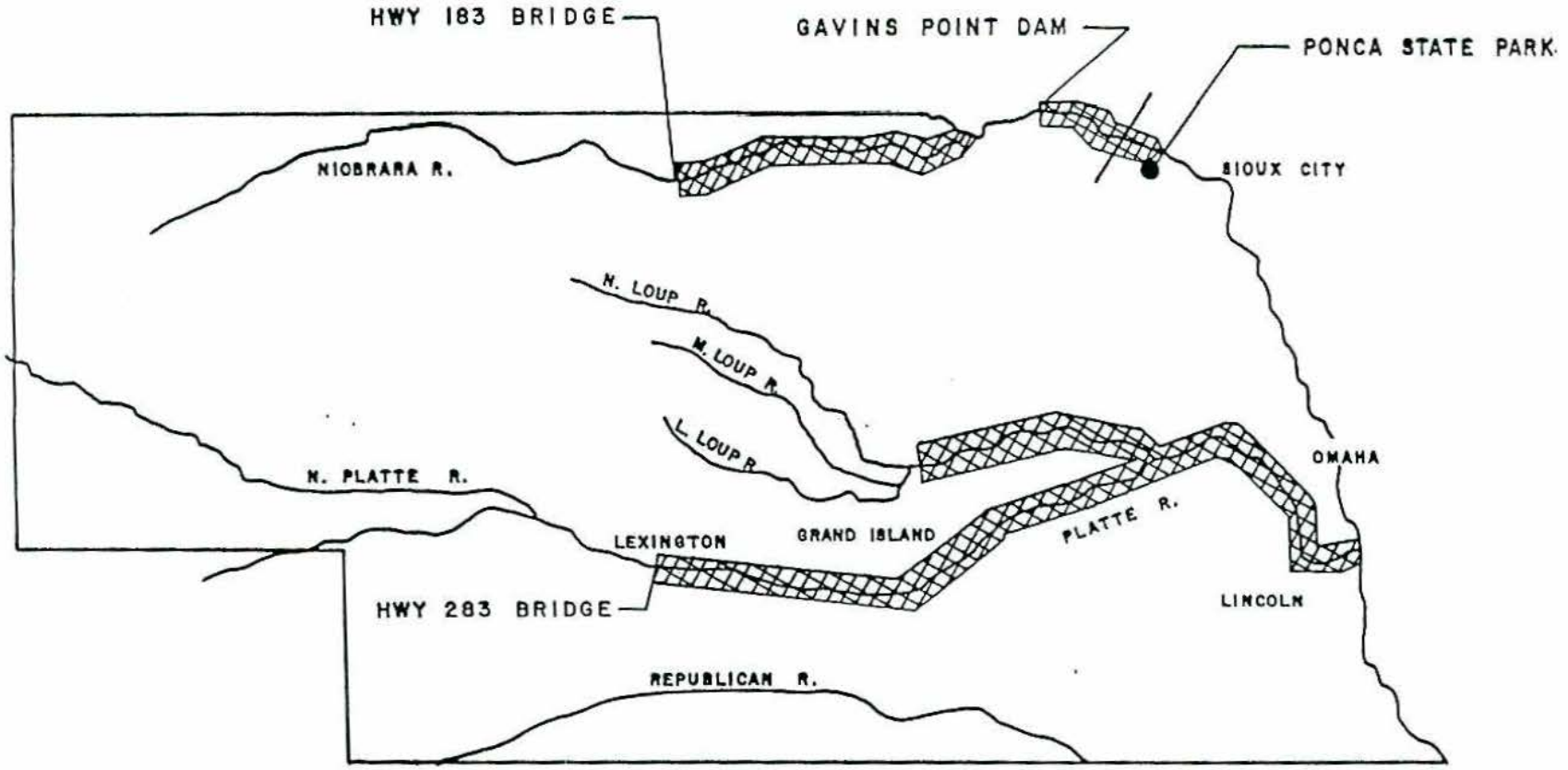

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ESSENTIAL PIPING PLOVER HABITAT IN NEBRASKA

(EXISTING AND REOCCURRING SANDBARS WITHIN THE CROSS-HATCHED AREAS CONTAIN ESSENTIAL HABITAT)

(DOTS INDICATE ESSENTIAL AREAS)

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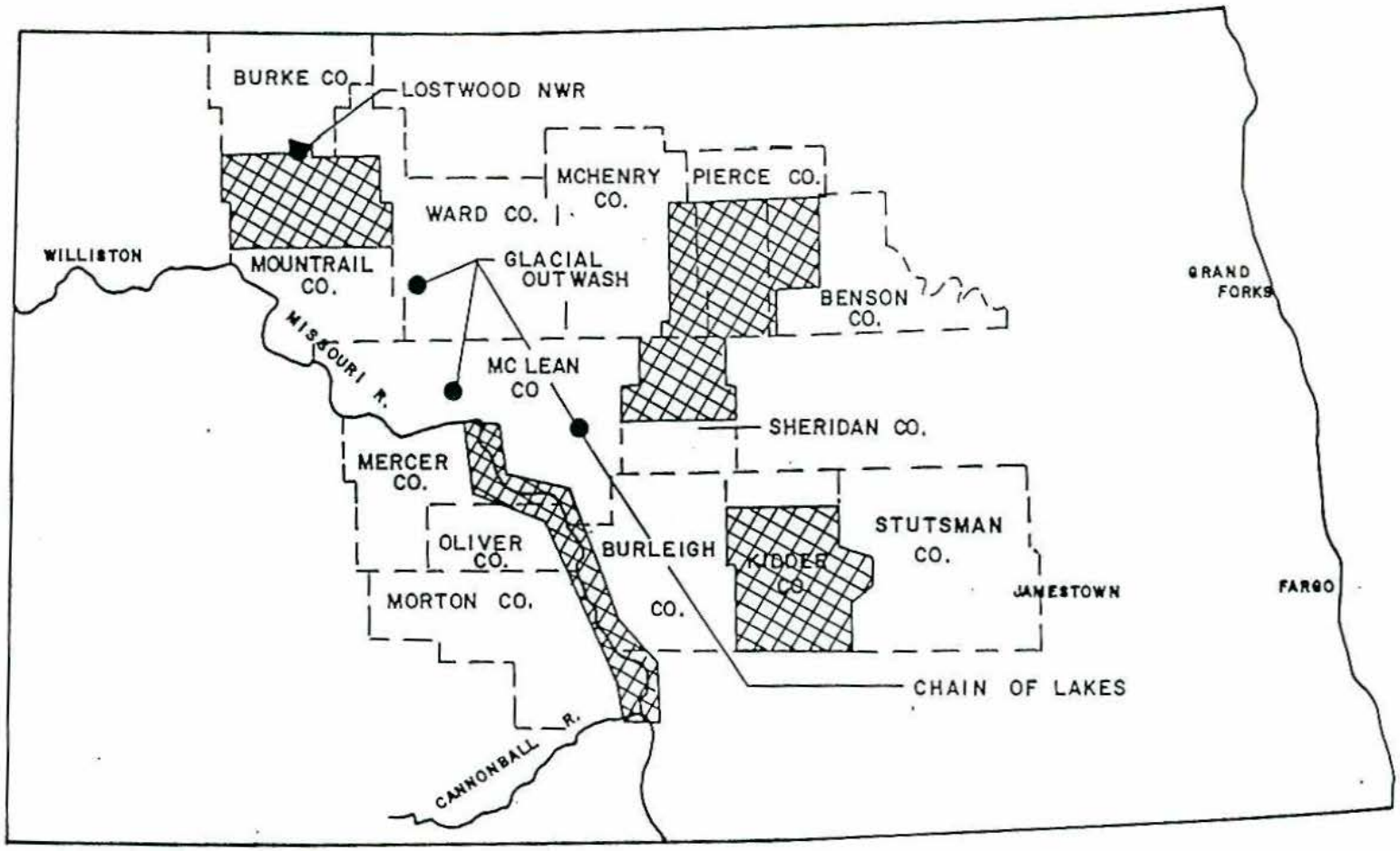

ESSENTIAL PIPING PLOVER HABITAT IN NORTH DAKOTA

(ALKALI WETLANDS AND EXISTING AND REOCCURRING SANDBARS WITHIN CROSS-HATCHED AREAS CONTAIN ESSENTIAL HABITAT)

(DOTS INDICATE ESSENTIAL AREAS)

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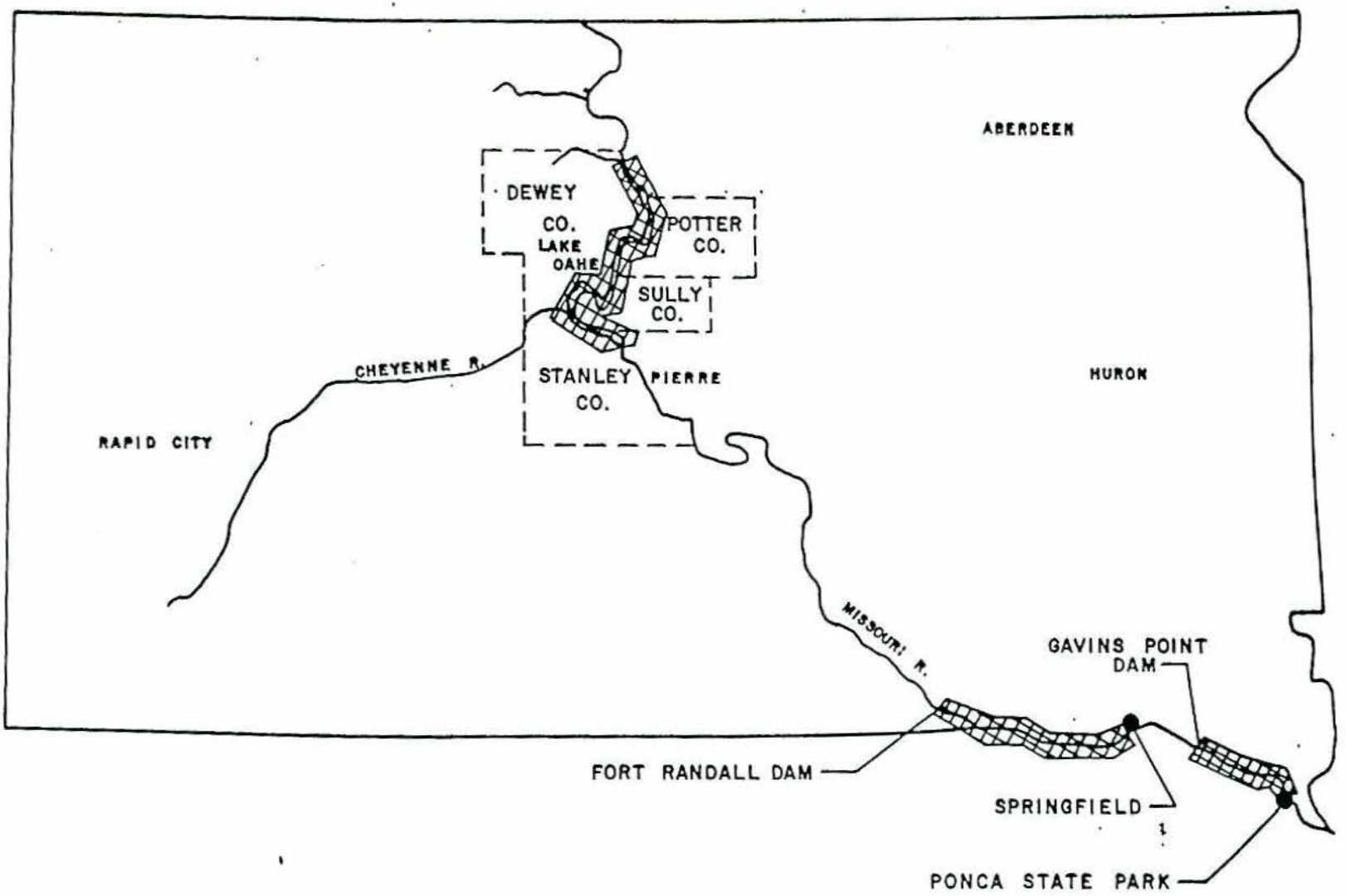

ESSENTIAL PIPING PLOVER HABITAT IN SOUTH DAKOTA

(EXISTING AND REOCCURRING SANDBARS WITHIN THE CROSS – HATCHED AREAS CONTAIN ESSENTIAL HABITAT)

(DOTS INDICATE ESSENTIAL AREAS)

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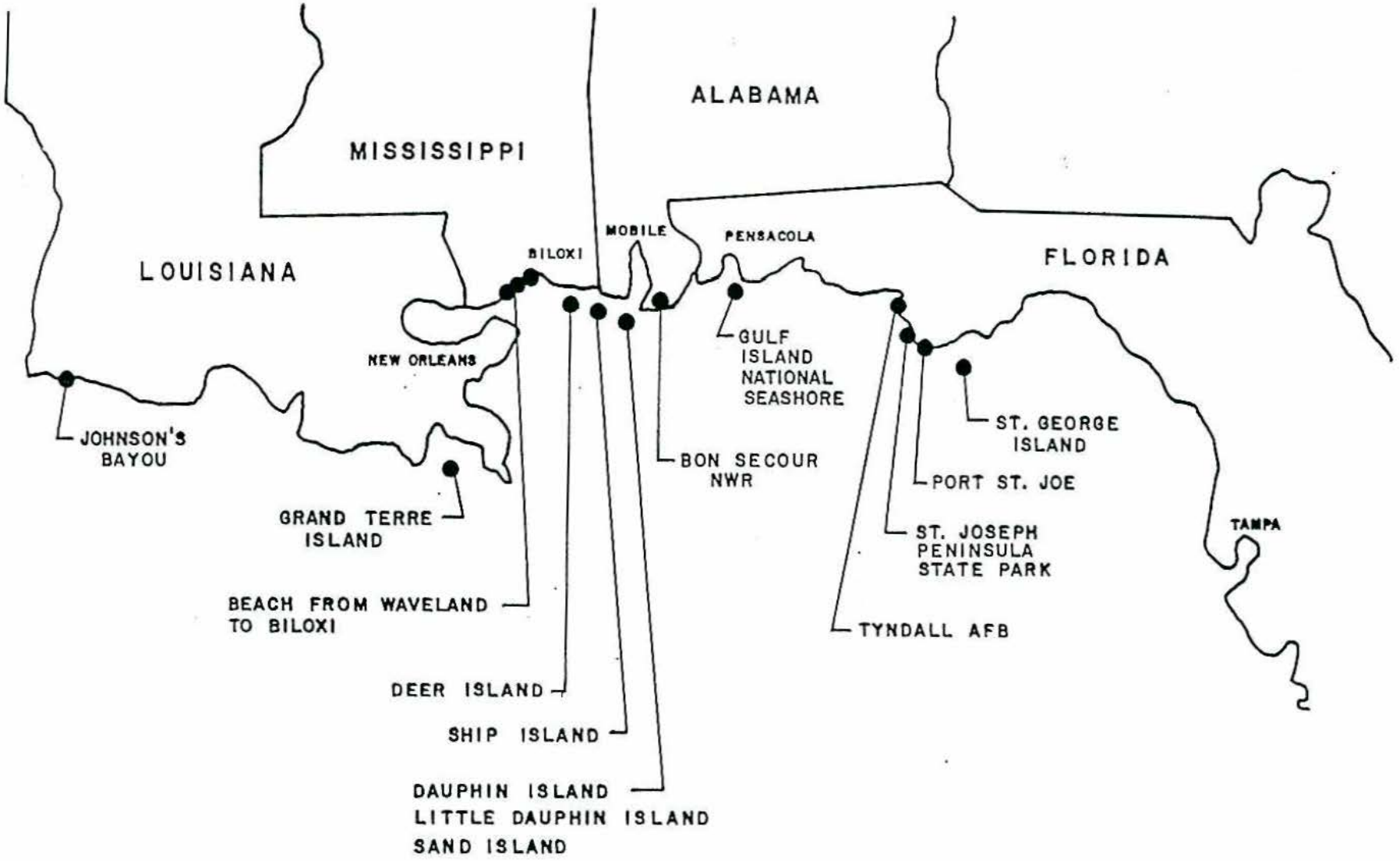

ESSENTIAL PIPING PLOVER HABITAT IN LOUISIANA, MISSISSIPPI, ALABAMA AND FLORIDA (DOTS INDICATE ESSENTIAL AREAS)

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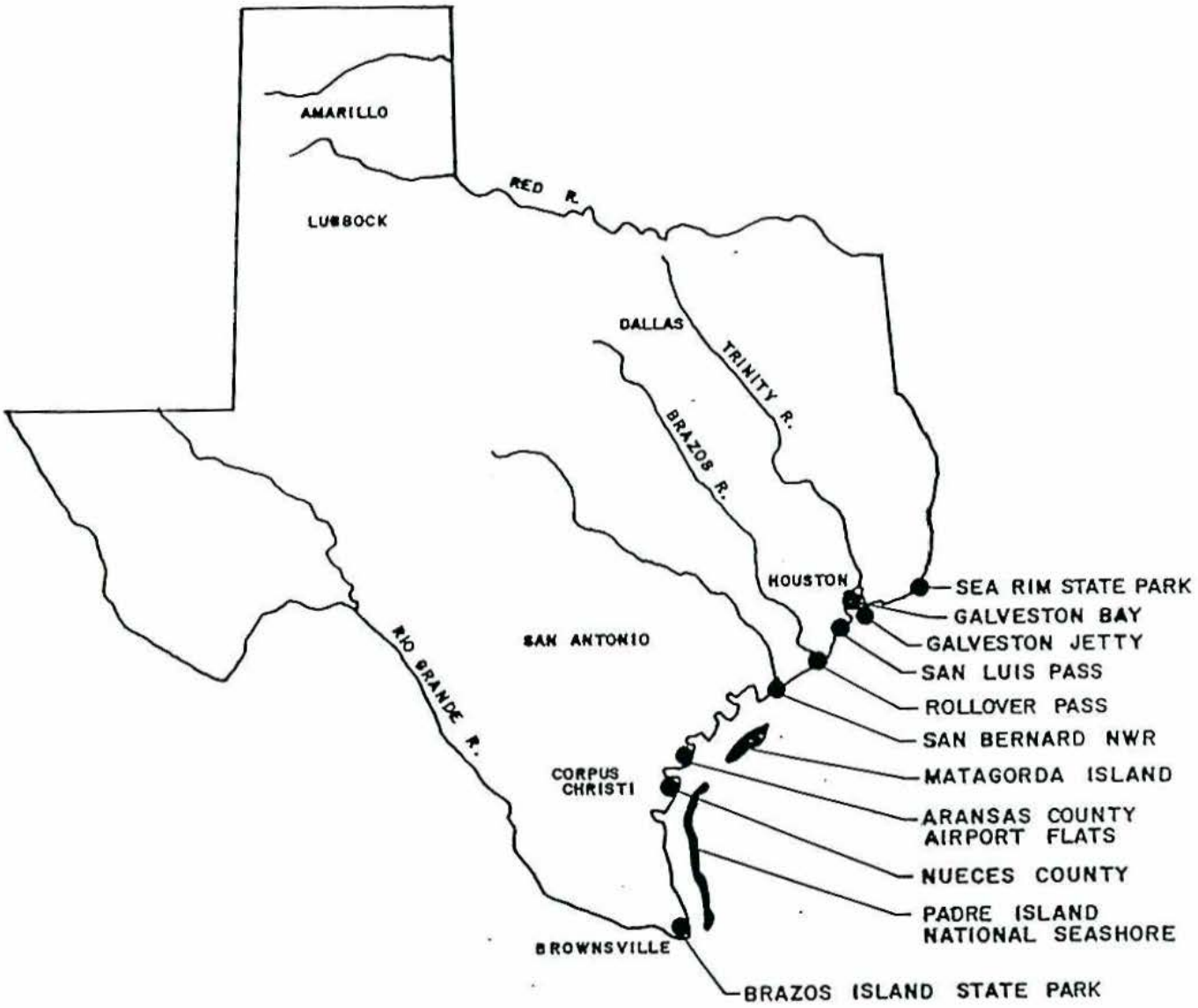

ESSENTIAL PIPING PLOVER HABITAT IN TEXAS
(DOTS AND SHADED AREAS INDICATE ESSENTIAL AREAS)

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APPENDIX 3

International Color Banding Scheme For Piping Plovers

In an effort to coordinate color marking of Piping Plovers, the Atlantic Coast and Great Lakes/Northern Great Plains Recovery Teams have developed a color flagging scheme that will provide information about the birds' population dynamics, migration, and wintering activities. A color flagging system using UV stable "DARVIC" blanks for forming leg flags will be required on all color marking authorizations. The color flagging scheme is:

ATLANTIC COAST	GREAT LAKES/GREAT PLAINS
Black - MA	White - Prairie Canada*
Red - VA, MD*	Green - ND, MN*
Yellow - NY, NJ*	Orange - MI, MT*
Brown - Maritime Canada	Light Blue - SD, NE*

*Alternate legs will be used to distinguish between States or Provinces.

Handling or disturbing Piping Plovers requires an endangered species permit which can be obtained from the U.S. Fish and Wildlife Service regional offices (State permits may also be required).

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Authorizations to color mark or band Piping Plovers must be obtained from:

Bird Banding Laboratory
U.S. Fish and Wildlife Service
Office of Migratory Bird Management
Laurel, MD 20708

Report sightings to:

Bird Banding Laboratory
U.S. Fish and Wildlife Service
Office of Migratory Bird Management
Laurel, MD 20708

and:

Dr. Susan Haig
Dept. of Zoological Research
National Zoological Park
Smithsonian Institution
Washington, D.C. 20008

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APPENDIX 4

Preparation of International Flags for Banding Piping Plovers

As outlined in Appendix 3, U.S. and Canadian recovery efforts have adopted an international flagging scheme to provide quick and precise identification of marked Piping Plovers, regardless of the time of year. Described below is the process for constructing the flags. They are quite simple to make, can be prepared before going into the field, and are placed on Piping Plovers in the same manner as a color band. Flags have been used successfully on Piping Plovers for four years or more in North Dakota, Minnesota, and Manitoba. Furthermore, they are used extensively on Sanderlings (Calidris alba), Red Knots (Calidris canutus), and other shorebird species (Myers et al. 1983) with great success.

Materials:

1. UV stable .5 cm x 3.5 cm DARVIC plastic strips in the appropriate color. Order from A.C. Hughes, 1 High St., Hampton Hill, Middlesex England, TW12 1NA.
2. A glass stirring rod of a diameter comparable to a Piping Plover color band.
3. A stove or bunsen burner
4. Pan or beaker of hot water
5. Pan of cool water
6. Tweezers or forceps

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Procedure: (See illustrations below)

1. Bring water to a boil.

2. Using forceps, pick up one plastic strip, hold in hot water until pliable.

3. Remove plastic strip and immediately wrap around stirring rod so that equal amounts of the plastic strip are on each side of the rod.

4. Use forceps to tighten tabs at base end closest to stirring rod. Hold tabs together tightly so that when released, there is no gap between the two tabs and each is exactly parallel to the other.

5. Dip finished flag in cold water.

6. If finished flag is not correct, you may remelt the strip and start again, although the plastic does not wrap as tightly the second time.

7. In the field, use a banding spoon to place flag on Piping Plover. The two tabs should close tightly enough so that glue or further melting is not necessary. Be sure the flag is not too tight on the birds' leg.

8. Flags work best when placed above the USFWS band or a color band.

9. Wait to place flags on chicks until they are near fledging.

BIRD'S EYE VIEW OF FLAG PREPARATION

A. DARVIC Strip

B. Wrap around rod

C. Pinch to insure tightness.

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APPENDIX 5

Guidelines For Conducting Piping Plover Censuses and Surveys

(Adopted from Dyer et al. 1987)

Recently, many surveys and intensive studies have been conducted on Piping Plovers. Concerns have been raised that such studies may affect productivity of breeding birds by disrupting incubation and brooding efforts, and by rendering nests and chicks more susceptible to predators. While it is recognized that such work is necessary to establish baseline data on population size and trends, it is hoped that research personnel will attempt to reduce stress to nesting birds and focus research efforts only on critical needs.

In order to analyze population size and trends, it is important that state surveys be conducted in a consistent manner, with standardized results. Currently, some states record nesting pairs while others tabulate only adult birds seen. For a one-time census, number of breeding pairs would be the most valuable data to record. Examples of "breeding pairs" would be a pair together on territory, a nest seen with either bird incubating, or adult(s) seen with young. A courting male should not be taken a prima facie evidence of nesting, as males may be unmated and still displaying or a member of the nonbreeding cohort. If a male is seen directing courting activity at a nearby female, a breeding pair should be recorded. All other adults, whether nonbreeders or transients, should be recorded but included separate from breeding pairs. If it is

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possible to make a follow-up census to count fledged young, productivity information should be recorded as the number of fledged young/breeding pair. Ideally, "fledged young" should have acquired first juvenile plumage. However, if the young are nearly at that stage (20+ days old), it is safe to assume that they will eventually fledge and so can be included as fledged young.

General Survey Guidelines

For general censuses (for example: how many pairs of Piping Plovers nest in Nebraska?), observers should visit sites when plovers are on territory and visible, but when nesting birds are the least sensitive to disturbance. The best "window" is probably early in the morning during a two-week period from the middle to end of incubation. Total incubation requires 25 to 30 days after the clutch of eggs (n=4) is complete. Towards the end of incubation, adult birds exhibit great fidelity to the nest and are not as inclined to desert as at the beginning of incubation.

In a follow-up census to count young, the best period will occur when the young are able to fly and capable of leaving the nest area. From observations made from the initial survey, predict peak hatching dates and allow 20 days so that young will be nearly mature and less sensitive to disturbance and predation. Young chicks are often lead into the dunes by adults, making them impossible to find. Renesting attempts should be documented for accurate productivity estimates.

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Survey Conditions

Early morning is the best time to survey nesting Piping Plovers. Adults and young are generally more active and feeding in the morning before beach use increases. While adults are incubating, excessive heat as well as cold, can be damaging to eggs. Disturbance should be minimized during the heat of mid-day when eggs need to be shaded by adult birds. If an early morning time frame is not practical, late afternoon is the second choice. Periods of rain or other inclement weather (very hot or cold days) should be avoided, since it is critical that adults be able to incubate or brood young without disturbance during such conditions.

Survey Methods

Recognizing that every site is unique in beach width, topography, etc., the following general suggestion are offered: Two observers are ideal to efficiently conduct a census in a given area: one person monitors the nest and birds from a distance (100 yards), while the other approaches more closely.

Equipment: In most cases, a pair of binoculars (7X+) will be sufficient, although a spotting scope (of 20X+) will insure proper identification of color bands. The scope can be used by one observer to maintain visual contact with a potential nest site at a distance (100 yards), while another observer approaches the site more closely with binoculars. A field notebook is necessary to record observations, habitat parameters, etc.

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Route: For a typical beach situation, most nests will be located near the vegetation line. Walk a route parallel to the shoreline, but not so far up the beach that nests are accidentally disturbed. Walk slowly and listen for birds that might not yet be visible to the eye. For wide areas of habitat, additional parallel transects may be necessary to get accurate results.

Locating Territories and Nests: As a nest is approached adult birds will usually be vocal (loud, two-note "peep-lo"), particularly later in incubation. During egg-laying, adults often leave the nest site silently, making it difficult to confirm nesting. After aggressive or vocal adults are located, both observers should continue past the nest site, with one observer maintaining visual contact with the birds. Once far enough past to calm adult birds (distance varies, depending on individual pairs), both observers should crouch to diminish their profile and continue to observe the birds. If the birds are not agitated, one adult will return to the nest site within a few minutes. If birds appear disturbed, move further away, maintaining eye contact with the birds. Once the incubating bird returns to the nest, one observer should use the spotting scope to watch the nest site, while the other approaches to get a closer look. The approaching observer should maintain vision on the exact spot that the bird was sitting. It should be possible to see the nest through binoculars at a distance of 30+ feet and further approach is discouraged. Human scent around nests may

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draw in predators. Since it is well documented that Piping Plovers nests usually have a clutch of four eggs, the only reason for a close approach is to determine the exact stage of nesting. Observation of a four egg clutch does not allow prediction of hatching times, since the last egg could have been laid 1 or 30 days ago. Observed clutches of 1-3 eggs, however, are probable indications that incubation is about to begin or that a renesting is occurring.

"Broken Wing" Display: This activity, described by several authors, indicates that an observer is very close to a nest or young. It is usually performed when small chicks are present or when the nest is nearing the end of incubation. Observers encountering this display should immediately leave the area until the bird is calm, and then crouch to observe further activity through optics.

Non-Nesting/Transient Birds: With some practice, it is usually possible to delineate non-nesting birds from those actively defending territories. Transients, as well as pre- and post-nesting birds, are generally not very vocal and qccupy mud flats or other neutral areas distinct from beach nesting habitat. Any suspected non-breeder should be watched carefully as it may ba a member of a breeding pair temporarily feeding away from the nest site.

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Marking the Nest: Nest marking is not recommended during a general census. Instead, natural landmarks or photographs should be used. If two surveys are done during the season (one to count nesting attempts and the other to gather productivity data), they should be done in exactly the same manner, so that all territories located on the initial trip will be encountered again later, making marking unnecessary. If markers are deemed necessary due to beach dynamics and conditions, they should be innocuous, such as dull wooden stakes or objects already present on the beach (e.g. driftwood). Markers should be placed well away from the nest (at least 30 feet) with the relationship to the nest duly recorded. Avoid using markers which might attract visitation or which might be moved by beach-goers.

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APPENDIX 6

Agreements and Easements for Protection

of Essential Piping Plover Habitat

1. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service and Canadian Wildlife Service for coordination of protection, management, and recovery efforts for the Piping Plover.

2. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, National Park Service, U.S. Fish and Wildlife Service, and the state wildlife agency, for permanent protection and management of all essential habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

3. U.S. Fish and Wildlife Service, National Park Service, and Army Corps of Engineers should acquire easements and/or fee title of essential Piping Plover habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

4. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, Bureau of Reclamation, U.S. Fish and Wildlife Service, Platte River Whooping Crane Habitat Maintenance Trust, and the state wildlife agency, for the permanent protection and management of all essential habitat on the Platte River in Nebraska.

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5. The U.S. Fish and Wildlife Service should provide land protection of essential Piping Plover habitat on the Platte River system.

6. Memorandum of Understanding should be developed between The Nature Conservancy, Bureau of Land Management, state wildlife agency, and the U.S. Fish and Wildlife Service for the permanent protection and management of essential Piping Plover habitat at the Chain of Lakes, North Dakota.

7. Memorandum of Understanding should be developed between the North Dakota Game and Fish Department and the U.S. Fish and Wildlife Service for the permanent protection and management of essential Piping Plover habitat owned and/or managed by the North Dakota Game and Fish Department.

8. The U.S. Fish and Wildlife Service should provide land protection of essential Piping Plover habitat within the two glacial outwash plains in central North Dakota. Land protection should extend over the wetland as well as the upland.

9. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service, State of Minnesota, Canadian Wildlife Service, and Province of Ontario, for the permanent protection and management of essential habitat at Lake of the Woods Minnesota/Ontario.

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10. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, state natural resource agency, and the U.S. Fish and Wildlife Service for the permanent protection and management of essential habitat at Lake of the Woods, Minnesota.

11. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service, state wildlife agency, and the U.S. Army Corps of Engineers governing the deposition of dredge spoils within the Great Lakes for purposes of enhancing or creating Piping Plover habitat.

12. Memorandum of Understanding should be developed between the National Park Service, state wildlife agency, and the U.S. Fish and Wildlife Service for the permanent protection and management of essential habitat in the Great Lakes.

13. Memorandum of Understanding should be developed between U.S. Army Corps of Engineers, National Park Service, The Nature Conservancy, state wildlife agency, and U.S. Fish and Wildlife Service, for permanent protection and management of essential wintering habitat.

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14. Memorandum of Understanding should be developed between Texas Parks and Wildlife Department, Texas General Land Office, The Nature Conservancy, National Park Service, and U.S. Fish and Wildlife Service for the permanent protection of essential Piping Plover winter habitat on lands owned and/or managed by the Texas Parks and Wildlife Department.

15. Due to the presence of Piping Plovers on Gulf and Atlantic coastal barrier habitat, U.S. Fish and Wildlife Service will participate closely with current Department of the Interior efforts in developing the Coastal Barrier Resource System.

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Part V

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule; Final Rule and Interim Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R5–ES–2011–0024; 4500030113]

RIN 1018–AY98

Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule, and interim rule with request for comments.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine threatened species status under the Endangered Species Act of 1973 (Act), as amended, for the northern long-eared bat (*Myotis septentrionalis*), a bat species that occurs in 37 States, the District of Columbia, and 13 Canadian Provinces. The effect of this final rule will be to add the northern long-eared bat to the List of Endangered and Threatened Wildlife.

We are also establishing an interim rule under the authority of section 4(d) of the Act that provides measures that are necessary and advisable to provide for the conservation of the northern long-eared bat. We are seeking public comments on this interim rule, and we will publish either an affirmation of the interim rule or a final rule amending the interim rule after we consider all comments we receive. If you previously submitted comments or information on the proposed 4(d) rule we published on January 16, 2015, please do not resubmit them. We have incorporated them into the public record, and we will fully consider them in our final determination on the 4(d) rule.

DATES: *Effective dates:* The final rule amending 50 CFR 17.11 and the interim rule amending 50 CFR 17.40 are both effective May 4, 2015.

Comments on the interim rule amending 50 CFR 17.40: We will accept comments on the interim rule amending 50 CFR 17.40 received or postmarked on or before July 1, 2015. Comments submitted electronically using the Federal eRulemaking Portal (see **ADDRESSES**, below) must be received by 11:59 p.m. Eastern Time on the closing date.

ADDRESSES: *Document availability:* The final listing rule is available on the Internet at *http://www.regulations.gov* under Docket No. FWS–R5–ES–2011–0024 and at *http://www.fws.gov/midwest/Endangered.* Comments and materials we received, as well as supporting documentation we used in preparing the final listing rule, are available for public inspection at *http://www.regulations.gov,* and by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Twin Cities Ecological Services Office, 4101 American Blvd. East, Bloomington, MN 55425; telephone (612) 725–3548, ext. 2201; or facsimile (612) 725–3609.

Comments on the interim rule amending 50 CFR 17.40: You may submit comments on the interim rule amending 50 CFR 17.40 by one of the following methods:

(1) Electronically: Go to the Federal eRulemaking Portal: *http://www.regulations.gov.* In the Search box, enter FWS–R5–ES–2011–0024, which is the docket number for this rulemaking. Then click on the Search button. Please ensure that you have located the correct document before submitting your comments. You may submit a comment by clicking on ''Comment Now!''

(2) By hard copy: Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS–R5–ES–2011–0024; Division of Policy, Performance, and Management Programs; U.S. Fish and Wildlife Service, MS: BPHC; 5275 Leesburg Pike, Falls Church, VA 22041–3803.

We request that you send comments only by one of the methods described above. We will post all comments on *http://www.regulations.gov.* This generally means that we will post any personal information you provide us (see the Public Comments Solicited on the Interim 4(d) Rule section, below, for more information).

FOR FURTHER INFORMATION CONTACT: Lisa Mandell, Deputy Field Supervisor, U.S. Fish and Wildlife Service, Twin Cities Ecological Services Field Office, 4101 American Blvd. East, Bloomington, MN 55425; telephone (612) 725–3548, ext. 2201; or facsimile (612) 725–3609. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Final Listing Rule

Why we need to publish a rule: Under the Endangered Species Act, a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. Listing a species as an endangered or threatened species can only be completed by issuing a rule. This rule will finalize the listing of the northern long-eared bat (*Myotis septentrionalis*) as a threatened species.

The basis for our action: Under the Endangered Species Act, we can determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. We have determined that white-nose syndrome is the predominant threat to the species.

Peer review and public comment: We sought comments from independent specialists to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal. We also considered all comments and information we received during the comment periods.

Interim 4(d) Rule

The need for the regulatory action and how the action will meet that need: Consistent with section 4(d) of the Act, this interim 4(d) rule provides measures that are tailored to our current understanding of the conservation needs of the northern long-eared bat.

Statement of legal authority for the regulatory action: Under section 4(d) of the Act, the Secretary of the Interior has discretion to issue such regulations as she deems necessary and advisable to provide for the conservation of the species. The Secretary also has the discretion to prohibit by regulation with respect to a threatened species, any act prohibited by section 9(a)(1) of the Act.

Summary of the major provisions of the regulatory action: The interim species-specific 4(d) rule prohibits purposeful take of northern long-eared bats throughout the species' range, except in instances of removal of northern long-eared bats from human structures and authorized capture and handling of northern long-eared bat by individuals permitted to conduct these same activities for other bats (for a period of 1 year after the effective date of the interim 4(d) rule).

In areas not yet affected by white nose syndrome (WNS), a disease currently affecting many U.S. bat populations, all incidental take resulting from any otherwise lawful activity will be excepted from prohibition.

In areas currently known to be affected by WNS, all incidental take prohibitions apply, except that take

attributable to forest management practices, maintenance and limited expansion of transportation and utility rights-of-way, prairie habitat management, and limited tree removal projects shall be excepted from the take prohibition, provided these activities protect known maternity roosts and hibernacula. Further, removal of hazardous trees for the protection of human life or property shall be excepted from the take prohibition.

Previous Federal Action

Please refer to the proposed listing rule for the northern long-eared bat (78 FR 61046; October 2, 2013) for a detailed description of previous Federal actions concerning this species. On October 2, 2013, we published in the **Federal Register** (78 FR 61046) a proposed rule to list the northern long-eared bat as an endangered species under the Act. The proposed rule had a 60-day comment period, ending on December 2, 2013. On December 2, 2013, we extended this comment period through January 2, 2014 (78 FR 72058). On June 30, 2014, we announced a 6-month extension of the final determination on the proposed listing rule for northern long-eared bat, and we reopened the public comment period on the proposed rule for 60 days, ending August 29, 2014 (79 FR 36698). On November 18, 2014, we again reopened the comment period on the proposed listing for an additional 30 days, ending December 18, 2014 (79 FR 68657). During the comment period we received one request for a public hearing, which was held in Sundance, Wyoming, on December 2, 2014. On January 16, 2015, we published a proposed rule to create a species-specific rule under section 4(d) of the Act (a ''4(d) rule'') that would provide measures that are necessary and advisable to provide for the conservation of the northern long-eared bat, if it were to be listed as a threatened species (80 FR 2371). At that time, we also reopened the public comment period on the October 2, 2013, proposed listing rule; we accepted public comments on both proposals for 60 days, ending March 17, 2015.

Background

Taxonomy and Species Description

The northern long-eared bat belongs to the order *Chiroptera,* suborder *Microchiroptera,* family *Vespertilionidae,* subfamily *Vespertilioninae,* genus *Myotis,* and subgenus *Myotis* (Caceres and Barclay 2000, p. 1). The northern long-eared bat was considered a subspecies of Keen's long-eared myotis (*Myotis keenii*) (Fitch and Schump 1979, p. 1), but was recognized as a distinct species by van Zyll de Jong in 1979 (1979, p. 993), based on geographic separation and difference in morphology (as cited in Caceres and Pybus 1997 p. 1; Caceres and Barclay 2000, p. 1; Nagorsen and Brigham 1993, p. 87; Whitaker and Hamilton 1998, p. 99; Whitaker and Mumford 2009, p. 207; Simmons 2005, p. 516). The northern long-eared bat is currently considered a monotypic species, with no subspecies described for this species (Caceres and Barclay 2000, p. 1; Nagorsen and Brigham 1993, p. 90; Whitaker and Mumford 2009, p. 214; van Zyll de Jong 1985, p. 94). Reynolds (2013, pers. comm.) stated that there have been very few genetic studies on this species; however, data collected in Ohio suggest relatively low levels of genetic differentiation across that State (Arnold 2007, p. 157). In addition, Johnson *et al.* (2014, upaginated) assessed nuclear genetic diversity at one site in New York and several sites in West Virginia, and found little evidence of population structure in northern long-eared bats at any scale. This species has been recognized by different common names, such as: Keen's bat (Whitaker and Hamilton 1998, p. 99), northern myotis (Nagorsen and Brigham 1993, p. 87; Whitaker and Mumford 2009, p. 207), and the northern bat (Foster and Kurta 1999, p. 660). For the purposes of this finding, we refer to this species as the northern long-eared bat, and recognize it as a listable entity under the Act.

A medium-sized bat species, the northern long-eared bat's adult body weight averages 5 to 8 grams (g) (0.2 to 0.3 ounces), with females tending to be slightly larger than males (Caceres and Pybus 1997, p. 3). Average body length ranges from 77 to 95 millimeters (mm) (3.0 to 3.7 inches (in)), tail length between 35 and 42 mm (1.3 to 1.6 in), forearm length between 34 and 38 mm (1.3 to 1.5 in), and wingspread between 228 and 258 mm (8.9 to 10.2 in) (Caceres and Barclay 2000, p. 1; Barbour and Davis 1969, p. 76). Pelage (fur) colors include medium to dark brown on its back; dark brown, but not black, ears and wing membranes; and tawny to pale-brown fur on the ventral side (Nagorsen and Brigham 1993, p. 87; Whitaker and Mumford 2009, p. 207). As indicated by its common name, the northern long-eared bat is distinguished from other *Myotis* species by its relatively long ears (average 17 mm (0.7 in); Whitaker and Mumford 2009, p. 207) that, when laid forward, extend beyond the nose up to 5 mm (0.2 in; Caceres and Barclay 2000, p. 1). The tragus (projection of skin in front of the external ear) is long (average 9 mm (0.4 in); Whitaker and Mumford 2009, p. 207), pointed, and symmetrical (Nagorsen and Brigham 1993, p. 87; Whitaker and Mumford 2009, p. 207). There is an occasional tendency for the northern long-eared bat to exhibit a slight keel on the calcar (spur of cartilage arising from inner side of ankle; Nagorsen and Brigham 1993, p. 87). This can add some uncertainty in distinguishing northern long-eared bats from other sympatric *Myotis* species (Lacki 2013, pers. comm.). Within its range, the northern long-eared bat can be confused with the little brown bat (*Myotis lucifugus*) or the western long-eared myotis (*Myotis evotis*). The northern long-eared bat can be distinguished from the little brown bat by its longer ears, tapered and symmetrical tragus, slightly longer tail, and less glossy pelage (Caceres and Barclay 2000, p. 1; Kurta 2013, pers. comm.). The northern long-eared bat can be distinguished from the western long-eared myotis by its darker pelage and paler membranes (Caceres and Barclay 2000, p. 1).

Distribution and Relative Abundance

The northern long-eared bat ranges across much of the eastern and north-central United States, and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993, p. 89; Caceres and Pybus 1997, p. 1; Environment Yukon 2011, p. 10) (see Figure 1, below). In the United States, the species' range reaches from Maine west to Montana, south to eastern Kansas, eastern Oklahoma, Arkansas, and east to South Carolina (Whitaker and Hamilton 1998, p. 99; Caceres and Barclay 2000, p. 2; Simmons 2005, p. 516; Amelon and Burhans 2006, pp. 71–72). The species' range includes all or portions of the following 37 States and the District of Columbia: Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming.

The October 2, 2013, proposed listing rule included Florida within the range of the northern long-eared bat; however, since that time we have learned that the species was known from only a single historical winter (1954) record in

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Jackson County, Florida, and all other historical and recent surveys at this cave and 12 other caves (all in Jackson County) since this record was observed have not found the northern long-eared bat. Further, there are no known summer records for the State (Florida Fish and Wildlife Conservation Commission 2013, in litt.). Historically, the species has been most frequently observed in the northeastern United States and in the Canadian Provinces of Quebec and Ontario, with sightings increasing during swarming and hibernation periods (Caceres and Barclay 2000, p. 2). Much of the available data on northern long-eared bats are from winter surveys, although they are typically observed in low numbers because of their preference for inconspicuous roosts (Caceres and Pybus 1997, p. 2) (for more information on use of hibernacula, see *Biology,* below). More than 1,100 northern long-eared bat hibernacula have been identified throughout the species' range in the United States, although many hibernacula contain only a few (1 to 3) individuals (Whitaker and Hamilton 1998, p. 100). Known hibernacula (sites with one or more winter records of northern long-eared bats) include: Alabama (2), Arkansas (41), Connecticut (8), Delaware (2), Georgia (3), Illinois (21), Indiana (25), Kentucky (119), Maine (3), Maryland (8), Massachusetts (7), Michigan (103), Minnesota (11), Missouri (more than 269), Nebraska (2), New Hampshire (11), New Jersey (7), New York (90), North Carolina (22), Oklahoma (9), Ohio (7), Pennsylvania (112), South Carolina, (2), South Dakota (21), Tennessee (58), Vermont (16), Virginia (8), West Virginia (104), and Wisconsin (67). Northern long-eared bats are documented in hibernacula in 29 of the 37 States in the species' range. Other States within the species' range have no known hibernacula (due to no suitable hibernacula present, lack of survey effort, or existence of unknown retreats).

For purposes of organization, the U.S. portion of the northern long-eared bat's range is discussed below in four parts: eastern range, midwest range, southern range, and western range. In these sections, we have identified the species' historical status, in addition to its current status within each State. For those States where white-nose syndrome (WNS) has been detected (see Table 1), we have assessed the impact the disease has had on the northern long-eared bat's distribution and relative abundance to date. For a discussion on anticipated spread of WNS to currently unaffected States, see ''White-nose Syndrome'' and ''Effects of White-nose Syndrome on the Northern Long-eared Bat'' under the *Factor C* discussion.

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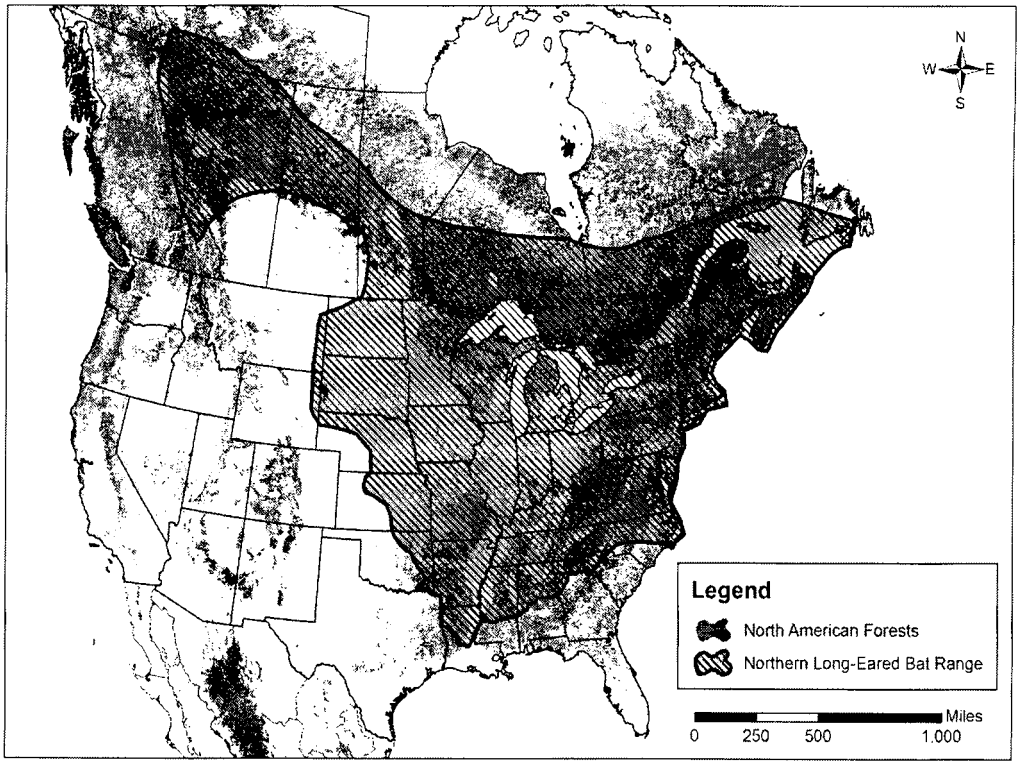
Northern Long-Eared Bat (*Myotis septentrionalis*) Range



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Eastern Range

For purposes of organization in this rule, the eastern geographic area includes the following States and the District of Columbia: Delaware, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, Pennsylvania, Vermont, Virginia, West Virginia, New York, and Rhode Island. Historically, the northern long-eared bat was widely distributed in the eastern part of its range (Caceres and Barclay 2000, p. 2). Prior to documentation of WNS, northern long-eared bats were consistently caught during summer mist-net surveys and detected during acoustic surveys in the eastern United States (Service 2014, unpublished data). Northern long-eared bats continue to be distributed across much of the historical range, but there are many gaps within the range where bats are no longer detected or captured, and in other areas, their occurrence is sparse. Similar to summer distribution, northern long-eared bats were known to occur in many hibernacula throughout the East. Since WNS has been

documented, multiple hibernacula now have zero reported northern long-eared bats. Frick *et al.* (2015, p. 6) documented the local extinction of northern long-eared bats from 69 percent of sites included in their analyses (468 sites where WNS has been present for at least 4 years in Vermont, New York, Pennsylvania, Maryland, West Virginia, and Virginia).

In Delaware, the species is rare, but has been found at two hibernacula within the State during winter or fall swarming periods. Summer mist-net surveys have documented 14 individuals all from New Castle County, and there is also a historical record from this county in 1974 (Niederriter 2012, pers. comm.; Delaware Division of Fish and Wildlife 2014, in litt.). WNS was confirmed in the State in the winter of 2009–2010, and WNS was confirmed in Delaware in the two northern long-eared bat hibernacula during the winters of 2011–2012 and 2012–2013 (Delaware Division of Fish and Wildlife 2014, in litt.). Mortality of northern long-eared bats due to WNS has been documented at both of these hibernacula during winter surveys.

In Connecticut, the northern long-eared bat was historically one of the most commonly encountered bats in the State, and was documented Statewide (Dickson 2011, pers. comm.). WNS was first confirmed in Connecticut in the winter of 2008–2009. Prior to WNS detection in Connecticut, northern long-eared bats were found in large numbers (*e.g.,* often greater than 400 and up to 1,000 individuals) in hibernacula; however, no northern long-eared bats were found in any of the eight known hibernacula in the State (where the species was found prior to WNS) in 2012 or 2013 surveys (Service 2015, unpublished data).

In Maine, three bat hibernacula are known, and northern long-eared bats have been observed in all of these sites. The species has also been found in the summer in Acadia National Park (DePue 2012, unpublished data), where northern long-eared bats were fairly common in 2009–2010 (242 northern long-eared bats captured, comprising 27 percent of the total captures for the areas surveyed) (National Park Service (NPS) 2010, unpublished data). Recent findings from Acadia National Park show a precipitous decline in the northern long-eared bat population in less than 4 years, based on mist-net surveys conducted 2008–2014 (NPS 2014, in litt.). WNS was first confirmed in the State in the winter of 2010–2011. Prior to WNS, the northern long-eared bat was found in numbers greater than 100 at two of the three regularly surveyed hibernacula; however, in 2013, only one northern long-eared bat was found during surveys conducted at all three of the State's primary hibernacula (Maine Department of Inland Fisheries and Wildlife (MDIFW) 2013, in litt.). In addition, the northern long-eared bat was infrequently found in summer acoustic surveys conducted in the State in 2013, which contrasts with widespread, frequent acoustic detections of *Myotis* species and mist net captures of northern long-eared bats prior to WNS impact (MDIFW 2015, in litt.).

In Maryland, there are eight known hibernacula for the northern long-eared bat, three of which are railroad tunnels (Maryland Department of Natural Resources (MD DNR) 2014, unpublished data). WNS was first confirmed in Maryland in the winter of 2009–2010. In all five of the known caves or mines in the State, the species is thought to be extirpated due to WNS (MD DNR 2014, unpublished data). It is unknown if the species is extirpated from the known railroad tunnel hibernacula in the State, primarily because the majority of bats in these hibernacula are not visible or accessible during winter hibernacula surveys; however, no northern long-eared bats have been observed in accessible areas in these tunnel hibernacula during recent winter surveys (MD DNR 2014, unpublished data). Acoustic surveys conducted since 2010 (pre- and post-WNS) in the western portion of Maryland have also demonstrated northern long-eared bat declines due to WNS (MD DNR 2014, unpublished data).

In Massachusetts, there are seven known hibernacula. WNS was first confirmed in the State in the winter of 2007–2008. Previous to WNS confirmation in the State, the northern long-eared bat was found in relatively larger numbers for the species in some hibernacula. In 2013 and 2014 winter surveys conducted in Massachusetts hibernacula, either zero or one northern long-eared bat individual were found in all known hibernacula (Service 2015, unpublished data).

In New Hampshire, northern long-eared bats were known to inhabit at least nine mines and two World War II bunkers, and have been found in summer surveys (Brunkhurst 2012, unpublished data). The northern long-eared bat was one of the most common species captured (27 percent of captures) in the White Mountain National Forest in 1993–1994 (Sasse and Pekins 1996, pp. 93–95). WNS was confirmed in the State in the winter of 2008–2009. Data from both hibernacula surveys and summer surveys have shown a dramatic decline (99 percent) in northern long-eared bat numbers compared to pre-WNS numbers (NHFG 2013, in litt.). Results from hibernacula surveys conducted at four of New Hampshire's hibernacula in 2014 found no northern long-eared bats; previous to WNS infection, the species was found in relatively high numbers (*e.g.,* 75–127 individuals) in most of these hibernacula. Furthermore, a researcher conducted mist-net surveys over 7 years pre-and post-WNS (2005–2011) at Surry Mountain Lake in Cheshire County, New Hampshire, and found a 98 percent decline in capture rate of northern long-eared bats (Moosman *et al.* 2013, p. 554).

In New Jersey, one of the seven known northern long-eared bat hibernacula is a cave, and the rest are mines (Markuson 2011, unpublished data). Northern long-eared bats consisted of 6 to 14 percent of the total number of summer captures at Wallkill River National Wildlife Refuge from 2006–2010 (Kitchell and Wight 2011, in litt.). WNS was first confirmed in the State in the winter of 2008–2009. There have been limited consistent hibernacula and summer surveys conducted in the State to enable analyses of northern long-eared bat population trends pre- and post-WNS. Although small sample sizes precluded statistical comparison, Kitchell and Wight (2011, in litt.) and Bohrman and Fecske (2013, p. 77) documented a slight, overall decline in annual northern long-eared bat mist-net captures at Great Swamp National Wildlife Refuge following the outbreak of WNS. For 3 years prior to the disease's local emergence (2006–2008), northern long-eared bats represented 8–9 percent of total bats captured. Although the northern long-eared bat capture rate rose to 14 percent in 2009, it dropped to 6 percent in 2010, and further to 2 percent in 2012, suggesting a downward trend.

Historically, the northern long-eared bat was found in both summer and winter surveys conducted across Pennsylvania (Pennsylvania Game Commission (PGC) 2014, in litt.). Historically, the species was found in 112 hibernacula in the State. Fall swarm trapping conducted in September and October of 1988–1989, 1990–1991, and 1999–2000 at two hibernacula with large historical numbers of northern long-eared bats had total captures ranging from 6 to 30 bats per hour, which demonstrated that the species was abundant at these hibernacula (PGC 2012, unpublished data). WNS was first confirmed in the State in 2008–2009. Since that time, northern long-eared bat

winter survey numbers declined by 99 percent, in comparison to pre-WNS numbers (PGC 2014, in litt.; PGC 2014, unpublished data). Currently, the northern long-eared bat can still be found in portions of Pennsylvania during the summer; however, the number of summer captures continues to decline. The number of summer captures has declined an additional 15 percent annually, amounting to an overall decline of 76 percent (not including survey information from 2014) from pre-WNS capture rates. The PGC stated that the data support that the decline is attributable to WNS, rather than a lack of habitat or other direct impacts (PGC 2014, in litt.).

In Vermont, the northern long-eared bat was once one of the State's most common bats, but is now its rarest (Vermont Fish and Wildlife Department (VFWD) 2014, in litt.). Prior to 2009, the species was found in 16 hibernacula, totaling an estimated 458 animals, which was thought to be an underestimate due to the species' preference for hibernating in hibernacula cracks and crevices (VFWD 2014, unpublished data). WNS was confirmed in Vermont in the winter of 2007–2008. According to the VFWD, it is believed that all of the State's caves and mines that serve as bat hibernacula are infected with WNS. State-wide hibernacula, summer mist-net, and acoustic and fall swarm data collected in 2010 documented 93–100 percent declines in northern long-eared bat populations post-WNS (VFWD 2014, in litt.). In most recent surveys, few northern long-eared bats were found in three hibernacula in 2012–2013; however no individuals were found in any surveyed hibernacula in 2013–2014 winter surveys. Prior to WNS detection, summer capture data (from 2001–2007) indicated that northern long-eared bats comprised 19 percent of bats captured, and the northern long-eared bat was considered the second most common bat species in the State (Smith 2011, unpublished data). As for fall swarm data, in 2013, capture surveys at Aeolus Cave captured and identified 465 bats, only 3 of which were northern long-eared bats (VFWD 2014, in litt.).

In Virginia, the northern long-eared bat was historically considered ''fairly common'' during summer mist-net surveys; however, they were considered ''uncommon'' during winter hibernacula surveys and have been found in eight hibernacula (Reynolds 2012, unpublished data). WNS was first confirmed in Virginia in 2008–2009. Prior to WNS detection in the State (prior to 2011), 1.4 northern long-eared bats were captured per 1,000 units of effort during summer mist-net surveys conducted at sites Statewide. In 2011, there was an increase in captures, with 3.1 bats captured per unit effort. However, in 2013 in the same survey areas, 0.05 northern long-eared bats were captured per 1,000 units of effort, which amounts to a 96 percent decline in the population (Virginia Department of Game and Inland Fisheries (VDGIF) 2014, unpublished data). In 2013, over 85 percent of summer surveys resulted in no northern long-eared bat captures. Fall swarm trends have been similar, with capture rates per hour declining from 3.6 in 2009, to 0.3 in 2012, amounting to a decline of 92 percent (VDGIF 2014, unpublished data).

In West Virginia, northern long-eared bats were historically found regularly in hibernacula surveys, but typically in small numbers (fewer than 20 individuals) in caves (Stihler 2012, unpublished data). The species has also been found in 41 abandoned coal mines during fall swarming surveys conducted from 2002 to 2011, in the New River Gorge National River and Gauley River National Recreation Area, both managed by the NPS; the largest number observed was 157 in one of the NPS mines (NPS 2011, unpublished data). The species has been found in 104 total hibernacula in the State. WNS was first documented in hibernacula in the eastern portion of West Virginia in the winter of 2008–2009. Similar to some other WNS-affected States, northern long-eared bats can still be found across the State (similar pre- and post-WNS distribution); however, it is unclear if northern long-eared bat abundance is greater in West Virginia than other WNS-affected States and, therefore, whether WNS impacts are less severe to date. Across the State, northern long-eared bat summer captures decreased from 32.5 percent in 2008, and 33.8 percent in 2011, to around 20 percent for all subsequent years (West Virginia Division of Natural Resources 2014, unpublished data). However, percent capture data alone does not indicate whether the northern long-eared bat is declining in the State, especially if all bat captures are declining, as it only indicates their abundance relative to other bat species. Standardized catch per unit effort or other similar data are necessary to make population trend comparisons over time. Francl *et al.* (2012, p. 35) standardized data by captures per net night from 37 counties (31 counties pre-WNS (1997–2008) and 8 counties in 2010) in West Virginia, and had 1.4 captures per net-night pre-WNS and 0.3 captures per net night post-WNS. At one site monitored over time (Monongahela National Forest), average northern long-eared bat calls per mile of acoustic route declined by 31–81 percent (depending on software package used) from 2009–2012 (Johnson *et al.* 2014, unpaginated). Similarly, mist-net capture rates declined by 93 percent from 2006–2008 to 2014 (Johnson *et al.* 2014, unpaginated). Overall, although northern long-eared bats are still captured across West Virginia (*i.e.,* they have a similar distribution as they did pre-WNS), there are marked declines in capture rates.

In New York, the northern long-eared bat was historically one of the most widely distributed hibernating bat species in the State, identified in 90 out of 146 known bat hibernacula (New York State Department of Environmental Conservation (NYSDEC) 2014, in litt.). The species has also been observed in summer mist-net and acoustic surveys. Summer mist-net surveys conducted in New York (primarily for Indiana bat (*Myotis sodalis*) presence-absence surveys) from 2003–2008 resulted in a range of 0.21–0.47 northern long-eared bats per net night, and declined to 0.01 bats per net night in 2011 (Herzog 2012, unpublished data). New York is considered the epicenter for WNS, and the disease was first found in the State in the winter of 2006–2007. The NYSDEC confirmed that the decline experienced by this species due to WNS is both widespread and severe in the State (NYSDEC 2014, in litt.). Most hibernacula surveys conducted after the onset of WNS (2008 through 2013) found either one or zero northern long-eared bats (Service 2015, unpublished data). There are few long-term data sets for northern long-eared bats across the State, but one such site is the Fort Drum Military Installation, where acoustic surveys and mist-net surveys have monitored summer populations before (2003–2007) and after the onset of WNS (2008–2010). Ford *et al.* (2011, p. 130) reported significant declines (pre- vs. post-WNS) in mean acoustic call rates for northern long-eared bats as a part of this study at Fort Drum. No northern long-eared bats have been captured in mist-nets on Fort Drum since 2011.

There are two known hibernacula for bats in Rhode Island; however, no northern long-eared bats have been observed at either of these. There is also limited summer data available for the State; however, there were six summer records of northern long-eared bats from 2011 mist-net surveys in Washington County (Brown 2012, unpublished data).

We have no information regarding the species in the District of Columbia;

however WNS is presumed to be impacting the species because WNS occurs in all neighboring States.

Midwest Range

For purposes of organization in this rule, the midwestern geographic area includes the following States: Missouri, Illinois, Iowa, Indiana, Ohio, Michigan, Wisconsin, and Minnesota. The species is captured during summer mist-net surveys in varying abundance throughout most of the Midwest, and historically was considered one of the more frequently encountered bat species in the region. However, the species was historically observed infrequently and in small numbers during hibernacula surveys throughout the majority of its range in the Midwest. WNS has since been documented in Illinois, Indiana, Ohio, Michigan, Wisconsin, and Missouri. In Minnesota and Iowa, the presence of the fungus that causes WNS has been confirmed, but the disease itself has not been observed. Overall, clear declines in winter populations of northern long-eared bats have been observed in Ohio and Illinois (Service 2014, unpublished data).

There are no firm population size estimates for the northern long-eared bat rangewide; nor do we have the benefit of a viability analysis; however, a rough estimate of the population size in a portion of the Midwest has been calculated. That estimate shows there may have been more than four million bats in the six-State area that includes the States of Illinois, Indiana, Iowa, Ohio, Michigan, and Missouri (Meinke 2015, pers. comm.). This population size estimate (for the northern long-eared bat) was developed for the Midwest Wind Energy Multi-Species Habitat Conservation Plan (MSHCP) and was calculated by adjusting the 2013 Indiana bat winter population size (within the 6 States) based on the ratio of northern long-eared bats compared to Indiana bats in summer mist-net surveys. This estimate has limitations, however. The principal limitation is that the estimate is based on data that were primarily gathered prior to the onset of WNS in the Midwest; thus declines that have occurred in WNS-affected States are not reflected in the estimated number. Taking into account the documented effects of WNS in the Midwest to date (declines currently limited primarily to Ohio and Illinois), there may still be several million bats within the six-State area. Because post-WNS survey numbers for the species have not been included in this population estimate and WNS continues to spread throughout these 6 States, there is uncertainty as to the accuracy of this estimate, and it should be considered a rough estimate.

The northern long-eared bat has been documented in 76 of 114 counties in Missouri; its abundance in the summer is variable across the State and is likely related to the presence of suitable forest habitat and fidelity to historical summer areas. There are approximately 269 known northern long-eared bat hibernacula that are concentrated in the karst landscapes (characterized by underground drainage systems with sinkholes and caves) of central, eastern, and southern Missouri (Missouri Department of Conservation 2014, in litt.). Similar to other more predominantly karst areas, the northern long-eared bat is difficult to find in Missouri caves, and thus is rarely found in large numbers. *Pseudogymnoascus destructans* (Pd) was first detected in Missouri in the winter of 2009–2010; however, the majority of sites in the State that have been confirmed with WNS were confirmed more recently, during the winter of 2013–2014. Due to low numbers historically found in hibernacula in the State, it is difficult to determine if changes in count numbers are due to natural fluctuations or to WNS. However, there was one northern long-eared bat mortality observed during the winter of 2013–2014 (WNS Workshop 2014, pers. comm.). Furthermore, Elliott (2015, pers. comm.) noted that surveyors are detecting indicators of decline (changes in bat behavior) as well as actual declines in numbers of northern long-eared bats in hibernacula in the State. As for summer survey data, mist-net and acoustic surveys conducted across Missouri in the summer of 2014 indicate continued distribution throughout the State. However, there were fewer encounters with northern long-eared bats in some parts of the State in 2014, as compared to previous years. Specifically, surveys conducted on the Mark Twain National Forest in 2014 indicate a decline in the overall number of captures of all bat species, including fewer northern long-eared bats than expected (Amelon 2014, pers. comm.; Harris 2014, pers. comm.). Further, in southwest Missouri, northern long-eared bats have been encountered during mist-net surveys conducted on the Camp Crowder Training Site in 2006, 2013, and 2014. Overall, the number of northern long-eared bat captures has decreased since 2006, relative to the level of survey effort (number of net nights) (Missouri Army National Guard 2014, pp. 2–3; Robbins and Parris 2013, pp. 2–4, Robbins *et al.* 2014, p. 5). Additionally, during a 2-year survey (2013–2014) at a State park in north-central Missouri, 108 northern long-eared bats were captured during the first year, whereas only 32 were captured during the second year, with a similar level of effort between years (Zimmerman 2014, unpublished data).

In Illinois, northern long-eared bats have been found in both winter hibernacula counts and summer mist-net surveys. Northern long-eared bats have been documented in 21 hibernacula in Illinois, most of which are in the southern portion of the State (Davis 2014, p. 5). Counts of more than 100 bats have been documented in some hibernacula, and a high of 640 bats was observed in a southern Illinois hibernaculum in 2005; however, much lower numbers of northern long-eared bats have been observed in most Illinois hibernacula (Service 2015, unpublished data). WNS was first discovered in the State during the winter of 2012–2013. Mortality of northern long-eared bats was observed 1 year later, during the winter of 2013–2014, at two of the State's major hibernacula, which are in the central part of the State. At one hibernaculum, there was a drop-off in numbers of northern long-eared bats observed over the winter, with 371 individuals occupying the hibernaculum in November of 2013, and by March of 2014, there were 10 individuals, which amounts to a 97 percent decline (Davis 2014, pp. 6–18). At the other hibernaculum, in March of 2013, there were 716 northern long-eared bats counted; in November of 2013, there were 171 individuals; and in March of 2014, there were 3 individuals, with a decline of over 99 percent (Davis 2014, pp. 6–18).

During the summer, northern long-eared bats have been observed in landscapes with a variety of forest cover throughout Illinois. Surveys conducted across the State, related to highway projects and research activities, resulted in the capture of northern long-eared bats in moderately forested counties in western and eastern Illinois (*e.g.,* Adams, Brown, and Edgar Counties), as well as in northern counties where forests are highly limited (*e.g.,* Will and Kankakee Counties) (Mengelkoch 2014, unpublished data; Powers 2014, unpublished data). Pre-WNS, northern long-eared bats were regularly caught in mist-net surveys in the Shawnee National Forest in southern Illinois (Kath 2013, pers. comm.). The average number of northern long-eared bats caught during surveys between 1999 and 2011 at Oakwood Bottoms in the Shawnee National Forest was fairly consistent (Carter 2012, pers. comm.). Summer bat surveys in 2007 and 2009

at Scott Air Force Base in St. Clair County resulted in a low numbers of captures (a few individuals) of northern long-eared bats, and, in 2014, no northern long-eared bats were encountered (Department of the Air Force 2007, pp. 10–14; Department of the Air Force 2010, pp. 11–12). Overall, summer surveys from Illinois have not documented a decline due to WNS to date.

In Iowa, there are only summer mist-net records for the northern long-eared bat, and the species has not been documented in hibernacula in the State. Northern long-eared bats have been recorded during many mist-net surveys since the 1970s. Recent records include documented captures in 13 of 99 counties across the central and southeastern portions of the State. In 2011, 8 individuals (including 3 lactating females) were captured in west-central Iowa (Howell 2011, unpublished data). During summer 2014, one nonreproductive female was tracked to a roost in Fremont County in southwest Iowa (Environmental Solutions and Innovations, Inc. 2014, pp. 52–56). In Scott County, southeastern Iowa, four female northern long-eared bats (two pregnant and two nonreproductive) were captured in June 2014, along the Wapsi River (Chenger and Tyburec 2014, p. 6). WNS has not been detected in Iowa to date; however, the fungus that causes WNS was first found at a hibernaculum in Iowa in the winter of 2011–2012.

Northern long-eared bats have been observed in both winter hibernacula surveys and, more commonly, in summer surveys in Indiana. Indiana has 25 known hibernacula with winter records of one or more northern long-eared bat. However, it is difficult to find large numbers of individuals in caves and mines during hibernation in Indiana (Whitaker and Mumford 2009, p. 208). Therefore, reliable winter population estimates are largely lacking in Indiana. WNS was confirmed in the State in the winter of 2010–2011. Although population trends are difficult to assess because of historically low numbers, mortality of northern long-eared bats due to WNS has been confirmed in the State (WNS Workshop 2014, pers. comm.). Historically, the northern long-eared bat was considered common throughout much of Indiana, and was the fourth or fifth most abundant bat species captured during summer surveys in the State in 2009. The species has been captured in at least 51 of 92 counties, often captured in mist-nets along streams, and was the most common bat taken by trapping at mine entrances (Whitaker and Mumford 2009, pp. 207–208). The abundance of northern long-eared bats appears to vary geographically within Indiana during the summer. For example, during three summers (1990, 1991, and 1992) of mist-netting in the northern half of Indiana, 37 northern long-eared bats were captured at 22 of 127 survey sites, and they only represented 4 percent of all bats captured (King 1993, p. 10). In contrast, northern long-eared bats were the most commonly captured bat species (38 percent of all bats captured) during three summers (2006, 2007, and 2008) of mist-netting on two State forests in south-central Indiana (Sheets *et al.* 2013, p. 193). The differences in abundance in north versus south Indiana are due to there being few hibernacula in northern Indiana; consequently, migration distances to suitable hibernacula are great, and the species is not as common in summer surveys in the northern as in the southern portion of the State (Kurta 2013, in litt.). Long-term summer mist-netting surveys in Indiana have started to show a potential downward trend in northern long-eared bat numbers (*e.g.,* Indianapolis airport project, Interstate Highway 69 project; Service 2015, unpublished data); however, there was fluctuation in the count numbers from these surveys prior to WNS detection in the State, and it may be too early to confirm a downward trend based on these data. In Indiana, the Hardwood Ecosystem Experiment has collected summer mist-net data from 2006 through 2014 for the northern long-eared bat in Morgan-Monroe and Yellowwood State Forests, and has found consistent numbers of bats captured to date (Service 2015, unpublished data).

In Ohio, there are seven known hibernacula (Norris 2014, unpublished data) used by northern long-eared bat, and the species is regularly collected Statewide as incidental catches in summer mist-net surveys for Indiana bats (Boyer 2012, pers. comm.). WNS was first detected in the State in the winter of 2010–2011. Two hibernacula in Ohio contained approximately 90 percent of the State's overall winter bat population prior to WNS detection. The pre-WNS combined population average (5 years of survey data) for both sites was 282 northern long-eared bats, which declined to 17 northern long-eared bats in winter 2013–2014 (post-WNS). This amounts to a decline of northern long-eared bats from pre-WNS numbers of 90 percent in one of the hibernacula and 100 percent in the other (Norris 2014, pp. 19–20; Ohio Department of Natural Resources (ODNR) 2014, unpublished data). The (ODNR) conducted Statewide summer acoustic surveys along driving transects across the State from 2011 to 2014. Although they have not yet analyzed calls for individual species, such as the northern long-eared bat, initial results indicate a 56 percent decline in recorded *Myotis* bat species' calls over the 3-year period (ODNR 2014, unpublished data). Capture rates from mist-net surveys, which were primarily conducted to determine Indiana bat presence, were conducted pre-WNS detection in Ohio (2007–2011) and were compared to capture rates post-WNS (2012–2013), and it was found that capture rates of northern long-eared bats declined by 58 percent per mist-net site post-WNS (Service 2015, unpublished data). Several parks in Summit County, Ohio, have been conducting mist-net surveys for northern long-eared bats (among other bat species) since 2004 (Summit Metro Parks 2014, in litt.), with numbers fluctuating. Their data noted a potential slight decline in northern long-eared bat numbers prior to WNS (however, there was a slight increase in 2011), and after WNS was detected in the area, a sharp decline was documented in capture rates. In surveys conducted in 2013 and 2014, no northern long-eared bats were captured at any of the parks surveyed (where the species was previously found; Summit Metro Parks 2014, in litt.).

In Michigan, the northern long-eared bat is known from 36 (physical detections in 33 counties and acoustic detections from 3 additional counties) of 83 counties and is commonly encountered in parts of the northern Lower Peninsula and portions of the Upper Peninsula (Kurta 1982, p. 301; Kurta 2013, pers. comm.; Bohrman 2015, pers. comm.). WNS was first confirmed in Michigan in the winter of 2014–2015. Cave bat mortality was documented in 2014–2015, although mortality was not specifically confirmed for northern long-eared bats. The majority of hibernacula in Michigan are in the northern and western Upper Peninsula; therefore, there are very few cave-hibernating bats in general in the southern half of the Lower Peninsula during the summer because the distance to hibernacula is too great (Kurta 1982, pp. 301–302). It is thought that the few bats that do spend the summer in the southern half of the Lower Peninsula may hibernate in caves or mines in neighboring States (Kurta 1982, pp. 301–302).

In Wisconsin, the northern long-eared bat was historically reported as one of the least abundant bats, based on hibernacula surveys, acoustic surveys,

and summer mist-netting efforts (Amelon and Burhans 2006, pp. 71–72; Redell 2011, pers. comm.). However, summer surveys conducted in 2014 revealed a more widespread distribution than previously thought (Wisconsin Department of Natural Resources (WDNR) 2014, unpublished data). In the summer of 2014, WDNR radio-tracked 12 female northern long-eared bats in four regions in the State and collected information on selected roost tree species and characteristics (WNDR 2014, unpublished data). In addition, acoustic and mist-net data was collected by a pipeline project proponent in 2014, which resulted in new records for the species in many surveyed areas along a corridor from the northwest part through the southeast part of the State (WDNR 2014, unpublished data). The northern long-eared bat has been observed in 67 hibernacula in the State. WNS was confirmed in Wisconsin in the winter of 2013–2014. A recent population viability analysis in Wisconsin found that ''there are no known natural refugia or highly resistant sites on the landscape, which will likely lead to statewide extinction of the species once WNS infects the major hibernacula'' (Peery *et al.* 2013, unpublished data; WDNR 2014, in litt.).

The northern long-eared bat is known from 11 hibernacula in Minnesota. WNS has not been detected in Minnesota; however, the fungus that causes WNS was detected in 2011–2012. Prior to 2014, there was little information on northern long-eared bat summer populations in the State. In 2014, passive acoustic surveys conducted at a new proposed mining area in central St. Louis County detected the presence of northern long-eared bats at each of 13 sites sampled, accounting for approximately 14 percent of all recorded bat calls (Smith *et al.* 2014, pp. 3–4). Mist-net surveys in 2014 at seven sites on Camp Ripley Training Center, Morrison County, resulted in capture of 4 northern long-eared bats (5 percent of total captures), and at five sites on the Superior National Forest, Lake and St. Louis Counties, resulted in capture of 24 northern long-eared bats (55 percent of total captures) (Catton 2014, pp. 2–3). Acoustic and mist-net data were collected by a pipeline project proponent in 2014, which surveyed a 300-mile (mi) (483-kilometer (km)) corridor through the northern third of the State. Positive detections were recorded for Hubbard, Cass, Crow Wing, Aitkin, and Carlton Counties, and northern long-eared bats were the most common species captured by mist-net (Merjent 2014, unpublished data). Mist-net surveys were conducted the previous year (2013) on the Kawishiwi District of the Superior National Forest, and resulted in capture of 13 northern long-eared bats (38 percent of total captures) over nine nights of netting at eight sites (Grandmaison *et al.* 2013, pp. 7–8).

Southern Range

For purposes of organization in this rule, southern geographic area includes: Alabama, Arkansas, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, and Tennessee. In the South, the northern long-eared bat is considered more common in States such as Kentucky and Tennessee, and less common in the southern extremes of its range (*e.g.,* Alabama, Georgia, and South Carolina). The absence of widespread survey efforts in several States is likely limiting the known range of the species, as well as information on its relative abundance (Armstrong 2015, pers. comm.). In the southern part of the species' range, Kentucky is the only State with Statewide survey data prior to 2010, primarily as a result of survey efforts for other listed bats species, such as the Indiana bat. WNS has been documented at many northern long-eared bat hibernacula in this region, with mortality confirmed at many sites.

Northern long-eared bats were historically observed in the majority of hibernacula in Kentucky and have been a commonly captured species during summer surveys (Lacki and Hutchinson 1999, p. 11; Hemberger 2015, pers. comm.). The northern long-eared bat has been documented throughout the majority of Kentucky, with historical records in 91 of its 120 counties. Eighty-five counties have summer records, and 68 of those include reproductive records (*i.e.,* captures of juveniles or pregnant, lactating, or post-lactating adult females) (Hemberger 2015, pers. comm.). WNS was first observed in Kentucky in 2011. Currently there are more than 60 known WNS-infected northern long-eared bat hibernacula in the State (Kentucky Department of Fish and Wildlife Resources (KDFWR) 2014, unpublished data). Bat mortality at infected sites was first documented in 2013, and increased in 2014 (KDFWR 2014, unpublished report). However, population trends are difficult to assess as northern long-eared bat numbers in these hibernacula have historically been variable. Summer survey data for Kentucky lack a standardized unit of effort and, therefore, cannot be used to assess population trends. However, Silvis *et al.* (2015, p. 6) documented significant summer population declines within four maternity colonies on Fort Knox Military Installation during their 3-year study (from 2012–2014), presumably due to WNS.

In Tennessee, northern long-eared bats have been observed in both summer mist-net surveys and winter hibernacula counts. Summer mist-net surveys from 2002 through 2013 resulted in the capture of more than 1,000 individuals, including males and juveniles or pregnant, lactating, or post-lactating adult females (Flock 2014, unpublished data). During the winter of 2009–2010, the Tennessee Wildlife Resource Agency (TWRA) began tracking northern long-eared bat populations and has since documented northern long-eared bats in 58 hibernacula, with individual hibernaculum populations ranging from 1 to 136 individuals (TWRA 2014, unpublished data). According to TWRA, Tennessee has over 9,000 caves and less than 2 percent of those have been surveyed, which led them to suggest that there could be additional unknown northern long-eared bat hibernacula in the State (TWRA 2013, in litt.). WNS was first documented in Tennessee in the winter of 2009–2010. WNS-related mortality was documented (including northern long-eared bat mortality) in 2014 (WNS Workshop 2014, pers. comm.); however, there is no pre-WNS data from these sites, and we cannot draw any conclusions regarding population trends based on hibernacula surveys. TWRA (2013, in litt.) indicates that summer mist-netting data for the eastern portion of the State showed a pre-WNS (2000–2008) capture frequency of 33 percent and post-WNS (2010–2012) capture frequency of 31 percent. These data do not have a standardized unit of effort, and, therefore, they cannot be used to assess population trends. Conversely, Lamb (2014, pers. comm.) observed declines in summer capture trends of several species of bats, including the northern long-eared bat, at Arnold Air Force Base in south-central Tennessee from 1998 to 2014. In the Great Smoky Mountains National Park, 2014 capture rates of northern long-eared bats in comparison to 2009–2012 declined by 71 to 94 percent (across all sites) based on unit of effort comparisons (NPS 2014, in litt.; Indiana State University 2015, in litt.).

In 2000, during sampling of bat populations in the Kisatchie National Forest, Louisiana, three northern long-eared bats, including two males and one lactating female, were collected. These were the first official records of the species from Louisiana, and the presence of a reproductive female likely represents a resident summer colony

(Crnkovic 2003, p. 715). Northern long-eared bats have not been documented using caves in Louisiana, including the five known caves that occur within 54 miles (87 km) of the collection site (Crnkovic 2003, p. 715). Neither WNS nor the fungus that cause WNS has been detected in Louisiana to date.

In Georgia, northern long-eared bat winter records are rare (Georgia Department of Natural Resources (GA DNR) 2014, in litt.). However, this species is commonly captured during summer mist-net surveys (GA DNR 2014, in litt.). Twenty-four summer records were documented between 2007 and 2011. Mist-net surveys were conducted in the Chattahoochee National Forest in 2001–2002 and 2006–2007, with 51 total individual records for the species (Morris 2012, unpublished data). WNS was first detected in the State in the winter of 2012–2013. With historically small numbers of northern long-eared bats found in hibernacula surveys in Georgia, we cannot draw conclusions regarding population trends based on hibernacula surveys. WNS-related mortality has been documented in cave bats in the State; however, northern long-eared bat mortality has not been documented to date.

Northern long-eared bats have been documented in 22 hibernacula in North Carolina. All known hibernacula are caves or mines located in the western part of the State (North Carolina Wildlife Resources Commission 2014, unpublished data), although summer records for the species exist for both the eastern and western parts of the State. In the summer of 2007, six northern long-eared bats were captured in Washington County, North Carolina (Morris *et al.* 2009, p. 356). Both adults and juveniles were captured, suggesting that there is a reproducing resident population (Morris *et al.* 2009, p. 359). Reproductive females and adult males have recently been documented in the northeastern part of the State. Mist-netting and acoustic data indicate that the northern long-eared bat may be active almost year-round in eastern portions of the State, likely due to mild winter temperatures and insect availability in coastal counties (North Carolina Department of Transportation 2014, in litt.). In North Carolina, WNS was first documented in the winter of 2008–2009. Northern long-eared bats have declined by 95 percent in hibernacula where WNS has been present for 2 or more years, with smaller declines documented in hibernacula infected for less than 2 years (Weeks and Graeter 2014, pers. comm.).

Northern long-eared bats are known from the mountain region of three counties in northwestern South Carolina: Oconee, Pickens, and Greenville. There are two known northern long-eared bat hibernacula in the State: one is a cave that had 26 northern long-eared bats present in 1995, but has not been surveyed since, and the other is a tunnel where only one bat was found in 2011 (Bunch 2011, unpublished data). In South Carolina, WNS was first documented in the winter of 2012–2013. Bat mortality due to WNS has not been documented to date. Winter northern long-eared bat records are infrequent in the State. When present in hibernacula counts, their numbers range from 24 (1995 survey of a Pickens County hibernaculum) to single records in Oconee County (South Carolina Department of Natural Resources 2015, in litt.). Thus, population trends cannot be determined based on hibernacula surveys, due to historically low numbers of northern long-eared bats found.

Northern long-eared bats are known from 41 hibernacula in Arkansas, although there are typically few individuals (*e.g.,* fewer than 10 individuals) observed (Sasse 2012, unpublished data). Saugey *et al.* (1993, p. 104) reported the northern long-eared bat to be rather common during fall swarming at abandoned mines in the Ouachita Mountains. Additionally, Heath *et al.* (1986, p. 35) found 57 pregnant females roosting in a mine in the spring of 1985. Summer surveys in the Ouachita Mountains of central Arkansas from 2000–2005 tracked 17 males and 23 females to 43 and 49 day-roosts, respectively (Perry and Thill 2007, pp. 221–222). In 2013 summer surveys in the Ozark St. Francis National Forest, the northern long-eared bat was the most common species captured (Service 2014, unpublished data). Pd was first detected in the State in the winter of 2011–2012; however, WNS was confirmed at different sites (than where Pd was first confirmed) in 2013–2014. Northern long-eared bat mortality was documented (five individuals) from one of the sites where WNS was first confirmed in 2013–2014 (WNS Workshop 2014, pers. comm.). Mortality of northern long-eared bats from WNS was observed in the State's largest hibernacula in 2015; 2015 surveys found 120 northern long-eared bats in that hibernacula, where counts in recent years often numbered 200 to 300 (Bitting 2015, pers. comm.).

Northern long-eared bats are known from two hibernacula in Alabama, where typically few individuals (*e.g.,* fewer than 20) are observed (Sharp 2014, unpublished data). Surveys conducted during the Southeast Bat Diversity Network bat blitz in 2008 reported the northern long-eared bat to be rather common in late summer/early fall swarm at known bat caves in Alabama (Sharp 2014, unpublished data). Summer surveys, mostly conducted between 2001 and 2008, in Alabama have documented 71 individual captures, including both males and reproductively active females (Sharp 2014, unpublished data). WNS was first documented in Alabama in the winter of 2011–2012.

The northern long-eared bat is known to occur in seven counties along the eastern edge of Oklahoma (Stevenson 1986, p. 41). The species is known from nine hibernacula, where typically they are observed in low numbers (*e.g.,* 1 to 20 individuals). However, a larger colony uses a cave on the Ouachita National Forest in southeastern Oklahoma (LeFlore County) during the winter (9 to 96 individuals) and during the fall (9 to 463 individuals) (Perry 2014, pers. comm.). Northern long-eared bats have been recorded from 21 caves (7 of which occur on the Ozark Plateau National Wildlife Refuge) during the summer. The species has regularly been captured in summer mist-net surveys at cave entrances in Adair, Cherokee, Sequoyah, Delaware, and LeFlore Counties, and are often one of the most common bats captured during mist-net surveys at cave entrances in the Ozarks of northeastern Oklahoma (Stark 2013, pers. comm.; Clark and Clark 1997, p. 4). Small numbers of northern long-eared bats (typical range of 1 to 17 individuals) also have been captured during mist-net surveys along creeks and riparian zones in eastern Oklahoma (Stark 2013, pers. comm.; Clark and Clark 1997, pp. 4, 9–13). Neither WNS nor Pd has been detected in Oklahoma to date.

Although the northern long-eared bat was not considered abundant in Kentucky and Tennessee historically (Harvey *et al.* 1991, p. 192), research conducted from 1990–2012 found the species abundant in summer mist-net surveys (Hemberger 2012, pers. comm.; Pelren 2011, pers. comm.; Lacki and Hutchinson 1999, p. 11). With the exception of Kentucky and possibly portions of Tennessee, western North Carolina, and northwestern Arkansas, where the species appears broadly distributed, there simply was not historically adequate effort expended to determine how abundant the species was in States such as South Carolina, Georgia, Alabama, Mississippi, and Louisiana. Due to this lack of surveys,

historical variability of winter populations, or lack of standardized data, it is difficult to draw conclusions about winter population trends pre- and post-WNS introduction in this region. Similarly, summer population trends are also difficult to summarize at this time due to a lack of surveys or standardized data.

Western Range

For purposes of organization in this rule, this region includes the following States: South Dakota, North Dakota, Nebraska, Wyoming, Montana, and Kansas. The northern long-eared bat is historically less common in the western portion of its range than in the northern portion of the range (Amelon and Burhans 2006, p. 71), and is considered common in only small portions of the western part of its range (*e.g.,* Black Hills of South Dakota) and uncommon or rare in the western extremes of the range (*e.g.,* Wyoming, Kansas, Nebraska) (Caceres and Barclay 2000, p. 2); however, there has been limited survey effort throughout much of this part of the species' range. To date, WNS has not been found in any of these States.

The northern long-eared bat has been observed hibernating and residing during the summer in the Black Hills National Forest in South Dakota and is considered abundant in the region. Capture and banding data for survey efforts in the Black Hills of South Dakota and Wyoming showed northern long-eared bats to be the second most common bat banded (159 of 878 total bats) during 3 years of survey effort (Tigner and Aney 1994, p. 4). South Dakota contains 21 known hibernacula, all within the Black Hills, 9 of which are abandoned mines (Bessken 2015, pers. comm.). The largest number of northern long-eared bats was observed in a hibernaculum near Hill City, South Dakota; 40 northern long-eared bats were observed in this mine in the winter of 2002–2003 (Tigner and Stukel 2003, pp. 27–28). A summer population was found in the Dakota Prairie National Grassland and Custer National Forest in 2005 (Lausen undated, unpublished data). Using mist-nets and echolocation detectors, northern long-eared bats have also been observed in small numbers in the Buffalo Gap National Grasslands (Tigner 2004, pp. 13–30; Tigner 2005, pp. 7–18). Additionally, northern long-eared bats, including some pregnant females, have been captured during the summer along the Missouri River in South Dakota (Swier 2006, p. 5; Kiesow and Kiesow 2010, pp. 65–66). Swier (2003, p. 25) found that of 52 bats collected in a survey along the Missouri River, 42 percent were northern long-eared bats. Acoustic data recorded by bat monitoring stations operated by the South Dakota Department of Game, Fish, and Parks (SDDGFP) also detected the northern long-eared bat sporadically throughout the State (across 16 counties) in 2011 and 2012 (SDDGFP 2014, in litt.)

Summer surveys in North Dakota (2009–2011) documented the species in the Turtle Mountains, the Missouri River Valley, and the Badlands (Gillam and Barnhart 2011, pp. 10–12). No northern long-eared bat hibernacula are known within North Dakota. During the winters of 2010–2013, Barnhart (2014, unpublished; Western Area Power Administration 2015, in litt.) documented 3 bat hibernacula and 18 potential hibernacula in Theodore Roosevelt National Park; however, no northern long-eared bat were found.

Northern long-eared bats have been observed at two quarries located in east-central Nebraska (Geluso 2011, unpublished data). However, the species is known to summer in the northwestern parts of Nebraska, specifically Pine Ridge in Sheridan County, and a small maternity colony has been recently documented (Geluso *et al.* 2014, p. 2). A reproducing population has also been documented north of Valentine in Cherry County (Benedict *et al.* 2000, pp. 60–61). During an acoustic survey conducted during the summer of 2012, the species was present in Cass County (east-central Nebraska). Similarly, acoustic surveys in Holt County, on the Grand Prairie Wind Farm, observed the northern long-eared bat at five of seven sites (Mattson *et al.* 2014, pp. 2–3). Limestone quarries in Cass County are used as hibernacula by this species and others (White *et al.* 2012, p. 3). White *et al.* (2012, p. 2) state that the bat is uncommon or absent from extreme southeastern Nebraska; however, surveys in Otoe County found two northern long-eared bats, a female and a male, and telemetry surveys identified roosts in the county (Brack and Brack 2014, pp. 52–53).

During acoustic and mist-net surveys conducted throughout Wyoming in the summers of 2008–2011, 32 separate observations of northern long-eared bats were made in the northeast part of the State, and breeding was confirmed (U.S. Forest Service (USFS) 2006, unpublished data; Wyoming Game and Fish Department (WGFD) 2012, unpublished data). Northern long-eared bats have also been observed at Devils Tower National Monument in Wyoming during the summer months, and primarily used forested areas of the monument (NPS 2014, in litt.). To date, there are no known hibernacula in Wyoming, and it is unclear if there are existing hibernacula used by northern long-eared bats, although the majority of potential hibernacula (abandoned mines) within the State occur outside of the northern long-eared bat's range (Tigner and Stukel 2003, p. 27; WGFD 2012, unpublished data).

Montana has only one known record of a northern long-eared bat in the State, a male collected in an abandoned coal mine in 1978 in Richland County (Montana Fish, Wildlife, and Parks (MFWP) 2012, unpublished data). The species has not been reported in eastern Montana since the 1978 record, despite mist-net and acoustic surveys conducted in the eastern portion of the State through 2014 (Montana Natural Heritage Program 2015, in litt.). The specimen of this single bat collected in the State is currently undergoing genetic testing to determine whether the record is indeed a northern long-eared bat (Montana Natural Heritage Program 2015, in litt.; MFWP 2015, in litt.).

In Kansas, the northern long-eared bat was first documented in 1951, when individual bats were documented hibernating in the gypsum mines of Marshall County (Schmidt *et al.* 2015, unpaginated). The status of the gypsum mines as hibernaculum in Kansas is widely unknown. Northern long-eared bats were thought to only migrate through central Kansas until pregnant females were discovered in north-central Kansas in 1994 and 1995 (Sparks and Choate 1995, p. 190). Since then, northern long-eared bats have been considered relatively common in riparian woodlands in Phillips, Rooks, Graham, Osborne, Ellis, and Russel Counties (Schmidt *et al.* 2015, unpaginated).

Canadian Range

The northern long-eared bat occurs throughout the majority of the forested regions of Canada, although it is found in higher abundance in eastern Canada than in western Canada, similar to in the United States (Caceres and Pybus 1997, p. 6). However, the scarcity of records in the western parts of Canada may be due to more limited survey efforts. It has been estimated that approximately 40 percent of the northern long-eared bat's global range is in Canada (Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2012, p. 9). The population size for the northern long-eared bat in Canada is unknown, but likely numbered over a million prior to the 2010 arrival of WNS in Canada (COSEWIC 2013, p. xv1). The range of the northern long-eared bat in Canada includes Alberta, British Columbia,

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Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nova Scotia, Prince Edward Island, Ontario, Quebec, Saskatchewan, and Yukon (COSEWIC 2012, p. 4). There are no records of the species overwintering in Yukon and Northwest Territories (COSEWIC 2012, p. 9).

Habitat

Winter Habitat

Northern long-eared bats predominantly overwinter in hibernacula that include caves and abandoned mines. Hibernacula used by northern long-eared bats vary in size from large, with large passages and entrances (Raesly and Gates 1987, p. 20), to much smaller hibernacula (Kurta 2013, in litt.). These hibernacula have relatively constant, cooler temperatures (0 to 9 degrees Celsius (°C) (32 to 48 degrees Fahrenheit (°F))) (Raesly and Gates 1987, p. 18; Caceres and Pybus 1997, p. 2; Brack 2007, p. 744), with high humidity and no air currents (Fitch and Shump 1979, p. 2; van Zyll de Jong 1985, p. 94; Raesly and Gates 1987, p. 118; Caceres and Pybus 1997, p. 2). The sites favored by northern long-eared bats are often in very high humidity areas, to such a large degree that droplets of water are often observed on their fur (Hitchcock 1949, p. 52; Barbour and Davis 1969, p. 77). Northern long-eared bats, like eastern small-footed bats (*Myotis leibii*) and big brown bats (*Eptesicus fuscus*), typically prefer cooler and more humid conditions than little brown bats, but are less tolerant of drier conditions than eastern small-footed bats and big brown bats (Hitchcock 1949, pp. 52–53; Barbour and Davis 1969, p. 77; Caceres and Pybus 1997, p. 2). Northern long-eared bats are typically found roosting in small crevices or cracks in cave or mine walls or ceilings, sometimes with only the nose and ears visible, and thus are easily overlooked during surveys (Griffin 1940a, pp. 181–182; Barbour and Davis 1969, p. 77; Caire *et al.* 1979, p. 405; van Zyll de Jong 1985, p. 9; Caceres and Pybus 1997, p. 2; Whitaker and Mumford 2009, pp. 209–210). Caire *et al.* (1979, p. 405) and Whitaker and Mumford (2009, p. 208) commonly observed individuals exiting caves with mud and clay on their fur, also suggesting the bats were roosting in tighter recesses of hibernacula. Additionally, northern long-eared bats have been found hanging in the open, although not as frequently as in cracks and crevices (Barbour and Davis 1969, p. 77; Whitaker and Mumford 2009, pp. 209–210). In 1968, Whitaker and Mumford (2009, pp. 209–210) observed three northern long-eared bats roosting in the hollow core of stalactites in a small cave in Jennings County, Indiana.

To a lesser extent, northern long-eared bats have also been observed overwintering in other types of habitat that resemble cave or mine hibernacula, including abandoned railroad tunnels, (Service 2015, unpublished data). Also, in 1952, three northern long-eared bats were found hibernating near the entrance of a storm sewer in central Minnesota (Goehring 1954, p. 435). Kurta *et al.* (1997, p. 478) found northern long-eared bats hibernating in a hydroelectric dam facility in Michigan. In Massachusetts, northern long-eared bats have been found hibernating in the Sudbury Aqueduct (Massachusetts Department of Fish and Game 2012, unpublished data). Griffin (1945, p. 22) found northern long-eared bats in December in Massachusetts in a dry well, and commented that these bats may regularly hibernate in ''unsuspected retreats'' in areas where caves or mines are not present. Although confamilial (belonging to the same taxonomic family) bat species (*e.g.,* big brown bats) have been found using non-cave or mine hibernacula, including attics and hollow trees (Neubaum *et al.* 2006, p. 473; Whitaker and Gummer 1992, pp. 313–316), northern long-eared bats have only been observed over-wintering in suitable caves, mines, or habitat with the same types of conditions found in suitable caves or mines to date.

Summer Habitat

I. Summer Roost Characteristics

During the summer, northern long-eared bats typically roost singly or in colonies underneath bark or in cavities or crevices of both live trees and snags (Sasse and Pekins 1996, p. 95; Foster and Kurta 1999, p. 662; Owen *et al.* 2002, p. 2; Carter and Feldhamer 2005, p. 262; Perry and Thill 2007, p. 222; Timpone *et al.* 2010, p. 119). Males' and nonreproductive females' summer roost sites may also include cooler locations, including caves and mines (Barbour and Davis 1969, p. 77; Amelon and Burhans 2006, p. 72). Northern long-eared bats have also been observed roosting in colonies in human-made structures, such as in buildings, in barns, on utility poles, behind window shutters, and in bat houses (Mumford and Cope 1964, p. 72; Barbour and Davis 1969, p. 77; Cope and Humphrey 1972, p. 9; Burke 1999, pp. 77–78; Sparks *et al.* 2004, p. 94; Amelon and Burhans 2006, p. 72; Whitaker and Mumford 2009, p. 209; Timpone *et al.* 2010, p. 119; Bohrman and Fecske 2013, pp. 37, 74; Joe Kath 2013, pers. comm.).

The northern long-eared bat appears to be somewhat flexible in tree roost selection, selecting varying roost tree species and types of roosts throughout its range. Northern long-eared bats have been documented in roost in many species of trees, including: black oak (*Quercus velutina*), northern red oak (*Quercus rubra*), silver maple (*Acer saccharinum*), black locust (*Robinia pseudoacacia*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), sourwood (*Oxydendrum arboreum*), and shortleaf pine (*Pinus echinata*) (*e.g.,* Mumford and Cope 1964, p. 72; Clark *et al.* 1987, p. 89; Sasse and Pekins 1996, p. 95; Foster and Kurta 1999, p. 662; Lacki and Schwierjohann 2001, p. 484; Owen *et al.* 2002, p. 2; Carter and Feldhamer 2005, p. 262; Perry and Thill 2007, p. 224; Timpone *et al.* 2010, p. 119). Northern long-eared bats most likely are not dependent on certain species of trees for roosts throughout their range; rather, many tree species that form suitable cavities or retain bark will be used by the bats opportunistically (Foster and Kurta 1999, p. 668). Carter and Feldhamer (2005, p. 265) hypothesized that structural complexity of habitat or available roosting resources are more important factors than the actual tree species.

In the majority of northern long-eared bat telemetry studies, roost trees consist predominantly of hardwoods (*e.g.,* Foster and Kurta 1999, p. 662; Lacki and Schwierjohann 2001, p. 484; Broders and Forbes 2004, p. 606). Broders and Forbes (2004, p. 605) reported that female northern long-eared bat roosts in New Brunswick were 24 times more likely to be shade-tolerant, deciduous trees than conifers. Of the few northern long-eared bat telemetry studies in which conifers represented a large proportion of roosts, most were reported as snags (*e.g.,* Cryan *et al.* 2001, p. 45; Jung *et al.* 2004, p. 329). Overall, these data suggest that hardwood trees most often provide the structural and microclimate conditions preferred by maternity colonies and groups of females, which have more specific roosting needs than solitary males (Lacki and Schwierjohann 2001, p. 484), although softwood snags may offer more suitable roosting habitat for both genders than hardwoods (Perry and Thill 2007, p. 222; Cryan *et al.* 2001, p. 45). One reason deciduous snags may be preferred over conifer snags is increased resistance to decay, and consequently roost longevity, of the former (USFS 1998).

Many studies have documented the northern long-eared bat's selection of both live trees and snags, with a range of 10 to 53 percent selection of live roosts found (Sasse and Pekins 1996, p. 95; Foster and Kurta 1999, p. 668; Lacki and Schwierjohann 2001, p. 484; Menzel *et al.* 2002, p. 107; Carter and Feldhamer 2005, p. 262; Perry and Thill 2007, p. 224; Timpone *et al.* 2010, p. 118). Foster and Kurta (1999, p. 663) found 53 percent of roosts in Michigan were in living trees, whereas in New Hampshire, 66 percent of roosts were in live trees (Sasse and Pekins 1996, p. 95). The use of live trees versus snags may reflect the availability of such structures in study areas (Perry and Thill 2007, p. 224) and the flexibility in roost selection when there is a sympatric bat species present (*e.g.,* Indiana bat) (Timpone *et al.* 2010, p. 120). Most telemetry studies describe a greater number of dead than live roosts (*e.g.,* Cryan *et al.* 2001, p. 45; Lacki and Schwierjohann 2001, p. 486; Timpone *et al.* 2010, p. 120; Silvis *et al.* 2012, p. 3). A significant preference for dead or dying trees was reported for northern long-eared bats in Kentucky (Silvis *et al.* 2012, p. 3), Illinois, and Indiana; in South Dakota (Cryan *et al.* 2001, p. 45) and West Virginia, northern long-eared bat roost plots contained a higher than expected proportion of snags (Owen *et al.* 2002, p. 4). Moreover, most studies reporting a higher proportion of live roosts included trees that had visible signs of decline, such as broken crowns or dead branches (*e.g.,* Foster and Kurta 1999, pp. 662,663; Ford *et al.* 2006, p. 20). Thus, the tendency for northern long-eared bats (particularly large maternity colonies) to use healthy live trees appears to be fairly low.

In tree roosts, northern long-eared bats are typically found beneath loose bark or within cavities and have been found to use both exfoliating bark and crevices to a similar degree for summer roosting habitat (Foster and Kurta 1999, p. 662; Lacki and Schwierjohann 2001, p. 484; Menzel *et al.* 2002, p. 110; Owen *et al.* 2002, p. 2; Perry and Thill 2007, p. 222; Timpone *et al.* 2010, p. 119).

Canopy coverage at northern long-eared bat roosts has ranged from 56 percent in Missouri (Timpone *et al.* 2010, p. 118), to 66 percent in Arkansas (Perry and Thill 2007, p. 223), to greater than 75 percent in New Hampshire (Sasse and Pekins 1996, p. 95), to greater than 84 percent in Kentucky (Lacki and Schwierjohann 2001, p. 487). Studies in New Hampshire and British Columbia have found that canopy coverage around roosts is lower than in available stands (Sasse and Pekins 1996, p. 95). Females tend to roost in more open areas than males, likely due to the increased solar radiation, which aids pup development (Perry and Thill 2007, p. 224). Fewer trees surrounding maternity roosts may also benefit juvenile bats that are starting to learn to fly (Perry and Thill 2007, p. 224). However, in southern Illinois, northern long-eared bats were observed roosting in areas with greater canopy cover than in random plots (Carter and Feldhamer 2005, p. 263). Roosts are also largely selected below the canopy, which could be due to the species' ability to exploit roosts in cluttered environments; their gleaning behavior suggests an ability to easily maneuver around obstacles (Foster and Kurta 1999, p. 669; Menzel *et al.* 2002, p. 112).

Results from studies have found the diameters of roost trees selected by northern long-eared bats vary greatly. Some studies have found that the diameter-at-breast height (dbh) of northern long-eared bat roost trees was greater than random trees (Lacki and Schwierjohann 2001, p. 485), and others have found both dbh and height of selected roost trees to be greater than random trees (Sasse and Pekins 1996, p. 97; Owen *et al.* 2002 p. 2). However, other studies have found that roost tree mean dbh and height did not differ from random trees (Menzel *et al.* 2002, p. 111; Carter and Feldhamer 2005, p. 266). Based on a consolidation of data from across the northern long-eared bat range (Sasse and Pekins 1996, pp. 95–96; Schultes 2002, pp. 49, 51; Perry 2014, pers. comm.; Lereculeur 2013, pp. 52–54; Carter and Feldhamer 2005, p. 263; Foster and Kurta 1999, p. 663; Lacki and Schwierjohann 2001, pp. 484–485; Owens *et al.* 2002, p. 3; Timpone *et al.* 2010, p. 118; Lowe 2012, p. 61; Perry and Thill 2007, p. 223; Lacki *et al.* 2009, p. 1,171), roost tree dbh most commonly used (close to 80 percent of over 400 documented maternity tree roosts) by northern long-eared bat maternity colonies range from 10 to 25 centimeters (cm) (4 to 10 inches).

As for elevation of northern long-eared bat roosts, Lacki and Schwierjohann (2001, p. 486) have found that northern long-eared bats roost more often on upper and middle slopes than lower slopes, which suggests a preference for higher elevations, possibly due to increased solar heating. Silvis *et al.* (2012, p. 4), found that selection of mid- and upper-slope roost areas may also be a function of the landscape position, whereby forest stands are most subjected to disturbance (*e.g.,* wind, more intense fire, more drought stress, higher incidence of insect attack) that in turn creates suitable roost conditions among multiple snags and trees within the stand.

Some studies have found tree roost selection to differ slightly between male and female northern long-eared bats. Some studies have found male northern long-eared bats more readily using smaller diameter trees for roosting than females, suggesting males are more flexible in roost selection than females (Lacki and Schwierjohann 2001, p. 487; Broders and Forbes 2004, p. 606; Perry and Thill 2007, p. 224). In the Ouachita Mountains of Arkansas, both sexes primarily roosted in pine snags, although females roosted in snags surrounded by fewer midstory trees than did males (Perry and Thill 2007, p. 224). In New Brunswick, Canada, Broders and Forbes (2004, pp. 606–607) found that there was spatial segregation between male and female roosts, with female maternity colonies typically occupying more mature, shade-tolerant deciduous tree stands and males occupying more conifer-dominated stands. Data from West Virginia at the Fernow Experimental Forest and the former Westvaco Ecosystem Research Forest (both of which contain both relatively unmanaged, older, mature stands; early successional/mid-age stands; and fire-modified stands) suggest that females choose smaller diameter, suppressed understory trees, whereas males often chose larger, sometimes canopy-dominant trees for roosts, perhaps in contrast to other tree-roosting myotids such as Indiana bats (Menzel *et al.* 2002, p. 112; Ford *et al.* 2006, p. 16; Johnson *et al.* 2009a, p. 239). A study in northeastern Kentucky found that males did not use colony roosting sites and were typically found occupying cavities in live hardwood trees, while females formed colonies more often in both hardwood and softwood snags (Lacki and Schwierjohann 2001, p. 486). However, males and nonreproductively active females are found roosting within home ranges of known maternity colonies the majority of the time (1,712 of 1,825 capture records or 94 percent) within Kentucky (Service 2014, unpublished data), suggesting little segregation between reproductive females and other individuals in summer.

II. Summer Roosting Behavior

Northern long-eared bats actively form colonies in the summer (Foster and Kurta 1999, p. 667) and exhibit fission-fusion behavior (Garroway and Broders 2007, p. 961), where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form

smaller groups (fission) before returning to the main unit (Barclay and Kurta 2007, p. 44). As part of this behavior, northern long-eared bats switch tree roosts often (Sasse and Pekins 1996, p. 95), typically every 2 to 3 days (Foster and Kurta 1999, p. 665; Owen *et al.* 2002, p. 2; Carter and Feldhamer 2005, p. 261; Timpone *et al.* 2010, p. 119). In Missouri, the longest time spent roosting in one tree was 3 nights; however, up to 11 nights spent roosting in a human-made structure has been documented (Timpone *et al.* 2010, p. 118). Bats switch roosts for a variety of reasons, including temperature, precipitation, predation, parasitism, sociality, and ephemeral roost sites (Carter and Feldhamer 2005, p. 264). Ephemeral roost sites, with the need to proactively investigate new potential roost trees prior to their current roost tree becoming uninhabitable (*e.g.,* tree falls over), may be the most likely scenario (Kurta *et al.* 2002, p. 127; Carter and Feldhamer 2005, p. 264; Timpone *et al.* 2010, p. 119).

Fission-fusion dynamics also drives maternal roosting behaviors and relatedness within social groups of northern long-eared bats. Patriquin *et al.* (2013, p. 952) found that the average relatedness of social group members (northern long-eared bat individuals in nearby colonies that may occasionally share roosts) was low; however, familiar pairs of females (females that frequently roosted together) were more closely related than expected by chance. Consistent with these genetic findings, Garroway and Broders (2007, p. 960), Patriquin *et al.* (2010, p. 904), and Johnson *et al.* (2011, p. 227) observed nonrandom roosting behaviors, with some female northern long-eared bats roosting more frequently together than with other females.

Roosts trees used by northern long-eared bats are often in fairly close proximity to each other within the species' summer home range. For example, in Missouri, Timpone *et al.* (2010, p. 118) radio-tracked 13 northern long-eared bats to 39 roosts and found the mean distance traveled between roost trees was 0.67 km (0.42 mi) (range 0.05–3.9 km (0.03–2.4 mi)). In Michigan, the longest distance moved by the same bat between roosts was 2 km (1.2 mi), and the shortest was 6 meters (m) (20 feet (ft)) (Foster and Kurta 1999, p. 665). In the Ouachita Mountains of Arkansas, Perry and Thill (2007, p. 22) found that individuals moved among snags that were within less than 2 hectares (ha) (5 acres). Johnson *et al.* (2011, p. 227) found that northern long-eared bats form social groups in networks of roost trees often centered on a central-node roost. Central-node roost trees may be similar to Indiana bat primary roost trees (locations for information exchange, thermal buffering), but they were identified by the degree of connectivity with other roost trees rather than by the number of individuals using the tree (Johnson *et al.* 2011, p. 228).

Spring Staging

Spring staging for the northern long-eared bat is the time period between winter hibernation and spring migration to summer habitat (Whitaker and Hamilton 1998, p. 80). During this time, bats begin to gradually emerge from hibernation, exit the hibernacula to feed, but re-enter the same or alternative hibernacula to resume daily bouts of torpor (state of mental or physical inactivity) (Whitaker and Hamilton 1998, p. 80). The staging period for the northern long-eared bat is likely short in duration (Whitaker and Hamilton 1998, p. 80; Caire *et al.* 1979, p. 405). In Missouri, Caire *et al.* (1979, p. 405) found that northern long-eared bats moved into the staging period in mid-March through early May. In Michigan, Kurta *et al.* (1997, p. 478) determined that by early May, two-thirds of the *Myotis* species, including the northern long-eared bat, had dispersed to summer habitat. Variation in timing (onset and duration) of staging for Indiana bats was based on latitude and weather (Service 2007, pp. 39–40, 42); similarly, timing of staging for northern long-eared bats is likely based on these same factors.

Fall Swarming

The swarming season fills the time between the summer and winter seasons (Lowe 2012, p. 50) and the purpose of swarming behavior may include: Introduction of juveniles to potential hibernacula, copulation, and stopping over sites on migratory pathways between summer and winter regions (Kurta *et al.* 1997, p. 479; Parsons *et al.* 2003, p. 64; Lowe 2012, p. 51; Randall and Broders 2014, pp. 109–110). The swarming season for some species of the genus *Myotis* begins shortly after females and young depart maternity colonies (Fenton 1969, p. 601). During this time, both male and female northern long-eared bats are present at swarming sites (often with other species of bats). During this period, heightened activity and congregation of transient bats around caves and mines is observed, followed later by increased sexual activity and bouts of torpor prior to winter hibernation (Fenton 1969, p. 601; Parsons *et al.* 2003, pp. 63–64; Davis and Hitchcock 1965, pp. 304–306). For the northern long-eared bat, the swarming period may occur between July and early October, depending on latitude within the species' range (Fenton 1969, p. 598; Kurta *et al.* 1997, p. 479; Lowe 2012, p. 86; Hall and Brenner 1968, p. 780; Caire *et al.* 1979, p. 405). The northern long-eared bat may investigate several cave or mine openings during the transient portion of the swarming period, and some individuals may use these areas as temporary daytime roosts or may roost in forest habitat adjacent these sites (Kurta *et al.* 1997, pp. 479, 483; Lowe 2012, p. 51). Many of the caves and mines associated with swarming are also used as hibernacula for several species of bats, including the northern long-eared bat (Fenton 1969, p. 599; Glover and Altringham 2008, p. 1498; Randall and Broders 2014, p. 109; Kurta *et al.* 1997, p. 484; Whitaker and Rissler 1992a, p. 132).

Little is known about northern long-eared bat roost selection outside of caves and mines during the swarming period (Lowe 2012, p. 6). Lowe (2012, pp. 32, 58, 63) documented northern long-eared bats in the Northeast roosting in both coniferous and deciduous trees or stumps as far away as 3 miles (7 km) from the swarming site. Although Lowe (2012, pp. 61, 64) hypothesized that tree roosts used during the fall swarming season would be similar to summer roosts, there was a difference found between summer and fall in the variation in distances bats traveled from the capture site to roost, roost orientation, and greater variation of roost types (*e.g.,* roost species, size, decay class) in the fall. Greater variation among roosts during the swarming season may be a result of the variation in energy demands that individual northern long-eared bats exhibit during this time (Lowe 2012, p. 64; Barclay and Kurta 2007, pp. 31–32).

Biology

Hibernation

Northern long-eared bats hibernate during the winter months to conserve energy from increased thermoregulatory demands and reduced food resources. To increase energy savings, individuals enter a state of torpor, when internal body temperatures approach ambient temperature, metabolic rates are significantly lowered, and immune function declines (Thomas *et al.* 1990, p. 475; Thomas and Geiser 1997, p. 585; Bouma *et al.* 2010, p. 623). Periodic arousal from torpor naturally occurs in all hibernating mammals (Lyman *et al.* 1982, p. 92), although arousals remain among the least understood of hibernation phenomena (Thomas and

Geiser 1997, p. 585). Numerous factors (*e.g.,* reduction of metabolic waste, body temperature, and water balance) have been proposed to account for the occurrence and frequency of arousals (Thomas and Geiser 1997, p. 585). Each time a bat arouses from torpor, it uses a significant amount of energy to warm its body and increase its metabolic rate. The cost and number of arousals are the two key factors that determine energy expenditures of hibernating bats in winter (Thomas *et al.* 1990, p. 475). For example, little brown bats used as much fat during a typical arousal from hibernation as would be used during 68 days of torpor, and arousals and subsequent activity may constitute 84 percent of the total energy used by hibernating bats during the winter (Thomas *et al.* 1990, pp. 477–478).

In general, northern long-eared bats arrive at hibernacula in August or September, enter hibernation in October and November, and emerge from the hibernacula in March or April (Caire *et al.* 1979, p. 405; Whitaker and Hamilton 1998, p. 100; Amelon and Burhans 2006, p. 72). However, hibernation may begin as early as August (Whitaker and Rissler 1992b, p. 56). In Copperhead Cave (a mine) in west-central Indiana, the majority of bats enter hibernation during October, and spring emergence occurs from about the second week of March to mid-April (Whitaker and Mumford 2009, p. 210). In Indiana, northern long-eared bats become more active and start feeding outside the hibernaculum in mid-March, evidenced by stomach and intestine contents. This species also showed spring activity earlier than little brown bats and tri-colored bats (*Perimyotis subflavus*) (Whitaker and Rissler 1992b, pp. 56–57). In northern latitudes, such as in upper Michigan's copper-mining district, hibernation may begin as early as late August and continue for 8 to 9 months (Stones and Fritz, 1969, p. 81; Fitch and Shump 1979, p. 2). Northern long-eared bats have shown a high degree of philopatry (using the same site multiple years) for a hibernaculum (Pearson 1962, p. 30), although they may not return to the same hibernaculum in successive seasons (Caceres and Barclay 2000, p. 2).

Typically, northern long-eared bats were not abundant and composed a small proportion of the total number of bats observed hibernating in a hibernaculum (Barbour and Davis 1969, p. 77; Mills 1971, p. 625; Caire *et al.* 1979, p. 405; Caceres and Barclay 2000, pp. 2–3). Although usually observed in small numbers, the species typically inhabits the same hibernacula with large numbers of other bat species, and occasionally are found in clusters with these other bat species. Other species that commonly occupy the same habitat include little brown bat, big brown bat, eastern small-footed bat, tri-colored bat, and Indiana bat (Swanson and Evans 1936, p. 39; Griffin 1940a, p. 181; Hitchcock 1949, pp. 47–58; Stones and Fritz 1969, p. 79). Whitaker and Mumford (2009, pp. 209–210), however, infrequently found northern long-eared bats hibernating beside little brown bats, Indiana bats, or tri-colored bats. Barbour and Davis (1969, p. 77) found that the species was rarely recorded in concentrations of more than 100 in a single hibernaculum.

Northern long-eared bats have been observed moving among hibernacula throughout the winter, which may further decrease population estimates (Griffin 1940a, p. 185; Whitaker and Rissler 1992a, p. 131; Caceres and Barclay 2000, pp. 2–3). Whitaker and Mumford (2009, p. 210) found that this species flies in and out of some mines and caves in southern Indiana throughout the winter. In particular, the bats were active at Copperhead Cave periodically all winter, with northern long-eared bats being more active than other species (such as little brown bats and tri-colored bats) hibernating in the cave. Though northern long-eared bats fly outside of the hibernacula during the winter, they do not feed; hence the function of this behavior is not well understood (Whitaker and Hamilton 1998, p. 101). It has been suggested, however, that bat activity during winter could be due in part to disturbance by researchers (Whitaker and Mumford 2009, pp. 210–211).

Northern long-eared bats exhibit significant weight loss during hibernation. In southern Illinois, Pearson (1962, p. 30) found an average weight loss of 20 percent during hibernation in male northern long-eared bats, with individuals weighing an average of 6.6 g (0.2 ounces) prior to January 10, and those collected after that date weighing an average of 5.3 g (0.2 ounces). Whitaker and Hamilton (1998, p. 101) reported a weight loss of 41–43 percent over the hibernation period for northern long-eared bats in Indiana. In eastern Missouri, male northern long-eared bats lost an average of 3 g (0.1 ounces), or 36 percent, during the hibernation period (late October through March), and females lost an average of 2.7 g (0.1 ounces), or 31 percent (Caire *et al.* 1979, p. 406).

Migration and Homing

While the northern long-eared bat is not considered a long-distance migratory species, short regional migratory movements between seasonal habitats (summer roosts and winter hibernacula) have been documented between 56 km (35 mi) and 89 km (55 mi) (Nagorsen and Brigham 1993 p. 88; Griffin 1940b, pp. 235, 236; Caire *et al.* 1979, p. 404). Griffin (1940b, pp. 235, 236) reported that a banded male northern long-eared bat had traveled from one hibernaculum in Massachusetts to another in Connecticut over the 2-month period of February to April, a distance of 89 km (55 mi). The spring migration period typically runs from mid-March to mid-May (Caire *et al.* 1979, p. 404; Easterla 1968, p. 770; Whitaker and Mumford 2009, p. 207); fall migration typically occurs between mid-August and mid-October.

Northern long-eared bats have shown a high degree of philopatry (tendency to return to the same location) for a hibernaculum (Pearson 1962), although they may not return to the same hibernaculum in successive seasons (Caceres and Barclay 2000). Banding studies in Ohio, Missouri, and Connecticut show return rates to hibernacula of 5.0 percent (Mills 1971, p. 625), 4.6 percent (Caire *et al.* 1979, p. 404), and 36 percent (Griffin 1940a, p. 185), respectively. An experiment showed an individual bat returned to its home cave up to 32 km (20 mi) away after being removed 3 days prior (Stones and Branick 1969, p. 158).

Reproduction

Mating occurs from late July in northern regions to early October in southern regions and commences when males begin to aggregate around hibernacula and initiate copulation activity (Whitaker and Hamilton 1998, p. 101; Whitaker and Mumford 2009, p. 210; Caceres and Barclay 2000, p. 2; Amelon and Burhans 2006, p. 69). Copulation occasionally occurs again in the spring (Racey 1982, p. 73), and can occur during the winter as well (Kurta 2014, in litt.). Hibernating females store sperm until spring, exhibiting delayed fertilization (Racey 1979, p. 392; Caceres and Pybus 1997, p. 4). Ovulation takes place near the time of emergence from hibernation, followed by fertilization of a single egg, resulting in a single embryo (Cope and Humphrey 1972, p. 9; Caceres and Pybus 1997, p. 4; Caceres and Barclay 2000, p. 2); gestation is approximately 60 days, based on like species (Kurta 1995, p. 71). Males are generally reproductively inactive from April until late July, with testes enlarging in preparation for breeding in most males during August and September (Caire *et al.* 1979, p. 407; Amelon and Burhans 2006, p. 69; Kurta 2013, in litt.).

Maternity colonies, consisting of females and young, are generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3); however, one group of 100 adult females was observed in Vermilion County, Indiana (Whitaker and Mumford 2009, p. 212). In West Virginia, maternity colonies in two studies had a range of 7 to 88 individuals (Owen *et al.* 2002, p. 2) and 11 to 65 individuals, with a mean size of 31 (Menzel *et al.* 2002, p. 110). Lacki and Schwierjohann (2001, p. 485) found that the number of bats within a given roost declined as the summer progressed. Pregnant females formed the largest aggregations (mean=26) and post-lactating females formed the smallest aggregation (mean=4). The largest overall reported colony size of 65 bats. Other studies have also found that the number of individuals roosting together in a given roost typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, p. 667; Lacki and Schwierjohann 2001, p. 485; Garroway and Broders 2007, p. 962; Perry and Thill 2007, p. 224; Johnson *et al.* 2012, p. 227). Female roost site selection, in terms of canopy cover and tree height, changes depending on reproductive stage; relative to pre- and post-lactation periods, lactating northern long-eared bats have been shown to roost higher in tall trees situated in areas of relatively less canopy cover and lower tree density (Garroway and Broders 2008, p. 91).

Adult females give birth to a single pup (Barbour and Davis 1969, p. 104). Birthing within the colony tends to be synchronous, with the majority of births occurring around the same time (Krochmal and Sparks 2007, p. 654). Parturition (birth) likely occurs in late May or early June (Caire *et al.* 1979, p. 406; Easterla 1968, p. 770; Whitaker and Mumford 2009, p. 213), but may occur as late as July (Whitaker and Mumford 2009, p. 213). Broders *et al.* (2006, p. 1177) estimated a parturition date of July 20 in New Brunswick. Lactating and post-lactating females were observed in mid-June in Missouri (Caire *et al.* 1979, p. 407), July in New Hampshire and Indiana (Sasse and Pekins 1996, p. 95; Whitaker and Mumford 2009, p. 213), and August in Nebraska (Benedict 2004, p. 235). Juvenile volancy (flight) often occurs by 21 days after birth (Krochmal and Sparks 2007, p. 651, Kunz 1971, p. 480) and has been documented as early as 18 days after birth (Krochmal and Sparks 2007, p. 651). Subadults were captured in late June in Missouri (Caire *et al.* 1979, p. 407), early July in Iowa (Sasse and Pekins 1996, p. 95), and early August in Ohio (Mills 1971, p. 625).

Maximum lifespan for northern long-eared bats is estimated to be up to 18.5 years (Hall *et al.* 1957, p. 407). Most mortality for northern long-eared bats and many other species of bats occurs during the juvenile stage (Caceres and Pybus 1997, p. 4).

Foraging Behavior

Northern long-eared bats are nocturnal foragers and use hawking (catching insects in flight) and gleaning (picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, p. 88; Ratcliffe and Dawson 2003, p. 851). Observations of northern long-eared bats foraging on arachnids (spiders) (Feldhamer *et al.* 2009, p. 49), presence of green plant material in their feces (Griffith and Gates 1985, p. 456), and non-flying prey in their stomach contents (Brack and Whitaker 2001, p. 207) suggest considerable gleaning behavior. The northern long-eared bat has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Nagorsen and Brigham 1993, p. 88; Brack and Whitaker 2001, p. 207; Griffith and Gates 1985, p. 452), with diet composition differing geographically and seasonally (Brack and Whitaker 2001, p. 208). Feldhamer *et al.* (2009, p. 49) noted close similarities of all *Myotis* diets in southern Illinois, while Griffith and Gates (1985, p. 454) found significant differences between the diets of northern long-eared bats and little brown bats. The most common insects found in the diets of northern long-eared bats are lepidopterans (moths) and coleopterans (beetles) (Brack and Whitaker 2001, p. 207; Lee and McCracken 2004, pp. 595–596; Feldhamer *et al.* 2009, p. 45; Dodd *et al.* 2012, p. 1122), with arachnids also being a common prey item (Feldhamer *et al.* 2009, p. 45). Northern long-eared bats have the highest frequency call of any bat species in the Great Lakes area (Kurta 1995, p. 71). Gleaning allows this species to gain a foraging advantage for preying on moths because moths are less able to detect these high frequency echolocation calls (Faure *et al.* 1993, p. 185).

Most foraging occurs above the understory, 1 to 3 m (3 to 10 ft) above the ground, but under the canopy (Nagorsen and Brigham 1993, p. 88) on forested hillsides and ridges, rather than along riparian areas (Brack and Whitaker 2001, p. 207; LaVal *et al.* 1977, p. 594). This coincides with data indicating that mature forests are an important habitat type for foraging northern long-eared bats (Caceres and Pybus 1997, p. 2). Occasional foraging also takes place over small forest clearings and water, and along roads (van Zyll de Jong 1985, p. 94). Foraging patterns indicate a peak activity period within 5 hours after sunset followed by a secondary peak within 8 hours after sunset (Kunz 1973, pp. 18–19). Brack and Whitaker (2001, p. 207) did not find significant differences in the overall diet of northern long-eared bats between morning (3 a.m. to dawn) and evening (dusk to midnight) feedings; however there were some differences in the consumption of particular prey orders between morning and evening feedings. Additionally, no significant differences existed in dietary diversity values between age classes or sex groups (Brack and Whitaker 2001, p. 208).

Home Range

Northern long-eared bats exhibit site fidelity to their summer home range (Perry 2011, pp. 113–114; Johnson *et al.* 2009a, p. 237; Jackson 2004, p. 87; Foster and Kurta 1999, p. 665). During this period, northern long-eared bats roost (Sasse and Pekins 1996, pp. 95–96; Owen *et al.* 2002, p. 1; Perry and Thill 2007, pp. 224–225; Timpone *et al.* 2010, p. 116) and forage (Owen *et al.* 2003, pp. 354–355; Sheets 2010, pp. 3–4, 18; Tichenell *et al.* 2011, p. 985; Dodd *et al.* 2012, p. 1120) in forests. Their home ranges, which include both the foraging and roosting areas, may vary by sex. Broders *et al.* (2006, p. 1117) found home ranges of females (mean of 8.6 ha (21.3 acres)) to be larger than males (mean of 1.4 ha (3.5 acres)), though Lereculeur (2013, p. 20) found no difference between sexes at a study site in Tennessee. Also, Broders *et al.* (2006, p. 1117) and Henderson and Broders (2008, p. 958) found foraging areas (of either sex) to be six or more times larger than roosting areas. At sites in the Red River Gorge area of the Daniel Boone National Forest, Lacki *et al.* (2009, p. 1169) found female home range size to range from 19 to 172 ha (47 to 425 acres). Owen *et al.* (2003, p. 353) estimated average maternal home range size to be 65 ha (161 acres). Home range size of northern long-eared bats in this study site was small relative to other bat species, but this may be due to the study's timing (during the maternity period) and the small body size of northern long-eared bats (Owen *et al.* 2003, pp. 354–355). The mean distance between roost trees and foraging areas of radio-tagged individuals in New Hampshire was 602 m (1,975 ft) with a range of 60 to 1,719 m (197 to 5,640 ft) (Sasse and Pekins 1996, p. 95). Work on Prince Edward Island by Henderson and

Broders (2008, p. 956) found female northern long-eared bats traveling approximately 1,100 m (3,609 ft) between roosting and foraging areas.

Summary of Factors Affecting the Species

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the northern long-eared bat. There are several factors presented below that affect the northern long-eared bat to a greater or lesser degree; however, we have found that no other threat is as severe and immediate to the northern long-eared bat's persistence as the disease, white-nose syndrome (WNS), discussed below under Factor C. WNS is currently the predominant threat to the species, and if WNS had not emerged or was not affecting the northern long-eared bat populations to the level that it has, we presume the species' would not be experiencing the dramatic declines that it has since WNS emerged. Therefore, although we have included brief discussions of other factors affecting the species, the focus of the discussion below is on WNS.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Hibernation Habitat

Modifications to bat hibernacula, by erecting physical barriers (*e.g.,* doors, gates), to control cave and mine access can affect the microclimate of the subterranean habitat, and thus the ability of the cave or mine to support hibernating bats, including the northern long-eared bat. These well-documented effects on cave-hibernating bat species were discussed in the Service's Indiana Bat Draft Recovery Plan (Service 2007, pp. 71–74). Anthropogenic modifications to cave and mine entrances, such as the addition of restrictive gates or other structures intended to exclude humans, may not only alter flight characteristics and access (Spanjer and Fenton 2005, p. 1110), but may change airflow and alter internal microclimates of the caves and mines, eliminating their utility as hibernacula (Service 2007, p. 71). For example, Richter *et al.* (1993, p. 409) attributed the decline in the number of Indiana bats at Wyandotte Cave, Indiana (which harbors one of the largest known population of hibernating Indiana bats), to an increase in the cave's temperature resulting from restricted airflow caused by a stone wall erected at the cave's entrance. After the wall was removed, the number of Indiana bats increased markedly over the next 14 years (Richter *et al.* 1993, p. 412; Brack *et al.* 2003, p. 67). Similarly, northern long-eared bats were likely negatively impacted when the entrance to John Friend Cave in Maryland was filled with large rocks in 1981, which closed the only known access to the cave (Gates *et al.* 1984, p. 166). We conclude, based on the need for specific hibernation requirements of any cave-hibernating bat, that alteration of hibernacula could result in adverse impacts to individual northern long-eared bats.

In addition to the direct access modifications to caves discussed above, debris buildup at entrances or on cave gates can also significantly modify the cave or mine site characteristics by restricting airflow and the course of natural water flow. Water flow restriction could lead to flooding, thus drowning hibernating bats (Amelon and Burhans 2006, p. 72). For example, in Minnesota, 5 of the 11 known northern long-eared bat hibernacula are subject to flooding, presenting a threat to hibernating bats (Nordquist 2012, pers. comm.). Flooding has been noted in hibernacula in other States within the range of the northern long-eared bat, but to a lesser degree. Although modifications to hibernacula can lead to mortality of northern long-eared bats, we do not conclude it has resulted in population-level effects.

Mining operations, mine passage collapse (subsidence), and mine reclamation activities can also affect bats and their hibernacula. Internal and external collapse of abandoned coal mines was identified as one of the primary threats to northern long-eared bat hibernacula at sites located within the New River Gorge National River and Gauley River National Recreation Area in West Virginia (Graham 2011, unpublished data). In States surveyed for effects to northern long-eared bats by hibernacula collapse, responses varied, with the following number of hibernacula in each State reported (not all States surveyed responded) as susceptible to collapse: 1 (of 7) in Maryland, 3 (of 11) in Minnesota, 1 (of 5) in New Hampshire, 4 (of 15) in North Carolina, 1 (of 2) in South Carolina, and 1 (of 13) in Vermont (Service 2011, unpublished data). Previous and current mining operations pose a direct threat to northern long-eared bat from mine collapse in parts of its range.

Before Federal and State cave protection laws were put in place, there were several reported instances where mines were closed while bats were hibernating, thereby entombing entire colonies (Tuttle and Taylor 1998, p. 8). For the northern long-eared bat, loss of potential winter habitat through mine closures has been noted as a concern in Virginia, although visual inspections of openings are typically conducted to determine whether gating is warranted (Reynolds 2011, unpublished data). In Nebraska, closing quarries, and specifically sealing quarries in Cass and Sapry Counties, is considered a potential threat to northern long-eared bats (Geluso 2011, unpublished data).

In general, threats to the integrity of bat hibernacula have decreased since the Indiana bat was listed as endangered in 1967, and since the implementation of Federal and State cave protection laws and abandoned mine reclamation programs. Increasing awareness about the importance of cave and mine microclimates to hibernating bats and regulation under the Act have helped to alleviate the destruction or modification of hibernation habitat, at least where the Indiana bat and gray bat (*Myotis grisescens*) are present (Service 2007, p. 74). The northern long-eared bat has likely benefited from the protections given to the Indiana bat and the gray bat and their winter habitat, in areas where its range overlaps with those species' ranges.

Disturbance of Hibernating Bats

Human disturbance of hibernating bats has long been considered a threat to cave-hibernating bat species like the northern long-eared bat, and is discussed in detail in the Service's Indiana Bat Draft Recovery Plan (Service 2007, pp. 80–85). The primary forms of human disturbance to hibernating bats results from cave commercialization (cave tours and other commercial uses of caves), recreational caving, vandalism, and research-related activities (Service 2007, p. 80). Arousal during hibernation causes the greatest amount of energy depletion in

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hibernating bats (Thomas *et al.* 1990, p. 477). Human disturbance at hibernacula, specifically non-tactile disturbance such as changes in light and sound, can cause bats to arouse more frequently, causing premature energy store depletion and starvation, as well as increased tactile disturbance amongst bats (Thomas 1995, p. 944; Speakman *et al.* 1991, p. 1103), leading to marked reductions in bat populations (Tuttle 1979, p. 3). Prior to the outbreak of WNS, Amelon and Burhans (2006, p. 73) indicated that ''the widespread recreational use of caves and indirect or direct disturbance by humans during the hibernation period pose the greatest known threat to this species (northern long-eared bat).'' Olson *et al.* (2011, p. 228), hypothesized that an increase in the hibernating bat population (including northern long-eared bats) was related to decreased visits by recreational users and researchers at Cadomin Cave in Alberta, Canada. Bilecki (2003, p. 55) states that the reduction of four species of bats, including the northern long-eared bat, was ''directly related to high human use and abuse'' of a cave. Disturbance during hibernation could cause movements within or between caves (Beer 1955, p. 244).

Of 14 States that assessed the possibility of human disturbance at bat hibernacula within the range of the northern long-eared bat, 13 identified at least 1 known hibernacula as potentially impacted by human disturbance (Service 2012, unpublished data). Eight of these 14 States (Arkansas, Kentucky, Maine, Minnesota, New Hampshire, North Carolina, South Carolina, and Vermont) indicated the potential for human disturbance at over 50 percent of the known hibernacula in that State. Nearly all States without WNS identified human disturbance as the primary threat to hibernating bats, and all others (including WNS-positive States) noted human disturbance as the next greatest threat after WNS or of significant concern (Service 2012, unpublished data).

The threat of commercial use of caves and mines during the hibernation period has decreased at many sites known to harbor Indiana bats, and we conclude that this also applies to northern long-eared bats. However, effects from recreational caving are more difficult to assess. In addition to unintended effects of commercial and recreational caving, intentional killing of bats in caves by shooting, burning, and clubbing has been documented (Tuttle 1979, pp. 4, 8). Intentional killing of northern long-eared bats has been documented at a small percentage of hibernacula (*e.g.,* one case of shooting disturbance in Maryland and one case of bat torching in Massachusetts where approximately 100 bats (northern long-eared bats and other species) were killed) (Service, unpublished data), but we do not have evidence that this is happening on a large enough scale to have population-level effects.

In summary, while there are isolated incidents of previous disturbance to northern long-eared bats from both intentional disturbance and recreational use of caves and mines, we conclude that there is no evidence suggesting that this threat in itself has led to population-level declines.

Summer Habitat

As discussed in detail in the Background (*Biology,* ''I. Summer Roost Characteristics'') section, above, northern long-eared bats require forest for roosting, raising young, foraging, and commuting between roosting and foraging habitat. Northern long-eared bats will also roost in manmade structures, to a lesser extent. The two common causes of loss or modification of habitat are conversion of forest for other land use and forest modification.

I. Forest Conversion

Forest conversion is the loss of forest to another land cover type (*e.g.,* grassland, cropland, development) and may result in: Loss of suitable roosting or foraging habitat; fragmentation of remaining forest patches, leading to longer flights between suitable roosting and foraging habitat; removal of (fragmenting colonies/networks) travel corridors; and direct injury or mortality (during active season clearing). While forest conversion may occur throughout all States within the species' range, impacts to the northern long-eared bat and their habitat typically occur at a more local-scale *(i.e.,* individuals and potentially colonies).

The USFS (2014, p. 7) summarized U.S. forest trends and found a decline from 1850 to the early 1900s, and a general leveling off since that time; therefore, conversion from forest to other land cover types has been fairly stable with conversion to forest (cropland reversion/plantings). For example, according to the U.S. Forest Service's Forest Inventory and Analysis, the amount of forested land within the 37 States and the District of Columbia of the northern long-eared bat's range increased from 414,297,531 acres in 2004 and 2005, to 423,585,498 acres in 2013 (Association of Fish and Wildlife Agencies 2014, in litt; Miles 2014, *http://apps.fs.fed.us/Evalidator/evalidator.jsp*). However, between 2001 and 2006, there was a net loss of 1.2 percent of forest across the United States with most losses in the Southeast and West, and a net loss of interior forest (a forest parcel embedded in a 40-acre landscape that has at least 90 percent forest land cover) of 4.3 percent (USFS 2014, p. 18) throughout the continental United States, which increased forest fragmentation and smaller remaining forest patches. There is some evidence that northern long-eared bats have an affinity for less fragmented habitat (interior forest) (Broders *et al.* 2006, p. 1181; Henderson *et al.* 2008, p. 1825). Also, forest ownership varies widely across the species' range in the United States. Private lands may carry with them a higher risk for conversion than do public forests, a factor that must be considered when assessing risk of forest conversion now and in the future. Private land ownership is approximately 81 percent in the East and 30 percent in the West (USFS 2014, p. 15).

Some of the highest rates of development in the conterminous United States are occurring within the range of the northern long-eared bat (Brown *et al.* 2005, p. 1856), and contribute to loss of forest habitat. The 2010 Resources Planning Act (RPA) Assessment (USFS 2012) summarized findings about the status, trends, and projected future of U.S. forests. This assessment was influenced by a set of scenarios with varying assumptions with regard to global and U.S. population, economic growth, climate change, wood energy consumption, and land use change from 2010 to 2060. It projects forest losses of 6.5–13.8 million ha (16–34 million acres or 4–8 percent of 2007 forest area) across the conterminous United States, and forest loss is expected to be concentrated in the southern United States, with losses of 3.6–8.5 million ha (9–21 million acres) (USFS 2012, p. 12).

Wind energy development continues to increase throughout the northern long-eared bat's range. Iowa, Illinois, Oklahoma, Minnesota, Kansas, and New York are amongst the top 10 States for wind energy capacity (installed projects) in the United States (American Wind Energy Association (AWEA) 2013, unpaginated). If projects are sited in forested habitats, effects from wind energy development may include tree-clearings associated with turbine placement, road construction, turbine lay-down areas, transmission lines, and substations. See *Factor E. Other*

Natural or Manmade Factors Affecting Its Continued Existence for a Discussion on Effects to Bats From the Operation of Wind Turbines

Surface coal mining is common in the central Appalachian region, which includes portions of Pennsylvania, West Virginia, Virginia, Kentucky, Ohio, and Tennessee, and is one of the major drivers of land cover change in the region (Sayler 2008, unpaginated). Surface coal mining may also destroy forest habitat in parts of the Illinois Basin in southwest Indiana, western Kentucky, and Illinois (King 2013, pers. comm.).

Natural gas extraction is expanding across the United States, particularly throughout the range of the northern long-eared bat. Natural gas extraction involves fracturing rock formations using highly pressurized water and other various chemicals (Hein 2012, p. 1). Natural gas extraction and transmission, particularly across the Marcellus Shale region, which includes large portions of New York, Pennsylvania, Ohio, and West Virginia, is expected to expand over the coming years. In Pennsylvania, for example, nearly 2,000 Marcellus natural gas wells have already been drilled or permitted, and if development trends continue, as many as 60,000 more could be built by 2030 (Johnson 2010, pp. 8, 13). Habitat necessary for establishing maternity colonies and foraging may be lost and degraded due to the practice of forest clearing for well pads and associated infrastructures (*e.g.,* roads, pipelines, and water impoundments). These actions could decrease the amount of suitable interior forest habitat available to northern long-eared bats.

There are a variety of reasons forests are being converted (*e.g.,* urban development, energy production, and transmission) within the range of the northern long-eared bat. Impacts to northern long-eared bats from loss of forest vary depending on the timing, location, and extent of the removal. While bats can sometimes flee during tree removal, removal of occupied roosts (during spring through fall) is likely to result in direct injury or mortality to some northern long-eared bats. This is particularly likely during cool spring months (when bats enter torpor) and if flightless pups or inexperienced flying juveniles are also present. Removal of forest outside of northern long-eared bat summer home range, or away from hibernacula, would not likely directly impact the species. However, removal of forest within a summer home range (regardless of when it is removed) may negatively impact the species, depending on the extent of removal and the amount of remaining suitable roosting and foraging habitat.

Some portions of the northern long-eared bat's range are more forested than others. In areas with little forest or highly fragmented forests (*e.g.,* western U.S. edge of the range, central Midwestern states; see Figure 1, above), impact of forest loss would be disproportionately greater than similar-sized losses in heavily forested areas (*e.g.,* Appalachians and northern forests). Also, the impact of habitat loss within a northern long-eared bat's home range is expected to vary depending on the scope of removal. Northern long-eared bats are flexible in which tree species they select as roosts, and roost trees are an ephemeral resource; therefore, the species likely can tolerate some loss of roosts, provided suitable alternative roosts are available. Silvis *et al.* (2014, pp. 283–290) modeled roost loss of northern long-eared bats, and Silvis *et al.* (2015, pp. 1–17) removed known northern long-eared bat roosts during the winter in the field to determine how this would impact the species. Once removals totaled 20–30 percent of known roosts, a single maternity colony network started showing patterns of break-up. Sociality is hypothesized to increase reproductive success (Silvis *et al.* 2014, p. 283), and smaller colonies would be expected to have reduced reproductive success.

Longer flights to find alternative suitable habitat and colonial disruption may result from removal of roosting or foraging habitat. Northern long-eared bats emerge from hibernation with their lowest annual fat reserves, and return to their summer home ranges. Because northern long-eared bats have summer home range fidelity (Foster and Kurta 1999, p. 665; Patriquin *et al.* 2010, p. 908; Broders *et al.* 2013, p. 1180), loss or alteration of forest habitat may put additional stress on females when returning to summer roost or foraging areas after hibernation. Females (often pregnant) have limited energy reserves available for use if forced to seek out new roosts or foraging areas. Hibernation and reproduction are the most energetically demanding periods for temperate-zone bats, including the northern long-eared bat (Broders *et al.* 2013, p. 1174). Bats may reduce metabolic costs of foraging by concentrating efforts in areas of known high prey profitability, a benefit that could result from the bat's local roosting and home range knowledge and site fidelity (Broders *et al.* 2013, p. 1181). Cool spring temperatures provide an additional energetic demand, as bats need to stay sufficiently warm or enter torpor. Entering torpor comes at a cost of delayed parturition; bats born earlier in the year have a greater chance of surviving their first winter and breeding in their first year of life (Frick *et al.* 2010b, p. 133). Delayed parturition may also be costly because young of the year and adult females would have less time to prepare for hibernation (Broders *et al.* 2013, p. 1180). Female northern long-eared bats typically roost colonially, with their largest population counts occurring in the spring (Foster and Kurta 1999, p. 667), presumably as one way to reduce thermal costs for individual bats (Foster and Kurta 1999, p. 667). Therefore, similar to other temperate bats, northern long-eared bats have multiple high metabolic demands (particularly in spring), and must have sufficient suitable roosting and foraging habitat available in relatively close proximity to allow for successful reproduction.

In summary, U.S. forest area trends have remained relatively stable with some geographic regions facing more conversion than others in the recent past. In the future, forest conversion is expected to increase, whether from commercial or residential development, energy production, or other pressures on forest lands. While monitoring efforts for impacts to northern long-eared bats from forest conversion did not often occur in the past, we expect that impacts likely occurred, but the species appears to have been resilient to these impacts prior to the emergence of WNS. In areas where WNS is present, there are additional energetic demands for northern long-eared bats. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder *et al.* 2012, p. 8; Warnecke *et al.* 2012, p. 7001) and have wing damage (Meteyer *et al.* 2009, p. 412; Reichard and Kunz 2009, p. 458) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, successful pregnancy and pup-rearing, and healing. Current and future forest conversion may have negative additive impacts where the species has been impacted by WNS. Impacts from forest conversion to individuals or colonies would be expected to range from indirect impact (*e.g.,* minor amounts of forest removal in areas outside northern long-eared bat summer home ranges or away from hibernacula) to minor (*e.g.,* largely forested areas, areas with robust northern long-eared bat populations) to significant (*e.g.,* removal of a large percentage of summer home range,

highly fragmented landscapes, areas with WNS impacts).

II. Forest Management

Unlike forest conversion, forest management maintains forest habitat on the landscape, and the impacts from management activities are for the most part considered temporary in nature. Forest management includes multiple practices, and this section specifically addresses timber harvest. Timber harvesting includes a wide variety of practices from selected harvest of individual trees to clearcutting. Impacts from forest management would be expected to range from positive (*e.g.,* maintaining or increasing suitable roosting and foraging habitat within northern long-eared bat home ranges) to neutral (*e.g.,* minor amounts forest removal, areas outside northern long-eared bat summer home ranges or away from hibernacula) to negative (*e.g.,* death of adult females or pups or both).

The best available data indicate that the northern long-eared bat shows a varied degree of sensitivity to timber harvesting practices. For example, Menzel *et al.* (2002, p. 112) found northern long-eared bats roosting in intensively managed stands in West Virginia; indicating that there were sufficient suitable roosts (primarily snags) remaining for their use. At the same study site, Owen *et al.* (2002, p. 4) concluded that northern long-eared bats roosted in areas with abundant snags, and that in intensively managed forests in the central Appalachians, roost availability was not a limiting factor. Northern long-eared bats often chose black locust and black cherry as roost trees, which were quite abundant and often regenerate quickly after disturbance (*e.g.,* timber harvest). Similarly, Perry and Thill (2007, p. 222) tracked northern long-eared bats in central Arkansas and found roosts were located in eight forest classes with 89 percent in three classes of mixed pine-hardwood forest. The three classes of mixed pine-hardwood forest that supported the majority of the roosts were partially harvested or thinned, unharvested (50–99 years old), and group selection harvest (Perry and Thill 2007, pp. 223–224).

Certain levels of timber harvest may result in canopy openings, which could result in more rapid development of bat young. In central Arkansas, Perry and Thill (2007, pp. 223–224) found female bat roosts were more often located in areas with partial harvesting than males, with more male roosts (42 percent) in unharvested stands than female roosts (24 percent). They postulated that females roosted in relatively more open forest conditions because they may receive greater solar radiation, which may increase developmental rates of young or permit young bats a greater opportunity to conduct successful initial flights (Perry and Thill 2007, p. 224). Cryan *et al.* (2001, p. 49) found several reproductive and nonreproductive female northern long-eared bat roost areas in recently harvested (less than 5 years) stands in the Black Hills of South Dakota in which snags and small stems (dbh of 2 to 6 inches (5 to 15 cm)) were the only trees left standing; however, the largest colony (n = 41) was found in a mature forest stand that had not been harvested in more than 50 years.

Forest size and continuity are also factors that define the quality of habitat for roost sites for northern long-eared bats. Lacki and Schwierjohann (2001, p. 487) stated that silvicultural practices could meet both male and female roosting requirements by maintaining large-diameter snags, while allowing for regeneration of forests. Henderson *et al.* (2008, p. 1825) also found that forest fragmentation effects northern long-eared bats at different scales based on sex; females require a larger unfragmented area with a large number of suitable roost trees to support a colony, whereas males are able to use smaller, more fragmented areas. Henderson and Broders (2008, pp. 959–960) examined how female northern long-eared bats use the forest-agricultural landscape on Prince Edward Island, Canada, and found that bats were limited in their mobility and activities are constrained when suitable forest is limited. However, they also found that bats in a relatively fragmented area used a building for colony roosting, which suggests an alternative for a colony to persist in an area with fewer available roost trees.

In addition to impacts on roost sites, we consider effects of forest management practices on foraging and traveling behaviors of northern long-eared bats. In southeastern Missouri, the northern long-eared bat showed a preference for contiguous tracts of forest cover (rather than fragmented or wide open landscapes) for foraging or traveling, and different forest types interspersed on the landscape increased likelihood of occupancy (Yates and Muzika 2006, p. 1245). Similarly, in West Virginia, female northern long-eared bats spent most of their time foraging or travelling in intact forest, diameter-limit harvests (70–90 year-old stands with 30–40 percent of basal area removed in the past 10 years), and road corridors, with no use of deferment harvests (similar to clearcutting) (Owen *et al.* 2003, p. 355). When comparing use and availability of habitats, northern long-eared bats preferred diameter-limit harvests and forest roads. In Alberta, Canada, northern long-eared bats avoided the center of clearcuts and foraged more in intact forest than expected (Patriquin and Barclay 2003, p. 654). On Prince Edward Island, Canada, female northern long-eared bats preferred open areas less than forested areas, with foraging areas centered along forest-covered creeks (Henderson and Broders 2008, pp. 956–958). In mature forests in South Carolina, 10 of the 11 stands in which northern long-eared bats were detected were mature stands (Loeb and O'Keefe 2006, p. 1215). Within those mature stands, northern long-eared bats were more likely to be recorded at points with sparse or medium vegetation rather than points with dense vegetation, suggesting that some natural gaps within mature forests can provide good foraging habitat for northern long-eared bats (Loeb and O'Keefe 2006, pp. 1215–1217). However, in southwestern North Carolina, Loeb and O'Keefe (2011, p. 175) found that northern long-eared bats rarely used forest openings, but often used roads. Forest trails and roads may provide small gaps for foraging and cover from predators (Loeb and O'Keefe 2011, p. 175). In general, northern long-eared bats prefer intact mixed-type forests with small gaps (*i.e.,* forest trails, small roads, or forest-covered creeks) in forest with sparse or medium vegetation for forage and travel rather than fragmented habitat or areas that have been clearcut.

Impacts to northern long-eared bats from forest management would be expected to vary depending on the timing of removal, location (within or outside northern long-eared bat home range), and extent of removal. While bats can flee during tree removal, removal of occupied roosts (during spring through fall) is likely to result in direct injury or mortality to some percentage of northern long-eared bats. This percentage would be expected to be greater if flightless pups or inexperienced flying juveniles were also present. Forest management outside of northern long-eared bat summer home ranges or away from hibernacula would not be expected to result in impacts to this species. However, forest management within a summer home range (regardless of when it is removed) may result in impacts to this species, depending on the extent of removal and amount of remaining suitable roosting and foraging habitat.

Unlike forest conversion, forest management is not usually expected to

result in a permanent loss of suitable roosting or foraging habitat for northern long-eared bats. On the contrary, forest management is expected to maintain a forest over the long term for the species. However, localized long-term reductions in suitable roosting and/or foraging habitat can occur from various forest practices (*e.g.,* clearcuts). As stated above, northern long-eared bats have been found in forests that have been managed to varying degrees, and as long as there is sufficient suitable roosting and foraging habitat within their home range and travel corridors between those areas, we would expect northern long-eared bat colonies to continue to occur in managed landscapes. However, in areas with WNS, we believe northern long-eared bats are likely less resilient to stressors and maternity colonies are smaller. Given the low inherent reproductive potential of northern long-eared bats (max of one pup per female), death of adult females or pups or both during tree felling reduces the long-term viability of those colonies.

Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range

Although there are various forms of habitat destruction and disturbance that present potential adverse effects to the northern long-eared bat, they are not considered the predominant threat to the species. Even if all habitat-related stressors were eliminated or minimized, the significant effects of WNS on the northern long-eared bat would remain. Therefore, below we present a few examples, but not a comprehensive list, of conservation efforts that have been undertaken to lessen effects from habitat destruction or disturbance to the northern long-eared bat.

Direct protection of caves and mines can be accomplished through installation of bat-friendly gates that allow passage of bats while reducing disturbance from human entry as well as changes to the cave microclimate from air restrictions. One of the threats to bats in Michigan is the closure of unsafe mines in such a way that bats are trapped within or excluded; however, there have been efforts by the Michigan Department of Natural Resources and others to work with landowners who have open mines to encourage them to install bat-friendly gates to close mines to humans, but allow access to bats (Hoving 2011, unpublished data). The NPS has proactively taken steps to minimize effects to underground bat habitat resulting from vandalism, recreational activities, and abandoned mine closures (Plumb and Budde 2011, unpublished data). In addition, the NPS is properly gating abandoned coal mine entrances, using a ''bat-friendly'' design, as funding permits (Graham 2011, unpublished data). All known hibernacula within national grasslands and forestlands of the Rocky Mountain Region of the USFS are closed during the winter hibernation period, primarily due to the threat of WNS, although this will reduce disturbance to bats in general inhabiting these hibernacula (USFS 2013, unpaginated). Because of concern over the importance of bat roosts, including hibernacula, the American Society of Mammalogists developed guidelines for protection of roosts, many of which have been adopted by government agencies and special interest groups (Sheffield *et al.* 1992, p. 707).

Many States are also taking a proactive stance to conserve and restore forest and riparian habitats with specific focus on maintaining forest patches and connectivity. For example, Montana is developing best management practices for riparian habitat protection. Other States have established habitat protection buffers around known Indiana bat hibernacula that will also serve to benefit northern long-eared bat by maintaining sufficient quality and quantity of swarming habitat. Some States have also limited tree-clearing activities to the winter, as a measure that would protect maternity colonies and non-volant pups during summer months. Many States are undertaking research and monitoring efforts to gain more information about habitat needs of and use by northern long-eared bat.

Summary of the Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

We have identified several potential threats to the northern long-eared bat due to impacts to their winter and summer habitats. Winter habitat may be impacted by both human and non-human modification of hibernacula, particularly damaging is the altering or closing of hibernacula entrances. These modifications can lead to a partial or complete loss of utility as hibernacula. Humans can also disturb hibernating bats, either directly or indirectly, potentially resulting in an increase in energy consuming arousal bouts during hibernation (Thomas 1995, pp. 940–945; Johnson *et al.* 1998, pp. 255–260). Human disturbance at hibernacula has been identified by many States as the next greatest threat after WNS.

During the summer, northern long-eared bat habitat loss is primarily due to forest conversion and forest management. Throughout the range of northern long-eared bats, forest conversion is expected to increase due to commercial and urban development, energy production and transmission, and natural changes. Forest conversion can result in a myriad of effects to the species, including direct loss of habitat, fragmentation of remaining habitat, and direct injury or mortality. Forest management activities, unlike forest conversion, typically result in temporary (non-permanent) impacts to northern long-eared bat summer habitat. The impact of management activities may be positive, neutral, or negative to the northern long-eared bat depending on scale, the management practice, and timing. However, these potential impacts can be greatly reduced with the use of measures that avoid or minimize effects to bats and their habitat. Potential benefits to the species from forest management practices include keeping forest on the landscape and creation and management of roosting and foraging habitat (from some forest management practices).

Many activities continue to pose a threat to the summer and winter habitats of northern long-eared bats. While, these activities alone were unlikely to have significant, population-level effects, there is now likely a cumulative effect on the species in portions of range that have been impacted by WNS. Also, there have been numerous conservation efforts directed at lessening the effects of habitat destruction or disturbance on the species, including cross-State and cross-agency collaboration on habitat restoration and hibernacula protection.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

There are very few records of the northern long-eared bat being collected specifically for commercial, recreational, scientific, or educational purposes, and thus we do not consider such collection activities to pose a threat to the species. Disturbance of hibernating bats as a result of recreational use and scientific research activities in hibernacula is discussed under Factor A.

Factor C. Disease or Predation

Disease

I. White-Nose Syndrome

White-nose syndrome (WNS) is an emerging infectious wildlife disease that poses a considerable threat to hibernating bat species throughout North America (Service 2011, p. 1). WNS is responsible for unprecedented mortality of insectivorous bats in

eastern North America (Blehert *et al.* 2009, p. 227; Turner *et al.* 2011, pp. 13, 22). The first evidence of the disease (a photo of bats with fungus) was documented at Howes Cave in Schoharie County, New York, 32 mi (52 km) west of Albany, on February 16, 2006, but WNS was not actually discovered until January 2007, when it was found at four additional caves around Schoharie County (Blehert *et al.* 2009, p. 227). Since that time, WNS has spread rapidly throughout the Northeast, Southeast, Midwest, and eastern Canada. As of February 2015, WNS has been confirmed (meaning one or more bats in the State have been analyzed and confirmed with the disease) in 25 States (Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin) and 5 Canadian provinces (New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec). Although WNS has not been confirmed in Rhode Island (2 known hibernacula) or the District of Columbia (no known hibernacula), their size and proximity to heavily impacted WNS-confirmed States make it reasonable to conclude that bat populations are also affected by WNS there. Three additional States (Iowa, Minnesota, and Mississippi) are considered suspect for WNS based on the detection of the causative fungus, Pd (Lorch *et al.* 2011, pp. 376–379; Muller *et al.* 2013, pp. 253–259), on bats within those States, but no mortality or other signs of the disease have been documented at those locations as of December 2014. Evidence suggestive of the presence of Pd on one bat in Oklahoma was recently reassessed, and it was concluded that those initial findings are no longer supported (United States Geologic Survey (USGS) 2014, p. 1). Therefore, Oklahoma is no longer considered a suspect (meaning Pd confirmed) State for WNS. Table 1 (below) provides a summary of the States in which WNS is currently present.

State or district	WNS present?	First winter WNS confirmed	Documented WNS mortality in bats
Alabama	Yes	2011–2012	Yes.
Arkansas	Yes	2013–2014	Yes.
Connecticut	Yes	2007–2008	Yes.
District of Columbia	Unknown.		
Delaware	Yes	2011–2012	Yes.
Georgia	Yes	2012–2013	Yes.
Illinois	Yes	2012–2013	Yes.
Indiana	Yes	2010–2011	Yes.
Iowa	Pd	Pd only (2011–2012)	No.
Kansas	No.		
Kentucky	Yes	2010–2011	Yes.
Louisiana	No.		
Maine	Yes	2010–2011	Yes.
Maryland	Yes	2009–2010	Yes.
Massachusetts	Yes	2007–2008	Yes.
Michigan	Yes	2013–2014	Yes.
Minnesota	Pd	Pd only (2011–2012)	No.
Mississippi	Pd	Pd only (2013–2014)	No.
Missouri	Yes	2011–2012	Yes.
Montana	No.		
Nebraska	No.		
New Hampshire	Yes	2008–2009	Yes.
New Jersey	Yes	2008–2009	Yes.
New York	Yes	2006–2007	Yes.
North Carolina	Yes	2010–2011	Yes.
North Dakota	No.		
Oklahoma	No.		
Ohio	Yes	2010–2011	Yes.
Pennsylvania	Yes	2008–2009	Yes.
Rhode Island	Unknown.		
South Carolina	Yes	2012–2013	No.
South Dakota	No.		
Tennessee	Yes	2009–2010	Yes.
Vermont	Yes	2007–2008	Yes.
Virginia	Yes	2008–2009	Yes.
West Virginia	Yes	2008–2009	Yes.
Wisconsin	Yes	2013–2014	Yes.
Wyoming	No.		

Seven species of North American hibernating bats have been confirmed with WNS to date: big brown bat, gray bat, eastern small-footed bat, little brown bat, northern long-eared bat, Indiana bat, and tricolored bat. The effect of WNS appears to vary greatly by species, with several species exhibiting high mortality and others showing low or no appreciable population-level effects (Turner *et al.* 2011, p. 13). The fungus that causes WNS has been detected on five additional species, but with no evidence of the infection characteristic of the disease; these include Rafinesque's big-eared bat (*Corynorhinus rafinesquii*), Virginia big-eared bat (*C. townsendii virginianus*), silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and southeastern bat (*Myotis austroriparius*).

The impacts of WNS on North American bat populations have been

substantial. Service and State biologists estimate that at least 5.7 million to 6.7 million bats of several species have died from WNS (Service 2012, p. 1). Dzal *et al.* (2011, p. 393) documented a 78 percent decline in the summer activity of little brown bats in New York State, coinciding with the arrival and spread of WNS, suggesting large-scale population effects. Turner *et al.* (2011, p. 22) reported an 88 percent decline in the number of all hibernating bats at 42 sites across New York, Pennsylvania, Vermont, Virginia, and West Virginia. Furthermore, Frick *et al.* (2010a, p. 681) concluded that the little brown bat, formerly the most common bat in the northeastern United States, is undergoing catastrophic declines in the region due to WNS, and is at risk of regional extirpation in the near future. Similarly, Thogmartin *et al.* (2013, p. 171) predicted that WNS is likely to extirpate the federally endangered Indiana bat over large parts of its range. While recent models by Ingersoll *et al.* (2013, p. 8) have raised some questions about the status of bat populations prior to the arrival of WNS, the empirical evidence from surveys of six species of hibernating bats in New York State, revealed populations that were likely stable or increasing prior to the emergence of WNS (Service 2011, p. 1). Subsequent to the emergence of WNS, decreases in some species of bats at affected hibernacula have ranged from 30 to 100 percent (Frick *et al.* 2010a, p. 680; Turner *et al.* 2011, pp. 16–19, 22).

The pattern of spread of WNS has generally followed predictable trajectories along recognized migratory pathways and overlapping summer ranges of hibernating bat species, with some exception. The range expansion of WNS and Pd has not only been limited to known migratory movements of bats. Kunz and Reichard (2010, p. 12) assert that WNS is spread and transmitted mainly through bat-to-bat contact; however, evidence suggests that fungal spores can be transmitted by humans (USGS National Wildlife Health Center (NWHC), Wildlife Health Bulletin 2011–05, unpaginated), and bats can also become infected by coming into contact with contaminated cave substrate (Darling and Hicks 2012, pers. comm.).

White-nose syndrome is caused by the psychrophilic (cold-loving) fungus Pd, which is likely exotic to North America, and only recently arrived on the continent (Puechmaille *et al.* 2011, p. 8; Foster, pers. comm.; Warnecke *et al.* 2012, p. 7001). The fungus grows on and within exposed soft tissues of hibernating bats (Lorch *et al.* 2011, p. 376; Gargas *et al.* 2009, pp. 147–154), and the resulting mycelium (vegetative part of fungus) is the white filamentous growth visible on the muzzle, ears, or flight membranes (wings and tail) of affected bats that is characteristic of WNS. Epidermal (skin) erosions that are filled with fungal hyphae (branching, filamentous structures of fungi) are the diagnostic standard for WNS (Blehert *et al.* 2009, p. 227; Meteyer 2009, p. 412). Pd grows optimally at temperatures from 5 to 16 °C (41 to 61 °F), the same temperature range at which North American bats typically hibernate (Blehert *et al.* 2009, p. 227; Verant *et al.* 2012, p. 4). The temperature in caves that serve as bat hibernacula ranges from 2 to 14 °C (36 to 57 °F), permitting year-round persistence and growth of the fungus on cave substrates, allowing such hibernacula to serve as a reservoir for maintaining the fungus through summer months in the absence of bats (Blehert *et al.* 2009, p. 227; Reynolds *et al.* 2015, unpaginated). Growth is relatively slow at optimal temperatures (5 to 16 °C (41 to 61 °F)), and no growth occurs at temperatures above 21.4 °C (75 °F) (Blehert *et al.* 2009, p. 227; Verant *et al.* 2012, pp. 4, 6). Although Pd does not grow above 21.4 °C, it is known to remain viable for extended periods of time above that temperature (Lorch *et al.* 2013, p. 237; Hoyt *et al.* 2014, pp. 2–3). Declines in Indiana bats have been greater under more humid conditions, suggesting that growth of the fungus and either intensity or prevalence of infections are higher in more humid conditions (Langwig *et al.* 2012, p. 1055). However, the effect of humidity on impacts of WNS in bat populations may vary among species. Furthermore, fungal load and prevalence varies among species in WNS-infected sites (Langwig *et al.* 2015, p. 4).

Although Pd has been isolated from numerous bat species in Europe, it is hypothesized that these species have evolved in the presence of the fungus (Wibbelt *et al.* 2010, p. 1241). Pikula *et al.* (2012, p. 210) confirmed that bats found dead in the Czech Republic exhibited lesions consistent with WNS infection; however, the authors also stated that the lesions were not believed to have contributed to the cause of death for those individuals. In all, there are now 12 European bat species, including one Rhinolophid in the sub-order Megachiroptera, that have been confirmed with the WNS disease (Zukal *et al.* 2014, p. 8) (based on the case definitions established in North America (USGS, NWHC 2014, unpaginated)), although no mortality has been documented to date in Europe. This point illustrates the fact that Pd is capable of infecting a wide variety of bat hosts across a large spatial scale.

Bats affected by WNS are characterized by some or all of the following signs: (1) Excessive or unexplained mortality at or near the hibernaculum; (2) visible fungal growth on wing and tail membranes, the muzzle, or the ears of live or recently dead bats; (3) abnormal behaviors including conspicuous daytime activity outside of the hibernaculum, shifts of large numbers to the cold areas near the entrance or elsewhere in the hibernaculum, and decreased arousal with human disturbance inside hibernaculum (torpid bats responding to noise and vibrations in the cave); (4) moderate to severe wing damage in nontorpid bats; and (5) and depleted fat reserves by mid-winter (USGS, NWHC 2012, p. 1; Service 2011, p. 2). Although the exact process or processes by which WNS leads to death remains unconfirmed, we do know that the fungal infection is responsible, and it is possible that reduced immune function during torpor compromises the ability of hibernating bats to combat the infection (Bouma *et al.* 2010, p. 623; Moore *et al.* 2011, p. 10; Moore *et al.* 2013, pp. 6–7; Reeder *et al.* 2012, p. 8; Johnson *et al.* 2014, unpaginated). It has also been hypothesized that immune reconstitution inflammatory syndrome (IRIS) causes mortality when systemic Pd-infections established during torpor initiate a massive inflammatory response when the infected bat emerges from hibernation (Meteyer *et al.* 2012, pp. 585, 587).

No information was known about Pd and WNS prior to 2007. Early working hypotheses demonstrated that it was not known whether WNS-affected bats before the hibernation season began or if bats arrived at hibernacula sites unaffected and entered hibernation with sufficient fat stores (WNS Science Strategy Group 2008, p. 7). Hibernating bats rely on stored fats to survive winter months, when insect prey is not available. In a related study, 12 of 14 bats (10 little brown bats, 1 big-brown bat, and 1 tri-colored bat) had appreciable degree of fat stores, even though they were infected with WNS and were on the lower end of the normal range of body weight (Courtin *et al.* 2010, p. 214). Further research has lead scientists to suggest that bats are capable of clearing fungal infections during the summer in some areas, and are likely re-infected with Pd when they return to swarming sites or hibernacula in the fall (Langwig *et al.* 2015, p. 6). However, Dobony (2014, pers. comm.) noted the presence of viable Pd in a maternity roost throughout summer

months, indicating that in some situations bats can be exposed to the fungus year-round. Boyles and Willis (2010, pp. 92–98) hypothesized that infection by Pd alters the normal arousal cycles of hibernating bats, particularly by increasing arousal frequency, duration, or both. In fact, Reeder *et al.* (2012, p. 5) and Warnecke *et al.* (2012, p. 2) observed an increase in arousal frequency in laboratory studies of hibernating bats infected with Pd. A disruption of this torpor–arousal cycle could cause bats to metabolize fat reserves too quickly, thereby leading to starvation (Warnecke *et al.* 2012, p. 4). The root cause of these increased arousal bouts remains under investigation, but some have suggested that skin irritation from the fungus might cause bats to arouse and remain out of torpor for longer than normal to groom (Boyles and Willis 2010, p. 93). Routine arousal bouts serve to maintain critical conditions like water balance and immune function; however, arousals are energetically costly, and anything resulting in greater energy expenditure has the potential to cause mortality.

It has also been hypothesized that resulting mortality from infection of Pd is due specifically to fungal infection of bats' wings. Cryan *et al.* (2010, pp. 135–142) suggests that mortality may be caused by catastrophic disruption of wing-dependent physiological functions. The authors also hypothesized that Pd may cause dehydration, trigger thirst-associated arousals, cause significant circulatory and thermoregulatory disturbance, disrupt respiratory gas exchange, and destroy wing structures necessary for flight control (Cryan *et al.* 2010, p. 141). Further, the wings of winter-collected WNS-affected bats often reveal signs of infection, and the degree of damage observed suggests functional impairment (Willis *et al.* 2011, pp. 370–371; Cryan *et al.* 2010, pp. 137–138). In related research, Cryan *et al.* (2013, p. 398) found that electrolytes tended to decrease as wing damage increased in severity; electrolytes are necessary for maintaining physiological homeostasis, and any imbalance could be life-threatening (Cryan *et al.* 2013, p. 398). Again, although the exact proximate mechanism by which WNS affects bats is still under investigation, the fact that it can result in death for many hibernating bat species is well documented.

Effects of White-Nose Syndrome on the Northern Long-Eared Bat

The northern long-eared bat is susceptible to WNS, and mortality of northern long-eared bats due to the disease has been confirmed throughout the majority of the WNS-affected range (Ballmann 2013, pers. comm.; Last 2013, pers. comm.). The observed spread of WNS in North America has been rapid, with the fungus that causes the disease (Pd) expanding over 1,000 miles (1,609 km) from the first documented evidence in New York in February 2006, to 28 States and 5 Canadian provinces by February 2015. Pd now affects an estimated 60 percent of the northern long-eared bat's total geographic range, and is expected to continue to spread at a similar rate through the rest of the range (Service 2015, unpublished data). WNS has been confirmed in 25 of the 37 States (does not include the District of Columbia) in the range of northern long-eared bat. Furthermore, although WNS has not been confirmed in Rhode Island or the District of Columbia, those areas are entirely surrounded by WNS.

Although there is some variation in spread dynamics and the impact of WNS on bats when it arrives at a new site, we have no information to suggest that any site within the known range of the northern long-eared bat would be unsusceptible to the arrival of Pd. There is some evidence that microclimate may affect fungal and disease progression and there is a possibility that certain conditions may hinder disease progression in infected bats at some sites, but the degree to which this can be predicted at continental scales remains uncertain. Given the appropriate amount of time for exposure, WNS appears to have had similar levels of impact on northern long-eared bats everywhere the species has been documented with the disease. Therefore, absent direct evidence to suggest that some northern long-eared bats that encounter Pd do not contract WNS, available information suggests that the species will be impacted by WNS everywhere in its range.

Northern long-eared bats may favor small cracks or crevices in cave ceilings, making locating them more challenging during hibernacula surveys than other species that are typically found in clusters in open areas (*e.g.,* little brown bat, Indiana bat). However, winter surveys represent the best available data for assessing population trends for this species (Ingersoll *et al.* 2013, p. 9; Herzog 2015, pers. comm.). Progression from the detection of a few bats with visible fungus to widespread mortality may take a few weeks to 2 years (Turner *et al.* 2011, pp. 20–21). Although there is variation in when the decline is observed (*e.g.,* a few weeks to 2 years after detection of the disease), there appears to be little or no variation as to whether a decline happens (Service 2014, unpublished data). Microclimate inside the cave, duration and severity of winter, hibernating behavior, body condition of bats, genetic structure of the colony, and other variables may affect the timeline and severity of impacts at the site level. However, there is no evidence to date that any of these variables would greatly delay or reduce mortality in infected colonies.

WNS has been present in the eastern portion of the northern long-eared bat's range the longest; therefore, there is a greater amount of post-WNS hibernacula and summer data available from that region to discuss and examine the impacts of the disease on the species. Turner *et al.* (2011, p. 22) compared the most recent pre-WNS count to the most recent post-WNS count for 6 cave bat species and reported a 98 percent total decline in the number of hibernating northern long-eared bats at 30 hibernacula in New York, Pennsylvania, Vermont, Virginia, and West Virginia through 2011. Data analyzed in this study were limited to sites with confirmed WNS mortality for at least 2 years and sites with comparable survey effort across pre- and post-WNS years.

The Service conducted an analysis of additional survey information at 103 sites across 12 U.S. States and Canadian provinces (New York, Pennsylvania, Vermont, West Virginia, Virginia, New Hampshire, Maryland, Connecticut, Massachusetts, North Carolina, New Jersey, and Quebec) and found comparable declines in winter colony size. All 103 sites analyzed had historical records of northern long-eared bat presence, at least one survey in the 10-year period before WNS was detected, and at least one survey conducted 2 or more years after WNS was detected (Service 2014, unpublished data). In these sites, total northern long-eared bat counts declined by an average of 96 percent after the arrival of WNS; 68 percent of the sites declined to zero northern long-eared bats, and 92 percent of sites declined by more than 50 percent. Similarly, Frick *et al.* (2015, p. 6) documented that northern long-eared bats are now considered extirpated from 69 percent of the hibernacula (in Vermont, New York, Pennsylvania, Maryland, Virginia, and West Virginia) that had colonies of northern long-eared bats prior to WNS. Similar observations have been documented over several years. In a study by Langwig *et al.* (2012, p. 1054), 14 populations of northern long-eared bats in New York, Vermont, and Connecticut became locally extinct within 2 years due to disease, and no

population was remaining 5 years post-WNS (Langwig *et al.* 2012, p. 1054). In addition, Langwig (2014, in litt.) stated that, in more than 50 caves and mines surveyed in New York, Vermont, New Hampshire, Virginia, and Illinois, the northern long-eared bat is extirpated from all sites (that had continuous population counts) where WNS has been present for more than 4 years. Hibernacula surveys conducted in Pennsylvania in 2013 revealed a 99 percent decline (637 to 5 bats) at 34 sites where northern long-eared bats were known to hibernate prior to WNS (PGC 2013, unpublished data). In the Northeast, where WNS has been present for 5 or more years, the northern long-eared bat is only rarely encountered on the summer landscape. For example, in Vermont, the species was the second most common bat in the State before WNS, and it is now one of the least likely to be encountered (VFWD 2014, in litt.). Northern long-eared bats were also widespread throughout New York prior to WNS; however, post-WNS captures of this species have declined dramatically (approximately 93 percent) in the eastern part of the State (NYSDEC 2012, unpublished data). The one potential exception in New York is the Long Island population, where the species continues to be found in small numbers during summer surveys. However, these observations are unproven at this point and are the basis for ongoing research. Long-term summer data (including pre- and post-WNS) for the northern long-eared bat, where available, corroborate the population decline observed during hibernacula surveys. For example, summer surveys from 2005–2011 near Surry Mountain Lake in New Hampshire showed a 98 percent decline in capture success of northern long-eared bats post-WNS, which is similar to the hibernacula data for the State (a 95 percent decline) (Moosman *et al.* 2013, p. 554). Likewise, summer monitoring in Virginia from 2009 to present has revealed that declines in northern long-eared bats were not observed by VDGIF until 2 years after the severe declines were observed during winter and fall monitoring efforts in the State (Reynolds 2013, pers. comm.). These trends provide context for the indices of abundance of northern long-eared bats reported in States such as Pennsylvania and West Virginia, where the arrival of Pd at sites has been prolonged over several years (Miller-Butterworth *et al.* 2014). For example, in Pennsylvania, declines of 99 percent of northern long-eared bats counted in winter surveys corresponded with declines of 76 percent in summer capture rates; additionally, the decline in summer captures continues at an average rate of 15 percent annually (PGC 2014, in litt.). The fact that similar severe declines are documented in both summer and winter estimates demonstrates that northern long-eared bats are succumbing to WNS both at conspicuous hibernacula where they are surveyed and at undocumented hibernacula where they are not monitored directly.

Early reports from WNS-affected States in the Midwest reveal that similar rates of decline in northern long-eared bats are already occurring or are fast approaching. As reported in the *Distribution and Relative Abundance* section, above, in the two Ohio mines where an estimated 90 percent of Ohio's winter bat population hibernates, northern long-eared bat numbers decreased by 94 percent (combined for both hibernacula) from pre-WNS average counts (ODNR 2014, unpublished data). During the summer, ODNR Statewide acoustic surveys show a decline in northern long-eared bats of 56 percent since the pre-WNS years (ODNR 2014, unpublished data). Summer capture rates of northern long-eared bats from mist-net surveys (mostly conducted for Indiana bat presence) have declined by 58 percent per mist-net site post-WNS (Service 2014, unpublished data). Also, at two Illinois' major hibernacula, significant mortality of northern long-eared bats was observed in the first year after WNS was first detected, and the population at one site experienced a 97 percent decline, while the population decline at the second site was over 99 percent (Illinois Department of Natural Resources 2014, unpublished data).

As stated in the *Distribution and Relative Abundance* section, above, in the southern portion of the species' range, it is difficult to draw conclusions about winter population trends pre- and post- WNS introduction (due to a lack of surveys, historical variability of winter populations, or lack of standardized data); however, northern long-eared bat mortality associated with WNS has been observed at sites in Arkansas, Kentucky, North Carolina, and Tennessee. Also, some declines have been documented via hibernacula surveys in this region. For example, at a hibernaculum in Arkansas, mortality of northern long-eared bats was documented in the first year of known infection with Pd (Sasse 2014, pers. comm.). Over 70 percent of the 185 northern long-eared bats tested for the presence of Pd in Tennessee hibernacula between 2011 and 2014 were found to have Pd (Bernard 2014, in litt.). Also, in the Great Smoky Mountains National Park, 2014 capture rates of northern long-eared bats in comparison to 2009–2012 declined by 71 to 94 percent (across all sites) based on unit of effort comparisons (NPS 2014, in litt.; Indiana State University 2015, in litt.). Summer population trends are also difficult to summarize at this time, due to a lack of surveys or standardized data, although long-term data at localized sites have shown declines in northern long-eared bats.

All models of WNS spread dynamics predict that Pd, and hence the disease, will continue to spread (Maher *et al.* 2012, pp. 5–7; Ihlo 2013, unpublished; Hallam *et al.,* unpublished). These models estimate the disease will cover the entirety of the northern long-eared bat's range (within the models limited geographic limits (the United States)) by sometime between 2 and about 40 years (although estimating WNS arrival dates was not a primary objective of the analysis; Maher *et al.* 2012, pp. 5–7; Ihlo 2013, unpublished; Hallam *et al.,* unpublished). However, these models all have significant limitations (*e.g.,* failure to account for: Transmission through non-cave hibernacula, spread through Canada, and various biological aspects of disease transmission), and in many instances have either overestimated (predicted WNS would impact later) or underestimated the time at which WNS would arrive in counties that have become infected since the model was published. WNS arrived to surveyed sites 1 to 5 years (mean=2 years) earlier than predicted or when predicted by the Ihlo (2013, unpublished) model. WNS arrived 1 to 4 years later (mean=1 year) than predicted by Maher *et al.* (2012, pp. 1–8) in approximately 75 counties; 1 to 46 years earlier (mean=5 years) than predicted in approximately 75 counties; and when predicted in approximately 25 counties. For example, Pd was documented in Jasper County, Mississippi, in 2014, 45 years in advance of predictions by Maher *et al.* (2012). Maher (2014, in litt.) also commented that the spread rate of Pd may increase with longer winters, suggesting that spread of Pd in the northern portion of the northern long-eared bat's range with longer winters would be faster than in portions with shorter winters.

As described, there are limitations and uncertainties with relying on these models to predict the rate at which the fungus will spread to currently unaffected areas. Thus, we instead relied on the observed rate of spread to date of Pd to develop a calculation of projected rate of spread through the

remaining portion of the northern long-eared bat's range. WNS was first recorded in a cave in New York in 2006. Based on the observed spread of Pd from its point of origin in New York that has occurred to date, the area affected by Pd in North America is expanding at an average rate of roughly 175 miles (280 km) per year. At this average rate of spread, Pd can be expected to occur throughout the range of the northern long-eared bat in an estimated 8 to 9 years from December 2014. The COSEWIC used a similar method to calculate spread in their assessment of 3 bat species; they estimated that the entire range of the northern long-eared bat would be infected within 12 to 15 years (COSEWIC 2013, p. xiv) from November 2013.

Northern long-eared bats exhibit behaviors (*e.g.,* hibernating solitarily or in small clusters, using alternative hibernacula) that have been hypothesized to potentially limit exposure to Pd and reduce the impacts of WNS; however, there currently is no empirical evidence to suggest that these behaviors have mitigated the impacts of WNS, and the northern long-eared bat has been found to be one of the most highly susceptible bat species to WNS (Langwig *et al.* 2015, p. 4). Griffin (1945) reported that northern long-eared bats hibernate in ''unsuspected retreats,'' away from large colonies of other species and where caves and mines are not present, suggesting they may be able to limit exposure to Pd. In the southern extent of their range, northern long-eared bats have been documented sporadically arousing from torpor throughout the winter and moving between hibernacula (Griffin 1940a, p. 185; Whitaker and Rissler 1992a, p. 131; Caceres and Barclay 2000, pp. 2–3). It has been suggested that these periodic arousals provide a hypothetical mechanism by which fungal growth, and resulting infection, may be limited. However, as described in the ''Hibernation'' section under *Biology,* above, northern long-eared bats prefer to hibernate at temperatures between 0 and 9 °C (Raesly and Gates 1987, p. 18; Caceres and Pybus 1997, p. 2; Brack 2007, p. 744), which falls within the optimal growth limits of Pd, 5 and 16 °C (41 and 61 °F) (Blehert *et al.* 2009, p. 227; Verant *et al.* 2012, p. 4), making them susceptible to WNS infection once exposed to Pd, regardless of hibernaculum type. Northern long-eared bats also roost in areas within hibernacula that have higher humidity. Cryan *et al.* (2010, p. 138) suggested this roosting preference may be due to the northern long-eared bat's high intrinsic rates of evaporative water loss during torpor. Langwig *et al.* (2012, p. 1055) suggested that these more humid conditions could explain why northern long-eared bats actually experience higher rates of infection than other species, such as Indiana bats.

Northern long-eared bats have been reported to enter hibernation in October or November, but sometimes return to hibernacula as early as August, and emerge in March or April (Caire *et al.* 1979, p. 405; Whitaker and Hamilton 1998, p. 100; Amelon and Burhans 2006, p. 72). This extended period of time (in comparison to many other cave bat species that have been less impacted by WNS) may explain observed differences in fungal loads of Pd when compared to less susceptible species because the fungus has more time to infect bats and grow. Langwig *et al.* (2015, p. 4) determined that nearly 100 percent of northern long-eared bats sampled in 30 hibernacula across 6 States (New York, Vermont, Massachusetts, Virginia, New Hampshire, and Illinois) were infected with Pd early in the hibernation period, and that northern long-eared bats had the highest Pd-load of any other species in these sites. Similar patterns of high prevalence and fungal load in northern long-eared bats were reported by Bernard (2014, pers. comm.; Bernard 2014, in litt.) for bats surveyed outside of hibernacula in Tennessee during the winter. Furthermore, the northern long-eared bat occasionally roosts in clusters or in the same hibernacula as other bat species that are also susceptible to WNS (see the ''Hibernation'' section under *Biology,* above,) and are susceptible to bat-to-bat transmission of WNS.

Information provided to the Service by a number of State agencies demonstrates that the area currently (as of 2015) affected by WNS likely constitutes the core of the species' range, where densities of northern long-eared bats were highest prior to WNS. Further, it has been suggested that the species was considered less common or rare in the extreme southern, western, and northwestern parts of its range (Caceres and Barclay 2000, p. 2; Harvey 1992, p. 35), areas where WNS has not yet been detected. The northern long-eared bat has been extirpated from hibernacula where WNS, has been present for a significant number of years (*e.g.,* 5 years), and has declined significantly in other hibernacula where WNS has been present for only a few years. A corresponding decline on the summer landscape has also been witnessed. As WNS expands to currently uninfected areas within the range of northern long-eared bat, there is the expectation that the disease, wherever found, will continue to negatively affect the species. WNS is the predominant threat to the northern long-eared bat rangewide, and it is likely to spread to the entirety of the species' range.

II. Other Diseases

Infectious diseases observed in North American bat populations include rabies, histoplasmosis, St. Louis encephalitis, and Venezuelan equine encephalitis (Burek 2001, p. 519; Rupprecht *et al.* 2001, p. 14; Yuill and Seymour 2001, pp. 100, 108). Rabies is the most studied disease of bats, and can lead to mortality, although antibody evidence suggests that some bats may recover from the disease (Messenger *et al.* 2003, p. 645) and retain immunological memory to respond to subsequent exposures (Turmelle *et al.* 2010, p. 2364). Bats are hosts of rabies in North America (Rupprecht *et al.* 2001, p. 14), accounting for 24 percent of all wild animal cases reported during 2009 (Blanton *et al.* 2010, p. 648). Although rabies is detected in up to 25 percent of bats submitted to diagnostic labs for testing, less than 1 percent of bats sampled randomly from wild populations test positive for the virus (Messenger *et al.* 2002, p. 741). Northern long-eared bat is among the species reported positive for rabies virus infection (Constantine 1979, p. 347; Burnett 1989, p. 12; Main 1979, p. 458); however, rabies is not known to have appreciable effects to the species at a population level.

Histoplasmosis has not been associated with the northern long-eared bat and may be limited in this species compared to other bats that form larger aggregations with greater exposure to guano-rich substrate (Hoff and Bigler 1981, p. 192). St. Louis encephalitis antibody and high concentrations of Venezuelan equine encephalitis virus have been observed in big brown bats and little brown bats (Yuill and Seymour 2001, pp. 100, 108), although data are lacking on the prevalence of these viruses in northern long-eared bats. Equine encephalitis has been detected in northern long-eared bats (Main 1979, p. 459), although no known population declines have been found due to presence of the virus. Northern long-eared bats are also known to carry a variety of pests including chiggers, mites, bat bugs, and internal helminthes (Caceres and Barclay 2000, p. 3). However, the level of mortality caused by WNS far exceeds mortality from all other known diseases and pests of the northern long-eared bat.

Predation

Animals such as owls, hawks, raccoons, skunks, and snakes prey upon bats, although a limited number of animals consume bats as a regular part of their diet (Harvey *et al.* 1999, p. 13). Northern long-eared bats are believed to experience a small amount of predation; therefore, predation does not appear to be a population changing cause of mortality (Caceres and Pybus 1997, p. 4; Whitaker and Hamilton 1998, p. 101).

Predation has been observed at a limited number of hibernacula within the range of the northern long-eared bat. Of the State and Federal agency responses received pertaining to northern long-eared bat hibernacula and threat of predation, 1 hibernaculum in Maine, 3 in Maryland (2 of which were due to feral cats), 1 in Minnesota, and 10 in Vermont were reported as being prone to predation. In one instance, domestic cats were observed killing bats at a hibernaculum used by northern long-eared bat in Maryland, although the species of bat killed was not identified (Feller 2011, unpublished data). Turner (1999, personal observation) observed a snake (species unknown) capture an emerging Virginia big-eared bat in West Virginia. Tuttle (1979, p. 11) observed (eastern) screech owls (*Otus asio*) capturing emerging gray bats. Northern long-eared bats are known to be affected to a small degree by predators at summer roosts. Carver and Lereculeur (2013, pp. N6–N7) observed predation of a northern long-eared bat by a gray rat snake during the summer; Sparks *et al.* (2003, pp. 106–107) described attempts by raccoons to prey on both Indiana bats and evening bats. Avian predators, such as owls and magpies, have been known to successfully take individual bats as they roost in more open sites, although this most likely does not have an effect on the overall population size (Caceres and Pybus 1997, p. 4). In summary, because bats are not a primary prey source for any known natural predators, it is unlikely that predation has substantial effects on the species at this time.

Conservation Efforts To Reduce Disease or Predation

As mentioned above, WNS is responsible for unprecedented mortality in some species of hibernating bats in eastern North America, including the northern long-eared bat, and the disease continues to spread. In 2011, the Service, in partnership with several other State, Federal, and Tribal agencies, finalized a national response plan for WNS (*A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats; https://www.whitenosesyndrome.org/national-plan/white-nose-syndrome-national-plan*) to provide a common framework for the investigation and management of WNS (Service 2011, p. 1). In 2012, a sister plan was finalized for the national response to WNS in Canada (*A National Plan to Manage White Nose Syndrome in Bats in Canada; http://www2.ccwhc.ca/publications/Canadian%20WNS%20Management%20Plan.pdf*), allowing for a broader coordinated response to the disease throughout the two countries. The multi-agency, multi-organization WNS response team, under the U.S. National Plan and in coordination with Canadian partners, has and continues to develop recommendations, tools, and strategies to slow the spread of WNS, minimize disturbance to hibernating bats, and improve conservation strategies for affected bat species. Some of these products include: Decontamination protocols; cave management strategies and best management practices (BMPs); forestry BMPs; nuisance wildlife control operator BMPs; transportation and bridge BMPs; hibernacula microclimate monitoring recommendations; wildlife rehabilitator BMPs; and a bat species ranking document for conservation actions. These containment and other strategies are intended to slow the spread of WNS and allow time for development of management options. The multi-agency, multi-partner National WNS Decontamination protocol (*https://www.whitenosesyndrome.org/topics/decontamination*) was developed to provide specific procedures to minimize the risk of transmitting the fungus when conducting work involving close direct contact with bats, their environments, or associated materials. In addition to bat-to-bat transmission of the disease agent, fungal spores can also be transmitted by human actions (USGS NWHC, Wildlife Health Bulletin 2011–05, unpaginated), and decontamination remains one of the only management options available to reduce the risk of human-assisted transmission. Decontamination protocols have been integrated into other protocols and BMPs that involve close direct contact with bats or their environments.

In 2009, the Service also issued a recommendation for a voluntary moratorium on all caving activity in States known to have hibernacula affected by WNS, and all adjoining States, unless conducted as part of an agency-sanctioned research or monitoring project (Service 2009, entire). These recommendations have been reviewed annually and a revised version, including a multi-agency endorsement through the national WNS Steering Committee, is expected to be completed soon. Though not mandatory or required, many State, Federal, and Tribal agencies, along with other organizations and entities, operating within the northern long-eared bat's range have incorporated the recommendations and protocols in the WNS National Plan in their own local response plans. The Western Bat Working Group, for example, has developed a *White-nose Syndrome Action Plan,* a comprehensive strategy to prevent the spread of WNS that covers States currently outside the range of WNS (Western Bat Working Group 2010, pp. 1–11).

The NPS is currently updating their cave management plans (for parks with caves) to include actions to minimize the risk of WNS spreading to uninfected caves. These actions include WNS education, screening visitors for disinfection, and closure of caves if necessary (NPS 2013, *http://www.nature.nps.gov/biology/WNS*). In April 2009, all caves and mines on USFS lands in the Eastern and Southern Regions were closed on an emergency basis in response to the spread of WNS, and closures on other USFS lands have been announced as well. In 2014, the closure order was extended for 5 more years in the USFS's Southern Region. Eight National Forests in the Eastern Region contain caves or mines that are used by bats; caves and mines on seven of these National Forests (Allegheny, Hoosier, Ottawa, Mark Twain, Monongahela, Shawnee, and Wayne) were closed, and no closure is needed for the one mine on the eighth National Forest (Green Mountain) because it is already gated with a bat-friendly structure. Forest supervisors continue to evaluate the most recent information on WNS to inform decisions regarding extending cave and mine closures for the purpose of slowing the spread of WNS and reducing the impacts of disturbance on WNS-affected bat populations (USFS 2013, *http://www.fs.usda.gov/detail/r9/plants-animals/wildlife/?cid=stelprdb5438954*). Caves and mines on USFS lands in the Rocky Mountain Region were closed on an emergency basis in 2010, in response to WNS, but since then have been reopened (USFS 2013, *http://www.fs.usda.gov/detail/r2/home/?cid=stelprdb5319926*). In place of the emergency closures, the Rocky Mountain Region will implement an adaptive management strategy that will

require registration to access an open cave, prohibit use of clothing or equipment used in areas where WNS is found, require decontamination procedures prior to entering any and all caves, and require closure of all known hibernacula caves during the winter hibernation period. Although the above-mentioned WNS-related conservation measures may help reduce or slow the spread of the disease, these efforts are not currently enough to ameliorate the population-level effects to the northern long-eared bat.

Research is also under way to develop control and treatment options for WNS-infected bats and environments. A number of potential treatments are currently being explored and are in various stages of development. Risks to other biota or the environment need to be assessed when considering disease management trials in a field setting. No treatment strategies have been tested on the northern long-eared bat, to date, and there remains no demonstrated safe or effective treatment for WNS. It remains unknown whether treatment of bats may increase survival or allow the northern long-eared bat to survive exposure to the pathogen. Potential treatment of the northern long-eared bat will be further complicated by the dispersed winter roosting habits of the species and difficulty finding the species in hibernacula. Further, no treatment in development has demonstrated any potential to allow a species to adapt to the presence of the pathogen. More research and coordination is needed to address the safety and effectiveness of any treatment proposed for field use and to meet regulatory requirements prior to consideration of widespread application. Therefore, a landscape-scale approach to reduce the impacts of WNS is still at least a few years away.

Summary of Disease and Predation

The northern long-eared bat is highly susceptible to white-nose syndrome and mortality of the species due to the disease has been documented throughout the majority of its range. WNS is caused by the nonnative fungus Pd, which is believed to have originated in Europe. WNS has been found in 25 States and 5 Canadian provinces since first discovered in New York in 2007, and at least seven bat species are confirmed to be susceptible in North America. The fungus that causes WNS has been documented in an additional three States. WNS infection, characterized by visible fungal growth on the bat, alters the normal arousal cycles of hibernating bats, causes severe wing damage, and depletes fat reserves, and it has resulted in substantial mortality of North American bat populations.

The effect of WNS on northern long-eared bats has been especially severe and has caused mortality in the species throughout the majority of the WNS-affected range. This is currently viewed as the predominant threat to the species, and if WNS had not emerged or was not affecting northern long-eared bat populations to the level that it has, we presume the species would not be declining to the degree observed. A recent study revealed that the northern long-eared bat has experienced a precipitous population decline, estimated at approximately 96 percent (from hibernacula data) in the northeastern portion of its range, due to the emergence of WNS. WNS has spread to approximately 60 percent of the northern long-eared bat's range in the United States, and if the observed average rate of spread of Pd continues, the fungus will be found in hibernacula throughout the entire species' range within 8 to 13 years based on the calculated rate of spread observed to date (by both the Service and COSEWIC). We expect that similar declines as seen in the East and portions of the Midwest will be experienced in the future throughout the rest of the species' range. There has been a sustained and coordinated effort between partners (*e.g.,* Federal, State, Canada, nongovernment) to curtail the spread of WNS, and while these measures may reduce or slow the spread of WNS, these efforts are currently not enough to ameliorate the population-level effects on the northern long-eared bat. Also, research is under way to develop control and treatment options for WNS-infected bats and hibernacula; however, additional research is needed before potential treatments are implemented on a landscape scale.

Other diseases are known or suspected to infect northern long-eared bats, but none is known to have appreciable effects on the species. Also, it is unlikely that predation is significantly affecting the species at this time.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Under this factor, we examine whether existing regulatory mechanisms are inadequate to address the threats to the species discussed under the other factors. Section 4(b)(1)(A) of the Act requires the Service to take into account ''those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species. . . .'' In relation to Factor D under the Act, we interpret this language to require the Service to consider relevant Federal, State, and tribal laws, regulations, and other such mechanisms that may reduce any of the threats we describe in threat analyses under the other four factors. We give strongest weight to statutes and their implementing regulations and to management direction that stems from those laws and regulations. An example would be State governmental actions enforced under a State statute or constitution, or Federal action under statute.

Having evaluated the significance of the threat as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms are inadequate to address the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the effects from one or more identified threats. In this section, we review existing State, Federal, and local regulatory mechanisms to determine whether they effectively reduce or remove threats to the northern long-eared bat.

No existing regulatory mechanisms have been shown to sufficiently protect the species against WNS, the primary threat to the northern long-eared bat; thus, despite regulatory mechanisms that are currently in place, the species is still at risk. There are, however, some mechanisms in place to provide some protection from other factors that may act cumulatively with WNS. As such, the discussion below provides a few examples of such existing regulatory mechanisms.

Canadian Laws and Regulations

In 2014, the northern long-eared bat was determined, under an emergency assessment, to be endangered under the Canadian Species at Risk Act (SARA) (Species at Risk Public Registry 2014). The SARA makes it an offense to kill, harm, harass, capture, or take an individual of a listed species that is endangered or threatened; possess, collect, buy, sell, or trade an individual of a listed species that is extirpated, endangered, or threatened, or its part or derivative; or to damage or destroy the residence of one or more individuals of a listed endangered or threatened species or of a listed extirpated species if a recovery strategy has recommended its reintroduction. For most of the species listed under SARA, including the northern long-eared bat, the prohibitions on harm to individuals and destruction of residences are limited to Federal lands.

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U.S. Federal Laws and Regulations

Several laws and regulations help Federal agencies protect bats on their lands, such as the Federal Cave Resources Protection Act (16 U.S.C. 4301 *et seq.*) that protects caves on Federal lands and the National Environmental Policy Act (42 U.S.C. 4321 *et seq.*) review, which serves to mitigate effects to bats due to construction activities on federally owned lands. The NPS has additional laws, policies, and regulations that protect bats on NPS units, including the NPS Organic Act of 1916 (16 U.S.C. 1 *et seq.*), NPS management policies (related to exotic species and protection of native species), and NPS policies related to caves and karst systems (provides guidance on placement of gates on caves not only to address human safety concerns, but also for the preservation of sensitive bat habitat) (Plumb and Budde 2011, unpublished data). Even if a bat species is not listed under the Act, the NPS works to minimize effects to the species. In addition, the NPS Research Permitting and Reporting System tracks research permit applications and investigator annual reports, and NPS management policies require non-NPS studies conducted in parks to conform to NPS policies and guidelines regarding the collection of bat data (Plumb and Budde 2011, unpublished data).

The northern long-eared bat is considered a ''sensitive species'' throughout the USFS's Eastern Region (USFS 2012, *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5384459.pdf*). As such, the northern long-eared bat must receive, ''special management emphasis to ensure its viability and to preclude trends toward endangerment that would result in the need for Federal listing. There must be no effects to sensitive species without an analysis of the significance of adverse effects on the populations, its habitat, and on the viability of the species as a whole. It is essential to establish population viability objectives when making decisions that would significantly reduce sensitive species numbers'' (Forest Service Manual (FSM) 2672.1, *http://www.fs.fed.us/im/directives/fsm/2600/2672-2672.24a.txt*).

State Laws and Regulations

The northern long-eared bat is listed in few of the States within the species' range. The northern long-eared bat is listed as endangered under the Massachusetts endangered species act, under which all listed species are, ''protected from killing, collecting, possessing, or sale and from activities that would destroy habitat and thus directly or indirectly cause mortality or disrupt critical behaviors.'' In addition, listed animals are specifically protected from activities that disrupt nesting, breeding, feeding, or migration (Massachusetts Division of Fisheries and Wildlife 2012, unpublished document). In Wisconsin, all cave bats, including the northern long-eared bat, were listed as threatened in the State in 2011, due to previously existing threats and the impending threat of WNS (Redell 2011, pers. comm.). It is illegal to take, transport, possess, process, or sell any wild animal that is included on the Wisconsin Endangered and Threatened Species List without a valid endangered or threatened species permit. Certain development projects (*e.g.,* wind energy), however, are excluded from regulations that are in place to protect the species in Wisconsin (WDNR, unpublished document, 2011, p. 4). In Vermont, the northern long-eared bat was provided protection by being listed as endangered under the Vermont endangered species law. Except where authorized by separate chapters of the law, the Vermont law states, ''a person shall not take, possess or transport wildlife or plants that are members of an endangered or threatened species.'' The northern long-eared bat is considered as some form of species of concern in 18 States: ''Species of Greatest Concern'' in Alabama and Rhode Island; ''Species of Greatest Conservation Need'' in Delaware, Iowa, and Michigan; ''Species of Concern'' in Ohio and Wyoming; ''Rare Species of Concern'' in South Carolina; ''Imperiled'' in Oklahoma; ''Critically Imperiled'' in Louisiana; ''Species of Conservation Concern'' in Missouri, and ''Species of Special Concern'' in Indiana, Maine, Minnesota, New Hampshire, North Carolina, Pennsylvania, and South Carolina. In Kansas, the State has been petitioned to evaluate the northern long-eared bat as ''threatened'' in accordance with the Kansas Nongame and Endangered Species Act.

In the following States, there is either no State protection law or the northern long-eared bat is not protected under the existing law: Arkansas, Connecticut, Florida, Georgia, Illinois, Kansas, Kentucky, Maryland, Mississippi, Montana, Nebraska, New Jersey, New York, North Dakota, Tennessee, Virginia, and West Virginia. In Kentucky, although the northern long-eared bat does not have a State listing status, it is considered protected from take under Kentucky State law.

Wind energy development regulation varies by State within the northern long-eared bat's range. For example, in Virginia, although there are not currently any wind energy developments in the State, new legislation requires operators to ''measure the efficacy'' of mitigation, with the objective of reducing bat fatalities (Reynolds 2011, unpublished data). In Vermont, all wind energy facilities are required to conduct bat mortality surveys, and at least two of the three currently permitted wind facilities in the State include application of operational adjustments (curtailment) to reduce bat fatalities (Smith 2011, unpublished data). Other States, many of which have expansive wind energy development, have no regulatory program for wind energy projects.

Summary of Inadequacy of Existing Regulatory Mechanisms

No existing regulatory mechanisms have been shown to sufficiently protect the species against WNS, the primary threat to the northern long-eared bat. Therefore, despite regulatory mechanisms that are currently in place for the northern long-eared bat, the species is still at risk, primarily due to WNS, as discussed under *Factor C.*

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Wind Energy Development

Significant bat mortality has been witnessed associated with utility-scale (greater than or equal to 0.66 megawatt (MW)) wind turbines along forested ridge tops in the eastern and northeastern United States and in agricultural areas of the Midwest (Johnson 2005, p. 46; Arnett *et al.* 2008, p. 63; Cryan 2011, p. 364; Arnett and Baerwald 2013, p. 441; Hayes 2013, p. 977; Smallwood 2013, p. 26). Recent estimates of bat mortality from wind energy facilities vary considerably depending on the methodology used and species of bat. Arnett and Baerwald (2013 p. 443) estimated that 650,104 to 1,308,378 bats had been killed at wind energy facilities in the United States and Canada as of 2011, and expected another 196,190 to 395,886 would be lost in 2012. Other bat mortality estimates range from ''well over 600,000 . . . in 2012'' (Hayes 2013, p. 977; [but see Huso and Dalthorp 2014, p. 546–547]) to 888,000 bats per year (Smallwood 2013, p. 26), and mortality can be expected to increase as more turbines are installed on the landscape. The majority of bats killed include migratory foliage-roosting species the

hoary bat (*Lasiurus cinereus*) and eastern red bat, and the migratory, tree- and cavity-roosting silver-haired bat (Arnett *et al.* 2008, p. 64; Cryan 2011 p. 364; Arnett and Baerwald 2013, p. 444).

The Service reviewed post-construction mortality monitoring studies at 62 unique operating wind energy facilities in the range of the northern long-eared bat in the United States and Canada. In these studies, 41 northern long-eared bat mortalities were documented, comprising less than 1 percent of all bat mortalities. Northern long-eared bat mortalities were detected throughout the study range, including: Illinois, Indiana, Maryland, Michigan, Missouri, New York, Pennsylvania, West Virginia, and Ontario. Northern long-eared bat mortalities were detected at 29 percent of the facilities studied. There is a great deal of uncertainty related to extrapolating these numbers to generate an estimate of total northern long-eared bat mortality at wind energy facilities due to variability in post-construction survey effort and methodology (Huso and Dalthorp 2014, pp. 546–547). Bat mortality can vary between years and between sites, and detected carcasses are only a small percentage of total bat mortalities. Despite these limitations, Arnett and Baerwald (2013, p. 444) estimated that wind energy facilities in the United States and Canada killed between 1,175 and 2,433 northern long-eared bats from 2000 to 2011.

The number of bats actually killed at the facilities discussed above is certainly larger than the 41 individuals that were found. Only a portion of carcasses are found during post-construction mortality surveys, most studies only cover a 1- or 2-year period at a single site, and only some facilities conduct monitoring and make the results available to the Service (Cryan 2011, pp. 368–369). Additionally, if mortality occurs at a specific wind facility in a given year, it is reasonable to expect that mortality will occur throughout the operational life of the wind facility (approximately 20 years). Sustained annual mortality of individual northern long-eared bats at a particular wind facility could result in impacts to local populations.

There are three impacts of wind turbines that may explain proximate causes of bat fatalities, which include: (1) Bats collide with turbine towers; (2) bats collide with moving blades; or (3) bats suffer internal injuries (barotrauma) after being exposed to rapid pressure changes near the trailing edges and tips of moving blades (Cryan and Barclay 2009, p. 1331). Researchers have recently indicated that traumatic injury, including bone fractures and soft tissue trauma caused by collision with moving blades, is the major cause of bat mortality at wind energy facilities (Rollins *et al.* 2012, pp. 365, 368; Grodsky *et al.* 2011, p. 920). Grodsky *et al.* (2011, p. 924) suggested that these injuries can lead to an underestimation of bat mortality at wind energy facilities due to delayed lethal effects. However, the authors also noted that the surface and core pressure drops behind the spinning turbine blades are high enough (equivalent to sound levels that are 10,000 times higher in energy density than the threshold of pain in humans) to cause significant ear damage to bats flying near wind turbines (Grodsky *et al.* 2011, p. 924). Bats suffering from ear damage would have a difficult time navigating and foraging, as both of these functions depend on the bats' ability to echolocate (Grodsky *et al.* 2011, p. 924). While earlier papers indicated that barotrauma may also be responsible for a considerable portion of bat mortality at wind energy facilities (Baerwald *et al.* 2008, pp. 695–696), in a more recent study, researchers found only 6 percent of wind turbine killed bats at one site were possibly killed by barotrauma (Rollins *et al.* 2012, p. 367). In a separate study, Grodsky *et al.* (2011, p. 920 and 922) found that 74 percent of carcasses had bone fractures and more than half had mild to severe hemorrhaging in the middle or inner ears; thus it is difficult to attribute individual fatalities exclusively to either direct collision or barotrauma.

Wind energy development is rapidly increasing throughout the northern long-eared bat's range. Iowa, Illinois, Oklahoma, Minnesota, Kansas, and New York are within the top 10 States for wind energy capacity (installed megawatts) in the United States (AWEA 2013, unpaginated). There is a national movement towards a 20 percent wind energy sector in the U.S. market by 2030 (United States Department of Energy (US DOE)2008, unpaginated). Through 2012, wind energy has achieved its goals in installation towards the targeted 20 percent by 2030 (AWEA 2015, unpaginated). If the target is achieved, it would represent nearly a five-fold increase in wind energy capacity during the next 15 years (Loss *et al.* 2013, pp. 201–209). While locations of future wind energy projects are largely influenced by ever-changing economic factors and are difficult to predict, sufficient wind regimes exist to support wind power development throughout the range of the northern long-eared bat (US DOE 2015, unpaginated), and wind development can be expected to increase throughout the range in future years. Wind energy facilities have been constructed in areas within a large portion of the range of the northern long-eared bat, thus this species is exposed to the risk of turbine-related mortality. However, northern long-eared bats are rarely detected as mortalities, even in areas where they are known to be common on the landscape.

We conclude that there may be adverse effects posed by wind energy development to northern long-eared bats; however, there is no evidence suggesting effects from wind energy development itself has led to population-level declines in this species. Further, given the low mortality rates experienced and estimated, we believe northern long-eared bats are not as vulnerable to mortality from wind turbines as other species of bats (*e.g.,* hoary bat, silver-haired bat, red bat, big brown bat, little brown bat, and tricolored bat). However, sustained annual mortality of individual northern long-eared bats at a particular wind energy facility could result in negative impacts to local populations.

Climate Change

Our analyses under the Act include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. As defined by the Intergovernmental Panel on Climate Change (IPCC), ''climate'' refers to average weather, typically measured in terms of the mean and variability of temperature, precipitation, or other relevant properties over time, and ''climate change'' thus refers to a change in such a measure that persists for an extended period, typically decades or longer, due to natural conditions (*e.g.,* solar cycles) or human-caused changes in the composition of the atmosphere or in land use (IPCC 2013, p. 1450). Detailed explanations of global climate change and examples of various observed and projected changes and associated effects and risks at the global level are provided in reports issued by the IPCC (2014 and citations therein); information for the United States at national and region levels is summarized in the National Climate Assessment (Melillo *et al.* 2014 entire and citations therein; see Melillo *et al.* 2014, pp. 28–45 for an overview). Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections we use ''downscaled'' projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher

resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it (see Melillo *et al.* 2014, Appendix 3, pp. 760–763 for a discussion of climate modeling, including downscaling). In our analysis, we use our expert judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects.

The unique life-history traits of bats and their susceptibility to local temperature, humidity, and precipitation patterns make them an early warning system for effects of climate change in regional ecosystems (Adams and Hayes 2008, p. 1120). Climate influences food availability, timing of hibernation, frequency and duration of torpor, rate of energy expenditure, reproduction, and rates of juvenile bat development (Sherwin *et al.* 2013, p. 178). Climate change may lead to warmer winters, which could lead to a shorter hibernation period, increased winter activity, and reduced reliance on the relatively stable temperatures of underground hibernation sites (Jones *et al.* 2009, p. 99). An earlier spring would presumably result in a shorter hibernation period and the earlier appearance of foraging bats (Jones *et al.* 2009, p. 99). An earlier emergence from hibernation may have no detrimental effect on populations if sufficient food is available (Jones *et al.* 2009, p. 99); however, predicting future insect population dynamics and distributions is complex (Bale *et al.* 2002, p. 6). Alterations in precipitation, stream flow, and soil moisture could alter insect populations and, therefore, food availability for bats (Rodenhouse *et al.* 2009, p. 250).

Climate change is expected to alter seasonal ambient temperatures and precipitation patterns across regions (Adams and Hayes 2008, p. 1115), which could lead to shifts in the range of some bat species (Loeb and Winters 2013, p. 107; Razgour *et al.* 2013, p. 1262). Suitable roost temperatures and water availability are directly related to successful reproduction in female insectivorous bats (Adams and Hayes 2008, p. 1116). Adams (2010, p. 2440) reported decreased reproductive success in female insectivorous bats in response to decreased precipitation. In contrast, Burles *et al.* (2009, p. 136) and Lucan *et al.* (2013, p. 154) reported decreased reproductive success in response to increased precipitation in little brown bats and Daubenton's bats (*Myotis daubentonii),* respectively. Annual precipitation in the northeast United States is projected to either remain stable or increase, although projections are highly variable (Frumhoff *et al.* 2007, p. 8). However, in comparison, Adams and Hayes (2008, p. 1120) predict an overall decline in bat populations in the western United States from reduced regional water storage caused by climate warming.

Warmer winter temperatures may also disrupt bat reproductive physiology. Northern long-eared bats breed in the fall, and spermatozoa are stored in the uterus of hibernating females until spring ovulation. If bats experience warmer hibernating conditions they may arouse prematurely, ovulate, and become pregnant (Jones *et al.* 2009, p. 99). Given this dependence on external temperatures, climate change is likely to affect the timing of reproductive cycles (Jones *et al.* 2009, p. 99), but making generalizations about the level of risk associated with changes in bat reproduction due to climate change is difficult (Sherwin *et al.* 2013, p. 176). Sherwin *et al.* (2013, p. 176) postulates that warmer climates may benefit female bats by causing earlier birth and weaning of young, allowing more time to mate and store fat reserves in preparation for hibernation. Research by Frick *et al.* (2010b, p. 133) supports this theory, whereby the authors showed giving birth earlier had significant fitness benefits, given that young born in early summer had a higher probability of surviving and breeding in their first year than pups born later in the summer.

The role of climate change in the spread of WNS is largely unknown. A shortened hibernation period and warmer winter temperatures may shorten exposure time and slow the spread of WNS. However, using three standard IPCC scenarios (Special Report: Emissions Scenarios (SRES) B1, least change in climate; A1B, intermediate change; and A2, most change), Maher *et al.* (2012, p. 6) showed accelerated spread of WNS under all scenarios relative to projections based on observed data.

Although we have information that suggests that climate change may affect the northern long-eared bat, we do not have evidence suggesting that climate change in itself has led to population declines; furthermore, the spread of WNS across the species' range is occurring rapidly, so discerning effects from climate change may be difficult.

Contaminants

Effects to bats from contaminant exposure have likely occurred and gone, for the most part, unnoticed in bat populations (Clark and Shore 2001, p. 204). Contaminants of concern to insectivorous bats like northern long-eared bats include organochlorine pesticides, organophosphate, carbamate and neonicotinoid insecticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), pyrethroid insecticides, and inorganic contaminants such as mercury (Clark and Shore 2001, pp. 159–214).

Detectable levels of organochlorine pesticides have been reported in northern long-eared bats (Eidels *et al.* 2007, p. 52). Organochlorine pesticides (*e.g.,* dichlorodiphenyltrichloroethane (DDT), chlordane) persist in the environment due to lipophilic (fat-loving) properties, and, therefore, readily accumulate within the fat tissue of bats. Because insectivorous bats have high metabolic rates, associated with flight and small size, their food intake increases the amount of organochlorines available for concentration in the fat (Clark and Shore 2001, p. 166). Because bats are long-lived, the potential for bioaccumulation is great, and effects on reproduction have been documented (Clark and Shore 2001, pp. 181–190). In maternity colonies, young bats appear to be at the greatest risk of mortality. This is because organochlorines become concentrated in the fat of the mother's milk and these chemicals continually and rapidly accumulate in the young as they nurse (Clark 1988, pp. 410–411).

In addition to indirect effects of organochlorine pesticides on bats via prey consumption, documented cases of direct effects involve application of pesticides to bats and their roosts. For example, when a mixture of DDT and chlordane was applied to little brown bats and their roost site, mortality from exposure was observed (Kunz *et al.* 1977, p. 478). Most organochlorine pesticides have been banned in the United States, and time trend analysis indicates that these pesticides have declined significantly over the 30 years since these compounds were restricted (Bayat *et al.* 2014, pp. 46–47).

Organochlorine pesticides have largely been replaced by organophosphate insecticides, which are generally short-lived in the environment and do not accumulate in food chains; however, risk of exposure is still possible from direct exposure from spraying or ingesting insects that have recently been sprayed but have not died, or both (Clark 1988, p. 411). Organophosphate and carbamate insecticides are acutely toxic to mammals. Some organophosphates may be stored in fat tissue and contribute to ''organophosphate-induced delayed neuropathy'' in humans (United States Environmental Protection Agency 2013, p. 44). Bats may lose their motor

coordination from direct application and are unlikely to survive in the wild in an incapacitated state lasting more than 24 hours (Plumb and Budde 2011, unpublished data). Northern long-eared bats may be exposed to organophosphate and carbamate insecticides in regions where methyl parathion is applied in cotton fields and where malathion is used for mosquito control (Plumb and Budde 2011, unpublished data). The organophosphate, chlorpyrifos, has high fat solubility and is commonly used on crops such as corn and soybeans (van Beelen 2000, p. 34 of Appendix 2; *http://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2009&map=CHLORPYRIFOS&hilo=L*).

Neonicotinoids have been found to cause oxidative stress, neurological damage and possible liver damage in rats, and immune suppression in mice (Kimura-Kuroda *et al.* 2011, p. 381; Duzguner and Erdogan 2012, p. 58; Badgujar *et al.* 2013, p. 408). Due to information indicating that there is a link between neonicotinoids used in agriculture and a decline in bee numbers, the European Union proposed a 2-year ban on the use of the neonicotinoids, thiamethoxam, imidacloprid, and clothianidin on crops attractive to honeybees, beginning in December of 2013 (Bergeson and Campbell PC, *http://www.lawbc.com/regulatory-developments/entry/proposal-for-restriction-of-neonicotinoid-products-in-the-eu/*).

The more recently developed ''third generation'' of pyrethroids have acute oral toxicities rivaling the toxicity of organophosphate, carbamate and organochlorine pesticides. These pyrethroids include: Esfenvalerate, deltamethrin, bifenthrin, tefluthrin, flucythrinate, cyhalothrin, and fenpropathrin (Mueller-Beilschmidt 1990, p. 32). Pyrethroids are increasingly used in the United States, and some of these compounds have very high fat solubility (*e.g.,* bifenthrin, cypermethrin) (van Beelen 2000, p. 34 of Appendix 2).

Like the organochlorine pesticides, PCBs and PBDEs are highly lipophilic and therefore readily accumulate in insectivorous bats. Measured concentrations of PCBs and PBDEs in little brown bats were high, in the parts-per-million range, in both WNS-infected and non-infected bats (Kannan *et al.* 2010, p. 617). High exposures to persistent organic pollutants can potentially be associated with various health effects, including immunosuppression, behavioral anomalies, and contaminant-induced enhancement of metabolic rate in bats (Kannan *et al.* 2010, p. 617). Outside of laboratory experiments, there is no conclusive evidence that bats have been killed by PCBs, although effects on reproduction have been observed (Clark and Shore 2001, pp. 192–194).

Northern long-eared bats forage on emergent insects and can be characterized as occasionally foraging over water (Yates and Evers 2006, p. 5), and, therefore, are at risk of exposure to bioaccumulation of inorganic contaminants (*e.g.,* cadmium, lead, mercury) from contaminated water bodies. Bats tend to accumulate inorganic contaminants due to their diet and slow means of elimination of these compounds (Plumb and Budde 2011, unpublished data). In Virginia, for example, the North Fork Holston River is a water body that was highly contaminated by a waterborne point source of mercury through contamination by a chlor-alkali plant. Based on findings from a pilot study for bats in 2005 (Yates and Evers 2006), there is sufficient information to conclude that bats from near-downstream areas of the North Fork Holston River have potentially harmful body burdens of mercury, although the effect on bats is unknown. Yates *et al.* (2014, pp. 46–49) collected over 2,000 tissue samples from 10 species of bats in the northeast United States. The highest mercury levels in fur and blood samples were detected in tri-colored, little brown, and northern long-eared bats. Divoll *et al.* (in prep) found that northern long-eared bats showed consistently higher mercury levels than little brown bats or eastern red bats sampled in Maine, which may be correlated with gleaning behavior and the consumption of spiders by northern long-eared bats. Bats recaptured during the study one or 2 years after their original capture maintained similar levels of mercury in fur year-to-year. Biologists suggest that individual bats accumulate body burdens of mercury that cannot be reduced once elevated to a certain threshold.

Exposure to holding ponds containing flow-back and produced water associated with hydraulic fracturing operations may also expose bats to toxins, radioactive material, and other contaminants (Hein 2012, p. 8). Cadmium, mercury, and lead are contaminants reported in hydraulic fracturing operations. Whether bats drink directly from holding ponds or contaminants are introduced from these operations into aquatic ecosystems, bats will presumably accumulate these substances and potentially suffer adverse effects (Hein 2012, p. 9).

A recent review on organic contaminants in bats by Bayat *et al.* (2014, pp. 40–52) ''suggests that bats today are exposed generally to lower contaminant concentrations, but that these can manifest in a range of sub-lethal neurological and physiological changes that may impact bat survival. Defining concentration endpoints for sub-lethal impacts, especially for the emerging contaminants, and linking these to effects on bat function, behavior or survival, and long term impacts on populations is limited.'' In summary, the best available data indicate that contaminant exposure may cause adverse effects to northern long-eared bats, but if population declines have occurred due to these factors, they have not been discernable.

Prescribed Burning

Eastern forest-dwelling bat species, such as the northern long-eared bat, likely evolved with fire management of mixed-oak ecosystems (Perry 2012, p. 182). A recent review of prescribed fire and its effects on bats (USFS 2012, p. 182) generally found that fire had beneficial effects on bat habitat. Fire may create snags for roosting and creates more open forests conducive to foraging on flying insects (Perry 2012, pp. 177–179), although gleaners such as northern long-eared bats may readily use cluttered understories for foraging (Owen *et al.* 2003, p. 355). Cavity and bark roosting bats, such as the northern long-eared, use previously burned areas for both foraging and roosting (Johnson *et al.* 2009a, p. 239; Johnson *et al.* 2010, p. 118). In Kentucky, the abundance of prey items for northern long-eared bats increased after burning (Lacki *et al.* 2009, p. 1170), and more roosts were found in post-burn areas (Lacki *et al.* 2009, p. 1169). Burning may create more suitable snags for roosting through exfoliation of bark (Johnson *et al.* 2009a, p. 240), mimicking trees in the appropriate decay stage for roosting bats. In contrast, a prescribed burn in Kentucky caused a roost tree used by a radio-tagged female northern long-eared bat to prematurely fall after its base was weakened by smoldering combustion (Dickinson *et al.* 2009, p. 56). Low-intensity burns may not kill taller trees directly but may create snags of smaller trees and larger trees may be injured, resulting in vulnerability (of the tree) to pathogens that cause hollowing of the trunk, which provides roosting habitat (Perry 2012, p. 177). Prescribed burning also opens the tree canopy, providing more canopy light penetration (Boyles and Aubrey 2006, p. 112; Johnson *et al.* 2009a, p. 240), which may facilitate faster development of juvenile bats

(Sedgeley 2001, p. 434). Although Johnson *et al.* (2009a, p. 240) found the amount of roost switching did not differ between burned and unburned areas, the rate of switching in burned areas of every 1.35 days was greater than that found in other studies (every 2 to 3 days) (Foster and Kurta 1999, p. 665; Owen *et al.* 2002, p. 2; Carter and Feldhamer 2005, p. 261; Timpone *et al.* 2010, p. 119).

Direct effects of fire on bats likely differ among species and seasons (Perry 2012, p. 172). Northern long-eared bats have been seen flushing from tree roosts shortly after ignition of prescribed fire during the growing season (Dickinson *et al.* 2009, p. 60). Fires of reduced intensity that proceed slowly allow sufficient time for roosting bats to arouse from sleep or torpor and escape the fire (Dickinson *et al.* 2010, p. 2200), although extra arousals from fire smoke could cause increased energy loss (Dickinson *et al.* 2009, p. 52). During prescribed burns, bats are potentially exposed to heat and gases; the roosting behavior of this species, however, may reduce its vulnerability to toxic gases. When trees are dormant, the bats are roosting in caves or mines (hibernacula can be protected from toxic gases through appropriate burn plans), and during the growing season, northern long-eared bats roost in tree cavities or under bark above the understory, above the area with the highest concentration of gases in a low-intensity prescribed burn (Dickinson *et al.* 2010, pp. 2196, 2200). Carbon monoxide levels did not reach critical thresholds that could harm bats in low-intensity burns at the typical roosting height for the northern long-eared bat (Dickinson *et al.* 2010, p. 2196); thus, heat effects from prescribed fire are of greater concern than gas effects on bats. Direct heat could cause injury to the thin tissue of bat ears and is more likely to occur than exposure to toxic gas levels during prescribed burns (Dickinson *et al.* 2010, p. 2196). In addition, fires of reduced intensity with shorter flame height could lessen the effect of heat to bats roosting higher in trees (Dickinson *et al.* 2010, p. 2196). Winter, early spring, and late fall generally contain less intense fire conditions than during other seasons and coincide with time periods when bats are less affected by prescribed fire due to low activity in forested areas. Furthermore, no young are present during these times, reducing the likelihood of heat injury to vulnerable young to fire (Dickinson *et al.* 2010, p. 2200). Prescribed fire objectives, such as fires with high intensity and rapid ignition in order to meet vegetation goals, must be balanced with the exposure of bats to the effects of fire (Dickinson *et al.* 2010, p. 2201). Currently, the Service and USFS strongly recommend not burning in the central hardwoods from mid- to late April through summer to avoid periods when bats are active in forests (Dickinson *et al.* 2010, p. 2200).

Bats that occur in forests are likely equipped with evolutionary characteristics that allow them to exist in environments with prescribed fire. Periodic burning can benefit habitat through snag creation and forest canopy gap creation, but frequency and timing need to be considered to avoid direct and indirect adverse effects to bats when using prescribed burns as a management tool. Adverse impacts to individual bats during the active season could be significantly reduced through development of appropriate burn plans that avoid and minimize heat production during prescribed burns. We conclude that there may be adverse effects posed by prescribed burning to individual northern long-eared bats; however, there is no evidence suggesting effects from prescribed burning itself have led to population declines.

Conservation Efforts To Reduce Other Natural or Manmade Factors Affecting Its Continued Existence

In the Midwest, rapid wind energy development is a concern with regard to its effect on bats (Baker 2011, pers. comm.; Kath 2012, pers. comm.). Due to the known impacts from wind energy development, in particular to listed (and species currently being evaluated to determine if listing is warranted) bird and bat species in the Midwest, the Service, State natural resource agencies, and wind energy industry representatives are developing the MSHCP. The planning area includes the Midwest Region of the Service, which includes all of the following States: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The MSHCP would allow permit holders to proceed with wind energy development, which may result in ''incidental'' taking of a listed species under section 10 of the Act, through issuance of an incidental take permit (77 FR 52754; August 30, 2012). Currently, the northern long-eared bat is included as a covered species under the MSHCP. The MSHCP will address protection of covered species through avoidance, minimization of take, and mitigation to offset ''take'' (*e.g.,* habitat preservation, habitat restoration, habitat enhancement) to help ameliorate the effect of wind development (77 FR 52754; August 30, 2012). In some cases, the USFS has agreed to limit or restrict burning in the central hardwoods from mid- to late April through summer to avoid periods when bats are active in forests (Dickinson *et al.* 2010, p. 2200).

Summary of Factor E

Using the best scientific and commercial data available, we have identified a number of natural or manmade factors that may have direct or indirect effects on the continued existence of northern long-eared bats.

Wind energy facilities have been built throughout a large portion of the range of northern long-eared bats, and have been found to cause mortality of northern long-eared bats. While mortality estimates vary between sites and years, sustained mortality at particular sites could result in negative impacts to local populations. Overall, northern long-eared bats are rarely detected as mortalities at wind facilities; however, there is a great amount of uncertainty associated with extrapolating detected northern long-eared bat mortalities to total bat mortalities. Also, wind energy development within the species' range is projected to continue to increase in future years.

Climate change may also affect this species, as northern long-eared bats are particularly sensitive to changes in temperature, humidity, and precipitation. Impacts from climate change may also indirectly affect the northern long-eared bat due to changes in food availability, timing of hibernation, and reproductive cycles, along with other factors, all of which may contribute to a shift in suitable habitat.

Environmental contaminants, in particular insecticides, pesticides, and inorganic contaminants, such as mercury and lead, may also have detrimental effects on northern long-eared bats. Contaminants may bioaccumulate (become concentrated) in the tissues of bats, potentially leading to a myriad of sublethal and lethal effects.

Northern long-eared bats likely evolved with fire in their habitat, and thus may benefit from fire-created habitat. However, there are potential negative effects from prescribed burning, including direct mortality. Therefore, when using prescribed burning as a management tool, fire frequency, timing, location, and intensity should all be considered in relation to the northern long-eared bat.

There is currently no evidence that these natural or manmade factors would have significant population-level effects on the northern long-eared bat when

considered alone. However, these factors may have a cumulative effect on this species when considered in concert with WNS, as this disease has led to dramatic northern long-eared bat population declines (see Factor C discussion, above). While there have been conservation efforts attempting to reduce the potential mortality of northern long-eared bats, particularly involving wind energy development and prescribed burning, these factors may still affect this species when considered cumulatively with white-nose syndrome (discussed below, in ''Cumulative Effects from Factors A through E'').

Cumulative Effects From Factors A Through E

WNS (Factor C) is the primary factor affecting the northern long-eared bat and has led to dramatic and rapid population-level effects on the species. WNS is the most significant threat to the northern long-eared bat, and the species would likely not be imperiled were it not for this disease. However, although the effects on the northern long-eared bat from Factors A, B, and E, individually or in combination, do not have significant effects on the species, when combined with the significant population reductions due to white-nose syndrome (Factor C), they may have a cumulative effect on this species at a local population scale.

Summary of Changes From the Proposed Listing Rule

Based on our review of the public comments, comments from other Federal and State agencies, peer review comments, issues raised at the public hearing, and new relevant information that has become available since the October 2, 2013, publication of the proposed rule, we have reevaluated our proposed listing rule and made changes as appropriate. Other than minor clarifications and incorporation of additional information on the species' biology and populations, this determination differs from the proposal in the following ways:

(1) Based on our analyses of the potential threats to the species, we have determined that the northern long-eared bat does not meet the definition of an endangered species, contrary to our proposed rule published on October 2, 2013 (78 FR 61046).

(2) Based on our analyses, we have determined that the species meets the definition of a threatened species. Therefore, on the effective date of this final listing rule (see **DATES**, above), the species will be listed as a threatened species in the List of Endangered and Threatened Wildlife at 50 CFR 17.11(h).

(3) We have further refined the estimated timeframe during which Pd (the fungus that causes white-nose syndrome) is expected to spread throughout the range of the northern long-eared bat.

(4) We have expanded the discussion of white-nose syndrome and the effects of white-nose syndrome on the northern long-eared bat under Factor C.

(5) We have included additional (most recent available) survey data for the species in the *Distribution and Relative Abundance* section, above.

Summary of Comments and Recommendations on the Proposed Listing Rule

In the proposed listing rule published on October 2, 2013, we requested that all interested parties submit written comments on the proposal by December 2, 2013. Following that first 60-day comment period, we held four additional public comment periods (see 78 FR 72058, December 2, 2013; 79 FR 36698, June 30, 2014; 79 FR 68657, November 18, 2014; 80 FR 2371, January 16, 2015) totaling an additional 180 days for public comments, with the final comment period closing on March 17, 2015. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposed listing. Newspaper notices inviting general public comment were published in multiple newspapers throughout the range of the species. We received a request for a public hearing; we held a public hearing on December 2, 2014, in Sundance, Wyoming. All substantive information provided during comment periods has either been incorporated directly into this final determination or is addressed below. Comments pertaining to the proposed 4(d) rule will be addressed in the final 4(d) rule, and are not included here.

Peer Reviewer Comments

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from seven knowledgeable individuals with scientific expertise that included familiarity with the northern long-eared bat and its habitat, biological needs, and threats. We received responses from four of the peer reviewers.

We reviewed all comments we received from the peer reviewers for substantive issues and new information regarding the listing of the northern long-eared bat. The peer reviewers generally concurred with our methods and conclusions in the proposed listing rule, and provided additional information, clarifications, and suggestions to improve the final listing rule. Peer reviewer comments are addressed in the following summary and are incorporated into the final rule as appropriate. Specific recommended edits were added under the corresponding section in the final listing rule.

(1) *Comment:* Peer reviewers (and other commenters) concurred with the Service's assessment that factors other than white-nose syndrome are not believed to be contributing to the current decline of the species rangewide. However, they believed that there could be localized impacts from these other stressors and that cumulative impacts may result from these other factors, in addition to white-nose syndrome, due to a diminished population. Several public commenters further stressed that these additional threats will become proportionately more harmful to the species after the onset of WNS, and protection from these other threats may affect whether the species can stabilize post-WNS.

Our Response: WNS is the most significant threat to the northern long-eared bat, and the species would likely not be imperiled were it not for this disease. Thus, the Service proposed listing the northern long-eared bat due primarily to the impacts of WNS. As stated by commenters, other activities may impact northern long-eared bats as well; however, we conclude that these factors are not believed to be independently impacting the species rangewide. However, although the effects on the northern long-eared bat from Factors A, B, and E, individually or in combination, do not have significant effects on the species, when combined with the significant population reductions due to white-nose syndrome (Factor C), they may have a cumulative effect on this species at a local population scale.

(2) *Comment:* Peer reviewers encouraged the Service to conduct a more extensive literature review. Other commenters also recommended a more extensive literature search and provided citations for relevant literature not included in the proposed listing rule. One reviewer suggested we review literature on the species' habitat requirements, and suggested that the species is more flexible than described in the proposed listing rule. One reviewer recommended, in particular, a more thorough review of literature related to bat community ecology or bat response to forest management where northern long-eared bats are one of many species examined.

Our Response: We have reviewed the literature provided by commenters and incorporated this information into this final listing rule, where appropriate. We also conducted further literature searches to determine if there was additional available literature relevant to the species' biology or the factors affecting its status, and incorporated that information into this final listing rule. In particular, we updated sections with the most recent literature pertaining to the predominant threat to the species, white-nose syndrome, and the resulting impact of the disease on the northern long-eared bat.

(3) *Comment:* One peer reviewer stated that it is critical to point out that these bats day-roost in an ephemeral resource (snags and cavity-trees), and, therefore, they are adapted to handle the dynamic nature of roost longevity and loss of roosts from disturbance in temperate forest systems.

Our Response: Northern long-eared bats are flexible in their tree species roost selection, and roost trees are an ephemeral resource; therefore, the species would be expected to tolerate some loss of roosts provided suitable alternative roosts are available. However, the impact of loss of roosting or foraging habitat within northern long-eared bat home ranges is expected to vary, depending on the scope of removal. See the ''Summer Habitat'' section under *Factor A,* above, for a more detailed discussion.

(4) *Comment:* One peer reviewer commented that the literature cited that is posted at *http://www.regulations.gov* was not complete, with several references in the text not appearing in the literature cited section, and many of the unpublished reports that are cited are unobtainable.

Our Response: We corrected this and added these missing references, in addition to any new references used in this final listing rule, to the literature cited list. A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* and upon request from the Twin Cities Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

The Act and our regulations do not require us to use only peer-reviewed literature, but instead require us to use the best scientific data available in a listing determination. We used information from many different sources, including articles in peer-reviewed journals, scientific status surveys and studies completed by qualified individuals, Master's thesis research that has been reviewed but not published in a journal, other unpublished governmental and nongovernmental reports, reports prepared by industry, personal communication about management or other relevant topics, conservation plans developed by States and counties, biological assessments, other unpublished materials, experts' opinions or personal knowledge, and other sources. You may request a copy of many of these unpublished reports by contacting the Service's Twin Cities Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**). Unpublished reports that we have used in making our listing determination include survey information that has been received from State agencies, which the public can request directly from these State agencies.

(5) *Comment:* Peer reviewers agreed that white-nose syndrome likely will spread throughout the range of the northern long-eared bat. One peer reviewer suggested that the rate of spread (through bat-to-bat contact) may slow in western areas, where hibernacula are not as abundant. ''Barriers provided by the Great Lakes and isolation from major cave areas in North America are presumably the reasons that the fungus has not yet reached the populations in northern Wisconsin and northern Michigan, and the lower density of hibernacula in the Great Plains may slow the spread in a similar way. However, there is no biological reason to believe that the disease will not spread throughout the entire range of the species.''

Our Response: As stated in this final listing rule, based on past and current rates of spread of the disease, we agree that the disease will likely spread throughout the range of the species. Regarding a slowing rate of spread in western areas due to fewer hibernacula, WNS has been confirmed at numerous hibernacula that are not caves or mines, including culverts, bunkers, forts, tunnels, excavations, quarries, and even houses. Since this peer review was submitted, white-nose syndrome has been documented in Wisconsin and the Upper Peninsula of Michigan. The spread of white-nose syndrome was addressed in more detail in our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above.

(6) *Comment:* Peer reviewers noted that, in the proposed listing rule, we did not stress the importance of the northern long-eared bat's sociality during the summer months, and suggested a further explanation on how social structures be maintained if populations have declined dramatically due to white-nose syndrome is needed. These peer reviewers further questioned if the species will be able to recover, even if white-nose syndrome is curtailed.

Our Response: Similar to other myotid bats (*e.g.,* Indiana bat, little brown bat), the northern long-eared bat is considered a highly social species, with females forming maternity colonies during the summer months. Peer reviewers expect that white nose-syndrome will reduce population sizes to a level that these groups may not be able to be maintained. Whether a species is ultimately recoverable is not something we consider when listing species; we are obligated to list species under the Act if they meet the definition of an endangered or a threatened species. We will consider what actions might be necessary to recover the species when we begin recovery planning and implementation. See our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, for a more detailed discussion of this topic.

(7) *Comment:* One commenter stated that although the proposed listing rule discusses the regulatory mechanisms that several States have employed to reduce the negative impact of wind development on this species, it fails to discuss potential regulatory efforts that could be controlled at the State level, including the impact of highway construction, forest management, and pest control regulations.

Our Response: In general, we devoted most effort to identifying conservation efforts that have been taken to reduce the impact of the predominant threat to the species: White-nose syndrome. We acknowledge that additional conservation efforts are underway in many arenas and they may address other cumulative threats.

(8) *Comment:* One peer reviewer disagreed with the assessment in the proposed listing rule that the species clusters and, therefore, is at greater risk of bat-to bat transmission of Pd while in hibernation. This reviewer stated, at least in Kentucky caves, that the species is most often seen hibernating alone or in very small groupings.

Our Response: We corrected this in this final listing rule. The northern long-eared bat occasionally can be found in clusters with other bats, but typically is found roosting singly during hibernation. Certain life-history characteristics of the northern long-eared bat (*e.g.,* proclivity to roost in areas with increased humidity of hibernacula, longer hibernation time period) are believed to increase the species' susceptibility to white-nose syndrome in comparison to other cave

bat species. Furthermore, of the six species with known mortality from WNS, the northern long-eared bat has demonstrated the greatest declines, based on winter count data. See our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, for a more detailed discussion.

(9) *Comment:* One reviewer stated that understanding the extent of the impact to northern long-eared bats remains difficult due to the behavior of the species during the winter, which includes movement between hibernacula, particularly during swarming and staging periods, and the ability of the species to hibernate in cracks and crevices, making it difficult to develop population estimates for winter counts.

Our Response: Despite the difficulties in observing or counting northern long-eared bats, winter hibernacula counts are the recommended method, and the only method with enough history to assess trends over time, for monitoring northern long-eared bats. Hibernacula surveys are considered the best available data for cave-dwelling bats in general. However, in recognition of the limitations of these data, we generally do not use the available hibernacula counts to estimate northern long-eared bat population size. Instead, we use the hibernacula data to understand and estimate population trends for the species. The relative difficulty of observing northern long-eared bats during hibernacula surveys should be consistent from year to year, and these data can be used to estimate relative change in numbers and indicate if the species is increasing or decreasing in number in those hibernacula. Thus, the total data available for known northern long-eared bat hibernacula can yield an individual site and cumulative indication of species population trend; the declines estimated at hibernacula are also corroborated by declines in acoustic records and mist-net captures in summer.

State Agency Comments

(10) *Comment:* State fish and wildlife management agencies (Montana, Louisiana, and Tennessee) commented that the listing of the northern long-eared bat should be limited to the portions of the range where decline has been documented. Another State (Wyoming) commented that there is insufficient data to warrant listing of the northern long-eared bat at a national level given the absence of white-nose syndrome in much of its range.

Our Response: Decisions under the Act cannot be made on a State-by-State basis, but at the species, subspecies, or distinct population segment (DPS) level. For the northern long-eared bat, we have determined that the species warrants listing as a threatened species throughout its range based on current threats (primarily due to WNS) and how those threats are likely to impact the species into the future. (See our response to Comment 36 for more information.)

White-nose syndrome or Pd have been confirmed in 28 States of the northern long-eared bat's 37-State (plus the District of Columbia) range. The species' range only extends into a small area in some of the States that remain uninfected with white-nose syndrome to date. Information provided to the Service by a number of State agencies and all models concerning the spread of white-nose syndrome demonstrates that white-nose syndrome will continue to spread throughout the range of the northern long-eared bat. Furthermore, based on the average rate of spread to date, Pd can be expected to occur throughout the range of the northern long-eared bat in an estimated 8 to 13 years (see our Factor C discussion in the section titled, ''White-nose Syndrome,'' above). Thus we have determined that the northern long-eared bat is threatened throughout its entire range.

(11) *Comment:* Several State and other commenters stated that the species should be listed as threatened rather than endangered for a variety of reasons: It would provide the Service with a better opportunity to protect the species from white-nose syndrome; we lack understanding of white-nose syndrome in the warmer regions with higher cave temperatures and shorter hibernation periods; a threatened status would allow for potential issuance of a 4(d) rule, which would allow the Service to implement regulations that are necessary and advisable to conserve the species, due to the large geographic size of the northern long-eared bat's range and the habitat variability within the large range; and a belief that endangered status is premature until more information is available.

Our Response: For the reasons stated in the Determination section of this final listing rule, the Service has determined that the northern long-eared bat is a threatened species, rather than an endangered species. Please see our response to other comments, which address the reasons specified by commenters for listing the species as threatened rather than endangered.

(12) *Comment:* One state commenter did not recommend a specific status for the species, but found that the species is not in danger of extinction in the immediate future, but could become so in the future.

Our Response: As explained in the Determination section of this final listing rule, although WNS is predicted to spread throughout the range of the species, in the currently uninfected areas we have no evidence that northern long-eared bat numbers have declined, and the present threats to the species in those areas are relatively low. Thus, because the fungus that causes WNS (Pd) may not spread throughout the species' range for another 8 to 13 years, because no significant declines have occurred to date in the portion of the range not yet impacted by the disease, and because some bats persist many years later in some geographic areas impacted by WNS (for unknown reasons), we conclude that the northern long-eared bat is not currently in danger of extinction throughout all of its range. However, because Pd is predicted to continue to spread, we also determine that the northern long-eared bat is likely to be in danger of extinction within the foreseeable future. Therefore, on the basis of the best available scientific and commercial information, we are listing the northern long-eared bat as a threatened species under the Act.

(13) *Comment:* Several States (Kentucky, Georgia, and Missouri) mentioned that, at the time they submitted their comments, there had not been any decline detected in northern long-eared bat population numbers. Specifically, Kentucky, and Georgia stated that the species is still commonly captured during summer surveys, even following white-nose syndrome confirmation in the State. Kentucky comments stated that the species' population in the State does not seem to be susceptible to white-nose syndrome.

Our Response: No decline has been documented in Georgia, Kentucky, or Missouri to date. However, mortality due to white-nose syndrome has been documented in cave bats in all four States, and mortality in northern long-eared bats has been documented in Kentucky and Missouri. Also, historically, there have been small numbers of northern long-eared bats found in hibernacula in these States; therefore, it is challenging to detect population changes based on hibernacula survey data alone in these States. Summer surveys, where available, often show a lower decline than corresponding hibernacula data in general. These differences likely stem from a combination of different survey techniques, differential influence of white-nose syndrome in the summer versus winter northern long-eared bat

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populations, and also the likelihood that the summer data do not reflect northern long-eared bat populations as well as the winter data, given the methods and locations from which they were derived. Although there may not be a decline in summer populations observed to date in these States, mortality has been documented, which indicates the species is susceptible to the disease in these States.

(14) *Comment:* Several State commenters (Oklahoma and Midwest Association of Fish and Wildlife Agencies (MAFWA) letter) mentioned that in the proposed listing rule, the Service described different regions of the northern long-eared bat's range as separate populations and the commenter interpreted that to mean each population was a ''subpopulation.''

Our Response: We removed ''population'' from this section of the rule to address any confusion. For the purposes of organization, the northern long-eared bat's range in the United States is discussed in four parts: eastern range, Midwest range, southern range, and western range. Separating the range of the bat is not meant to imply that there are distinct or separate ''subpopulations'' of the species.

(15) *Comment:* State and public commenters stated that white-nose syndrome research will be impacted if the northern long-eared bat is listed, as treatments cannot be tested on listed species.

Our Response: Under section 4 of the Act, a species shall be listed if it meets the definition of an endangered or threatened species because of any (one or more) of the five factors (threats), considering solely best available scientific and commercial data. Based on our analysis of the five factors, we conclude the northern long-eared bat meets the definition of a threatened species, particularly considering the effects of WNS on the species. Research that is conducted for the purpose of recovery of a species is an activity that can be authorized under section 10 of the Act, normally referred to as a recovery permit, or can be conducted by certain State conservation agencies by virtue of their authority under section 6 of the Act. White-nose syndrome research will be important for recovery of the species, and thus the Service will continue to support such actions.

(16) *Comment:* Both State and public commenters stated that the species is more common in southeast States, Kentucky and Tennessee in particular, than was depicted in the proposed listing rule. The State of Tennessee further questions if the historical core of the species' range is in the southern Appalachians, rather than the northeast, and commented that ''Tennessee has over 9,000 caves and less than 2 percent of those have been surveyed, which could mean that there are many more locations within the [S]tate that have significant numbers of [northern long-eared bats].''

Our Response: The Act requires us to make a determination using the best available scientific and commercial data in our review of the status of the species. In the proposed listing rule, we used the best available data at the time, which did not show the species to be as common, particularly in summer surveys. Based on more thorough data provided since the October 2, 2013, proposed rule (*e.g.,* summer survey data and winter hibernacula counts, peer reviewer comments), we have since learned the species may have been more commonly encountered, historically in Kentucky and Tennessee. We have corrected this in the final listing rule within the ''Southern Range'' section of the *Distribution and Relative Abundance* discussion, above. With regard to the potential for additional unsurveyed hibernacula in Tennessee, this was noted in the *Distribution and Relative Abundance* discussion, above. Also, there is no reason to believe that white-nose syndrome will not reach bat hibernacula simply because these sites are not monitored. Because we have documented consistently that northern long-eared bat declines are severe once white-nose syndrome is confirmed in a site, it is reasonable to expect that northern long-eared bat declines are similar at sites that are not or cannot be monitored.

(17) *Comment:* Two States (Minnesota and Missouri) and several public commenters requested that, if the species is listed, they be included as stakeholders in designating critical habitat and developing a recovery plan and best management plans.

Our Response: The Service appreciates the interest expressed by these commenters in being involved as stakeholders and welcomes all interested parties to be involved as potential stakeholders. We will work with stakeholders through recovery planning to identify areas that would aid in recovery of this species, and determine appropriate actions to take. The Service understands the importance of stakeholder participation and support in recovery of the northern long-eared bat and will continue to work with all stakeholders to this end.

(18) *Comment:* Several commenters, through a single letter produced by the Northeast Association of Fish and Wildlife Agencies, stated that known hibernacula containing northern long-eared bats are plentiful in many States, with 89 known in New York and 119 in Pennsylvania alone.

Our Response: Although there are a large number of known hibernacula that were historically used by northern long-eared bats, there are currently few, if any, individuals found during hibernacula surveys (post-WNS) in Pennsylvania and New York. Please refer to the *Distribution and Relative Abundance* section of this final listing rule, which discusses the current status of the species in these two States.

(19) *Comment:* Several States provided information on current and past conservation efforts that may benefit the northern long-eared bat. Also, other public comments noted that State, Federal, and private conservation efforts should be more thoroughly reviewed and included in the final listing rule. Specifically, many commenters mentioned that more weight should have been given to the 2008 white-nose syndrome plan, State white-nose syndrome plans, white-nose syndrome workshops, and State agency efforts in survey and white-nose syndrome research efforts.

Our Response: Information provided to us on additional conservation efforts has been added to the conservation efforts discussion under Factors A and C, above. It should be noted, however, that although recommendations set forth in these documents (*e.g.,* 2008 white-nose syndrome plan, State white-nose syndrome plans), if followed, may help reduce human-aided spread of white-nose syndrome, the efforts outlined in these plans have not yet identified a method by which WNS can be halted or its impacts reduced. Also, the white-nose syndrome national plan represents guidance that is not strictly enforced by any agency. Thus, although these plans will prepare management agencies to act to stop WNS should a viable option be presented, their ability to halt WNS is not guaranteed.

(20) *Comment:* Many States in the Northeast stated that white-nose syndrome continues to impact the northern long-eared bat in their respective States and have witnessed post-WNS confirmation of mortality and severe declines. Vermont, New Hampshire, and Maine all commented that the species was considered a common species in the State prior to white-nose syndrome confirmation and is now considered rare.

Our Response: Data received during data requests sent to the States corroborate these declines due to white-nose syndrome cited by commenters. This information is presented in

Distribution and Relative Abundance (in the ''Eastern Range'' and ''Southern Range'' sections) within the Background section of this final listing rule.

(21) *Comment:* One State questioned what recovery actions would need to be taken to stop the spread of white-nose syndrome throughout the northern long-eared bat's range.

Our Response: Recovery actions will be decided upon during recovery planning, after the species is listed. Recovery planning includes the development of a recovery outline shortly after a species is listed, preparation of a draft and final recovery plan, and revisions to the plan as significant new information becomes available. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. The recovery plan identifies site-specific management actions that will achieve recovery of the species, measurable criteria that determine when a species may be downlisted or delisted, and methods for monitoring recovery progress.

(22) *Comment:* One State commented that not all white-nose syndrome spread models are in agreement on how the disease will spread. They cited a model presented at the White-nose syndrome Workshop in 2012 (Puechmaille 2012), and indicated that this model suggested that the spread and impacts of the disease presented in the proposed listing rule were significantly overestimated.

Our Response: The Puechmaille model, cited by the commenter, has been presented in evolving forms at the past several annual White-nose syndrome Workshops. The type of model used by Puechmaille may be useful in predicting suitable habitat for WNS, but it is not sufficient to predict unsuitable habitat. Further, this model cannot be used to predict spread of WNS. Given the uncertainties of the Puechmaille model (as identified by the author), we did not consider this model in making inferences about white-nose syndrome (or Pd) spread dynamics or population-level impacts to the northern long-eared bat.

(23) *Comment:* One State commenter agreed with the statement offered in the proposed listing rule that there is no information to indicate that there are areas within the species' range that will not be impacted by white-nose syndrome. Life-history information, as well as what we currently know about the disease, suggests northern long-eared bats exhibit low resiliency due to their extreme susceptibility to the disease and their low reproductive rates.

Our Response: Information provided to the Service by a number of State agencies confirms the likelihood of white-nose syndrome spreading throughout the range of the northern long-eared bat. White-nose syndrome or Pd are now detected in 28 States and 5 Canadian provinces, all of which are in the range of the species. Pd has spread over 1,000 miles (1,609 km) from the primary site of detection in New York to western Missouri, northern Minnesota, and as far south as Alabama, Arkansas, Georgia, and Mississippi. Furthermore, although there is some variation in spread dynamics and the impact of WNS on bats when it arrives at a new site, no information suggests that any site would be unsusceptible to the arrival of Pd. Given the appropriate amount of time for exposure, WNS appears to have had similar levels of impact on northern long-eared bats everywhere the species has been documented with the disease. Therefore, absent direct evidence to suggest that some northern long-eared bats that encounter Pd do not contract WNS, available information suggests that the species will be impacted by WNS everywhere in its range. See our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, for more detailed information.

(24) *Comment:* Comments from Oklahoma stated that the northern long-eared bat is commonly captured in the counties where it occurs in the State, and survey results indicate the northern long-eared bat population throughout the southwestern portion of the species' range does not need protection under the Act at this time.

Our Response: We have incorporated information provided on the species' status for the northern long-eared bat in Oklahoma in the *Distribution and Relative Abundance* section of this final listing rule. As stated in response to another comment, decisions under the Act cannot be made on a State-by-State basis, but at the species, subspecies, or DPS level. When a species is listed, we work with all of our partners to develop and implement practical solutions to conserve and protect the species while enabling on-the-ground projects to move forward. The definition of ''species'' under the Act includes distinct population segments. For a DPS to be identified it must be markedly separated from other populations as a consequence of physical, physiological, ecological, or behavioral factors. It is unlikely, and we have no evidence, that a State boundary would separate one State's northern long-eared bat population from northern long-eared bats in adjacent States.

(25) *Comment:* One commenter stated that more State-specific data are needed considering the ambiguity and divergence across the range of the northern long-eared bat.

Our Response: The Act requires us to make a determination using the best available scientific and commercial data after conducting a review of the status of the species. In 2014, we requested additional survey data (hibernacula and summer) from all of the States within the range of the species (and the District of Columbia) and received information from the majority of States. We have added this updated information to the *Distribution and Relative Abundance* section of this final listing rule.

(26) *Comment:* Several commenters stated that hibernacula survey data are too unreliable to base the listing decision on for the northern long-eared bat because northern long-eared bats are often overlooked in winter surveys due to their cryptic nature and the fluctuation of winter numbers, and that rather the Service should base its listing decision on summer survey data. Further, some commenters stated that the Service did not compile and review complete summer data sets maintained by State agencies.

Our Response: We agree that northern long-eared bats are often difficult to observe during winter hibernacula surveys due to their tendency to roost deep in cracks and crevices within hibernacula. Despite the difficulties in observing or counting northern long-eared bats, winter hibernacula colony counts are the recommended method, and the only method with enough history to assess trends over time, for monitoring northern long-eared bats, and hibernacula surveys are considered the best available data for cave-dwelling bats in general. However, in recognition of the limitations of these data, we do not use the available hibernacula counts to estimate northern long-eared bat population size. Instead we use the hibernacula data to understand and estimate population trends for the species. The relative difficulty of observing northern long-eared bats during hibernacula surveys should be consistent from year to year, and these data can be used to estimate relative change in numbers and indicate if the species is increasing or decreasing in number in those hibernacula. Thus, the total data available for known northern long-eared bat hibernacula can yield an individual site and cumulative indication of species population trend; furthermore, declines estimated at hibernacula are corroborated by

declines in acoustic records and net captures in summer.

In 2014, we requested all available hibernacula and summer survey data from all State fish and wildlife agencies within the range of the species and received information from the majority of States. We also requested information from States while developing the proposed listing rule. All available information at the time was included in the proposed listing rule. The majority of long-term summer monitoring estimates corroborates the trends observed in hibernating colonies. Although it is important to include all available relevant summer data, summer data likely do not reflect northern long-eared bat populations as well as the winter data, given the variability in methods and locations from which they were derived. Although we acknowledge uncertainties in both summer and winter northern long-eared bat data, we believe that the winter data, at this time, provide a more reliable estimate of population trends. The *Distribution and Relative Abundance* section of this final listing rule includes the most recent data received from States within the species' range.

(27) *Comment:* Commenters stated that the Service is making an assumption that white-nose syndrome will spread throughout the range of the northern long-eared bat. One commenter stated that bat experts do not know with any degree of certainty how WNS affects bats, how it is transmitted, how quickly or extensively it will spread, or how it might be controlled. These commenters stated that these uncertainties in white-nose syndrome's spread make it impossible to forecast how the disease will spread and impact the species in different areas throughout its range.

Our Response: The question of if and when white-nose syndrome will spread throughout the range of the species has been considered extensively by the Service and its white-nose syndrome coordinators. Information provided to the Service by a number of State agencies demonstrates the likelihood of white-nose syndrome spreading throughout the range of the northern long-eared bat. White-nose syndrome or Pd is now detected in 28 States and 5 Canadian provinces, all of which are in the range of the species. From initial detection of white-nose syndrome in the winter of 2006–2007, Pd has spread over 1,000 miles (1,690 km) from the primary site of detection in the State of New York to western Missouri, northern Minnesota, and as far south as Alabama, Arkansas, Georgia, and Mississippi. All models we have consulted concerning the spread of white-nose syndrome predict the disease or Pd will continue to spread. As mentioned under our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, models that provide estimates of the timing of spread predict the disease will cover the entirety of the species' range between 2 and 40 years. However, these models all have significant limitations for predicting timing of spread, and in many instances have overestimated the time white-nose syndrome would arrive in currently uninfected counties by as much as 45 years.

As for how white-nose syndrome affects bats, how it is transmitted, and how it may be controlled, there has been a significant amount of research completed that has provided insight into these questions. Please see our Factor C discussion in the section titled, ''White-nose Syndrome,'' above, for a more detailed discussion.

(28) *Comment:* Several commenters, through a single letter produced by MAFWA, stated that recent survey data from Pennsylvania, a State amongst the hardest hit by WNS, indicate that hibernacula surveys may be overestimating the decline in northern long-eared bat numbers. A large 2013 sample of summer mist-netting shows that northern long-eared bat captures per unit effort (over 178,000 square-meter mist-net hours in 2001–2007; over 500,000 in 2013) remain at 24 percent of the level observed pre-WNS. In contrast, hibernacula surveys in Pennsylvania during the same time period show a 99 percent decline in northern long-eared bat observations. ''These results clearly demonstrate the significant disparity between the prevalence of northern long-eared bats recorded in hibernacula surveys and in summer surveys (Turner 2014, pers. comm.).''

Our Response: Numerous counties in western Pennsylvania were not confirmed with WNS until 2012, possibly attributable to geographic barriers that hinder movements of bats between eastern and western parts of the State (Miller-Butterworth *et al.* 2014). Nevertheless, a 76 percent decline in summer captures of northern long-eared bat (standardized for effort) represents a severe decline in the population over the past 7 years. These summer monitoring estimates corroborate the severe declines observed in hibernating colonies. Furthermore, summer monitoring in Virginia from 2009 to the present revealed that declines in northern long-eared bats were not observed by VDGIF until 2 years after the severe declines were observed during winter and fall monitoring efforts in the State (Reynolds 2012, pers. comm.). Therefore, the assertion that the difference between winter estimates (99 percent decline in count) and summer estimates (76 percent decline in captures) in Pennsylvania represents a significant disparity in the estimated impact of WNS in the State is premature and inconclusive in the context of the health of northern long-eared bat populations in Pennsylvania. Furthermore, summer monitoring in Pennsylvania reveals that declines in northern long-eared bat captures continued in 2014.

We agree that there are differences between summer and winter data for northern long-eared bat. Specifically, that summer data, where available, often show a lower decline than corresponding hibernacula data. We conclude that these differences likely stem from a combination of different survey techniques, differential influence of WNS in the summer versus winter northern long-eared bat populations, and also the likelihood that the summer data do not reflect northern long-eared bat populations as well as the winter given the methods and locations from which they were derived. Although we acknowledge uncertainties in both summer and winter northern long-eared bat data, we conclude that the winter data, at this time, provide a more reliable estimate of population trends.

(29) *Comment:* Comments from MAFWA stated that only a small proportion of known cave and mine hibernacula across the species' range have been surveyed or monitored for the northern long-eared bat. For example, ''Tennessee has over 9,000 caves and less than 2 percent of those have been surveyed, which could mean that there are many more locations within the State that have significant numbers of northern long-eared bat'' (TWRA 2014). The commenter stated that this is particularly true for many areas of Canada (COSEWIC 2013) and the central and western States where surveys of bat hibernacula are very limited.

Our Response: These are accurate statements. Additional counties in Tennessee have been confirmed with WNS each year since 2010. There is no reason to believe that WNS will not reach bat hibernacula simply because these sites are not monitored. We have several examples of hibernacula that were only identified after WNS was transmitted into the area and dead and dying bats were found on the landscape. Because we have seen consistently that northern long-eared bat declines are severe once WNS is confirmed in a site, it is reasonable to expect that northern long-eared bat declines are similar at

sites that are not or cannot be monitored. In 103 hibernacula throughout the East, 68 percent now have zero northern long-eared bats observed in winter surveys. An additional 24 percent have declined by more than 50 percent.

(30) *Comment:* MAFWA commented that recent research into slowing the spread of WNS has documented, in a laboratory setting, that Pd spores can be killed by *Rhodococcus rhodochrous* DAP96253 (RRDAP). They suggest that this potential treatment may increase bat survival and allow the northern long-eared bat to adapt to the presence of WNS.

Our Response: As noted by the States in this comment, strategies to slow the spread of WNS are in various early stages of development in the laboratory setting. Promising treatments, including RRDAP and others, are being considered for field trials. However, considerably more research and coordination is needed to address the safety and effectiveness of any treatment proposed for field use and to meet regulatory requirements prior to consideration of widespread application. In short, implementation of WNS treatments on a landscape-scale is likely years away.

Risks associated with application of any compound in a field setting remain largely unknown and undemonstrated when considering the additional harm to bats, other biota, or the environment. Furthermore, the RRDAP compound has not been tested on northern long-eared bats, so it has not yet been demonstrated to be safe or effective for this species. Therefore, the assertion that the treatment of bats with RRDAP or other agents may increase bat survival and allow northern long-eared bat to survive exposure to the pathogen is unsubstantiated. No treatment in development has demonstrated any potential to allow a species to ''adapt to the presence of the pathogen.''

Any treatment or application demonstrated to slow the spread and mortality of WNS will be an important tool for potential recovery actions. However, we cannot predict exactly when or if a treatment will be proven safe and effective for large-scale implementation that will affect species at a population level.

(31) *Comment:* Comments from MAWFA stated that there is evidence that little brown bats in Pennsylvania are showing an increasing trend in body mass at time of hibernation (Turner 2014, pers. comm.), and others have suggested that there is evidence that larger body mass increases survival from WNS infection (Jonasson and Willis 2011). The commenters concluded that these trends suggest that *Myotid* species, like the northern long-eared bat, are capable of adapting behavioral strategies for dealing with WNS infection.

Our Response: These observations suggest that there is an increase in body masses of little brown bats at some colonies where WNS has been present for several years. They do not demonstrate an evolutionary shift in behavioral or physiological strategy. Increased body mass may be a result of lesser competition for prey during the fattening period (which may still be potentially beneficial for surviving winter with WNS). Furthermore, this pattern of increasing body masses in pre-hibernating little brown bats has not been documented widely. It is also important to note that these observations have been made in little brown bat only, and not in northern long-eared bat. Jonasson and Willis (2011) studied fat consumption over winter in hibernating little brown bats unaffected by WNS. They hypothesized that fatter bats may be more likely to survive WNS, but they did not test this hypothesis. Likewise, the observations in Pennsylvania have not been tested for significance or repetition.

Though related, little brown bats and northern long-eared bats are distinctly different species that have exhibited different responses to Pd infection and WNS. Banding studies in the heavily affected northeastern States have confirmed that some little brown bats have survived multiple years of WNS exposure and infection, and little brown bats continue to be observed in some areas. However there is little, if any, data to support the same trend for northern long-eared bats. Efforts to band northern long-eared bat have been initiated; however, extremely low capture rates with only very few individuals banded make it difficult to examine survival trends with this species.

(32) *Comment:* One commenter disagreed that the highest rates of development in the conterminous United States occur within the range of the northern long-eared bat (Brown *et al.* 2005, p. 1856) and contribute to the loss of forest habitat. The commenter stated that forests within the range of the northern long-eared bat continue to recover from unsustainable forestry practices that were employed in the late 19th century.

Our Response: Although the commenter disagreed with the statement in the proposed listing rule with regard to rates of development within the range of the northern long-eared bat, there was no evidence presented to refute this statement. Further, information we have, in the proposed listing rule and in supporting documents, shows that rates of development and forest conversion in general within the species' range is not decreasing. For example, the USFS projected forest losses of 16 to 34 million acres (4 to 8 percent) by 2060 across the continental United States (USFS 2012).

(33) *Comment:* MAFWA stated that recent evidence documents a multitude of species in Europe coexist with the causative agent and do so by getting minimal infection and without documented mortality (Zukal *et al.* 2014). The commenter also stated that data recently presented at the 2014 WNS meeting show the amount of infection on surviving bats in the Northeast has decreased significantly from the period where mass mortality was experienced, and is now closer to the level of European infection.

Our Response: Pd and WNS were not investigated in Europe until after the disease was identified in North America. However, subsequent to the discovery of WNS in North America, European scientists have identified evidence of Pd dating back many decades, leading to the hypothesis that the fungus has been present in Europe for a long time. We cannot know what the impact of Pd has been on different bat species in Europe throughout evolutionary history. The fact that 13 species of European bats have been documented with WNS or Pd without documentation of significant declining populations has led to conclusions that those European species coexist with the disease. However, this observation does not mean WNS did not severely impact or even cause extinction of European bat species at some point in the past.

North American species differ significantly in physiology and ecology to similar species in Europe. We have gained considerable understanding of variability in impact of WNS among North American species, such as that certain species like the big brown bat and Townsend's big-eared bat appear resilient to or unaffected by the disease, while other species like the northern long-eared bat have declined substantially. Therefore, the best available data indicate there are variable response levels to WNS among bat species; northern long-eared bats are among the most susceptible species to WNS.

(34) *Comment:* One commenter stated that the impact of white-nose syndrome may have been overstated by the Service. They commented that the data used in the proposed listing rule only included known winter roost sites surveys and the rule does not state that

the species could be employing behavior plasticity and using alternative roosts. This same commenter also questioned carcass testing reports, as presented in the rule, confirming only 50 percent of individuals tested positive for white-nose syndrome.

Our Response: We acknowledge that northern long-eared bats may be using alternate, often unknown or unsurveyed, winter roosts and, as a result, may be unobserved during winter. However, regardless of the type of hibernacula used, northern long-eared bats require roosts with cool, humid conditions, which are also suitable for Pd growth. As for the question of the carcass testing reports, this information was removed in the final listing rule because it was potentially misleading. A small portion of dead bats are tested for the disease, especially in areas where WNS has not been confirmed recently. Therefore, reporting on the small number of bats tested does not give an accurate depiction of the impact of the disease on the species. Principally, the northern long-eared bat is susceptible to WNS, and mortality of northern long-eared bats due to the disease has been confirmed throughout the majority of the WNS-affected range.

Tribal Comments

(35) *Comment:* One Tribe provided information related to the biology, ecology, and threats faced by the northern long-eared bat that reinforced the data and information included in the Background section of this final rule. Additionally, the commenter provided information in response to other public comments that we had received and the letters received from the Midwest and Southeast Association of Fish and Wildlife Agencies and Regional Forester Groups and the Northeast Association of Fish and Wildlife Agencies. They also expressed their support for listing the species as endangered.

Our Response: We appreciate the input provided and incorporated it into the final rule where appropriate. For the reasons stated in the Determination section of this final listing rule, we have determined that the northern long-eared bat should be listed as threatened, rather than endangered. Please refer to that section for a detailed description of that determination.

Tribal Coordination

In October 2013, Tribes and multi-tribal organizations were sent letters inviting them to begin consultation and coordination with the service on the proposal to listing the northern long-eared bat. In August 2014, several Tribes and multi-tribal organizations were sent an additional letter regarding the Service's intent to extend the deadline for making a final listing determination by 6 months. A conference call was also held with Tribes to explain the listing process and discuss any concerns. Following publication of the proposed rule, the Service established 3 interagency teams (biology of the northern long-eared bat, non-WNS threats, and conservation measures) to ensure that States, Tribes, and other Federal agencies were able to provide input into various aspects of the listing rule and potential conservation measures for the species. Invitations for inclusion in these teams were sent to Tribes within the range of the northern long-eared bat. Two additional conference calls (in January and March 2015) were held with Tribes to outline the proposed species-specific 4(d) rule and answer questions. Through this coordination, some Tribal representatives expressed concern about how listing the northern long-eared bat may impact forestry practices, housing development programs, and other activities on Tribal lands.

Public Comments

(36) *Comment:* One commenter stated that listing should be restricted to the portion of the species' range that has experienced WNS, the current threat to this species. The commenter urged the Service to, instead of listing the species rangewide, consider listing as a DPS, because the species is stable across much of its range and a DPS will ''allow the Service to apply appropriate conservation measures in the area of greatest need.''

Our Response: When completing a status review in response to a petition to list a species, we conduct that review across the species' range, unless the petition requests that we evaluate a different entity, such as a DPS. The petition to list the northern long-eared bat requested that we consider whether listing is warranted for the species; the petition did not specifically ask us to consider whether any DPSs warrant listing. In conducting status reviews, we generally follow a step-wise process where we begin with a rangewide evaluation. If the species does not warrant listing rangewide, we then consider the status of other listable entities. Furthermore, the Service is to exercise its authority with regard to DPSs ''sparingly and only when the biological evidence indicates that such action is warranted'' (Senate Report 151, 96th Congress, 1st Session). For the northern long-eared bat, we have determined that the species warrants listing as a threatened species throughout its range based on current threats (primarily due to WNS) and how those threats are likely to impact the species into the future.

(37) *Comment:* A few commenters stated that the Service did not consider the benefit offered to the species from protection of other listed species, such as the Indiana bat. One commenter further stated that because of this overlap in the ranges of the two species, there is no reason to list the northern long-eared bat.

Our Response: There have been conservation efforts that have been undertaken to benefit other federally listed species, such as the Indiana bat, within the range of the northern long-eared bat. More detailed information can be found above, under *Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range.* However, prohibitions of the Act are species-specific; thus prohibitions from take would not apply to the northern long-eared bat simply due to another similar species being listed. Further, benefits to the northern long-eared bat that may occur as the result of other similar species that are listed are primarily habitat-related, and do not address the primary threat to the northern long-eared bat, WNS.

(38) *Comment:* Several commenters stated that the peer review of the proposed listing rule should have taken place prior to publication.

Our Response: In accordance with our policy published in the **Federal Register** on July 1, 1994 (59 FR 34270), we are to seek the expert opinions of at least three appropriate and independent specialists regarding proposed listing actions. We are to provide a summary of their review in the final decision, but are not required to conduct this peer review prior to the proposal. The purpose of peer review is to ensure that our final listing determination is based on scientifically sound data, assumptions, and analyses. We solicited expert opinion from seven peer reviewers with scientific expertise, including familiarity with the northern long-eared bat and its habitat, biological needs, and threats. We received responses from four of the peer reviewers, and have addressed their comments and incorporated relevant information into this final determination.

(39) *Comment:* A few commenters stated that the proposed listing rule was rushed due to judicial settlement.

Our Response: We disagree. The Service received a petition to list the northern long-eared bat and eastern

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small-footed bat in 2010. We published a substantial 90-day finding on June 29, 2011 (76 FR 38095), indicating that listing these two species may be warranted and initiating a status review. Completion of the status reviews were delayed due to listing resources expended on other higher priority rulemakings. On July 12, 2011, the Service filed a multiyear work plan as part of a settlement agreement with the Center for Biological Diversity and others, in a consolidated case in the U.S. District Court for the District of Columbia. A settlement agreement in Endangered Species Act Section 4 Deadline Litigation, No. 10–377 (EGS), Multi-district Litigation Docket No. 2165 (D.D.C. May 10, 2011) was approved by the court on September 9, 2011. The settlement agreement specified that listing determinations be made for more than 250 candidate species, and specified dates for several petitioned species with delayed findings. For the northern long-eared bat, the specified date for completing a 12-month finding, and a listing proposal if that finding was warranted, was September 30, 2013, 3 years after the receipt of the petition.

(40) *Comment:* Several commenters expressed their concern as to whether unpublished data cited in the proposed listing rule were peer-reviewed.

Our Response: Under the Act, we are obligated to use the best available scientific and commercial information, which in this case included results from surveys, reports by scientists and biological consultants, natural heritage data, and expert opinion from biologists with experience studying the northern long-eared bat and its habitat, whether published or unpublished. Additionally, we sought comments from independent peer reviewers to ensure that our determinations are based on scientifically sound data, assumptions, and analysis. We solicited information from the general public, nongovernmental conservation organizations, State and Federal agencies that are familiar with the species and its habitat, academic institutions, and groups and individuals that might have information that would contribute to our knowledge of the species, as well as the activities and natural processes that might be contributing to the decline of the species. All told, this information represents the best available scientific and commercial data on which to base this listing determination for the northern long-eared bat.

(41) *Comment:* A few commenters questioned if southern populations of northern long-eared bats are roosting in trees over the winter rather than hibernating in caves and mines and, therefore, might avoid contracting white-nose syndrome.

Our Response: Northern long-eared bats predominantly hibernate in caves and abandoned mines. There are a few documented instances of this species using other types of structures that simulate a cave-like environment that is suitable for hibernation. To date, there have been no documented cases of this species hibernating in trees. The species' physiological demands of hibernation limit selection of winter habitat to areas with relatively stable cool temperatures and humid conditions, which are the same conditions required for the persistence of Pd. See ''Hibernation'' in the *Biology* section of this final rule for a more complete description of habitat for the species.

(42) *Comment:* We received several comments that questioned how listing the northern long-eared bat will address or reverse the species' decline due to white-nose syndrome. One commenter stated that listing the species as ''endangered'' will not reverse its decline. Several stated that habitat loss is not a threat to the species, and white-nose syndrome is the only reason for the species' decline; therefore, placing additional restrictions on activities, such as tree clearing, will have minimal impact on conserving the species and will not halt the spread of white-nose syndrome.

Our Response: No other threat is as severe and immediate for the northern long-eared bat as white-nose syndrome. If this disease had not emerged, it is unlikely the northern long-eared population would be experiencing such a dramatic decline. However, as white-nose syndrome continues to spread and cause mortality, other sources of mortality could further diminish the species' resilience or ability to survive. White-nose syndrome has significantly reduced the numbers of northern long-eared bats throughout much of its range. Small or declining populations may be increasingly vulnerable to other impacts, even impacts to which they were previously resilient. These other impacts may include indirect impact (*e.g.,* clearing important roosting or foraging habitat) or direct impact (*e.g.,* cutting down occupied roost trees while pups are non-volant). We expect that northern long-eared bat populations with smaller numbers and with individuals in poor health will be less able to persist or to rebound.

The Service believes that restrictions alone are neither an effective nor a desirable means for achieving the conservation of listed species. We prefer to work collaboratively with private landowners, and strongly encourage individuals with listed species on their property to work with us to develop incentive-based measures such as safe harbor agreements or habitat conservation plans (HCPs), which have the potential to provide conservation measures that effect positive results for the species and its habitat while providing regulatory relief for landowners. The conservation and recovery of endangered and threatened species, and the ecosystems upon which they depend, is the ultimate objective of the Act, and the Service recognizes the vital importance of voluntary, nonregulatory conservation measures that provide incentives for landowners in achieving that objective.

(43) *Comment:* Commenters stated that information from New York and Vermont indicates that northern long-eared bat populations are holding steady or increasing.

Our Response: Contrary to information stated by this commenter, information we received from Vermont and New York indicate sharp population declines due to white-nose syndrome based on winter and summer data. Please see the ''Eastern Range'' section under *Distribution and Relative Abundance,* above, for a more detailed discussion of the information received from these two States. The one potential exception in New York is the Long Island population, where the species continues to be found during summer surveys. This may suggest that there may be scattered locations where this species has not been as severely impacted as other areas of eastern North America. However, these observations are unproven at this point and are the basis for ongoing research to determine the validity of a white-nose syndrome refugia hypothesis.

(44) *Comment:* One commenter stated that the Service should consider that there is a lack of evidence that mass mortality of northern long-eared bats due to white-nose syndrome is occurring outside the northeastern United States even though white-nose syndrome is continuing to spread. There have been no reported mass mortality events outside of the Northeast, and the northern long-eared bat continues to be commonly captured in mist-net surveys in some regions.

Our Response: To date, because impacts from WNS in the far South and West have not yet occurred, it is impossible to conclude that the timeframe and degree of impact will be identical. However, everything that has been observed to date suggests it will be

similar. Many sites in the Northeast were infected with WNS prior to development and validation of refined molecular tools to detect Pd. Thus, a hibernaculum in the Northeast was likely confirmed with white-nose syndrome when there were visible signs of the disease. With genetic tools, it may now be 2 to 3 years from the first detection of a Pd-positive bat at a site and visible signs of the disease in bats. Therefore, there remains some uncertainty in the applicability of the timeline observed in the Northeast to more recent observations in the Midwest and Southeast.

Additionally, there is evidence that microclimate inside the cave, duration and severity of winter, hibernating behavior, body condition of bats, genetic structure of the colony, and other variables may affect the timeline and severity of impacts at the hibernaculum level. However, evidence that any of these variables would greatly delay or reduce mortality in infected colonies has yet to surface. Some have speculated that climatic factors may extend the disease timeline or may result in lower mortality rates among bat populations in the southern United States; however, observations from the winter of 2013–2014 demonstrated the potential for white-nose syndrome-related mortality at sites believed to be in their first or second year of infection as far south as Alabama, Arkansas, and Georgia. Please see our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, for more information.

(45) *Comment:* One commenter stated that reported evidence for declines due to white-nose syndrome are based on localized hibernacula surveys, which fail to provide data sufficient to document regional or rangewide abundance or trends. Consistent with this, a recent report by the Committee on the Status of Species of Risk in Ontario (COSSARO) states: Any declines that have taken place can only be inferred from pre- and post-WNS monitoring of known hibernacula. Even then, a lack of baseline population information precludes an evaluation of what proportion of the known population is represented by inferred declines, since not all hibernacula are known, let alone receive regular monitoring attention (COSSARO 2013, p. 4).

Our Response: We received hibernacula data from most States throughout the range of the northern long-eared bat. These data have been included in our analysis of the impact of white-nose syndrome on the species. The information that was included in our analysis included pre- and post-white-nose syndrome data. We agree that we may not be aware of, and thus have not been surveying, all of the northern long-eared bat hibernacula within the species' range. However, it is also extremely likely that if these sites are used by hibernating bats, they exhibit consistently cool, humid conditions suitable for Pd growth. Thus, the bats using them will in all likelihood encounter Pd during activities at swarming and staging sites where they interact with other bats, even if they hibernate in smaller groups elsewhere. We do not use the available hibernacula counts to estimate northern long-eared bat population size; rather we use the hibernacula data to understand and estimate population trends for the species.

(46) *Comment:* One commenter stated that the Service mentioned that some spread models indicate that western and southern populations of the northern long-eared bat may not be impacted by white-nose syndrome; however, in the proposed listing rule we said that this would offer the species little respite since this is on the edge of the species' range. This commenter stated that this does not represent the best scientific and commercial data available. Another commenter similarly stated that Boyles and Brack (2009) and Ehlman *et al.* (2013) describe models that predict the possibility of lower mortality at lower latitudes, due to shorter winters and shorter hibernation in southern States, leading to reduced impact of white-nose syndrome.

Our Response: The model that the commenter referenced is Hallam and McCracken. (2011), which was discussed in the proposed listing rule. Hallam and McCracken (2011) tested temperature-dependence of white-nose syndrome spread, which at the time of the model creation (2011) supported the current distribution of white-nose syndrome. Although the analysis from this model predicted continued rapid spread throughout the United States, the model also suggested that there may be a temperature-dependent boundary in southern latitudes that may offer refuge to white-nose syndrome-susceptible bats. However, there are limitations in data availability for this model; several States in the Midwest and central regions were not included. In addition, after formation of the model, many counties below Hallam and McCracken's hypothesized temperature-dependent boundary have been confirmed with white-nose syndrome or have had Pd detected. Considering the limitations with this model, we cannot put a high degree of confidence in the conclusions drawn. Boyles and Brack (2009, p. 9) modeled survival rates of little brown bats during hibernation and determined that clustering (with other bats) and disturbances have an overall impact on survival rates during hibernation; however, there was no discussion of white-nose syndrome and its impact on cave bats. Ehlman *et al.* (2013, p. 581) developed a model using evaporative water loss at the stimulus for arousal in both healthy and white-nose syndrome-affected little brown bats. They concluded that populations experiencing shorter southern winters could persist longer than their northern counterparts when faced with white-nose syndrome. However, this is speculative at this time, as the authors acknowledged that there are few data on survival rates for the more southerly regions where white-nose syndrome has more recently spread.

(47) *Comment:* One commenter stated that the Service did not account for the limiting effects that the lower density and occurrence of hibernacula in the central United States will have on the rate of white-nose syndrome spread and its effects on the northern long-eared bat. They referred to peer review comments of A. Kurta (Nov. 12, 2013). The commenter contended that Kurta stated that such lower hibernacula density and occurrence will help protect the species from white-nose syndrome in those areas because the disease is believed to infect the species primarily through bat-to-bat transmission in hibernacula, where the conditions required for growth of the fungus occur.

Our Response: We have no reason to believe that the northern long-eared bat will be protected from white-nose syndrome in any portion of its range, including the central United States. The statement that white-nose syndrome spread will slow because there are fewer caves or mines serving as hibernacula in the western portion of the northern long-eared bat's range conflicts with the assertion made by other commenters that the northern long-eared bat will use a wide variety of sites as hibernacula (not just caves and mines). White-nose syndrome has been confirmed at numerous hibernacula that are not caves or mines (but with similar habitat conditions), including culverts, bunkers, forts, tunnels, excavations, quarries, and even houses. In addition, all models concerning the spread of white-nose syndrome predict the disease or Pd will continue to spread throughout the range, including the central United States. Models that provide estimates of the timing of spread, predict the disease will cover the entirety of the species'

range (within the models limited geographic limits: The United States) by sometime between 2 and about 40 years (see our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, for more information). These models all have significant limitations for predicting timing of spread and in many instances have overestimated when WNS would arrive in currently unaffected counties, in one case by as much as 45 years. Limitations include underestimating availability of non-cave hibernacula, lacking relevant biological variables of affected species, excluding spread through Canada or counties with insufficient data, and the fact that Pd is expanding its ecological niche in North America by demonstrating its viability in previously unexposed environments.

(48) *Comment:* One commenter suggested that the Service direct its efforts toward determining the exact original cause of white-nose syndrome, possible treatment strategies for bats, assessing under what conditions the fungus is transmitted and how it spreads, determining what the optimal environmental conditions are that allow the growth and transmission of the fungus, determining what is driving the spread of the fungus, and determining the differences in those colonies affected and unaffected by white-nose syndrome. This commenter stated that only when this critical information is known would the Service be able to determine appropriate listing actions, if necessary.

Our Response: Current knowledge on the cause of the disease, how and under what conditions the fungus is transmitted, how it spreads, and the optimal conditions that allow the growth of the fungus are explained in detail under our Factor C discussion in the section titled, ''White-nose Syndrome,'' above. As for treatment of the disease, the Service leads the national response to white-nose syndrome and supports research and actions identified in the national response plan to contain white-nose syndrome and develop treatments or controls. The Service has granted more than $19.5 million to institutions and Federal and State agencies for research and response actions. Containment strategies are intended to slow the spread of WNS and allow time to develop management options; they are not part of a recovery plan for affected species. There are a number of promising treatments currently in development, and in various stages of the research process. However, considerably more research and coordination is needed to address the safety and effectiveness of any treatment proposed for field use and to meet regulatory requirements prior to consideration of widespread application. In short, implementation of WNS treatments on a landscape-scale is likely years away. The multi-agency and multi-organization white-nose syndrome response team has and continues to develop recommendations, tools, and strategies to slow the spread of white-nose syndrome, minimize disturbance to hibernating bats, and improve conservation strategies for affected bat species. This collaboration will also prepare management agencies to implement WNS mitigation strategies once the strategies are validated. Information on some of these products developed by the response team can be found in our Factor C discussion in the section titled, ''Conservation Efforts to Reduce Disease or Predation,'' above. If listing is warranted, the Act requires us to list a species regardless of whether listing will ameliorate the threat to the species.

(49) *Comment:* During the second public comment period, one commenter requested a public hearing be held in Crook County, Wyoming. This commenter further stated that they were not given sufficient notice of the first public comment period.

Our Response: In response to the request from Crook County, Wyoming, to hold a public hearing, the Service held a public hearing in Sundance, Wyoming, on December 2, 2014. We consider the comment periods described in the introductory text of this section of the final rule (Summary of Comments and Recommendations on the Proposed Listing Rule) to have provided the public a sufficient opportunity for submitting both written and oral public comments. We contend that there has been adequate time for comment, as we accepted public comments on the proposed listing rule for the northern long-eared bat for a total of 240 days.

(50) *Comment:* Commenters stated that there is no information provided in the status review to indicate that the proposed listing or development of a recovery plan would reverse the species' decline.

Our Response: If listing is warranted, the Act requires us to list a species based on one of the five factors, alone or in combination. Disease is one of these factors to be considered. In making a determination as to whether a species meets the Act's definition of an endangered or threatened species, under section 4(b)(1)(A) of the Act the Secretary is to make that determination based solely on the basis of the best scientific and commercial data available. The question of whether there may be some positive benefit of listing the species is not considered in the decision process, only if the species meets the definition of an endangered or threatened species.

(51) *Comment:* Commenters stated that the listing should not be used as a funding mechanism to conserve the species.

Our Response: Although there are some funding opportunities available to promote recovery of listed species (*e.g.,* grants to the States under section 6 of the Act, funding through the Service's Partner's for Fish and Wildlife Program), we are required to make our determination based on the best scientific and commercial data available at the time of our rulemaking. The potential availability of funding does not enter into this decision of whether listing is warranted for a species. Instead we adhere to the requirements of the Act, to determine whether a species warrants listing based on our assessment of the five-factor threats analysis. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

(52) *Comment:* Several commenters stated that, in the proposed listing rule, the northern long-eared bat was described as ''commonly captured'' during summer surveys, which contradicts presented winter survey data.

Our Response: The information presented in the ''Distribution and Abundance'' section of the proposed listing rule described the historical distribution and abundance of the species prior to detection of white-nose syndrome in a given State or portion of a State. This section has been changed to *Distribution and Relative Abundance* in this final listing rule and includes a description of historical and current status to better reflect the current distribution and trend information for the species. The species is often ''commonly captured'' during summer surveys in areas within its range where it has not been impacted by white-nose syndrome; however, in areas where the

disease has been present for a longer period of time (the Northeast in particular), the species is no longer commonly captured even in summer surveys. Please see the *Distribution and Relative Abundance* section, above, for more detailed information.

(53) *Comment:* One commenter stated that we did not provide any evidence to support the notion that other factors are acting in combination with white-nose syndrome to reduce the viability of the species.

Our Response: Although we have not been able to directly observe the impact of these other factors in combination of white-nose syndrome, we contend that it is reasonable to expect that with populations that have been reduced due to white-nose syndrome, any additional stressors have the potential to reduce viability. However, depending on the type of stressor, the scale of impact may differ (rangewide vs. colony-level impact). Peer reviewers of the proposed listing rule concurred with the Service's assessment that cumulative impacts may result from other (other than white-nose syndrome) factors in addition to white-nose syndrome due to a diminished population. The Act requires us to determine if these other factors affect the northern long-eared bat's ability to persist following the effects of white-nose syndrome. Our continuing analyses are strengthening our understanding of these factors and helping us identify ways to address them.

(54) *Comment:* One commenter stated that the proposed listing rule's discussion of Factor C (disease or predation) includes various hypotheses of the causal connection between WNS and morbidity in the northern long-eared bat, but the Service admits that ''the exact process by which WNS leads to death remains undetermined.''

Our Response: Although the exact process or processes by which WNS leads to death remains unconfirmed, we do know that the fungal infection is responsible and it is possible that reduced immune function during torpor compromises the ability of hibernating bats to combat the infection. See our Factor C discussion in the section titled, ''White-nose Syndrome,'' above, for a more detailed discussion on white-nose syndrome and mortality in bats.

(55) *Comment:* One commenter stated their concern that potential seasonal forest management restrictions due to the listing will have detrimental impacts to their local forest industry and forest dependent communities, which will outweigh benefits to the species.

Our Response: In making a determination as to whether a species meets the Act's definition of an endangered or threatened species, under section 4(b)(1)(A) of the Act the Secretary is to make that determination based solely on the basis of the best scientific and commercial data available. The Act does not allow us to consider the impacts of listing on economics or humans activities whether over the short term, long term, or cumulatively. The question of whether there may be some positive benefit to the listing cannot by law enter into the determination. The evaluation of economic impacts comes into play only in association with the designation of critical habitat under section 4(b)(2) of the Act. Therefore, although we did not consider the economic impacts of the proposed listing, as such a consideration is not allowable under the Act, we will consider the potential economic impacts of a critical habitat designation (if prudent), including the potential benefits of such designation.

(56) *Comment:* One commenter stated that the Service should delay listing of the species for a minimum of 3 years while work continues to develop a solution to combat the disease.

Our Response: If listing is warranted, the Act requires us to list a species regardless of if listing will ameliorate the threat to the species. We are required to make our determination based on the best scientific and commercial data available at the time of our rulemaking. The Act requires the Service to publish a final rule within 1 year from the date we propose to list a species unless there is substantial disagreement regarding the sufficiency or accuracy of the available data relevant to the determination or revision concerned, but only for 6 months and only for purposes of soliciting additional data. Based on the comments received and data evaluated, we determined that an extension was necessary. However, we are able to extend the listing determination by 6 months and cannot extend the determination by 3 years, as recommended. As stated in response to a previous comment, there are a number of promising treatments currently in development, and in various stages of the research process. However, these potential treatments are still being analyzed in a clinical setting, and potential application outside of the laboratory is years away.

(57) *Comment:* Several commenters stated that more time is needed to complete population surveys for the northern long-eared bat before making a listing determination.

Our Response: Our Policy on Information Standards under the Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines (*http://www.fws.gov/informationquality/*), provide criteria and guidance, and establish procedures to ensure that our decisions are based on the best scientific data available at the time of our rulemaking. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to determine if a species warrants listing. Surveys completed after listing will continue to inform actions taken to conserve and recover the species.

(58) *Comment:* One researcher commented that results from his research show that Pd and WNS should be expected to occur in regions consistent with much of the current U.S. range of the northern long-eared bat in a relatively short time period, and demonstrated the potential spread to the majority of the contiguous United States. Further their model (Maher *et al.* 2012) showed that the spread rate increased with longer winters, suggesting that spread of Pd and WNS in the northern range of the species will be faster.

Our Response: We appreciate this comment and have added this information to our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above. This information supports information in this final listing rule regarding the spread of white-nose syndrome within the northern long-eared bat's range.

(59) *Comment:* One commenter notes that information presented in the proposed listing rule stated that summer surveys in the Northeast have confirmed rates of decline observed in northern long-eared bat hibernacula data post-WNS, with rates of decline ranging from 93 to 98 percent; however, the extent of that summer survey data is not given, so it is unclear how expansive the sample might have been, or how consistent all of the surveys were spatially across time.

Our Response: We have taken this comment into consideration and have further explained where and when declines have been observed within the species' range in the *Distribution and Relative Abundance* section of this final rule.

(60) *Comment:* Commenters stated that population declines of more than 90 percent in the core of the species' range, with more declines predicted due to WNS, constitutes a present danger of extinction throughout all or a significant portion of its range. The population declines do not represent a mere [likelihood] of becoming an endangered species within the foreseeable future, rather endangerment ''is not just a possibility on the horizon, endangerment is already here.''

Our Response: As explained in the Determination section of this final rule, although WNS is predicted to spread throughout the range of the species, in the currently uninfected areas we have no evidence that northern long-eared bat numbers have declined, and the present threats to the species in those areas are relatively low. Thus, because the fungus that causes WNS (Pd) may not spread throughout the species' range for another 8 to 13 years, because no significant declines have occurred to date in the portion of the range not yet impacted by the disease, and because some bats persist many years later in some geographic areas impacted by WNS (for unknown reasons), we conclude that the northern long-eared bat is not currently in danger of extinction throughout all of its range. However, because Pd is predicted to continue to spread, we also determine that the northern long-eared bat is likely to be in danger of extinction within the foreseeable future. Therefore, on the basis of the best available scientific and commercial information, we are listing the northern long-eared bat as a threatened species under the Act.

(61) *Comment:* One commenter stated that the Service did not adequately cultivate its partnership with the States when developing the proposed listing rule and stated that it is imperative that the final decision consider regional differences relative to the status of the species, as specifically identified by the State wildlife agencies.

Our Response: We requested all relevant data and information from States and Federal agencies prior to publishing the proposed rule. Additionally, in 2014, we requested all available hibernacula and summer survey data from all State fish and wildlife agencies within the range of the species to ensure the most up-to-date survey information was included in this final listing rule; we received information from the majority of States. Also, following publication of the proposed listing rule, the Service established three interagency teams to ensure that States, Tribes, and other Federal agencies were able to provide input into various aspects of the listing rule and potential conservation measures for the species. The three teams are: Biology of the Northern long-eared bat, Non-WNS Threats, and Conservation Measures. Invitations for inclusion in these teams were sent to all State agencies within the range of the northern long-eared bat. Further, MAFWA hosted a meeting in Bloomington, Minnesota, in October 2014, and invited biologists and foresters from all State agencies within the species' range to discuss the potential listing of the northern long-eared bat and conservation measures. The information presented in the resulting letters from several regions of the fish and wildlife and forestry associations were considered and included in this final listing determination.

(62) *Comment:* Several commenters addressed the Northern Long-eared Bat Interim Planning and Conference Guidance.

Our Response: The Interim Planning and Conference Guidance was designed for use until the publication of this final rule. While aspects of this guidance may be included in the recovery plan for northern long-eared bat, the guidance itself does not constitute a recovery plan. We appreciate these comments and will consider them in developing a recovery plan or any potential future consultation guidelines for the species.

(63) *Comment:* One commenter stated that, although no scientific research technique is perfect, (as stated by Ingersoll *et al.* 2013) hibernacula surveys are the most reliable and consistent datasets currently available for long-term, regional studies of North American bats.

Our Response: We agree that hibernacula surveys are the recommended method, and the only method with enough history to assess trends over time, for cave-dwelling bats, including the northern long-eared bat. In this final listing rule, we use the hibernacula data (in addition to summer data) to understand and estimate population trends for northern long-eared bat. The relative difficulty of observing northern long-eared bats during hibernacula surveys should be consistent from year to year, and these data can be used to estimate relative change in numbers and indicate if the species is increasing or decreasing in number in those hibernacula. Thus, the total data available for known northern long-eared bat hibernacula can yield an individual site and cumulative indication of species population trend; declines estimated at hibernacula are corroborated by declines in acoustic records and net captures in summer.

(64) *Comment:* One commenter stated that although the Service finalized its policy regarding interpretation of ''significant portion of its range'' during the comment period on the proposed listing for the northern long-eared bat, the Service should not rely on this policy in its final determination. The commenter asserted that the information in the proposed listing rule does not support that any portion the bat's range is ''significant.''

Our Response: The Service finalized its policy on the interpretation of the phrase ''significant portion of its range'' in the Act's definitions of ''endangered species'' and ''threatened species'' on July 1, 2014 (79 FR 37577). This policy became effective on July 31, 2014, and the Service is now applying that interpretation to its listing determinations as a matter of agency policy. According to that final policy, an analysis of whether a species is endangered or threatened in a significant portion of its range is only undertaken when a species is found to not warrant listing under the Act throughout its range. We have determined that the northern long-eared bat warrants listing as a threatened species throughout its range, and, therefore, we did not conduct an SPR analysis for the species in this final listing determination.

(65) *Comment:* One commenter suggested that northern long-eared bats may have greater potential for survivability because they roost singly rather than clustering in larger groups as do other species during hibernation.

Our Response: The northern long-eared bat occasionally can be found in clusters with other bats, but typically is found roosting singly during hibernation. Although the species does not roost in clusters as much as other cave-bat species during hibernation, there are other life-history factors that are believed to increase the northern long-eared bat's susceptibility to white-nose syndrome in comparison to other cave bat species (*e.g.,* proclivity to roost in areas with increased humidity of hibernacula, longer hibernation time period). See our Factor C discussion in the section titled, ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' above, for a more detailed discussion.

(66) *Comment:* Several commenters stated that forest practices conducted in Minnesota on County and other managed lands provide habitat for the northern long-eared bat and that properly managed forest has not affected northern long-eared bat populations.

Our Response: We state within the five-factor analysis (Summary of Factors Affecting the Species) that other factors (other than white-nose syndrome, including forest management) are not believed to be contributing the to the current decline species-wide. However, there could be localized impacts from these other stressors, such as forest management. Further, cumulative impacts may result from these other factors in addition to white-nose syndrome due to a diminished population in the future. See our Factor A discussion in the section titled, ''Summer Habitat,'' above, for a more detailed discussion of forest management and its impact on the northern long-eared bat.

(67) *Comment:* One commenter stated that listing the northern long-eared bat would negatively impact the species, because the presumed logging restriction would result in a loss of revenues from reduced logging profits and force the county to sell property, resulting in habitat fragmentation.

Our Response: In making a determination as to whether a species meets the Act's definition of an endangered or threatened species, under section 4(b)(1)(A) of the Act the Secretary is to make that determination based solely on the basis of the best scientific and commercial data available. The question of whether there may be some positive benefit to the listing cannot by law enter into the determination. The evaluation of economic impacts comes into play only in association with the designation of critical habitat under section 4(b)(2) of the Act. Therefore, although we did not consider the economic impacts of the proposed listing, as such a consideration is not allowable under the Act; we will consider the potential economic impacts of the critical habitat designation, including the potential benefits of such designation.

(68) *Comment:* Several commenters cited Ingersoll *et al.* (2013) as evidence that the northern long-eared bat was in decline prior to the onset of white-nose syndrome.

Our Response: The Service reviewed the Ingersoll *et al.* (2013) paper and was not able to find support for the conclusion that commenters made. Based on a sampling of data from four States during an 11- to 12-year period, the models utilized in Ingersoll did not treat hibernacula or time periods with and without WNS separately. Thus, there is no way to identify the impact of WNS on the model results, nor to show a pre-WNS model versus a post-WNS model. Moreover, the authors interpret their results to suggest that northern long-eared bat population declines did not increase as a result of WNS. The weight of other available evidence contradicts this interpretation, and still supports the conclusion that the bat was not imperiled prior to WNS.

(69) *Comment:* One commenter stated that ''climate change does not pose a threat to the [northern long-eared bat]'' and asserted that ''the Service should not reevaluate potential climate change impacts on the [northern long-eared bat]'' as the species is unlikely affected by climate change because they are roosting generalists, they are unlikely to become water stressed, and they are not limited to a northern latitude range, but rather occupy a large geographic range.

Our Response: Under the Act, we include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. The information presented in the ''Climate Change'' section under the Factor E discussion of this final listing rule thoroughly addresses the potential effects of a changing climate on the northern long-eared bat using the best available science.

(70) *Comment:* One commenter questioned whether Pd could grow and reproduce on non-bat substrates, and consequently spread to caves with no bats present. The commenter further states that the northern long-eared bat should not be listed to ''get ahead'' of WNS, as the potential future effects of WNS may or may not occur.

Our Response: Lorch *et al.* (2014) determined that Pd remains viable in cave substrate even in the absence of bats. Additionally, Reynolds *et al.* (2015) concluded that this persistence is sufficient to allow Pd to spread in the absence of bats, and determined that the potential for Pd to proliferate in the absence of bats greatly increases the possibility of this manner of spread. Regardless of the ability of Pd to grow and reproduce on its own, the best science supports the supposition that white-nose syndrome is the primary and current cause of the decline of the northern long-eared bat. Pd or white-nose syndrome has currently been detected in 28 U.S. States and 5 Canadian provinces in the range of northern long-eared bat. All models consulted on the spread of white-nose syndrome have predicted a continued spread of Pd. We have determined that the northern long-eared bat meets the definition of a threatened species under the Act based on its current status and what we can reasonable predict will occur in the future.

(71) *Comment:* One commenter was concerned that listing the northern long-eared bat ''could result in detrimental effects to current and future efforts to recover and provide suitable habitat for other threatened, endangered, and sensitive species'' while not addressing the primary threat of WNS. The commenter stated that other species may depend on some forest management for needed travel corridors, forest stand heterogeneity, and other activities.

Our Response: While it is true that WNS is the primary threat to the northern long-eared bat (as discussed in Summary of Factors Affecting the Species), forest management and other stressors could have localized impacts, as well as cumulative impacts in conjunction with WNS. For a more detailed discussion of forest management and its impact on the northern long-eared bat, please see our Factor A discussion in the section titled, ''Summer Habitat,'' above.

(72) *Comment:* Several commenters stated that the proposed listing rule overstated the impact from shale gas development. Commenters stated that the statements in the proposed listing rule regarding the number of wells projected and disturbance do not take into account the evolution and shift of technology of horizontal drilling and minimizing disturbance. Also, the surface disturbance created by the development of shale is temporary and many States require site restoration and reclamation as part of the permit and construction process.

Our Response: As stated previously with regard to threats other than WNS, although shale gas development may impact the species at a local level, it is not believed to be independently impacting the species rangewide.

(73) *Comment:* One commenter stated that the listing proposal does not adequately address the status of the northern long-eared bat in Canada. Currently, one third of its estimated geographic range lies within Canada, yet few data exist from this portion of the range from which a current status assessment or population trend can be drawn. Without comprehensive data from this large portion of the northern long-eared bat's geographic range, we cannot support the concept that this species is in danger of extinction.

Our Response: In 2014, the northern long-eared bat was determined, under an emergency assessment, to be endangered under the Canadian (SARA) (Species at Risk Public Registry 2014). It is estimated that approximately 40 percent of its global range is in Canada (COSEWIC 2012, p. 9; Species at Risk Public Registry 2014). Despite limited survey information on the species in Canada, the decision was made to list

the species under SARA because ''the imminent threat posed by WNS to these three bat species [northern long-eared bat, little brown bat, and tri-colored bat] were substantiated by verifiable evidence, which included evidence of the declines to these bats in Canada and the United States.'' WNS has been identified in five Canadian provinces: Ontario, Quebec, Prince Edward Island, Nova Scotia and New Brunswick.

(74) *Comment:* Several commenters stated that the impact from the oil and gas industry on the northern long-eared bat is low because the technology of drilling is changing, thus minimizing disturbance. These commenters stated that the discussion included in the proposed listing rule did not adequately address this issue.

Our Response: We acknowledge in this final rule that the footprint of oil and gas projects may be lessened by this new technology, and that some impact may be temporary in nature (see our Factor A discussion in the section titled, ''Summer Habitat,'' above). However, gas extraction continues to expand across the range of the northern long-eared bat and is still viewed as a type of forest conversion that may result in direct or indirect impact to the species, comparable to other forms of forest conversion. Although there could be localized impacts to northern long-eared bat populations from forest conversion relating to oil and gas development, factors other than white-nose syndrome are not believed to be contributing to the current decline of the species rangewide.

(75) *Comment:* One commenter presented two recently published models, Alves *et al.* (2014) and Escobar *et al.* (2014), which address WNS spread throughout North America and urged careful consideration of each model in estimating the potential spread of WNS across the range of the northern long-eared bat. This commenter stressed the limitations of these models in predicting the rate of spread; however, they acknowledged that one of the models (Escobar *et al.* (2014) predicted WNS will continue to spread to all suitable areas.

Our Response: We concur with the commenter's concerns regarding the limitations in using these models in predicting the rate of spread of WNS throughout the northern long-eared bat's range. Both Alves *et al.* (2014) and Escobar *et al.* (2014) are maximum entropy models, which are not effective for predicting areas unsuitable for Pd. Although these models may be useful in determining suitable habitat for Pd, they should not be used to predict or identify unsuitable habitat. For example, several sites predicted to be unsuitable for Pd by Alves *et al.* (September 2014) have already been confirmed with the disease. Due to these limitations, we have not used these models in arriving at the potential rate of spread of WNS across the northern long-eared bat's range.

(76) *Comment:* One organization commented that, since the Service proposed the species as endangered, we cannot decide to change the status to threatened in the final rule without first proposing the species as threatened and providing the public an opportunity to comment on that determination.

Our Response: In a proposed rule, the Service proposes the status it believes is warranted for the species, based on the information it has available at that time. After publishing that proposal, we seek comments on the underlying data and information used in that proposal, including the factors the Service considers in making a listing determination. In our final rulemaking, we analyze additional information and data received in peer review and public comments and testimony. Based on information received, in that final rulemaking we may take one of the following actions: (1) Publish a final listing rule as originally proposed, or as revised, because the best available biological data support it; or (2) withdraw the proposal because the biological information does not support listing the species. Thus, any time that we propose a species for listing, regardless of whether we propose to list the species as a threatened species or an endangered species, there are three possible outcomes of the rulemaking process: listing the species as endangered, listing the species as threatened, or withdrawing the proposed rule (and not listing the species). To use the terminology of case law regarding APA rulemaking, any of those three outcomes is necessarily a logical outgrowth of any proposed listing rule. Note also that the commenter did not argue (nor could it) that we must reopen a comment period before we determine to withdraw a proposed rule to list a species as endangered. It stands to reason that we could also determine to list as threatened, a result that diverges from a proposed endangered listing much lesser degree that a withdrawal, without reopening a comment period.

Furthermore, in this instance, the public was given additional notice that the Service may consider listing the species as threatened instead of endangered when it published a proposed species-specific rule under section 4(d) of the Act. Such 4(d) rules may only be considered for species listed as threatened. With the multiple public comments periods held on the proposal, the public was provided ample opportunity to comment on the listing status determination, and in fact, we received numerous comments on our proposal to list the northern long-eared bat that specifically addressed the status determination.

Determination

Our listing determination is guided by statutory definitions of the terms ''endangered'' and ''threatened.'' The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' The Service has further determined that the phrase ''in danger of extinction'' can be most simply expressed as meaning that a species is ''on the brink of extinction in the wild.'' See December 22, 2011, Memorandum from Acting FWS Director Dan Ashe Re: Determination of Threatened Status for Polar Bears [hereinafter the ''Polar Bear Memo'']. In at least one type of situation, where a species still has relatively widespread distribution, but has nevertheless suffered ongoing major reductions in numbers, range, or both as a result of factors that have not been abated, the Service acknowledges that no distinct determination exists between ''endangered'' and ''threatened.'' In such cases:

> Whether a species . . . is ultimately an endangered species or a threatened species depends on the specific life history and ecology of the species, the nature of the threats, and population numbers and trends. Even species that have suffered fairly substantial declines in numbers or range are sometimes listed as threatened rather than endangered (Polar Bear Memo, p. 6).

As discussed in more detail below, the northern long-eared bat resides firmly in this category where no distinct determination exists to differentiate between endangered and threatened. Therefore, our determination that this species is threatened is guided by the best available data on the biology of this species, and the threat posed by white-nose syndrome.

In determining whether to list the northern long-eared bat, and if so, whether it should be listed as endangered or as threatened, we are also guided by specific criteria set forth in section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, establishing procedures

for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

As discussed in detail below, we find that the northern long-eared bat is appropriately categorized as a threatened species. As discussed in detail under Factor C, in the sections titled ''White-nose Syndrome'' and ''Effects of White-nose Syndrome on the Northern Long-eared Bat,'' WNS has impacted the species throughout much of its range, and can be expected to eventually (from 2 to 40 years based upon models of WNS spread dynamics, but more probably within 8 to 13 years) spread and impact the species throughout its entire range. Once WNS becomes established in new areas, we can expect similar, substantial losses of bats beginning in the first few years following infection (Factor C). There is currently no effective means to stop the spread of this disease, or to minimize bat mortalities associated with the disease. The spread of WNS and its expected impact on the northern long-eared bat are reasonably foreseeable, and thus the species is likely to become an endangered species within the foreseeable future.

The Service also concludes, however, that while the species is likely to become an endangered species within the foreseeable future, it is not at the present time in danger of extinction. Stated another way, the species is not currently ''on the brink'' of extinction. In the time since our 2013 proposal to list the species as endangered, we have received and considered voluminous input on this issue. We have also obtained and carefully considered another 18 months of data and knowledge regarding the continuing effects of WNS on the species, and the prospects for spread of the disease throughout the entire range of the species. Since publication of the proposed rule in 2013, we have also received new population estimates for the species in some parts of its range. Several factors, in the aggregate, support a finding that the species is not currently endangered. For example, WNS has not yet been detected throughout the entire range of the species, and will not likely affect the entire range for some number of years (again, most likely 8 to 13 years). In addition, in the area not yet affected by WNS (about 40 percent of the species' total geographic range), the species has not yet suffered declines and appears stable (see *Distribution and Relative Abundance*, above). Finally, the species still persists in some areas impacted by WNS, thus creating at least some uncertainty as to the timing of the extinction risk posed by WNS. Even in New York, where WNS was first detected in 2007, small numbers of northern long-eared bats persist (see *Distribution and Relative Abundance*, above) despite the passage of approximately 8 years. Finally, coarse population estimates where they exist for this species indicate a population of potentially several million northern long-eared bats still on the landscape across the range of the species (see *Distribution and Relative Abundance*, above). No one factor alone conclusively establishes whether the species is ''on the brink'' of extinction. Taken together, however, the data indicate a current condition where the species, while likely to become in danger of extinction at some point in the foreseeable future, is not on the brink of extinction at this time.

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the northern long-eared bat. There are several factors that affect the northern long-eared bat; however, no other threat is as severe and immediate to the species persistence as WNS (Factor C). This disease is the prevailing threat to the species, and there is currently no known cure. While we have received some information concerning localized impacts or concerns (unrelated to WNS) regarding the status of the northern long-eared bat, it is likely true that many North American wildlife species have suffered some localized, isolated impacts in the face of human population growth and the continuing development of the continent. Despite this, based upon available evidence, the species as a whole appears to have been doing well prior to WNS.

Since WNS was first discovered in New York in 2007, the northern long-eared bat has experienced a severe and rapid decline in numbers, in the areas affected by the disease. As discussed in detail in Factor C, the available data (winter and summer surveys) indicate reductions in northern long-eared bat numbers due to WNS. Summer data, although more limited, indicate similar trends to those found in hibernacula surveys. Declines documented in summer surveys are sometimes smaller than the declines shown by winter/hibernacula surveys. For example, in Pennsylvania, pre and post-WNS winter surveys showed a 99 percent decline, with summer surveys showing a 76 percent decline. Unfortunately, summer data tend to show a continuing decline (*e.g.*, by 15 percent annually in Pennsylvania), which is likely to ultimately mirror the higher declines documented during the winter. We do not fully understand the reason for the difference, or ''lag'' between winter and summer trend data. Nonetheless, both winter and summer data ultimately corroborate one another to demonstrate declines in this species due to WNS; these data support our conclusion that the species is likely to become endangered within the foreseeable future.

Determining whether the northern long-eared bat is ''in danger of extinction,'' and thus either ''endangered'' or ''threatened'' under the Act, requires some consideration of the impact of the decline in numbers (as discussed under Factor C and summarized above) on the species' viability. We do not have firm rangewide population size estimates for this species (pre-WNS or post-WNS), nor do we have the benefit of a viability analysis. Nonetheless, principles of conservation biology are instructive in determining the impact of WNS on the viability of this species. Viability can be measured generally by a species' levels of resiliency, redundancy, and representation (Shaffer and Stein 2000, pp. 301–321). Resiliency means having the ability to withstand natural environmental fluctuations and anthropogenic stressors over time; redundancy means having a sufficient number of populations and distribution to guard against catastrophic events; and representation means having sufficient genetic and ecological diversity to maintain adaptive potential over time.

The presence of surviving northern long-eared bats in areas infected by WNS for up to 8 years creates at least some question as to whether this species is displaying some degree of long-term resiliency. It is unknown whether some populations that have survived the infection are now stabilizing at a lower density or whether the populations are still declining in response to the disease, and whether those populations have been reduced below sustainable levels. In the long term, based upon our best understanding of conservation biology, we believe the declines seen in this species may be unsustainable (see

Biology, above). Finally, it is also unclear whether the response of bats to Pd in Europe has utility in predicting the long-term viability of bats in North America in response to Pd, as bats in Europe are thought to have evolved with the fungus (Factor C). But we must acknowledge at least some uncertainty as to whether species numbers in the WNS-affected areas in North America represent dramatically reduced, but potentially sustainable, populations. Given that we do not as of yet have a means to stop the spread of WNS and we anticipate the same impact (high mortality) observed to date to occur as WNS spreads across the range, substantial losses in redundancy and representation are likely as well. Thus, we believe it is likely that the northern long-eared bat will decline to the point of being ''in danger of extinction.''

Having established that the northern long-eared bat is likely to decline to the point of being ''in danger of extinction,'' we next focus on the timing of when the species will reach the point of being ''in danger of extinction.'' In areas currently affected by WNS, there have clearly been significant population effects due to the disease. To date, however, WNS has not yet extended throughout the species' range. In the proposed listing rule, we concluded that the species was ''endangered'' (*i.e.*, in danger of extinction presently), as we believed that the rate of decline was unsustainable and WNS spread throughout the range was likely. In the listing proposal we also stated that WNS spread throughout the range would occur in the short term, but did not explicitly determine the timeframe. As explained under Factor C, the WNS spread models are not particularly useful in establishing a specific timeframe; together, these models indicate spread of WNS throughout the range by sometime between 2 and 40 years. Because of the lack of clarity on rate of spread obtained from the models, we believe it is more scientifically relevant to look at the rate of spread that has occurred to date on the landscape as a guide for the timeframe of WNS spread across the species' entire range. Using the data compiled to date, the fungus that causes WNS appears to have spread in all directions in North America, moving southwest at an average of over 175 miles (280 km) per year, but expanding in every direction where bats live. At this rate, the fungus will extend throughout the bat's entire range in about 8 to 9 years (Service 2015, unpublished data). Finally, we note that the Canadian COSEWIC recently estimated that Pd and/or WNS would spread through the entire range of the northern long-eared bat within 12 to 15 years (COSEWIC 2013, p. xiv). Taking into account the passage of time since publication of the COSEWIC estimate, we will place the Canadian estimate of the spread of Pd and/or WNS throughout the full range of the species to be 10 to 13 years. Taken together, we conclude that the best estimate of the spread of Pd throughout the range of the northern long-eared bat is likely between 8 and 13 years, noting that there is typically a delay (up to several years) in the onset of the disease from the first arrival of the fungus.

Although Pd/WNS is predicted to spread throughout the range of the species by 2023–2028, in the currently uninfected areas, northern long-eared bat numbers have not declined, and the present threats to the species in those areas are relatively low. The presence of potentially millions of northern long-eared bats across the species' range (see *Distribution and Relative Abundance*, above), while by no means dispositive in its own right, also indicates a current condition in which species is not ''on the brink'' of extinction. Because the fungus/disease may not spread throughout the species' range for another 8 to 13 years, because no significant declines have occurred to date in the portion of the range not yet impacted by the disease, and because some bats persist many years later in some geographic areas impacted by WNS (for unknown reasons), we conclude that the northern long-eared bat is not currently in danger of extinction throughout all of its range. However, because Pd is predicted to continue to spread, we also determine that the northern long-eared bat is likely to be in danger of extinction within the foreseeable future. Therefore, on the basis of the best available scientific and commercial information, we are listing the northern long-eared bat as a threatened species in accordance with sections 3(20) and 4(a)(1) of the Act.

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. Because we have determined that the northern long-eared bat is threatened throughout all of its range, no portion of its range can be ''significant'' for purposes of the definitions of ''endangered species'' and ''threatened species.'' See the Final Policy on Interpretation of the Phrase ''Significant Portion of Its Range'' in the Endangered Species Act's Definitions of ''Endangered Species'' and ''Threatened Species'' (79 FR 37577, July 1, 2014).

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness, and conservation by Federal, State, Tribal, and local agencies; private organizations; and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan identifies site-specific management actions that set a trigger for review of the five factors that control whether a species remains endangered or may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (composed of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the

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final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Twin Cities Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat protection, habitat restoration (*e.g.,* restoration of native vegetation) and management, research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

Following publication of this final listing rule, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost-share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, under section 6 of the Act, the States of Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming would be eligible for Federal funds to implement management actions that promote the protection or recovery of the northern long-eared bat. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Please let us know if you are interested in participating in recovery efforts for the northern long-eared bat. Additionally, we invite you to submit any new information on this species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

Federal agency actions within the species' habitat that may require conference or consultation or both as described in the preceding paragraph include management and any other landscape-altering activities on Federal lands administered by the U.S. Fish and Wildlife Service, USFS, NPS, and other Federal agencies; issuance of section 404 Clean Water Act (33 U.S.C. 1251 *et seq.*) permits by the U.S. Army Corps of Engineers; and funding for construction and maintenance of roads or highways by the Federal Highway Administration.

We may issue permits to carry out otherwise prohibited activities involving threatened wildlife under certain circumstances. Regulations governing permits are codified at 50 CFR 17.32. With regard to threatened wildlife, a permit may be issued for the following purposes: Scientific purposes, or the enhancement of propagation or survival, or economic hardship, or zoological exhibition, or educational purposes, or incidental taking, or special purposes consistent with the purposes of the Act. There are also certain statutory exemptions from the prohibitions, which are found in sections 9 and 10 of the Act.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a listing on proposed and ongoing activities within the range of listed species. At this time, other than those activities that are in compliance with the interim 4(d) rule described below, we are unable to identify specific activities that would not be considered to result in a violation of section 9 of the Act. Because the northern long-eared bat occurs in a variety of habitat conditions across its range, there are many different types of activities that, without site-specific conservation measures, may directly or indirectly affect the species.

Based on the best available information, the following activities may potentially result in a violation of section 9 the Act; this list is not comprehensive: Activities that may affect the northern long-eared bat that do not comport with the interim 4(d) rule (described below); activities that alter a northern long-eared bat hibernacula; activities that may disturb, alter, or destroy occupied maternity colony habitat; and activities that otherwise kill, harm, or harass northern long-eared bat at any time of the year.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Twin Cities Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Under section 4(d) of the Act, the Service has discretion to issue regulations that we find necessary and advisable to provide for the conservation of threatened wildlife. We may also prohibit by regulation with respect to threatened wildlife any act prohibited by section 9(a)(1) of the Act for endangered wildlife. For the northern long-eared bat, the Service has developed an interim 4(d) rule, described below, that is tailored to the specific threats and conservation needs of this species.

Provisions of the Interim Species-Specific 4(d) Rule for the Northern Long-Eared Bat

Under section 4(d) of the Act, the Secretary may publish a species-specific rule that modifies the standard protections for threatened species with prohibitions and exceptions tailored to the conservation of the species that are determined to be necessary and advisable. Under this interim 4(d) rule, the Service applies all of the prohibitions set forth at 50 CFR 17.31 and 17.32 to the northern long-eared bat, except as noted below. This interim rule under section 4(d) of the Act will not remove, or alter in any way, the consultation requirements under section 7 of the Act.

As discussed in the October 2, 2013, proposed rule (78 FR 61046), the primary factor supporting the proposed determination of endangered species status for the northern long-eared bat is the disease, white-nose syndrome. We further determined that other threat factors (including forest management activities; wind-energy development; habitat modification, destruction, and disturbance; and other threats) may have cumulative effects to the species in addition to WNS; however, they have

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not independently caused significant, population-level effects on the northern long-eared bat. Therefore, we are adopting a final rule to list the species as a threatened species, as explained earlier in this document, and in concert with that final rule, we are adopting an interim rule under section 4(d) of the Act to provide exceptions to the prohibitions for some of these activities that cause cumulative effects, as we deem necessary and advisable for the conservation of the species.

We conclude that certain activities described in this section, when conducted in accordance with the conservation measures identified herein, will provide protection for the northern long-eared bat during its most sensitive life stages. These activities are: Forest management activities (subject to certain time restrictions); maintenance and minimal expansion of existing rights-of-way and transmission corridors, also subject to certain restrictions; prairie management; other projects resulting in minimal tree removal; hazard tree removal; removal of bats from and disturbance within human structures; and capture, handling, attachment of radio transmitters, and tracking northern long-eared bats for a 1-year period following the effective date of this interim 4(d) rule (see **DATES**). The Service concludes that incidental take that is caused by these activities implemented on private, State, tribal, and Federal lands will not be prohibited provided those activities abide by the conservation measures in this interim rule and are otherwise legal and conducted in accordance with applicable State, Federal, tribal, and local laws and regulations.

Buffer Zone Around WNS and Pseudogymnoascus destructans (the Fungus that Causes WNS) Positive Counties (WNS Buffer Zone)

Currently, not all of the range of the northern long-eared bat is affected by WNS. Our status determination of the northern long-eared bat as a threatened species is primarily based on the impacts from WNS, and we also determined that the other threats, when acting on the species alone, are not causing the species to be in danger of extinction. Given this information, the Service concludes that while all purposeful take except removal of bats from human dwellings and survey and research efforts conducted within a 1-year period following the effective date of this interim 4(d) rule will be prohibited, all other take incidental to other lawful activities will be allowed in those areas of the northern long-eared bat's range not in proximity to documented occurrence of WNS or Pd, as identified by the Service.

Currently, WNS is mainly detected by surveillance at bat hibernacula. Thus, our direct detection of the disease is limited largely to wintering bat populations in the locations where they hibernate. However, bats are known to leave hibernacula and travel great distances, sometimes hundreds of miles, to summer roosts. Therefore, the impacts of the disease are not limited to the immediate vicinity around bat hibernacula, but have an impact on a landscape scale. For northern long-eared bats, as with all species, this means that the area of influence of WNS is much greater than the counties known to harbor affected hibernacula, resulting in impacts to a much larger section of the species' range. To fully represent the extent of WNS, we must also include these summer areas.

Overall, northern long-eared bats are not considered to be long-distance migrants, typically dispersing 40 to 50 miles (64 to 80 kilometers) from their hibernacula. However, other bat species that disperse much farther distances are also vectors for WNS spread and may transmit the disease to northern long-eared bat populations. It has been suggested that the little brown bat, in particular, be considered a likely source of WNS spread across eastern North America. Little brown bats tend to migrate greater distances, particularly in the western portions of their range, with distances up to 350 miles (563 km) or more recorded (see Ellison 2008, p. 21; Norquay *et al.* 2013, p. 510). In a recent study, reporting on bat band recoveries of little brown bats over a 21-year period, Norquay *et al.* (2013, pp. 509–510) describe recaptures between hibernacula and summer roosts with a maximum distance of 344 miles (554 km) and a median distance of 288 miles (463 km).

For the purpose of this interim rule, the counties within the northern long-eared bat's range that are considered to be affected by WNS are those within 150 miles (241 km) of the boundary of U.S. counties or Canadian districts where the fungus Pd or WNS has been detected. We acknowledge that 150 miles (241 km) does not capture the full range of potential WNS infection, but represents a compromise distance between the known migration distances of northern long-eared bats and little brown bats that is suitable for our purpose of estimating the extent of WNS infection on the northern long-eared bat. We have chosen to use county boundaries to delineate the boundary because they are clearly recognizable and will minimize confusion. If any portion of a county falls within 150 miles of a county with a WNS detection, the entire county will be considered affected. Anywhere outside of the geographic area defined by these parameters, northern long-eared bat populations will not be considered to be experiencing the impacts of WNS.

The Service defines the term ''WNS buffer zone'' as the set of counties within the range of the northern long-eared bat within 150 miles of the boundaries of U.S. counties or Canadian districts where the fungus Pd or WNS has been detected.

For purposes of this interim 4(d) rule, coordination with the local Service Ecological Services field office is recommended to determine whether specific locations fall within the WNS buffer zone. For more information about the current known extent of WNS and the 150-mile (241-km) buffer, please see *http://www.fws.gov/midwest/endangered/mammals/nlba/.*

Conservation Measures

Under this interim 4(d) rule, take incidental to certain activities conducted in accordance with the following habitat conservation measures, as applicable, will not be prohibited (*i.e.,* will be excepted from the prohibitions). For such take to be excepted, the activity must:

- Occur more than 0.25 mile (0.4 kilometer) from a known, occupied hibernacula;
- Avoid cutting or destroying known, occupied roost trees during the pup season (June 1–July 31); and
- Avoid clearcuts (and similar harvest methods, *e.g.,* seed tree, shelterwood, and coppice) within 0.25 mile (0.4 kilometer) of known, occupied roost trees during the pup season (June 1–July 31).

Note that activities that may cause take of northern long-eared bat that do not use these conservation measures may still be done, but only after consultation with the Service. This means that, while the resulting take from such activities is not excepted by this interim rule, the take may be authorized through other means provided in the Act (section 7 consultation or an incidental take permit).

Known roost trees are defined as trees that northern long-eared bats have been documented as using during the active season (approximately April–October). Once documented, a tree will be considered to be a ''known roost'' as long as the tree and surrounding habitat remain suitable for northern long-eared bat. However, a tree may be considered to be unoccupied if there is evidence

that the roost is no longer in use by northern long-eared bats. Currently, most states and Natural Heritage Programs do not track roosts and many have not tracked any northern long-eared bat occurrences. We anticipate that this will improve over time, as information on the species increases post-listing.

Known, occupied hibernacula are defined as locations where one or more northern long-eared bats have been detected during hibernation or at the entrance during fall swarming or spring emergence. Given the documented challenges of surveying for northern long-eared bats in the winter (use of cracks, crevices), any hibernacula with northern long-eared bats observed at least once, will continue to be considered ''known hibernacula'' as long as the hibernacula and its surrounding habitat remain suitable for northern long-eared bat. However, a hibernaculum may be considered to be unoccupied if there is evidence (*e.g.,* survey data) that it is no longer in use by northern long-eared bats.

These conservation measures aim to protect the northern long-eared bat during its most sensitive life stages. Hibernacula are an essential habitat and should not be destroyed or modified (any time of year). In addition, there are periods of the year when northern long-eared bats are concentrated at and around their hibernacula (fall, winter, and spring). Northern long-eared bats are susceptible to disruptions near hibernacula in the fall, when they congregate to breed and increase fat stores, which are depleted from migration, before entering hibernation. During hibernation, northern long-eared bat winter colonies are susceptible to direct disturbance. Briefly in spring, northern long-eared bats yet again use the habitat surrounding hibernacula to increase fat stores for migration to their summering grounds. This feeding behavior is particularly important for the females, who must obtain enough fat stores to carry not only themselves, but also their unborn pups, to their summer home range.

Risk of injury or death from being crushed when a roost tree is felled is most likely, but not limited, to nonvolant pups. The likelihood of roost trees containing larger number of northern long-eared bats is greatest during pregnancy and lactation (April–July) with exit counts falling dramatically after this time (Foster and Kurta 1999, p. 667; Sasse and Pekins 1996, pp. 91,92). Once the pups can fly, this risk is reduced because the pups will have the ability to flee their roost if it is being cut or otherwise damaged, potentially avoiding harm, injury, or mortality.

The Service concludes that a 0.25-mile (0.4-km) buffer should be sufficient to protect most known, occupied hibernacula and hibernating colonies. This buffer will provide basic protection for the hibernacula and hibernating bats in winter from direct impacts, such as filling, excavation, blasting, noise, and smoke exposure. This buffer will also protect some roosting and foraging habitat around the hibernacula.

The Service concludes that, in addition to preservation of known maternity roosts, a 0.25-mile (0.4-km) buffer for all clearcutting activities will be sufficient to protect the habitat surrounding known maternity roosts during the pup season. Clearcutting and similar methods is summarized here as the cutting of most or essentially all trees from an area; however, specific definitions are provided within the Society of American Foresters' Dictionary of Forestry. This buffer will prevent the cutting of known occupied roost trees, reduce the cutting of secondary roosts used by maternity colonies during the pup season from clearcutting activities, and protect some habitat for some known maternity colonies at least to some degree. Further, because colonies occupy more than one maternity roost in a forest stand and individual bats frequently change roosts, in some cases a portion of a colony or social network is likely to be protected by multiple 0.25 mile (0.4 km) buffers.

For purposes of this proposed rule and the conservation measures listed above, we recommend contacting the local state agency, State's Natural Heritage database, and local Service Ecological Services field office for information on the best current sources of northern long-eared bat records in your state to determine the specific locations of the ''known roosts'' and ''known hibernacula.'' These locations will be informed by records in each State's Natural Heritage database, Service records, other databases, or other survey efforts.

Forest Management

Continued forest management and silviculture is vital to the conservation and recovery of the northern long-eared bat. Under this interim rule, incidental take that is caused by forest management and silviculture activities that promote the long-term stability and diversity of forests, when carried out in accordance with the conservation measures, will not be prohibited. Forest management is the practical application of biological, physical, quantitative, managerial, economic, social, and policy principles to the regeneration, management, utilization and conservation of forests to meet specific goals and objectives (Society of American Foresters (SAF)(a), *http://dictionaryofforestry.org/dict/term/forest_management*). Silviculture is the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis (SAF(b), *http://dictionaryofforestry.org/dict/term/silviculture*). In addition to the conservation measures above, forest management and silviculture activities should also adhere to any applicable State water quality best management practices, where they exist. Further, we encourage the retention of snags and trees with characteristics (*e.g.,* cavities and cracks) favorable for the establishment and maintenance of maternity roosts.

The conversion of mature hardwood, or mixed, forest into intensively managed monoculture pine plantation stands, or non-forested landscape, is not exempted under this interim rule, as typically these types of monoculture pine plantations provide poor-quality bat habitat. Pine plantations are densely planted (*e.g.,* typically 675 to 750, or more, trees per acre) and are comprised of single-age or similar age class timber. They are typically managed for timber production with, depending on the product, a uniform, planned endpoint. Maximum stocking rates and short rotations result in the forfeiture of structural diversity in exchange for elevated rates of wood productivity. Plantation productivity may be further enhanced through the use of genetically improved stock, fertilization, extensive site preparation, and reduction of competition. These management actions prohibit variably stocked stands, layers of understory and midstory vegetation, and longer rotations that enhance and maintain habitat traits required by many forest-dependent wildlife species (Allen *et al.* 1996, p. 13).

Though forestry management and silviculture are vital to the long-term survival and recovery of the species, where northern long-eared bats are present when these forest management activities are performed, bats could be exposed to habitat alteration or loss or direct disturbance (*i.e.,* heavy machinery) or removal of maternity roost trees (*i.e.,* harvest). In general, however, the northern long-eared bat is considered to have more flexible habitat requirements than other bat species (Carter and Feldhamer 2005, pp. 265–

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266; Timpone *et al.* 2010, pp. 120–121), and most types of forest management should provide suitable habitat for the species over the long term (with the exception of conversion to monoculture pine forest, as discussed above). Based upon information obtained during previous comment periods on the proposed listing rule, approximately 2 percent of forests in States within the range of the northern long-eared bat are impacted by forest management activities annually (Boggess *et al.,* 2014, p. 9). Of this amount, in any given year a smaller fraction of forested habitat is impacted during the active season when pups and female bats are most vulnerable. These impacts are addressed by the above conservation measures adopted in this interim rule.

Therefore, we anticipate that habitat modifications resulting from forest management and silviculture will not significantly affect the conservation of the northern long-eared bat. Further, although activities performed during the species' active season (roughly April through October) may directly kill or injure individuals, implementation of the conservation measures provided for in this interim rule will limit take by protecting currently known populations during their more vulnerable life stages.

Routine Maintenance and Limited Expansion of Existing Rights-of-way and Transmission Corridors

Under this interim rule, incidental take that is caused by activities for the purpose of maintenance and limited expansion of existing rights-of-way and transmission corridors, when carried out in accordance with the conservation measures, will not be prohibited (*i.e.,* will be excepted from the prohibitions). Rights-of-way (ROW) and transmission corridors are in place for activities such as transportation (highways, railways), utility transmission lines, and energy delivery (pipelines), though they are not limited to just these types of corridors. Under this interim rule, take of the northern long-eared bat will not be prohibited provided the take is incidental to activities within the following categories:

(1) Routine maintenance within an existing corridor or ROW, carried out in accordance with the previously described conservation measures.

(2) Expansion of a corridor or ROW by up to 100 feet (30 m) from the edge of an existing cleared corridor or ROW, carried out in accordance with the previously described conservation measures.

General ROW routine maintenance is designed to limit vegetation growth, within an existing footprint, so that operations can continue smoothly. These activities may include tree trimming or removal, mowing, and herbicide spraying. However, depending on the purpose of the corridor or ROW, maintenance may only be performed infrequently, and trees and shrubs may encroach into, or be allowed to grow within, the ROW until such time as maintenance is required. Expansion of these areas requires removal of vegetation along the existing ROW to increase capacity (*e.g.,* road widening).

Northern long-eared bats can occupy various species and sizes of trees when roosting. Because of their wide variety of habitat use when roosting and foraging, it is possible that they may be using trees within or near existing ROWs. Therefore, vegetation removal within or adjacent to an existing ROW may remove maternity roost trees and foraging habitat. Individuals may also temporarily abandon the areas, avoiding the physical disturbance until the work is complete. While ROW corridors can be large in overall distance, due to the relatively small scale of the habitat alteration involved in maintenance of the existing footprint, potential take is limited. No new forest fragmentation is expected as this expands existing open corridors. We also expect that excepting take prohibitions from ROW maintenance and limited expansion will encourage co-location of new linear projects within existing corridors. We conclude that the overall impact of ROW maintenance and limited expansion activities is not expected to adversely affect conservation and recovery efforts for the species.

Prairie Management

Under this interim rule, incidental take that is caused by activities for the purpose of prairie management, when carried out in accordance with the conservation measures, will not be prohibited (*i.e.,* will be excepted from the prohibitions). Prairie management involves management to maintain existing prairies and grasslands or efforts to reestablish grasslands that had previously been converted, usually to cropland. In some areas of the northern long-eared bat's range, tree and shrub species are overtaking prairie areas. Landowners and agencies working to establish or conserve prairies may have to manage trees and brush in order to maintain grasslands. Management activities include cutting, mowing, burning, grazing, or using herbicides on woody vegetation to minimize encroachment into prairies (Grassland Heritage Foundation, accessed December 23, 2014 *http://www.grasslandheritage.org/*). In the absence of fire, some researchers found tree species progressively invade and will eventually dominate tallgrass prairie (Bragg and Hulbert 1976, p. 23; Towne and Owensby 1984, p. 397). In some areas, if prairies are not managed to keep woody vegetation suppressed, they can eventually become shrub or forest lands sometimes in as few as 40 years (Briggs *et al.* 2002, p. 578; Ratajczak *et. al* 2011, p. 3). We conclude that the overall impact of prairie management that removes or manages trees and brush to maintain prairies and grasslands is not expected to adversely affect conservation and recovery efforts for the species.

Projects Resulting in Minimal Tree Removal

Under this interim rule, incidental take that results from projects causing minimal tree removal, when carried out in accordance with the conservation measures, will not be prohibited (*i.e.,* will be excepted from the prohibitions). Throughout the millions of acres of forest habitat in the northern long-eared bat's range, many activities involve cutting or removal of individual or limited numbers of trees, but do not significantly change the overall nature and function of the local forested habitat. As such, activities that remove an acre or less of forested habitat are expected to have little or no impact on the ecological value and function and, therefore, will be considered to be ''minimal'' as defined by this rule. Examples of activities that might fall within this category are firewood cutting, shelterbelt renovation, removal of diseased trees, culvert replacement, habitat restoration for fish and wildlife conservation, and backyard landscaping. These ongoing activities can occur throughout the northern long-eared bat's range, but we do not believe they materially affect the local forest habitat for this species and in some cases increase habitat availability in the long term.

With respect to the term ''minimal,'' we limit the effect to an impact of one acre or less. Furthermore, the limitation of the impact to an acre or less may be interpreted as follows: One acre of contiguous habitat or one acre in total within a larger tract, whether that larger tract is entirely forested or a mixture of forested and non-forested cover types. Tract may be further defined as the property under the control of the project proponent or ownership. We conclude that the overall impact of projects causing this type of minimal tree removal is not expected to adversely affect conservation and recovery efforts for the species.

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Hazardous Tree Removal

Under this interim rule, incidental take that is caused by removal and management of hazardous trees will not be prohibited (*i.e.,* will be excepted from the prohibitions). Removal of hazardous trees completed, as necessary, for human safety or for the protection of human facilities is the intent of this exception. Hazardous trees typically have defects in their roots, trunk, or branches that make them likely to fall, with the likelihood of causing personal injury or property damage. The limited removal of these hazardous trees may be widely dispersed but limited, and should result in very minimal incidental take of northern long-eared bat. We recommend, however, that removal of hazardous trees be done during the winter, wherever possible, when these trees will not be occupied by bats. We conclude that the overall impact of removing hazardous trees is not expected to adversely affect conservation and recovery efforts for the species.

Removal of Bats From and Disturbance Within Human Structures

Under this interim rule, any take that is caused by removal of bats from and disturbance within human structures (*e.g.,* harm from excluding bats from their previous roost site) will not be prohibited (*i.e.,* will be excepted from the prohibitions), provided those actions comply with all applicable State laws. Northern long-eared bats have occasionally been documented roosting in human-made structures, such as houses, barns, pavilions, sheds, cabins, and bat houses (Mumford and Cope 1964, p. 72; Barbour and Davis 1969, p. 77; Cope and Humphrey 1972, p. 9; Amelon and Burhans 2006, p. 72; Whitaker and Mumford 2009, p. 209; Timpone *et al.* 2010, p. 119; Joe Kath 2013, pers. comm.). We conclude that the overall impact of bat removal from human structures is not expected to adversely affect conservation and recovery efforts for the species. In addition, we provide the following recommendations:

- Minimize use of pesticides (*e.g.,* rodenticides) and avoid use of sticky traps as part of bat evictions/exclusions.
- Conduct exclusions during spring or fall unless there is a perceived public health concern from bats present during summer and/or winter.
- Contact a nuisance wildlife specialist for humane exclusion techniques.

Capture, Handling, and Related Activities for Northern Long-Eared Bats for 1 Year

Under this interim rule, for a limited period of 1 year from the effective date of this interim 4(d) rule, purposeful take that is caused by the authorized capture, handling, and related activities (attachment of radio transmitters and tracking) of northern long-eared bats by individuals permitted to conduct these same activities for other bats will be excepted from the prohibitions. After this time period, all such take must be permitted following the Service's standard procedures under 10(a)(1)(A) of the Act. One method of determining presence/probable absence of northern long-eared bats is to conduct mist-netting at summer sites or harp trapping at hibernacula. Gathering of this information is essential to monitor the distribution and status of northern long-eared bats over time. In addition, northern long-eared bats are often captured incidentally to survey and study efforts targeted at other bat species (*e.g.,* Indiana bats). It is necessary and advisable for the conservation of northern long-eared bats to provide an exception for the purposeful take associated with these normal survey activities conducted by qualified individuals to promote and encourage the gathering of information following standard procedures (including decontamination) as these data will help us conserve and recover this species. To receive an exception, proponents must have an existing research permit under section 10(a)(1)(A) of the Act, or similar State collector's permit, for other bat species. The rationale for this limited time period is that it will be difficult to amend all permits in time for this year.

The Service concludes, for the reasons specified above, that all of the conservation measures, prohibitions, and exceptions identified in this interim rule individually and cumulatively are necessary and advisable for the conservation of the northern long-eared bat and will collectively promote the conservation of the species across its range.

We publish this interim species-specific rule under section 4(d) of the Act in full recognition that WNS is the primary threat to species continued existence. All of the other (non-WNS) threats combined did not lead to imperilment of the species, and elimination of all other non-WNS threats will not likely improve the potential for recovery of this species in any meaningful way unless we find a means to address WNS. We also recognize, however, that in those areas of the country impacted by WNS, some reasonable measures may be taken to protect the species from additive stresses as a result of other factors. By focusing on conservation measures that clearly protect individual bats, we minimize needless and preventable deaths of bats during the species' most sensitive life stages. Although not fully protective of every individual, the conservation measures identified in this interim rule help protect maternity and hibernating colonies, while allowing limited impacts to habitat. We have focused the Act's protections on the landscape scale by protecting known hibernacula, protecting the species from activities that would result in large-scale forest conversion or loss, and encouraging research on WNS and other aspects of the species' biology by simplifying the permitting process. This interim species-specific rule under section 4(d) of the Act provides the flexibility for certain activities to occur while not significantly impacting habitat for this species and while still promoting conservation of the species across its range.

Of the activities excepted by this interim rule, we project that forest management activities will have the greatest potential impact on the northern long-eared bat. Based upon information obtained during previous comment periods on the proposed listing rule, we expect approximately 2 percent of forests in States within the range of the northern long-eared bat to experience forest management activities this year (Boggess *et al.,* 2014, p. 9). Put another way, we would expect 98 percent of potential habitat to be completely unaffected by forest management while this interim rule is in effect. Of the remaining 2 percent, a smaller fraction of this forested habitat will actually be harvested during the northern long-eared bat's active season (April–October), and a smaller portion yet would be harvested during the pup season. For the remaining percentage of bats actually affected by forest management, we expect implementation of the conservation measures to significantly reduce the take of those individual bats where there are known northern long-eared bat roost trees. When occupied roosts are cut outside of the pup season or if undocumented northern long-eared bat roosts are cut while occupied, some portion of these individuals (particularly males) will flee the roost and survive. Thus, we anticipate only a small percentage (less than 1 percent) of northern long-eared

bats will be impacted by forestry management activities.

We anticipate that the additional activities covered by this interim species-specific 4(d) rule will only have a minimal impact on northern long-eared bat habitat and individuals. The activities associated with ROW management and expansion, minimal tree removal, prairie management, and hazard tree removal collectively impact only small percentages of northern long-eared bat habitat; low levels of take of individuals are expected given the limited scope of these activities and the season during which they occur.

We conclude that take of the northern long-eared bat excepted by this interim rule will be small and will not pose a significant impact on the conservation of the species as a whole. However, we recognize that there is some uncertainty regarding the level of take that may result and that there are other approaches and additional conservation measures could improve the overall conservation outcome of this interim species-specific rule under section 4(d) of the Act. We are seeking public comments on this interim rule (see Public Comments Solicited on the Interim 4(d) Rule, below), and we will publish either an affirmation of the interim rule or a final rule amending the interim rule after we fully consider all comments we receive. If you previously submitted comments or information on the proposed 4(d) rule we published on January 16, 2015 (80 FR 2371), please do not resubmit them. We have incorporated them into the public record, and we will fully consider them in our final determination on the 4(d) rule.

Table 2 (below) summarizes the details of the interim species-specific 4(d) rule for the northern long-eared bat.

Is the area affected by WNS (WNS buffer zone)?	Take prohibitions at 50 CFR 17.31 and 17.32	Take exceptions in interim 4(d) rule	
		Purposeful	Incidental
No	All apply, with the following exceptions listed here.	Actions with the intent to remove northern long-eared bats from within human structures and that comply with all applicable State regulations. Actions relating to capture and handling of northern long-eared bats by individuals permitted to conduct these same activities for other bats, for a period of 1 year following the effective date of the interim 4(d) rule.	Any incidental take of northern long-eared bats resulting from otherwise lawful activities.
Yes	All apply, with the following exceptions listed here.	Actions with the intent to remove northern long-eared bats from within human structures and that comply with all applicable State regulations. Actions relating to capture, and handling of northern long-eared bats by individuals permitted to conduct these same activities for other bats, for a period of 1 year following the effective date of the interim 4(d) rule.	Implementation of forest management, maintenance and expansion of existing rights-of-way (ROW) and transmission corridors, prairie management, and minimal tree removal projects that: • Occur more than 0.25 mile (0.4 km) from a known, occupied hibernacula; • Avoid cutting or destroying known, occupied roost trees during the pup season (June 1–July 31); and • Avoid clearcuts (and similar harvest methods, *e.g.,* seed tree, shelterwood, and coppice) within 0.25 mile (0.4 km) of known, occupied roost trees during the pup season (June 1–July 31). • Routine maintenance within an existing corridor or ROW, carried out in accordance with the previously described conservation measures. • Expansion of a corridor or ROW by up to 100 feet (30 m) from the edge of an existing cleared corridor or ROW, carried out in accordance with the previously described conservation measures. Removal of hazard trees for the protection of human life and property.

Need for Interim Final Rule

Under 5 U.S.C. 553(b)(3)(B) of the Administrative Procedure Act (APA), we have good cause to find that the delay in adopting a rule, which would be caused by adequately addressing and responding to public comments on the January 16, 2015, proposed rule (80 FR 2371), would be detrimental to the conservation of the northern long-eared bat and, therefore, is contrary to the public interest. If the Secretary went through the standard rulemaking process (granting requested extensions of the public notice-and-comment period and honoring requests for public hearings or meetings), we would be unable to finalize the conservation measures set forth in this interim rule concurrent with the final listing rule. This would result in the default provisions at 50 CFR 17.31 and 17.32 controlling northern long-eared bat management until we complete the standard process to adopt a 4(d) rule. That outcome would be contrary to the public interest in this case because immediate implementation of the interim rule has the advantage of providing a conservation benefit to northern long-eared bat that is unavailable under the general threatened species provisions at 50 CFR 17.31 and 17.32. Under this interim rule, the Service can continue to except the take that will result from the activities addressed within and still address the conservation of bats in individual known roost trees that need protection due to the impacts of WNS. The general threatened species

provisions at 50 CFR 17.31 and 17.32 would not allow such protection for northern long-eared bat. In addition, as discussed in detail in the preamble, applying the default provisions under 50 CFR 17.31 and 17.32, unmodified by a species-specific 4(d) rule, would not provide any significant conservation benefit to the species. Alternatively, another option left to the agency's discretion would be to have no prohibitions for a species determined to be threatened. However, as stated, we think that it is appropriate to provide some protection for this species during its most sensitive life stages so that the northern long-eared bat has the best chance of fighting WNS. We believe this interim species-specific 4(d) rule provides a balance between the default provisions at 50 CFR 17.31 and 17.32 and no take prohibitions by providing the flexibility for certain activities to occur while not significantly impacting habitat for this species and still promoting species conservation across its range.

In general, interim rules are effective immediately upon publication due to the urgency of the actions within those rules. The final rule listing the northern long-eared bat as threatened is published as a part of this document, and is effective in 30 days (see **DATES**). To avoid any confusion arising from varying effective dates, and because we cannot establish a 4(d) rule for a species that is not yet listed, this interim species-specific 4(d) rule will also be effective in 30 days (see **DATES**), to coincide with the effective date of the listing.

Public Comments Solicited on the Interim 4(d) Rule

We request comments or information from other concerned Federal and State agencies, the scientific community, or any other interested party concerning the interim 4(d) rule. We will consider all comments and information we receive during our preparation of an affirmation or final rule under section 4(d) of the Act. With regard to the interim 4(d) rule, we particularly seek comments regarding:

(1) Whether measures outlined in this interim rule under section 4(d) of the Act are necessary and advisable for the conservation and management of the northern long-eared bat.

(2) Whether it may be appropriate to except incidental take as a result of other categories of activities beyond those covered by this interim rule and, if so, under what conditions and with what conservation measures.

(3) Whether the Service should modify the portion of this interim rule under section 4(d) of the Act that defines how the portion of the northern long-eared bat range will be identified as the ''WNS buffer zone.'' We are seeking comments regarding the factors and process we used to delineate where on the ground we believe WNS is likely affecting the northern long-eared bat and whether that delineation should incorporate political boundaries (*e.g.*, county lines) for ease in describing the delineated area to the public.

(4) Additional provisions the Service may wish to consider for a revision to this interim rule under section 4(d) of the Act in order to conserve, recover, and manage the northern long-eared bat.

Please note that comments merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination, as section 4(b)(1)(A) of the Act directs that determinations as to whether any species is an endangered or a threatened species must be made ''solely on the basis of the best scientific and commercial data available.'' If you previously submitted comments or information on the January 16, 2015, proposed rule, please do not resubmit them. We have incorporated them into the public record, and we will fully consider them in our final determination on this interim rule. Our final determination on this interim rule will take into consideration all written comments and any additional information we receive. The final decision may differ from this interim final rule, based on our review of all information received during this rulemaking proceeding.

Our intent is to issue an affirmation of this interim rule or a final species-specific rule under section 4(d) of the Act for the northern long-eared bat by the end of the calendar year 2015.

You may submit your comments and materials concerning this interim rule by one of the methods listed in **ADDRESSES**. We request that you send comments only by the methods described in **ADDRESSES**.

If you submit information via *http://www.regulations.gov,* your entire submission—including any personal identifying information—will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on *http://www.regulations.gov.* Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing this interim rule, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Twin Cities Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Critical Habitat

Background

Critical habitat is defined in section 3 of the Act as:

(1) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features

(a) Essential to the conservation of the species, and

(b) Which may require special management considerations or protection; and

(2) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means to use and the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Critical habitat receives protection under section 7 of the Act through the requirement that Federal agencies ensure, in consultation with the Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such

designation does not require implementation of restoration, recovery, or enhancement measures by non-Federal landowners. Where a landowner requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) of the Act would apply, but even in the event of a destruction or adverse modification finding, the obligation of the Federal action agency and the landowner is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

Under the first prong of the Act's definition of critical habitat, areas within the geographical area occupied by the species at the time it was listed are included in a critical habitat designation if they contain physical or biological features (1) which are essential to the conservation of the species and (2) which may require special management considerations or protection. For these areas, critical habitat designations identify, to the extent known using the best scientific and commercial data available, those physical or biological features that are essential to the conservation of the species (such as space, food, cover, and protected habitat). In identifying those physical and biological features within an area, we focus on the principal biological or physical constituent elements (primary constituent elements such as roost sites, nesting grounds, seasonal wetlands, water quality, tide, soil type) that are essential to the conservation of the species. Primary constituent elements are those specific elements of the physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species.

Under the second prong of the Act's definition of critical habitat, we can designate critical habitat in areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. For example, an area currently occupied by the species but that was not occupied at the time of listing may be essential to the conservation of the species and may be included in the critical habitat designation. We designate critical habitat in areas outside the geographical area occupied by a species only when a designation limited to its range would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas should be designated as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, other unpublished materials, or experts' opinions or personal knowledge.

Habitat is dynamic, and species may move from one area to another over time. We recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine are necessary for the recovery of the species. For these reasons, a critical habitat designation does not signal that habitat outside the designated area is unimportant or may not be needed for recovery of the species. Areas that are important to the conservation of listed species, both inside and outside the critical habitat designation, continue to be subject to: (1) Conservation actions implemented under section 7(a)(1) of the Act, (2) regulatory protections afforded by the requirement in section 7(a)(2) of the Act for Federal agencies to ensure their actions are not likely to jeopardize the continued existence of any endangered or threatened species, and (3) section 9 of the Act's prohibitions on taking any individual of the species, including taking caused by actions that affect habitat. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. These protections and conservation tools will continue to contribute to recovery of this species. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, HCPs, or other species conservation planning efforts if new information available at the time of these planning efforts calls for a different outcome.

Prudency Determination

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time the species is determined to be endangered or threatened. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or (2) such designation of critical habitat would not be beneficial to the species.

There is currently no imminent threat of take attributed to collection or vandalism for the northern long-eared bat, and identification and mapping of critical habitat is not expected to initiate any such threat. In the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, then a prudent finding is warranted. In general, the potential benefits of designation may include: (1) Triggering consultation under section 7 of the Act, in new areas for actions in which there may be a Federal nexus where it would not otherwise occur because, for example, it is or has become unoccupied or the occupancy is in question; (2) focusing conservation activities on the most essential features and areas; (3) providing educational benefits to State or county governments or private entities; and (4) preventing people from causing inadvertent harm to the species. Therefore, because we have determined that the designation of critical habitat will not likely increase the degree of threat to the species and may provide some measure of benefit, we find that designation of critical habitat is prudent for the northern long-eared bat.

Critical Habitat Determinability

Having determined that designation is prudent, under section 4(a)(3) of the Act we must find whether critical habitat for the species is determinable. Our regulations at 50 CFR 424.12(a)(2) state that critical habitat is not determinable

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when one or both of the following situations exist: (i) Information sufficient to perform required analyses of the impacts of the designation is lacking, or (ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

We reviewed the available information pertaining to the biological needs of the species and habitat characteristics where this species is located. As information regarding the biological needs of the species is not sufficiently well known to permit identification of areas as critical habitat, we conclude that the designation of critical habitat is not determinable for the northern long-eared bat at this time.

There are many uncertainties in designating hibernacula as critical habitat for the northern long-eared bat. We lack sufficient information to define the physical and biological features or primary constituent elements with enough specificity; we are not able to determine how habitats affected by WNS (where populations previously thrived and are now extirpated) may contribute to the recovery of the species or whether those areas may still contain essential physical and biological features. Therefore, we currently lack the information necessary to propose critical habitat for the species.

There are also uncertainties with potential designation of summer habitat, specifically maternity colony habitat. Although research has given us indication of some key summer roost requirements, the northern long-eared bat appears to be somewhat opportunistic in roost selection, selecting varying roost tree species and types of roosts throughout the range. Although research has shown some consistency in female summer roost habitat (*e.g.,* selection of mix of live trees and snags as roosts, roosting in cavities, roosting beneath bark, and roosting in trees associated with closed canopy), the species and diameter of the tree (when tree roost is used) selected by northern long-eared bats for roosts vary widely depending on availability. Thus, it is not clear whether certain summer habitats are essential for the recovery of the species or whether these areas may require special management.

A careful assessment of the designation of hibernacula as critical habitat will require additional time to fully evaluate which features are essential to the conservation of the northern long-eared bat and how those features might change as WNS spreads. In addition, summer habitat will require a similar assessment and evaluation of the essential physical and biological features and what special management they might require. Additionally, we have not gathered sufficient economic and other data on the impacts of critical habitat designation. These factors must be considered as part of the designation process. Thus, we find that critical habitat is not determinable for the northern long-eared bat at this time.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*), need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244). It is the position of the Service that rules promulgated under section 4(d) of the Act concurrently with listing the species fall under the same rationale as outlined in the October 25, 1983, determination. For this reason, we did not conduct analysis under NEPA for the interim rule under section 4(d) of the Act. However, it is our intent to comply with NEPA standards at the time we publish either an affirmation of the interim 4(d) rule we are adopting in this document or a final rule amending the interim 4(d) rule based on comments we receive.

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes.

In October 2013, Tribes and multi-tribal organizations were sent letters inviting them to begin consultation and coordination with the service on the proposal to listing the northern long-eared bat. In August 2014, several Tribes and multi-tribal organizations were sent an additional letter regarding the Service's intent to extend the deadline for making a final listing determination by 6 months. A conference call was also held with Tribes to explain the listing process and discuss any concerns. Following publication of the proposed rule, the Service established 3 interagency teams (biology of the northern long-eared bat, non-WNS threats, and conservation measures) to ensure that States, Tribes, and other Federal agencies were able to provide input into various aspects of the listing rule and potential conservation measures for the species. Invitations for inclusion in these teams were sent to Tribes within the range of the northern long-eared bat and a few tribal representatives participated on those teams. Two additional conference calls (in January and March 2015) were held with Tribes to outline the proposed species-specific 4(d) rule and to answer questions. Through this coordination, some Tribal representatives expressed concern about how listing the northern long-eared bat may impact forestry practices, housing development programs, and other activities on Tribal lands.

Clarity of the Interim 4(d) Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(1) Be logically organized;

(2) Use the active voice to address readers directly;

(3) Use clear language rather than jargon;

(4) Be divided into short sections and sentences; and

(5) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the 4(d) rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, or the sections where you feel lists or tables would be useful.

References Cited

A complete list of references cited in this document is available on the Internet at *http://www.regulations.gov* and upon request from the Twin Cities Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this document are the staff members of the Twin Cities Ecological Services Field Office.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—ENDANGERED AND THREATENED WILDLIFE AND PLANTS

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; and 4201–4245, unless otherwise noted.

■ 2. Amend § 17.11(h) by adding an entry for ''Bat, northern long-eared'' in alphabetical order under MAMMALS to the List of Endangered and Threatened Wildlife to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
*	*	*	*	*	*		*
Bat, northern long-eared.	*Myotis septentrionalis.*	U.S.A. (AL, AR, CT, DE, DC, GA, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NH, NJ, NY, NC, ND, OH, OK, PA, RI, SC, SD, TN, VT, VA, WV, WI, WY); Canada (AB, BC, LB, MB, NB, NF, NS, NT, ON, PE, QC, SK, YT).	Entire	T	857	NA	17.40(o)
*	*	*	*	*	*		*

■ 3. Amend § 17.40 by adding paragraph (o) to read as follows:

§ 17.40 Special rules—mammals.

* * * * *

(o) Northern long-eared bat (*Myotis septentrionalis*). The provisions of this rule are based upon the occurrence of white-nose syndrome (WNS), a disease affecting many U.S. bat populations. The term ''WNS buffer zone'' identifies the portion of the range of the northern long-eared bat within 150 miles of the boundaries of U.S. counties or Canadian districts where the fungus Pd or WNS has been detected. For current information regarding the WNS buffer zone, contact your local Service ecological services field office. Field office contact information may be obtained from the Service regional offices, the addresses of which are listed in 50 CFR 2.2.

(1) Outside the WNS buffer zone, the following provisions apply to the northern long-eared bat:

(i) *Prohibitions.* Except as noted in paragraphs (o)(1)(ii)(A) and (B) of this section, all the prohibitions and provisions of §§ 17.31 and 17.32 apply to the northern long-eared bat.

(ii) *Exceptions from prohibitions.* (A) Purposeful take:

(*1*) Take resulting from actions taken to remove northern long-eared bats from within human structures, if the actions comply with all applicable State regulations.

(*2*) Take resulting from actions relating to capture, handling, and related activities for northern long-eared bats by individuals permitted to conduct these same activities for other species of bat until May 3, 2016.

(B) Any incidental (non-purposeful) take of northern long-eared bats resulting from otherwise lawful activities.

(2) Inside the WNS buffer zone, the following provisions apply to the northern long-eared bat:

(i) *Prohibitions.* Except as noted in paragraphs (o)(2)(ii)(A) and (B) of this section, all prohibitions and provisions of §§ 17.31 and 17.32 apply to the northern long-eared bat.

(ii) *Exceptions from prohibitions.* Take of northern long-eared bat is not prohibited in the following circumstances:

(A) Purposeful take:

(*1*) Take resulting from actions taken to remove northern long-eared bats from within human structures, if the actions comply with all applicable State regulations.

(*2*) Take resulting from actions relating to capture, handling, and related activities for northern long-eared bats by individuals permitted to conduct these same activities for other species of bat until May 3, 2016.

(B) Incidental take:

(*1*) Implementation of forest management, maintenance and expansion of existing rights-of-way and transmission corridors, prairie management, and minimal tree removal projects that:

(*i*) Occur more than 0.25 mile (0.4 kilometer) from a known, occupied hibernacula;

(*ii*) Avoid cutting or destroying known, occupied roost trees during the pup season (June 1–July 31); and

(*iii*) Avoid clearcuts (and similar harvest methods, *e.g.,* seed tree,

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shelterwood, and coppice) within 0.25 mile (0.4 kilometer) of known, occupied roost trees during the pup season (June 1–July 31).

(*2*) Routine maintenance within an existing corridor or right-of-way, carried out in accordance with the conservation measures set forth at paragraph (o)(2)(ii)(B)(*1*).

(*3*) Expansion of a corridor or right-of-way by up to 100 feet (30 meters) from the edge of an existing cleared corridor or right-of-way, carried out in accordance with the conservation measures set forth at paragraph (o)(2)(ii)(B)(*1*).

(*4*) Removal of hazardous trees for the protection of human life and property.

Dated: March 23, 2015.

Stephen Guertin,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2015–07069 Filed 4–1–15; 8:45 am]

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Part II

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot; Final Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R5–ES–2013–0097; 4500030113]

RIN 1018–AY17

Endangered and Threatened Wildlife and Plants; Threatened Species Status for the Rufa Red Knot

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine threatened species status under the Endangered Species Act of 1973 (Act), as amended, for the rufa red knot (*Calidris canutus rufa*). The rufa red knot is a migratory shorebird that breeds in the Canadian Arctic, winters in parts of the United States, the Caribbean, and South America, and primarily uses well-known spring and fall stopover areas on the Atlantic coast of the United States, although some follow a midcontinental migratory route. The effect of this regulation will be to add this species to the list of Endangered and Threatened Wildlife.

DATES: This rule becomes effective January 12, 2015.

ADDRESSES: This final rule is available on the internet at *http://www.regulations.gov* at Docket Number FWS–R5–ES–2013–0097 and at *http://www.fws.gov/northeast/redknot/.* Comments and materials we received, as well as supporting documentation we used in preparing this rule, are available for public inspection at *http://www.regulations.gov.* All of the comments, materials, and documentation that we considered in this rulemaking are available by appointment, during normal business hours at: U.S. Fish and Wildlife Service, New Jersey Field Office (see **FOR FURTHER INFORMATION CONTACT**).

FOR FURTHER INFORMATION CONTACT: Eric Schrading, Field Supervisor, U.S. Fish and Wildlife Service, New Jersey Field Office, 927 North Main Street, Building D, Pleasantville, New Jersey 08232, by telephone 609–383–3938 or by facsimile 609–646–0352. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Endangered Species Act, a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. Listing a species as an endangered or threatened species can only be completed by issuing a rule.

This rule will finalize the listing of the rufa red knot (*Calidris canutus rufa*) as a threatened species.

The basis for our action. Under the Endangered Species Act, we may determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. We have determined that the rufa red knot is a threatened species due to loss of both breeding and nonbreeding habitat; likely effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies (mismatches) in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions.

Peer review and public comment. We sought comments from three independent specialists with expertise on red knot biology and sea level rise to ensure that our designation is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal. Only one of the three peer reviewers provided comments on the proposal. This peer reviewer was generally supportive of the proposal, and provided substantive comments and documentation regarding biological differences between red knots in northern versus southern wintering areas. Many of these differences were already in the proposal but in separate locations; we consolidated and emphasized these differences, updating as appropriate with new information.

Previous Federal Action

Please refer to the proposed listing rule for the rufa red knot (78 FR 60024; September 30, 2013) and its Previous Actions supplement available online at *www.regulations.gov* under Docket Number FWS–R5–ES–2013–0097 for a detailed description of previous Federal actions concerning this species.

Background

Species Information

The rufa red knot (*Calidris canutus rufa*) is a medium-sized shorebird about 9 to 11 inches (in) (23 to 28 centimeters (cm)) in length. (Throughout this document, ''rufa red knot,'' ''red knot,'' and ''knot'' are used interchangeably to refer to the *rufa* subspecies. ''*Calidris canutus''* and ''*C. canutus''* are used to refer to the species as a whole or to birds of unknown subspecies. References to other particular subspecies are so indicated.) The red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast United States (Southeast), the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed.

The November 2014 Rufa Red Knot Background Information and Threats Assessment (Supplemental Document; Service 2014, entire), available online at *www.regulations.gov* under Docket Number FWS–R5–ES–2013–0097, provides a thorough assessment of the rufa red knot biology and ecology, historical distribution and abundance, population surveys and estimates, and threats to its survival. The Supplemental Document has been updated since the September 30, 2013 publication of the proposed rule with data received during the peer review and public comment processes and relevant scientific data that have become available. In the Supplemental Document, we compile biological data and a description of past, present, and likely future threats facing the red knot. Because data in these areas of science can be limited, some uncertainties are associated with the data and conclusions drawn from the data. We have attempted to clearly identify these uncertainties and assumptions, which are based on the best available scientific and commercial data, explicit in the Supplemental Document. The Supplemental Document provides the scientific basis for our decision (see Summary of Biological Status and Threats in this final rule), the legal basis for which is the Act and its regulations and policies (see Determination in this final rule).

Summary of Biological Status and Threats

In this section, we summarize the population and threats information previously provided in the proposed

rule (78 FR 60024; September 30, 2013) and updated as appropriate from new information received since the proposed rule's publication. See the Summary of Changes from the Proposed Rule section below for what has been updated.

We note that the proposed rule referenced four separate documents of supporting material—Previous Federal Actions, Rufa Red Knot Ecology and Abundance, Climate Change Background, and Factor D: The Inadequacy of Existing Regulatory Mechanisms. For this final rule, we have combined those documents into one Supplemental Document. From here forward, when we are referencing information in the proposed rule, we will use the proposed rule's **Federal Register** citation and page number (*e.g.,* 78 FR 60024, p. 60032); when we are referencing information in one of the proposed rule's supporting documents, we will use the document's name and page number (*e.g.,* Rufa Red Knot Ecology and Abundance, p. 5); and when we are referencing information now contained in the final rule's Supplemental Document, we will use the Supplemental Document's title and section (*e.g.,* Supplemental Document, Factor E—Reduced Food Availability—Horseshoe Crab Harvest).

Population Information: After a thorough review of the best available population data, we conclude that we do not have sufficient reliable data on which to derive a precise rangewide population estimate for the rufa red knot. For example, there are no rangewide population estimates for fall migration or breeding areas because birds are too dispersed. We have limited confidence in any population trends inferred from wintering areas in Brazil's north coast, the northern Gulf coast, and the Southeast United States because available data from these areas vary in geographic coverage, methods, and level of effort. However, there are several areas where surveys have been conducted using more consistent observers, methods, and geographic coverage: Tierra del Fuego and the Argentine coast (winter), Delaware Bay (spring), the east coast of South America (spring), and Virginia (spring).

For Tierra del Fuego, baseline population data are available from the 1980s, and annual counts are available from 2000 to 2013, all collected with the same methodology and surveyors. The most recent counts (2011 to 2013) are about 75 percent lower than the 1980s baseline. The annual counts (2000 to 2013) show that the decline began after 2000, but the population has apparently stabilized at a low level since 2011.

For Delaware Bay, baseline data are available from the early 1980s, and annual peak counts are available for 1986 to 2014. The core years of 1986 to 2008 were collected with consistent methodology and surveyors. Based on these data, there may have been declines in the Delaware Bay stopover population in the 1990s, but variability in the data makes it difficult to detect trends. In contrast, the decline in Delaware Bay red knot counts in the 2000s was sufficiently pronounced and sustained that we have confidence in the downward trend over this time period despite the variability in the data. The average of peak counts in Delaware Bay over the past decade (2005 to 2014) was about 70 percent lower than the 1980s baseline. However, Delaware Bay numbers appear to have stabilized or increased slightly from 2009 to 2014, despite our lower confidence in the data over this later period due to shifts in methodology and surveyors.

Data sets from three South American Atlantic coast spring stopovers also suggest declines roughly over this same timeframe (early 2000s relative to 1990s). We previously concluded that the Virginia spring stopover had been stable since the mid-1990s, but new information now indicates a decline in Virginia relative to the 1990s.

In summary, our analysis of the best available data concludes that an overall, sustained decline of red knot numbers occurred at Tierra del Fuego and Delaware Bay in the 2000s, and that these red knot populations may have stabilized at a relatively low level in the last few years. Although we lack sufficiently robust data to conclude if other wintering and stopover areas also declined, we conclude it is likely that declines at Tierra del Fuego and Delaware Bay drove an overall population decline (*i.e.,* lower total numbers), because these two sites supported a large majority of rangewide knots during the baseline 1980s period. This conclusion is consistent with efforts (by others) to evaluate long-term population trends using national or regional data from volunteer shorebird surveys and other sources, which have also generally concluded that red knot numbers have declined. Please refer to this final rule's Supplemental Document—Population Surveys and Estimates for a more detailed discussion of the population information available for the rufa red knot throughout its range, available online at *www.regulations.gov* under Docket FWS–R5–ES–2013–0097.

Threats: Substantial threats exist throughout the red knot's breeding, migration, and wintering range and these threats are likely to continue or intensify into the future. For a full discussion of the five factors (*i.e.,* Factors A, B, C, D, and E) assessed as a basis for making the listing determination, please see the Supplemental Document—Summary of Factors Affecting the Species available online at *www.regulations.gov* under Docket Number FWS–R5–ES–2013–0097. A summary is provided below:

(1) Past habitat losses in wintering and migration areas have reduced the resilience of the red knot (Factor A). Ongoing losses in these areas from sea level rise, shoreline hardening, and development are expected to continue into the coming decades (Factor A). Beach nourishment can be beneficial or detrimental to red knot habitat, though any negative effects are mostly considered to be short-term. More recently, vegetation and ecosystem changes resulting from climate change, and potentially from development, have begun to threaten habitat loss on the breeding grounds as well (Factor A).

(2) Threats to the current and future quality and quantity of prey resources occur throughout the red knot's range from climate change and other causes (*e.g.,* ocean acidification; warming coastal waters; marine diseases, parasites, and invasive species; sediment placement; recreation; and fisheries) (Factor E). Reduced food availability in Delaware Bay due to commercial harvest of the horseshoe crab (*Limulus polyphemus*) (HSC) is considered a primary causal factor in red knot population declines in the 2000s. (Red knots rely on horseshoe crab eggs as food during their spring stopover in Delaware Bay.) We do not consider the HSC harvest a threat under the science-based management framework that has been developed and adopted to explicitly link harvest quotas to red knot population growth (Factor D). However, HSC monitoring necessary for the implementation of the management framework was not conducted in 2013 or 2014 due to lack of funding; thus, the framework is not currently being implemented as it was intended to function. There is uncertainty regarding implementation of the framework in the future (Factor D). While we anticipate a fully functioning management framework would continue to adequately abate the threat to red knots from the HSC harvest, there are other biological factors independent of harvest that may limit the availability of HSC eggs into the future. For example, HSC population growth may be limited by a biological lag time because HSCs take up to 10-years to become sexually

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mature and therefore it may take at least that long for harvest restrictions (which have been phased in since 2000) to produce a corresponding increase in HSC populations. Other factors (*e.g.,* early life stage mortality, undocumented or underreported mortality) may also be slowing HSC population growth (Factor E). Most data suggest that the volume of horseshoe crab eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. However, because of the uncertain trajectory of horseshoe crab population growth, it is not yet known if the HSC egg resource will continue to adequately support red knot population growth over the next decade.

(3) The red knot faces ongoing and future increases in asynchronies (timing mismatches) throughout its migration and breeding range as a result of climate change and unknown causes (Factor E). Successful annual migration and breeding of red knots is highly dependent on the timing of departures and arrivals to coincide with favorable food and weather conditions in the spring and fall migratory stopover areas and on the Arctic breeding grounds (Factor E).

(4) On the arctic breeding grounds, normal 3- to 4-year cycles of high predation, mediated by rodent (*e.g.,* lemming) cycles, result in years with low reproductive output of red knots (in some years it is zero), but do not threaten the survival of the red knot at the subspecies level (Factor C). That is, when lemmings are abundant, predators (*e.g.,* arctic fox) concentrate on the lemmings, and shorebirds breed successfully, but when lemmings are in short supply, predators switch to shorebird eggs and chicks (Niles *et al.* 2008, p. 101; COSEWIC 2007, p. 19; Meltofte *et al.* 2007, p. 21; USFWS 2003, p. 23; Blomqvist *et al.* 2002, p. 152; Summers and Underhill 1987, p. 169). It is believed shorebirds, such as red knots, have adapted to these cycles, therefore these natural cycles are not considered a threat to the red knot. What is a threat, however, is that these natural rodent/predator cycles are being disrupted by climate change, which may increase predation rates on shorebirds over the long term and have subspecies-level effects (Factor C and Factor E) (Chapter 28 *in* IPCC 2014, p. 14; Fraser *et al.* 2013, pp. 13, 16; Brommer *et al.* 2010, p. 577; Ims *et al.* 2008, p. 79; Kausrud *et al.* 2008, p. 98). The documented collapse or dampening of rodent (*e.g.,* lemmings) population cycles of over the last 20 to 30 years in parts of the Arctic can be attributed to climate change with ''high confidence'' (Chapter 28 *in* IPCC 2014, p. 14). We conclude that disruptions in the rodent/predator cycle pose a substantial threat to the red knot, as they may result in prolonged periods of low reproductive output of red knots due to increased predation (Factor C). The substantial impacts of elevated egg and chick predation on shorebird reproduction are well known. Disruptions in the rodent/predator cycle may have already affected red knot populations and are likely to increase due to climate change (Factor C).

Other factors may cause additive red knot mortality. Individually these factors are not expected to have subspecies level effects; however, cumulatively, these factors could exacerbate the effects of the primary threats if they further reduce the species' resiliency. These secondary factors include hunting (Factor B); predation in nonbreeding areas (Factor C); and human disturbance, oil spills, and wind energy development especially near the coasts (Factor E).

In summary, the rufa red knot faces numerous threats across its range on multiple geographic and temporal scales. These threats are affecting the subspecies now and will continue to have subspecies-level effects into the future.

Summary of Changes From the Proposed Rule

The following minor but substantive changes have been made to the listing rule and the Supplemental Document (available online at *www.regulations.gov* under Docket FWS–R5–ES–2013–0097) based on new information that has become available since the publication of the proposed rule, including information received through peer review and public comments. These changes did not alter our previous assessment of the rufa red knot from the proposed rule to the final rule.

(1) We present new data and insights regarding the nonbreeding distributions of rufa red knots versus *Calidris canutus roselaari.*

(2) We have emphasized and consolidated information about the differences between rufa red knots from northern versus southern wintering areas.

(3) We have added new geolocator data and new analyses of available resightings data showing (a) movement of rufa red knots between the North American Central and Atlantic Flyways; (b) clusters of sightings along the Great Lakes, the Mississippi River and its tributaries, and other major water bodies away from the coasts; (c) apparent use of saline (or alkaline) lakes in the Northern Plains by northbound red knots using the Central Flyway; and (d) use of U.S. Atlantic coast habitats used by juveniles in summer and winter.

(4) We updated population information with winter counts in South America and the southeast United States. The 2013 red knot winter counts in Tierra del Fuego were down to the second lowest level on record, while the counts in northern Brazil were nearly double the previous high count recorded in 1986. The large number of knots found in Brazil in 2013 was likely the result of the survey team experiencing favorable tidal conditions throughout the survey period, and this is probably the team's best aerial survey estimate to date. In addition, a new report from the Georgia Department of Natural Resources (GDNR) based on mark-recapture mathematical models estimated that the northern wintering population may be around 20,000 birds; this number is consistent with some previous estimates but notably higher than the best available field survey from the Southeast of about 4,000 to 5,000 birds. However, we do not yet have information to determine whether the geographic extent of the ''northern'' population in the GDNR study includes areas outside the Southeast.

(5) We updated our analysis of climate change information based on new reports from the International Panel on Climate Change (IPCC) and National Climate Assessment. Updates include:

(a) The IPCC's increased certainty in the overall trajectory of global and regional climate changes over the next few decades.

(b) Recent assessments of the red knot's vulnerability to climate change indicating a large increase in extinction risk due to the likely loss of breeding (from arctic warming) and nonbreeding habitat (from sea level rise), as well as the red knot's high degree of habitat specialization and dependence on ecological synchronicities, and long migration distance.

(c) New reports finding, with high certainty, that arctic ecosystem changes are already under way and will continue, in some cases faster than previously anticipated. (The IPCC notes early warning signs that arctic ecosystems are already experiencing irreversible regime shifts.)

(d) A new conclusion by the IPCC that the documented collapse or dampening of rodent population cycles in some parts of the Arctic over the last 20 to 30 years can be attributed to climate change with ''high confidence.''

(e) An updated analysis of threats to red knot prey species from ocean acidification, temperature changes, and other aspects of climate change. (A new

report highlights the vulnerability of mollusks (which include the red knot's primary prey species in most of its range) to acidification (''high confidence'').)

(6) We updated the best available data regarding current and likely future rates of sea level rise. We also noted a new study showing that expected effects to migratory shorebird populations from sea level rise are disproportionally larger than the extent of projected habitat loss, especially for species (such as red knots) whose migration routes contain ''bottlenecks'' through which a large fraction of the population passes.

(7) We discussed new voluntary, regulatory, or proposed restrictions on red knot hunting (*e.g.,* in Barbados, Guadeloupe, Martinique, and French Guiana), but acknowledged that best available data are insufficient to determine if hunting is or was at levels in South America that may have a population-level effect.

(8) We updated Federal and State authorities to regulate the importation of Asian HSC species, which may pose a threat to native HSC populations.

(9) We noted the results of the Atlantic States Marine Fisheries Commission's (ASMFC) 2013 HSC stock assessment update showing that, in the Delaware Bay Region, there is evidence of increases in certain age or sex classes, but overall population trends have been largely stable (neither increasing nor decreasing) since the previous stock assessment in 2009.

(10) We updated our analysis of possible undocumented or underestimated HSC mortality with new information on poaching, bycatch, and sublethal effects of biomedical bleeding.

(11) We updated the discussion as follows about the Adaptive Resource Management (ARM) monitoring efforts to reflect uncertainty (due to lack of funding) in ongoing implementation:

(a) We continue to conclude that, as long as the ARM is in place and functioning as intended, ongoing HSC bait harvests should not be a threat to the red knot.

(b) Data necessary to support the ARM previously came from an annual HSC trawl survey conducted by the Virginia Polytechnic Institute (Virginia Tech) that was ended after 2012 due to lack of funding. The ARM modelers are working on the best way to switch to another, newer survey, the North East Area Monitoring and Assessment Program (NEAMAP), and we support those efforts.

(c) As of fall 2014, however, these efforts have not identified a method by which NEAMAP or other alternate data sets can be appropriately used to allow the functioning of the ARM models (ASMFC 2014b). Stable funding sources for other baywide monitoring programs necessary to support the ARM are also a concern.

(d) If the ARM cannot be implemented in any given year, ASMFC would choose between two options based on which it determines to be more appropriate—either use the previous year's harvest levels (as previously set by the ARM), or revert to an earlier management regime. Although the HSC fishery would continue to be managed under either of these options, the explicit link to red knot populations would be lost.

(e) Insufficient monitoring has already impacted the ability of the ASMFC to implement the ARM as intended (ASMFC 2014b; ASMFC 2012c, p. 13). Absent the necessary HSC monitoring data to use the ARM models for the 2015 season, ASMFC (2014b) has opted to use the 2014 harvest levels which we considered at the time to adequately ensure the red knot's food supply.

(12) We updated our analysis of disturbance with new findings from two sites on the Atlantic coast of New Jersey, showing that disturbance affected red knots' spatial uses of these sites and displaced knots from otherwise suitable habitats.

(13) We reorganized the wind energy development discussion by moving general information on avian collision and displacement hazards to a background section, not specific to either offshore or terrestrial development. We updated this section with new information including a new report on avian vulnerability to offshore wind development. We updated our conclusions that collision and displacement risks per turbine (notwithstanding differences in specific factors such as turbine size, design, operation, and siting) are likely higher along the coasts than far inland or far offshore.

(14) We updated the 50 CFR 17.11 table to add Martinique and the District of Columbia. We received new information that red knots occur on Martinique. The District of Columbia was already included in the known range of the red knot, but was inadvertently left off the table in the proposed rule.

Summary of Comments and Recommendations

In the proposed rule published on September 30, 2013 (78 FR 60024), we requested that all interested parties submit written comments on the proposal by November 29, 2013. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposal. A newspaper notice inviting general public comment was published in the USA Today on October 3, 2013. We received four requests for a public hearing. On April 4, 2014 (79 FR 18869), we reopened the comment period on the proposed rule until May 19, 2014, and announced that two public hearings would take place on May 6, 2014, in Corpus Christi, Texas, and Morehead City, North Carolina. On May 14, 2014 (79 FR 27548), we extended the public comment period until June 15, 2014, and announced that another public hearing would take place in Manteo, North Carolina on June 5, 2014. All substantive information provided during the comment periods is summarized above in the Summary of Changes from the Proposed Rule and has either been incorporated directly into this final determination or addressed in the more specific response to comments below.

A number of commenters, including a peer reviewer, Federal agencies, and States, provided new information or clarifications on information presented in the red knot proposed listing rule (78 FR 60024) and its supporting documents. Categories of new or clarified information include additional years of population estimates or sighting information throughout the rufa red knot's range, status of the rufa red knot and ecology in Argentina and French Guiana, beach cleaning, sea level rise and its projected effects on migratory shorebirds, disturbance, the Deepwater Horizon and Galveston oil spills, status of offshore wind energy development leases along the Atlantic coast, historical and current food resources and foraging habitat, migration and staging areas, updated stopover population size estimates in Delaware Bay, State restrictions on importing Asian HSC, ongoing management of HSC, habitat protection in Maine, and geolocator scope of inference. This new or clarified information has been incorporated, as appropriate, into this final rule or its Supplemental Document.

General Issues

(1) Comment: Several public, State, and Federal commenters submitted comments on topics related to other issues not specific to the red knot listing proposal. These issues include (a) general criticism of the Act (funding species' conservation and Service employees being a target of litigation, imposing fines that are too punitive, having negative effects on local

communities, producing decisions on which species survive and where public hearings are held, and using science that would not withstand National Academy of Science Review); (b) the information and analysis required to designate critical habitat; and (c) red knot or HSC population targets, other species, research, actions, or resources that should be considered, as well as where funding should be directed and whom the Service should work with as part of ongoing or future conservation activities and recovery planning for the rufa red knot.

Our Response: All of these comments are outside the scope of this final listing rule and will not be addressed here. Substantive comments related to critical habitat issues will be addressed during development of a proposed critical habitat rule for the red knot. Substantive comments related to future conservation of the red knot will be addressed during the development of a recovery outline and draft recovery plan.

(2) Comment: Several commenters, including one State, expressed concerns that the rufa red knot's listing could (a) result in restrictions on pedestrian and vehicular beach recreation, additional regulatory hurdles, decreased property values, and increased costs to otherwise lawful activities, all of which could cause negative effects to local communities, economies, and quality of life, and could erode the current goodwill of partners to work on red knot conservation; (b) result in reduced HSC harvest levels, causing economic impacts to fishermen reliant on the HSC bait fishery, potentially shifting harvest pressure to areas outside of Delaware Bay, and potentially creating incentives to import Asian HSC species for bait; (c) reduce availability of HSCs for biomedical uses; and (d) restrict beach access for HSC conservation programs (*e.g.,* rescue programs for volunteers to flip stranded crabs). Additionally, some commenters expressed frustration over existing beach access and management on National Park Service (NPS) lands because of other listed species and asked for expanded management options beyond beach closures. Conversely, other commenters asked for additional restrictions in places like Delaware Bay.

Our Response: While we appreciate the concern about potential management actions that may result from listing the rufa red knot or any species, the Act does not allow us to factor those concerns into our listing decision. Section 4(a)(1) of the Act specifies that we shall determine whether any species is threatened or endangered because of any of the following factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence. Section 4(b)(1)(A) further specifies that we shall make such determinations based solely on the best scientific and commercial data available. See *Our Response 60* regarding other implications of listing that we may not consider in evaluating whether a species meets the definition of threatened or endangered under the Act.

The Service does not make management decisions about any lands other than National Wildlife Refuges and National Hatcheries, but we remain committed to working with coastal communities to evaluate any effects of coastal management on the rufa red knot, and to implement actions in a manner consistent with the species' conservation using many of the Act's available tools. We will strive to build on existing management practices in local areas to limit disturbance to red knots and other shorebirds through coordination and partnership with the States, other Federal agencies, conservation groups, and local communities.

The Service does not have authority to directly regulate the HSC fishery, but we intend to continue our active role in the ASMFC's management of the HSC fishery, and will provide recommendations and technical assistance to ensure that future harvests of HSCs do not result in take of red knots under section 9 of the Act. See *Our Responses 45, 46, 48 through 50, 52, 111, 117, 120, and 121* below and the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest) for detailed answers related to other aspects of HSC management, including biomedical use and implications of importation of Asian HSC species.

(3) Comment: Several commenters asked how listing will benefit the red knot when its range spans several countries, yet the Act's jurisdiction is limited to the United States. Many of the threats discussed in the proposed rule either occur only in areas outside of the United States (*e.g.,* hunting) or are issues (*e.g.,* climate change) that cannot be affected by management under the Act. The Service cannot expect to achieve a fraction of the conservation success that has been achieved in Delaware Bay, given that the Act's prohibitions do not apply outside of the United States.

Our Response: The Act requires listing of a species that meets the definition of threatened or endangered even if we currently lack the means to fully abate the threats that cause it to be threatened or endangered. Notwithstanding, we disagree that listing will have no effect on threats such as adequacy of food supplies and hunting, and we expect these threats to be addressed during recovery planning. The development of a recovery plan will guide efforts intended to ensure the long-term survival and eventual recovery of the rufa red knot, as discussed in the proposed rule (78 FR 60024, p. 60097). While we acknowledge that listing will not have a direct impact on those aspects of climate change impacting the rufa red knot (*e.g.,* sea level rise, arctic and ocean warming, ocean acidification, timing changes in the annual cycles of natural systems, possible changes in storm patterns or predation pressures), we expect that listing will enhance national and international cooperation and coordination of conservation efforts, enhance research programs, and encourage the development of mitigation measures that could help slow habitat loss and population declines.

Benefits to the species outside the United States from listing include a prohibition on import. By regulating this activity, the Act ensures that people under the jurisdiction of the United States do not contribute to the further decline of listed species. Although the Act's prohibitions regarding listed species apply only to people subject to the jurisdiction of the United States, the Act can generate additional conservation benefits such as increase awareness of listed species, encourage research efforts to address conservation needs, or prioritize funding for *in-situ* conservation of the species in its range countries. The Act also provides for limited financial assistance to develop and manage programs to conserve listed species in foreign countries, encourages conservation programs for such species, and allows for assistance for programs, such as personnel and training.

While we agree that limiting HSC harvests and other actions in Delaware Bay have been instrumental in halting (though not yet reversing) the decline of the red knot, we do not agree that conservation of this species is impossible in other geographic areas. For example, the rufa red knot is listed as endangered in Canada and Argentina, was recently protected from hunting in the Caribbean, has been listed as a

protected species in French Guiana, and is a focus of active conservation programs in several countries including Canada, Argentina, and Chile. In the United States, there are ongoing conservation and research efforts in many areas outside Delaware Bay including Massachusetts, Virginia, North Carolina, South Carolina, Georgia, Florida, and Texas. Many important red knot areas within and outside the United States have been recognized as Western Hemisphere Shorebird Reserve Network sites.

(4) Comment: One commenter stated that the Act is currently under revision and it is advisable to postpone further listings until the changes are finalized.

Our Response: While we are aware of several proposed legislative changes to the Act, those changes may not come to fruition and we may not delay implementing the current Act while those proposed changes are being debated. In addition to the proposed legislative changes, we are actively working on a series of regulatory changes to improve the implementation of the Act (see our ''Improving ESA Implementation'' Web site for more information: *http://www.fws.gov/endangered/improving_ESA/index.html*).

Peer Reviewer Comments

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from three knowledgeable individuals with scientific expertise that included familiarity with the rufa red knot and its habitat, biological needs, and threats. We received responses from one of the peer reviewers.

We reviewed all comments received from the peer reviewer for substantive issues and new information regarding the listing of the rufa red knot. This peer reviewer was generally supportive of the overall proposal and, in addition to providing further site-specific information, generally confirmed our use of the best available scientific information. Peer reviewer comments are addressed in the following summary and incorporated into the final rule as appropriate.

(5) Comment: The peer reviewer stated there is nonscientifically reported evidence (newspaper articles, animal care center reports) that red tide poisoning has caused extensive death of knots on Florida's west coast.

Our Response: We appreciate the peer reviewer bringing this information to our attention. Unfortunately, we were unable to locate the sources of the suggested information and, therefore, cannot verify the content. However, we have obtained a report of one nonfatal case of red tide poisoning of a red knot in Florida (H. Barron pers. comm. April 29, 2014); the bird's blood was tested and confirmed to have a brevetoxin level of 2.64 nanograms/milliliter (ng/ml). Brevetoxin is a highly potent neurotoxin produced by red tide events. We have added this information to the Supplemental Document (Factor E—Harmful Algal Blooms—Gulf of Mexico). Though not documenting widespread effects or mortality from red tide, this report does confirm that red tide poisoning of red knots has occurred in Florida, which is otherwise unreported in the scientific literature.

(6) Comment: The peer reviewer noted that the proposed rule (78 FR 60024, p. 60045) states that uncontrolled invasive vegetation can cause a habitat shift from open or sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of red knot roosting habitat. The link between dense invasive vegetation and red knot habitat degradation is conjecture and should be strengthened with reference to a scientific study.

Our Response: We agree. We have revised this paragraph in the Supplemental Document (Factor A—Invasive Vegetation) to add citations to support the statement that uncontrolled invasive vegetation can cause a habitat shift from open or sparsely vegetated sand to dense vegetation. We have removed the wording ''resulting in the loss or degradation of red knot roosting habitat,'' because we are not aware of any scientific studies or other data documenting that such degradation has occurred. We have instead added the statement that, in nonbreeding habitats, *Calidris canutus* require sparse vegetation to avoid predation (Niles *et al.* 2008, p. 44; Piersma *et al.* 1993, pp. 338–339, 349).

(7) Comment: The peer reviewer stated that the Southeast coast of the United States is important during northward migration. Many red knots marked in Argentina and Chile are seen on the Atlantic coasts of Florida, Georgia, South Carolina, and North Carolina during, but not before, May. In addition, several other commenters stated the proposed rule did not identify North Carolina as having major or important spring or fall stopover areas.

Our Response: The Southeast, including North Carolina, was identified in the proposed rule as providing spring and fall stopover sites (Rufa Red Knot Ecology and Abundance, pp. 18, 50–51). Data characterizing the stopover usage of the Southeast, including North Carolina, are presented unchanged in the Supplemental Document (*e.g.,* figure 4; Population Surveys and Estimates—Spring Stopover Areas—Southeast United States). However, we have revised the text of the Supplemental Document (Population Surveys and Estimates—Spring Migration) to clarify that our review focused on geographically large spring stopovers with multiple years of survey data, but that other important spring stopover areas are known (*e.g.,* from International Shorebird Survey data, eBird, localized surveys). We have also revised the wording of the Supplemental Document (Migration—Atlantic Coast) to refer to ''well-known'' instead of ''major'' or ''important'' spring and fall stopover areas, since many potentially significant stopover areas have been surveyed only sporadically or are yet undiscovered. Finally, we have added the information provided by the peer reviewer regarding passage of southern-wintering birds along the Southeast coast during May (Migration—Atlantic Coast—Spring Timing and Distribution).

(8) Comment: The peer reviewer stated the proposed rule presented comprehensive evidence about threats to red knots during winter and northbound migration seasons, mostly focused on the longest-distance migrating knots that winter in Argentina and Chile. However, the proposed rule presented less information regarding northbound or southbound passage of the knots that spend winter seasons in regions north of the Equator. One issue that needs elaboration is the relative numbers of knots that winter in each of these two large regions and the differences of habitat use and migration strategies that exist between them.

Our Response: The proposed rule presented available data regarding numbers of red knots in each wintering area (Rufa Red Knot Ecology and Abundance pp. 38–45), summarized by Atkinson *et al.* (in Wader Study Group 2005) and Harrington *et al.* (2010b) regarding differences in migration strategy by wintering area (Rufa Red Knot Ecology and Abundance pp. 22, 32), and presented information regarding possibly greater reliance on HSC eggs by migrants from Argentina and Chile relative to birds from more northern wintering areas (Rufa Red Knot Ecology and Abundance pp. 31–33). In the Supplemental Document, we have added a section (Wintering—Northern Versus Southern) to summarize the differences between red knots from northern versus southern wintering areas that are discussed elsewhere in the document, moved and supplemented information to a new section (Migration—Differences in Migration

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Strategy by Wintering Region) on differences in migration strategies, and clarified information regarding differential reliance on HSC eggs (Wintering and Migration Food).

(9) Comment: The peer reviewer noted the proposed rule stated that red knots require stopovers rich in easily digested food to achieve adequate weight gain due to changes in the digestive system that birds undergo before long flights. This may be less true for the knots from northern wintering grounds.

Our Response: In the proposed rule, we noted this possible physiological difference between southern- and northern-wintering rufa red knots (Rufa Red Knot Ecology and Abundance, pp. 30–31), but we did not mention this possible difference in the section cited by this commenter (Rufa Red Knot Ecology and Abundance, p. 17). In the Supplemental Document (Species Information—Migration—Migration Biology), we have added a sentence to this paragraph to clarify that some researchers have suggested that digestive system changes are more pronounced, or have a more pronounced effect on energy budgets at the stopover areas, in southern-wintering (Argentina and Chile) than in northern-wintering (Southeast United States) rufa red knots (Niles *et al.* 2008, p. 36; Atkinson *et al.* 2006b, p. 41). We have also added a cross reference in this paragraph to refer readers to a more detailed discussion of this issue that is presented under Migration and Wintering Food—Horseshoe Crab Eggs—Possible Differential Reliance on Horseshoe Crab Eggs.

(10) Comment: The peer reviewer suggested the term ''full segregation'' is unclear with regard to migration strategies, routes, or stopover areas among red knots from different wintering areas. There is a good deal of segregation in stopover regimens and in molt regimens between southbound knots with destinations in Argentina and Chile versus northern-hemisphere wintering birds. There also appears to be some degree of difference in stopover habitat use between these two groups in northbound migration.

Our Response: We have clarified the lack of full segregation by providing examples in the Supplemental Document (Migration—Differences in Migration Strategy by Wintering Area). Also see *Our Responses 8* and *9* above.

(11) Comment: The peer reviewer stated northern- versus southern-wintering knots have different strategies in southward migration. The southern group has essentially passed through Atlantic regions of North America before September, and strongly depends upon being able to accumulate fat and protein prior to launching on over-ocean flights between North and South America. Northern-wintering birds, however, linger on the North American coast (*e.g.,* Massachusetts, Georgia coasts), are using ''stopover'' locations as molting areas, and are using different food and habitat resources as compared to the southern-wintering knots. The resource requirements by birds of these two groups during southward migration are quite different.

Our Response: We have added this information with supporting citations to the new section of the Supplemental Document (Migration—Differences in Migration Strategy by Wintering Region).

(12) Comment: The peer reviewer noted that, historically, oiling was perhaps an important problem to knots in Patagonia, and suggested limited information was available in the reference Harrington and Morrison 1980.

Our Response: Some of the data from Harrington and Morrison (1980) were presented in the proposed rule (78 FR 60024, p. 60086) from a secondary source (Niles *et al.* 2008, p. 98). We have added the rest of these data and this reference to the Supplemental Document (Factor E—Oil Spills and Leaks—South America).

(13) Comment: The peer reviewer stated that, although the Costa del Este area of Panama City, Panama (referenced in the proposed rule, 78 FR 60024, p. 60043), is a very important location for many kinds of shorebirds, few knots have been reported from here.

Our Response: We agree that only moderate numbers of *Calidris canutus* have been reported in most seasons from Panama's Pacific coast (which includes habitats near Panama City as well as other sites). However, larger numbers have been reported from Pacific Panama during fall migration. In the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 41–42, 52), we presented available data regarding numbers of *C. canutus* in Panama. We have consolidated and updated these data with new information in the Supplemental Document (see Population Surveys and Estimates—Central America and Pacific South America).

(14) Comment: The peer reviewer stated that recently published data show dramatic declines and shifting of stopover locations during south migration in Massachusetts.

Our Response: This information (Harrington *et al.* 2010a; Harrington *et al.* 2010b) was presented in the proposed rule (Rufa Red Knot Ecology and Abundance, p. 51). We have expanded the discussion of these results in the Supplemental Document (Migration—Atlantic Coast—Fall Timing and Distribution; Population Surveys and Estimates—Fall Stopover Areas).

(15) Comment: The peer reviewer stated that the proposed rule was incorrect in describing only small numbers of red knots on mid-Atlantic and northern Atlantic beaches between Memorial Day and Labor Day. Currently about 1,000 to 2,000 knots occur on the Massachusetts coast during the fall migration period, and numbers were previously much higher. Peak dates for these southbound migrants are in July and August.

Our Response: This statement appeared in the section of the proposed rule addressing beach cleaning (78 FR 60045). We have revised the Supplemental Document (Population Surveys and Estimates—Fall Stopover Areas; Factor A—Beach Cleaning) to correct this information.

(16) Comment: The peer reviewer stated that there has been a major shift of key stopover areas of knots in south migration in Massachusetts since the 1980s when up to 10,000 southern-wintering knots were heavily concentrated on the western shore of Cape Cod Bay (Harrington *et al.* 2010a).

Our Response: We discussed the findings of Harrington *et al.* (2010a) in the proposed rule (Rufa Red Knot Ecology and Abundance, p. 51). We have revised several sections of the Supplemental Document to provide more specific results from this study (Migration—Differences in Migration Strategy by Wintering Region; Historical Distribution and Abundance; Population Surveys and Estimates—Fall Stopover Areas).

(17) Comment: The peer reviewer stated that the proposed rule (78 FR 60024, p. 60046) notes that more red knots were documented in northeast Brazil in the 2000s than during the early 1980s. The wording of this paragraph could be misconstrued to suggest that habitats were improved by the development from shrimp farm ponds.

Our Response: We agree and have clarified this point in the Supplemental Document (Factor A—Agriculture and Aquaculture).

(18) Comment: The peer reviewer commented that the proposed rule (78 FR 60024, p. 60045) stated that beach-cleaning machines are likely to cause disturbance to roosting and foraging red knots. This is more of an issue with respect to roosting than to foraging. In almost all cases, raked areas would be

beaches that knots might use during high tides for roosting (if not for high levels of human disturbance), but not as sites for foraging. Beach cleaning generally happens on beaches intensively used for human recreation. Because of heavy human use, knots that might otherwise roost in these areas would generally avoid such locations. Thus, the issue would be disturbance versus beach cleaning.

Our Response: The proposed rule (78 FR 60024, p. 60077) noted that roosting red knots are particularly vulnerable to disturbance. We have revised the Supplemental Document to cross-reference this information under Factor A—Beach Cleaning, and to note in this same section that beach-cleaning typically occurs along or landward of the high tide line where red knots may roost but are unlikely to forage. The proposed rule (78 FR 60024, p. 60044) states that mechanical beach cleaning is most commonly conducted on beaches that are heavily used for tourism. We agree that disturbance to red knots from recreational activities may, on many beaches, be greater than the disturbance from the beach cleaning machines. However, beach cleaning may occur at times of day (*e.g.,* early morning, evening) when few recreational activities are taking place, thus increasing the total daily duration that knots are disturbed by human activities. Conversely, many raked beaches may have such high levels of human recreational use that red knots are precluded from using them entirely; in such cases there would be no incremental additional disturbance from the raking activities. We have added these conclusions to the Supplemental Document (Factor A—Beach Cleaning). In addition, the proposed rule already described (78 FR 60024, p. 60044) physical impacts to beach habitats from mechanical beach cleaning.

Federal Agency Comments

(19) Comment: One Federal agency provided data regarding the seasonality and abundance of red knots in or near units managed by the NPS in the Central and Eastern United States. To assess gross trends in occurrence of red knots across NPS units, this commenter considered vetted eBird data points where birding effort was reported, and found that, in the NPS units where most red knot occurrences were reported (Assateague Island, Cape Lookout, Cape Hatteras, Cape Cod, Gateway National Recreation Area, and Timucuan Ecological and Historic Preserve), a clear declining trend in red knot observations was detected since 1980.

Our Response: We thank the commenter and have added this trend information to the Supplemental Document (Population Surveys and Estimates). The information regarding the seasonality and abundance of red knots at individual NPS units will be valuable for purposes of recovery planning, management under section 7(a)(1) of the Act, and consultation under section 7(a)(2) of the Act.

(20) Comment: One Federal agency noted that several Navy installations within the range of the red knot have Integrated Natural Resources Management Plans in place that benefit the red knot, including provisions for shoreline protection.

Our Response: We appreciate this information and anticipate working closely with these installations as we develop a critical habitat designation, and develop and implement a recovery plan for the red knot.

(21) Comment: One Federal agency commented that the proposed rule and supporting document overemphasized the risks to the red knot, and birds in general, associated with offshore wind energy development. In addition, several States and other commenters stated that wind energy development outside of coastal areas is unlikely to be a significant threat to red knots.

Our Response: In both the proposed rule (78 FR 60024, pp. 60089–60093) and the Supplemental Document (Factor E—Wind Energy Development), we have summarized and characterized the best available data regarding risks to the red knot from both offshore and terrestrial wind energy development. We have made considerable revisions to this section of the Supplemental Document to reflect substantive public comments and new information (see also *Our Responses 62, 134* to *137*). We conclude that wind energy development, especially near the coasts, may cause some unquantifiable amount of red knot mortality into the foreseeable future, and that one model indicated this species is vulnerable to population-level effects from even low levels of anthropogenic mortality (Watts 2010, pp. 1, 39). Unless facilities are constructed at key stopover or wintering habitats, we do not expect wind energy development, especially offshore or inland, to cause significant direct habitat loss or degradation, or displacement of red knots from otherwise suitable habitats.

(22) Comment: One Federal agency stated that, in addition to the total number and height of offshore turbines, exposure is a factor contributing to avian collision risks. For red knots, exposure to offshore wind facilities is reduced because (1) they can fly nonstop for 1,500 miles (mi) (2,414 kilometers (km)), which limits their time over the open ocean, and (2) birds on long-distance flights, such as red knots crossing the offshore environment, fly at higher altitudes than short-distant migrants.

Our Response: We agree that exposure to wind turbines is a contributing factor to avian collision risk. The proposed rule (78 FR 60024, pp. 60090–60091) presented the findings of Burger *et al.* (2011, entire), who used a weight-of-evidence approach to examine the risks and hazards to red knots from offshore wind energy development on the OCS at three spatial levels of exposure. We concur that the red knot can fly nonstop for 1,500 mi (2,414 km) and that some knots have limited temporal exposure to the offshore environment (Normandeau Associates, Inc. 2011, p. 202). Geolocator data show certain knots crossing the OCS as many as six times per year, and because these numbers reflect only long flights, more crossings of the OCS may occur as birds make shorter flights between States (Burger *et al.* 2012c, p. 374).

It is estimated that the normal cruising altitude of red knots during migration is between 3,281 to 9,843 feet (ft) (1,000 to 3,000 meters (m)) (Burger *et al.* 2011, p. 346), well above the estimated height of even a 10-megawatt (MW) offshore turbine (681 ft; 207.5 m). However, lower flight altitudes may be expected when red knots encounter bad weather or high winds, and these lower flight altitudes are known to occur on ascent or descent from long-distance flights, during short-distance flights if they are blown off course, during short coastal migration flights, or during daily commuting flights (*e.g.,* between foraging and roosting habitats) (Burger *et al.* 2012c, pp. 375–376; Burger *et al.* 2011, p. 346), as discussed in the proposed rule (78 FR 60024, p. 60090).

(23) Comment: One Federal agency stated that some studies and analyses used in the proposed rule (78 FR 60024) fail to distinguish between onshore/nearshore and offshore wind energy development. This distinction is important because the species at risk and the magnitude of the risk can be considerably different. The agency further stated that coastal environments generally have higher concentrations of birds than offshore areas and that birds taking off from land may fly through the rotor zone before reaching cruising elevation. In addition, this commenter questioned our conclusions about the risk of bird collisions with offshore wind facilities, which were based on a

scientific paper (Kuvlesky *et al.* 2007) summarizing research from Europe.

Our Response: In the proposed rule (78 FR 60024, p. 60089–60092), we addressed separately land-based wind energy development (including along the coasts) versus in the offshore environment. Based on the high frequency and lower altitudes of red knot flights along the coast (*e.g.,* ascent or descent from long-distance flights, during short coastal migration flights, or during daily commuting flights between foraging and roosting habitats) (D. Newstead pers. comm. March 5, 2013; Burger *et al.* 2012c, pp. 375–376; Burger *et al.* 2011, p. 346; Stewart *et al.* 2007, p. 1; Alerstam *et al.* 1990, p. 201), we agree with the commenter that collision risk per turbine (notwithstanding differences such as size, design, operation, local habitats) along the coasts (both on land and nearshore) is likely higher than in areas either far offshore or far inland. We have revised the Supplemental Document (Factor E—Wind Energy Development—Terrestrial) to reflect this conclusion. We have also revised the Supplemental Document (Factor E—Wind Energy Development) to move the discussion of avian collision risk factors (*e.g.,* weather, light levels, lighting, turbine characteristics, habitats) and displacement effects to be generalized across both terrestrial and offshore wind energy facilities, as the citations supporting this discussion pertain to both.

In the proposed rule (78 FR 60024, pp. 60089–60091), we did not attempt to differentiate between nearshore (*e.g.,* State waters) and the OCS. Although we still have little information on avian impacts from turbines far offshore, we have updated our conclusions in the Supplemental Document (Factor E—Wind Energy Development—Offshore) to reflect geolocator results by Burger *et al.* (2012c, p. 373) and analysis by Burger *et al.* (2011, p. 346) suggesting red knot collision risk may decrease far offshore. Finally, we have removed the following statement from the Supplemental Document (Factor E—Wind Energy Development—Offshore): ''Research from Europe, where several offshore wind facilities are in operation, suggests that bird collision rates with offshore turbines may be higher than for turbines on land.'' Upon further review of the source cited for this statement (Kuvlesky *et al.* 2007, p. 2489), we found that these authors presented results from both coastal and nearshore wind facilities. Further, these authors went on to present countervailing findings from other studies, and did not cite any studies from wind turbines located far offshore. Therefore, we reasoned that this statement from the Kuvlesky *et al.* 2007 paper was not appropriate to include in this final rule.

(24) Comment: One Federal agency commented that the Bureau of Ocean Energy Management (BOEM) has worked with State Task Forces to determine the best locations for wind energy development to help avoid impacts. For example, areas being considered are greater than 9 mi (14 km) offshore; the Virginia lease area is 23.5 nautical miles (nm) (43.5 km) from Virginia Beach.

Our Response: We concur that siting far offshore may succeed in reducing overall avian collision hazards, including for red knots, although species that rely on the offshore environment for breeding, feeding, or sheltering (*e.g.,* certain seabirds and waterfowl) may have increased exposure risk to turbines farther offshore. We appreciate the work of BOEM to evaluate and minimize avian collision risks in siting decisions, and this information has been added to the Supplement Document (Factor E—Wind Energy Development—Offshore). However, we also updated this section of the Supplemental Document to compare these distances offshore with red knot use areas delineated by Burger *et al.* (2012c, p. 373) based on geolocator results, which do appear to have some overlap with both the offshore commercial wind energy development leases executed to date and the Wind Energy Areas (WEA) where BOEM will focus for future leases, including areas off the mouth of Delaware Bay (BOEM undated, p. 1).

(25) Comment: One Federal agency stated that BOEM recently published a study on the relative vulnerability of migratory bird species to offshore wind energy projects on the Atlantic OCS; the study ranked the relative vulnerability of 177 migratory bird species to collision and displacement by offshore wind turbines. The relative collision vulnerability of red knot was ''medium'' and the relative vulnerability to displacement ''low.''

Our Response: We have reviewed this report and incorporated the findings into the Supplemental Document (Factor E—Wind Energy Development—Offshore). We note that some of the factors considered in this report are not specific to the *rufa* subspecies of *Calidris canutus,* and thus the numerical vulnerability scores are not applicable to *rufa.*

Comments From States

(26) Comment: One State expressed disappointment in the Service's communication regarding the proposed rule. Because of the wide geographic scope of this listing proposal, the Service should have engaged all of the State wildlife agencies for their input prior to publication and should have briefed the State agency directors about the proposed expansion of the rufa red knot's listed range. In addition, several States and other commenters stated that the proposed rule contained inadequate justification for a sweeping change in the red knot's range from previous Service documents (*e.g.,* 2006 to 2011 Candidate Notices of Review (CNORs)).

Our Response: We regret that this State is disappointed in our communication efforts on the rufa red knot proposed listing. We acknowledge the proposed range was greatly expanded from what was described in the last CNOR update, but the proposed rule (78 FR 60024) and this final rule contain our analysis of, and conclusions drawn from, the best scientific and commercial data available. Substantial new data have become available since 2011, the last year we were required to update the knot's CNOR form. We also acknowledge that the 2011 CNOR form indicates the rufa red knot's range is limited to coastal areas and did not include interior portions of the coastal States or any inland States. The 2011 CNOR was based on the best data available at the time. Our understanding of the species' biology and occurrence records evolved rapidly based on results from geolocator research followed by enhanced analysis of national and regional databases. The proposed rule (Rufa Red Knot Ecology and Abundance, pp. 21, 23) explained the best available data and supported the expanded geographic scope of analysis under the Act. The discussion of these data has been updated and expanded in the Supplemental Document (Species Nonbreeding Distributions; Migration—Midcontinent; Migration and Wintering Habitat—Inland; Population Surveys and Estimates—Inland Areas Spring and Fall). We will strive to improve our communication with the States as we greatly value our conservation partnerships.

(27) Comment: Several States and other commenters stated that the proposed rule is generally lacking in scientific evidence and is based on speculative information. For example, (1) in the proposed rule, the Service repeatedly made undocumented claims and speculated that a variety of items ''may'' be a factor that could cause the demise of the species; (2) in describing threats and risks to the red knot, the proposed rule used terms such as high uncertainty, expected, likely, may, could, possibly, and unknown but

possible; (3) although the best available science has been used to generate predictions about some possible future impacts, best available science has not been used to examine and explain the relevance of potential threats (*e.g.,* sea level rise, climate change) to recent red knot population trends; (4) because of the potentially serious ramifications of a Federal listing on Federal programs and permitting processes, it is neither sufficient nor professional to base listing decisions so heavily upon speculation; and (5) the principle of best available science must be used to demonstrate causal relationships between threats and population change. In a related comment, one commenter stated that it is well-established that the Act does not provide for the listing of species on the basis of speculative, uncertain, or inconclusive information. A number of courts (*i.e., Conner* v. *Burford, Trout Unlimited* v. *Lohn, Ctr. for Biological Diversity* v. *Lubchenco, Bennett* v. *Spear,* and *Nat'l Res. Council* v. *Daley*) have determined that the threshold decision to list a species as threatened or endangered is not to be based on speculation or a misplaced intent to err on the side of species conservation. The default position for all species is that they are not protected under the Act.

Our Response: We disagree that our analysis is ''speculative.'' The Service is required to make listing determinations based on the best scientific and commercial data available. Sources of data include peer-reviewed journal articles; field notes and other unpublished data; and personal communications with species, habitat, and policy experts. We analyze these sources of data and use our best professional judgment to determine their credibility, in accordance with applicable data standards (Interagency Policy on Information Standards Under the Endangered Species Act (59 FR 34271); Information Quality Act (P.L. 106–554, section 515); Information Quality Guidelines and Peer Review (USFWS 2012f, entire). All data have some level of uncertainty, but the proposed rule properly identified, through citations, the data sources and was transparent in qualifying areas and levels of uncertainty.

In making a listing determination, we evaluate the threats affecting a species in the past, currently, and into the foreseeable future. What constitutes the foreseeable future may be different for each threat, given our confidence in the sources of the data and their level of certainty regarding future conditions. The proposed rule and Supplemental Document discuss what information we can reliably use to reasonably foresee into the future. As discussed below, the Act and our policies do not require a definitive knowledge of what will happen in the future, only what we may reasonably predict is likely to occur. Although there is some inherent uncertainty surrounding the threats we evaluated for the red knot, this does not prevent us from making a credible assessment of the likely direction and magnitude of those impacts, even though it may not be possible to make such predictions with precision. In addition, the proposed rule and its underlying data were available for peer review and extensive public review and comment, but the commenters did not provide additional substantive information to refute our analysis or assumptions.

Under section 4 of the Act, a species shall be listed if it meets the definition of threatened or endangered because of any (one or more) of the five factors that are a basis for making a listing determination, considering solely best available scientific and commercial data. Although many species proposed for listing have undergone, or are undergoing, a population decline, declining numbers (rangewide or in portions of the range) are not necessary for listing if a species is facing sufficient threats, now or in the foreseeable future, to meet the definition of threatened or endangered. Accordingly, not all threats contributing to a species' threatened or endangered status must be tied to past or ongoing population declines; threats for which the species is listed may not be affecting the species at the time it is being evaluated for listing, but are likely to do so in the future.

The commenter is incorrect in asserting that ''the default position for all species is that they are not protected under the Act,'' or that listings must be based on conclusive evidence. As stated above, the Act and our policies do not require a definitive knowledge of what will happen in the future, only what we may reasonably predict is likely to occur when making a listing determination.

Further, our decisions are not based on speculation or misplaced intentions. The Act requires the Service to base its listing determination on the ''best scientific and commercial data available'' (16 U.S.C. 1533(b)(1)(A)). The ''best available science'' requirement does not equate to the best possible science. Instead, this information standard simply prohibits the Service from disregarding available scientific evidence that is better than the evidence it initially relied upon. The Service is required to rely upon the best available science, even if that science is uncertain or even ''quite inconclusive'' (*i.e., Trout Unlimited* v. *Lohn,* 645 F. Supp. 2d 929, 947 (D. Or. 2007) (''*Trout Unlimited*''); *Southwest Center for Biological Diversity* v. *Babbitt,* 215 F.3d 58, 60, 342 U.S. App. D.C. 58 (D.C. Cir. 2000)). The case law cited by the commenters supports this position.

In distinguishing endangered from threatened, Congress defined ''threatened'' species as a species that is ''*likely* to become an endangered species within the foreseeable future throughout all or a significant portion of its range'' (16 U.S.C. 1532(20)) (emphasis added). Courts have acknowledged the word ''likely'' clearly means something less than 100 percent certain (*Trout Unlimited* at 947). Moreover, courts have found that an agency is entitled to particular deference where it has drawn conclusions from scientific data (*i.e., Marsh* v. *Or. Natural Res. Council,* 490 U.S. 360, 375–77 (1989); *Ethyl Corp.* v. *EPA,* 541 F.2d 1, 36 (D.C. Cir. 1976); *Oceana* v. *Evans,* 384 F. Supp. 2d 203, 219 (D.D.C. 2005) (citing cases)).

(28) Comment: Several States and other commenters stated that the rufa red knot geographic range should include only areas where the species occurs regularly (annually or near annually), and should avoid identifying jurisdictions (*e.g.,* States) merely because they represent continuous geographies between discrete regularly used stopover sites. As presented in the proposed rule, the red knot range is inconsistent with how the Service has defined the range of other listed migratory birds. These commenters also noted that although eBird is a useful resource, the Service should not have used it as the sole source for determining the species' range in a listing process, and suggested a more thorough and comprehensive review of occurrence records should be conducted.

Our Response: In both the proposed and final rules, we have defined the rufa red knot's range based on the best available data; however, we recognize that scientific understanding of this species' range will likely continue to improve over time. The Service may define a species' range using State boundaries or other geographically appropriate scale. How range is defined depends on characteristics of the species' biology and how it is listed (*i.e.,* as species/subspecies or a distinct population segment (DPS)). A species' or subspecies' range is typically described at the state or country scale. While the range of a DPS listing can include entire States, it is more typically defined at a more refined geographic scale because we must define where the discrete entity occurs.

We defined the rufa red knot's range based on the data from reliable published scientific literature, submitted manuscripts, and species' experts; occurrence data; and analysis (*e.g.,* estimated flight paths based on known wintering and breeding grounds combined with siting records). The regulations at 50 CFR 17.11(e) state, the ''historic range'' indicates the known general distribution of the species or subspecies as reported in the scientific literature. The present distribution may be greatly reduced from this historic range. This column [in the table at 50 CFR 17.11(h)] does not imply any limitations on the application of the prohibitions in the Act or implementing rules. Such prohibitions apply to all individuals of the species, *wherever found* [emphasis added]. Therefore, whether a specific State or geographic area is included or excluded from the textual description of the rufa red knot's range, the subspecies would be protected under the Act wherever it may be found, for as long as it remains federally listed. (See also *Our Response 33* below.) Although a species is listed wherever found, we strive to accurately describe the range in the 50 CFR 17.11 table based on the best available data at the time of listing. For earlier listed species such as the piping plover and Kirtland's warbler, certain tools to help us understand the migration routes of birds (*e.g.,* satellite transmitters, geolocators, eBird) were not available at the time.

See *Our Response 82* for explanation of how we have interpreted and utilized eBird data. We did not solely rely on eBird data to determine the rufa red knot's range. In addition to eBird, we also relied heavily on Newstead *et al.* 2013 (draft manuscript we had at the time) and Morrison and Harrington 1992, and to a lesser degree on Skagen *et al.* 1999. These four sources constituted the best available data at the time. For this final rule, we have also considered an analysis for the Mississippi Flyway done by our Midwest Region Migratory Bird Program (Russell 2014), the State reports provided by the Central Flyway Council and other commenters, updated versions of Newstead *et al.* (2013) and Carmona *et al.* (2013), and all other relevant new information we have received since March 2013 when we completed drafting of the proposed rule. These new sources further validate our assumptions and conclusions outlined in the proposed rule. See *Our Response 35,* below, and the Supplemental Document (Subspecies Nonbreeding Distribution) regarding how we have delineated the nonbreeding ranges of *C.c. rufa* versus *C.c. roselaari* based on the best available data.

(29) Comment: Several commenters, including States, stated that they were unaware of any reliably used stopover sites for the red knot in the interior portion of the United States. These commenters contended that bird occurrence data do not support the existence of stopover sites (defined as habitats or locations that consistently provide migrants with the opportunity to refuel and rest) within the Central Flyway States, and that observed behavior and diet reinforce the concept that red knots do not regularly use and do not require any inland wetland locations as stopover sites within the interior of the Central Flyway. Further, most interior records are for vagrant, single birds, and interior sightings are so sparse that they are ecologically insignificant. These State commenters specifically requested removal of their particular States from the range, and requested that listing of the rufa red knot not confer any requirements for any Federal or State agency or private landowner. Conversely, one commenter rebutted that, as is frequently the case for ''jump'' migrants, periodic weather events or other circumstances occasionally result in birds being grounded in locations or habitats that are only infrequently used along the flyway. This commenter also stated that while this may be the case for some of the interior areas, recent communications with biologists working in North Dakota indicate that habitats in this region (*e.g.,* Missouri River sandbars) are far more regularly used than eBird records or other databases would indicate. Further, additional unpublished geolocator tracks also show use of sites throughout the Missouri Coteau, on both U.S. and Canadian sides of the border, as spring migration stopovers. This commenter stated that the Service should make a more complete assessment of the occurrence of the species in North Dakota, and possibly other States, by contacting other biologists that may have additional information that is not captured in electronic databases.

Our Response: We also are unaware of any consistently used rufa red knot stopover sites in the U.S. portion of the Central Flyway. However, all three of our primary sources (Newstead *et al.* 2013, Skagen *et al.* 1999, and eBird.org 2014) suggest that habitats in the plains of southern Canada (Alberta, Saskatchewan, Manitoba) are routinely relied upon by migrating knots at least under certain conditions (*e.g.,* favorable water levels). In addition, from the relatively small sample size in Newstead *et al.* (2013, p. 56), one of six birds used North Dakota for 14 days in spring. We do not yet know how aberrant or representative this bird was, but these results indicate the possibility that the documented Northern Plains stopover region may be found to extend into the United States, as research on midcontinental migrants continues. This possibility is supported by the new geolocator information regarding additional knots on the U.S. side of the Missouri Coteau (D. Newstead pers. comm. May 8, 2014), including three in northern North Dakota, two in northern Montana, and one possibly further south (*e.g.,* Nebraska) (D. Newstead pers. comm. May 16, 2014). Newstead *et al.* (2013, p. 56) found that the Northern Plains were used as a northbound stopover by five of six birds in 2010 (including the one in North Dakota), with the sixth bird using Hudson Bay. Hudson Bay was used by three of three birds in 2011. Although the sample size (*e.g.,* recovered geolocators) is small, a large proportion of the recovered geolocators show red knots using a midcontinental flyway. Therefore, these results suggest that, in years when conditions favor it, a large proportion of midcontinental migrants may use Northern Plains stopovers in spring. In addition, birds using the Northern Plains as a spring stopover stayed an average of 16.2 days (Newstead *et al.* 2013, Table 3); this was not a short stop but actually similar to the stopover duration in Delaware Bay.

In the proposed rule, we did not define ''stopover site.'' In the Supplemental Document (Migration—Stopover Areas), we have added clarification that places where migrant birds stop to rest, drink, and eat are often described as either stopover or staging sites, with the two terms frequently used interchangeably (Warnock 2010, p. 621). We have adopted the definitions of Warnock (2010, p. 621) that all sites where migrants rest and feed are stopover sites, while staging sites are a subset of stopovers that provide abundant and predictable food resources without which birds would incur significant fitness costs.

We agree that many of the inland red knot sightings to date represent single birds. However, we understand the term ''vagrant'' to mean a bird that has strayed or been blown far from its usual range or migratory route; synonymous with ''accidental.'' According to Russell (2014, p. 1), ''accidental'' implies an extraordinary record, out of the normal pattern, and unlikely to occur again. Based on this understanding of the term,

we disagree with characterizing rufa red knots in the Central Flyway as vagrant, based on geolocator results showing that the midcontinent does constitute the most prevalent migratory route for at least some birds that winter in Texas (D. Newstead pers. comm. May 8, 2014; Newstead *et al.* 2013, entire). Based on these geolocator data, we conclude that a substantial proportion of Texas-wintering knots pass over the Central Flyway twice annually during migration. Other than the Northern Plains of southern Saskatchewan (and potentially extending into the northern U.S. plains), we are not currently aware of any other stopover sites in the Central Flyway that are routinely or intermittently relied upon by a substantial number of birds.

Further, there are clusters of sightings records in both the midcontinent and further east through the Mississippi Valley and along the Great Lakes. These cluster areas warrant further study to more fully evaluate their usage as red knot stopovers. (See Supplemental Document section Migration—Midcontinent—Stopovers.) As recommended by one commenter, we anticipate a more complete assessment of unpublished or anecdotal sightings data in the course of recovery planning. The existence of such additional sightings data, and the geographic clustering of the eBird data along water bodies, suggest that some inland areas may, upon further study, be found to routinely or intermittently support roosting and feeding red knots during migration.

(30) Comment: Several States and other commenters noted Newstead *et al.'s* (2013) findings that more than 10,000 red knots from the Atlantic coast have been uniquely marked. These commenters highlighted the authors' conclusion that ''The paucity of resightings in Texas suggests that most of these knots probably do not share the same wintering or stopover sites as those associated with the West Atlantic flyway.''

Our Response: We agree that available data do not show any use of a midcontinental (inland Texas through North Dakota) flyway by knots known to winter or stopover along the U.S. Atlantic coast. However, Newstead *et al.* 2013 go on to say, ''The paucity of resightings in Texas suggests that most of these knots probably do not share the same wintering or stopover sites as those associated with the West Atlantic flyway, *though the paucity may be the result of limited effort and/or reporting*'' [emphasis added]. Indeed, we have updated the Supplemental Document with new geolocator data confirming earlier indications (from resightings) that at least some Texas-wintering knots do mix with Atlantic coast birds during migration, both in Canada (Migration—Midcontinent—Spring) and the United States (Migration—Midcontinent—Flyway Fidelity).

(31) Comment: Several States and other commenters stated that records of this species' occurrence in the midcontinent suggest red knots use a ''jump'' migration strategy, whereby birds fly over the Southern and Central Great Plains and stopover at sites in the Northern Great Plains, principally in Southern Canada. Further, both spring and fall migrations involve a single 2- or 3-day flight between the Gulf coast and Canada.

Our Response: We agree that this picture of midcontinent migration (long ''jumps'' mainly to Southern Canada) is consistent with best available data. However, that body of available data (mainly Newstead *et al.* 2013, Skagen *et al.* 1999, and eBird.org 2014) is not extensive. Newstead *et al.* (2013) did find 2- or 3-day migration flights between Texas and the northern stopovers, based on a sample size of eight geolocators, some of which had been carried by the same birds for 2 full years. In addition to Newstead's research, our review of reliable national and regional occurrence data (Central Flyway Council 2013; eBird 2012; A. Simnor pers. comm. October 15, 2012) found multiple rufa red knot sighting records in every interior State. See *Our Response 29* for discussion of potential stopover areas in the interior United States.

(32) Comment: Several States and other commenters stated that a separate population of rufa red knots exists in the midcontinent of the United States and this population may constitute a DPS; therefore, a DPS analysis should be conducted. Further, these commenters stated that there is no compelling evidence that the midcontinental population meets the definition of threatened and none of the threats affecting the Atlantic coast population are applicable to the midcontinental population.

Our Response: Under the Act, we may list a species, subspecies, or a DPS of a vertebrate species. The Act's definition of ''species'' includes ''any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreed when mature.'' We have no evidence that the rufa red knot is composed of separate populations that may warrant protection of the Act at less than the subspecies level. Based on the best scientific and commercial data available, we determined the *rufa* subspecies of the red knot to warrant listing as threatened throughout its entire range.

(33) Comment: Several States and other commenters stated that giving infrequently or unused areas the same standing as regularly used and critically important sites ultimately hinders conservation efforts and is counterproductive. Listing in the Central Flyway States will result in expenditure of resources and create unnecessary bureaucracy (*e.g.,* to conduct consultations) in areas with little to no occupancy, potentially diverting resources away from coastal habitats where they would have substantially greater conservation benefit. Further, listing in the Central Flyway States has no conceivable conservation benefit to red knots or to noncoastal wetland habitats, which already derive protection from other listed species like the piping plover, whooping crane, and interior least tern.

Our Response: We disagree. The Service must make its determination on whether a species, subspecies, or DPS meets the definition of threatened or endangered based solely on the best available scientific and commercial data. This determination is based only on an analysis of the population and threats affecting the species as set forth under sections 4(a) and 4(b) of the Act. The extent to which a potential listing will or will not advance the conservation of any particular ecosystem (*e.g.,* noncoastal wetlands) is not a factor we may consider when determining whether a species meets the definition of threatened or endangered, nor may we consider economic information, including workload implications. As discussed above in *Our Response 28,* the provisions of the Act apply to all individuals of a listed species *wherever found* (emphasis added). Upon listing, therefore, the rufa red knot is protected by the Act wherever it occurs, even as scientific understanding of its range will likely continue to improve over time. That said, the Service has the appropriate tools under sections 7 and 10 of the Act to work with our State, Federal, and private partners to appropriately evaluate the likelihood of effects to red knots stemming from proposed activities. Such evaluations will be based on the species' level of exposure to the proposed activity, including the frequency and consistency of the species' occurrence in the affected area, and the type of activity, including its timing and duration. These evaluations may be done at different geographic scales.

During the recovery planning process we will focus on those stopover sites, both coastal and inland, that support the largest concentrations of birds, based on best available data. Inland habitats could be an important feature for certain flyways at certain times (*e.g.,* during particular weather conditions). Based on best available information, the Texas-wintering birds using the Central Flyway are important to the red knot's overall conservation because these birds contribute to the subspecies' resiliency and geographic representation. Protecting these birds and their habitats under the Act does have conservation benefit to the rufa red knot.

(34) Comment: One State commented that, given the longitudinal relationship between the Atlantic coast of the United States and the Pacific coast of South America, as well as the documented occurrence of marked *Calidris canutus rufa* in Panama and the central coast of Chile (González *et al.* 2006), it is conceivable that some *C.c. rufa* winter in sympatry (*e.g.,* occur in the same area) with *C.c. roselaari* along the Pacific coasts of Peru and Chile. Further, the subspecific affiliation of the knots that winter along the Pacific coast from southern Mexico through Chile is currently uncertain (78 FR 60024, p. 60026).

Our Response: We agree. We have updated the Supplemental Document (Subspecies Nonbreeding Distributions) with considerable new information and new conclusions regarding the nonbreeding distributions of the *rufa* and *roselaari* subspecies, including areas of likely or potential overlap.

(35) Comment: Several States and other commenters noted that the proposed rule includes inland States with low *Calidris canutus* occurrence (*e.g.,* Nebraska) while excluding other inland States with more numerous *C. canutus* occurrence records (*e.g.,* Utah). Despite past uncertainty, *C.c. roselaari* is now believed to be restricted to the Pacific coast based on current information.

Our Response: Numerical prevalence of *Calidris canutus* does not shed light on which subspecies (*C.c. roselarri* or *C.c. rufa*) predominate in any particular area. There is considerable uncertainty regarding the subspecific identity of *C. canutus* in the western interior United States, and it is possible that the two subspecies both occur in this area during migration. This uncertainty was reflected in questions 5 and 10 under ''Information Requested'' in the proposed rule (78 FR 60025). Despite a number of population-wide morphological differences (USFWS 2011a, p. 305), the *rufa* and *roselaari* subspecies cannot be distinguished in the field because physical variability among individuals results in overlaps in many physical parameters (*e.g.,* wing and bill length) between the two subspecies (USFWS 2011a, p. 205; Harrington 2001, pp. 4–5; Harrington *et al.* 1988, p. 441). Because these two subspecies cannot be distinguished in the field, other methods (*e.g.,* mark-resighting efforts, stable isotope analysis, genetics) are needed to delineate their distributions (D. Newstead pers. comm. September 14, 2012).

As discussed under *Our Response 28* and detailed in the Supplemental Document (Subspecies Nonbreeding Distributions—Western Interior United States), we defined the rufa red knot's Western U.S. range based on best available data from reliable published scientific literature, submitted manuscripts, and species' experts; occurrence data; and analysis (*e.g.,* estimated flight paths based on known wintering and breeding grounds combined with siting records). While it is possible that rufa red knots range nearly all the way to the Pacific coast during migration, we do not have any evidence to date (*e.g.,* genetics, mark-resightings, geolocator data, or stable isotope data) of *rufa* west of the Great Plains. We acknowledge considerable uncertainty around the subspecies composition in the Western States but conclude, based on best available data, that the *rufa* range likely extends to the western limit of the Great Plains (as mapped by the Level I ecoregions (U.S. Environmental Protection Agency (USEPA) 2013a)). See also *Our Response* 82 below.

(36) Comment: One State and several other commenters stated that, prior to a listing determination, more information is needed regarding the status and characteristics of red knot populations (*e.g.,* population status in Texas, connectivity of migratory flyways). In addition, gathering more scientific research on the red knot population in Texas will improve viability assessments of the entire subspecies throughout its range.

Our Response: The proposed rule presented best available data regarding red knot population size, diet, habitat use, and threats in Texas, as well as the prevalence and migration patterns of *Calidris canutus rufa* versus *C.c. roselaari* in Texas (Rufa Red Knot Ecology and Abundance pp. 5–7, 9, 14–16, 21–24, 27, 34–35, 42; Factor D pp. 10–11; 78 FR 60024, pp. 60030, 60033, 60035, 60039–60042, 60044–60045, 60052, 60056, 60059, 60063, 60078, 60081, 60085–60086, 60089, 60092). Section 4 of the Act directs that listing determinations be made on the basis of the best scientific and commercial data available. We evaluated approximately 1,400 references during the preparation of the proposed rule, and communicated with numerous species and threats experts, to comply with this data standard required by the Act. We solicited peer review on the proposed rule. Peer review comments are reflected in the Supplemental Document, which has also been updated with new data regarding Texas, the nonbreeding distribution of rufa red knots, and connectivity of the flyways (Subspecies Nonbreeding Distributions; Migration; Migration and Wintering Habitat) that has subsequently become available through the public comment period and clarification from experts. Although a more complete picture of red knot ecology in Texas will be helpful for recovery planning, research to generate these new data is not yet available. As discussed in *Our Response 27* above, the ''best available science'' requirement does not equate to the best possible science. We acknowledge certain data gaps (78 FR 60024, pp. 60024–60025) and uncertainties, some of which are inherent in all natural systems and all evaluations of future conditions; however, we conclude that the best available data are sufficient to document several population-level threats to the red knot, as well as its reduced population size relative to the early 1980s, and thus conclude that the red knot meets the definition of a threatened species.

(37) Comment: One State commented that the proposed rule did not provide comprehensive population numbers for either the historical or current population size for this subspecies or estimates that encompass the entire wintering range, the entire nesting range, or all of the potential migration stopover habitats along the U.S. Atlantic coast. This commenter believes the proposal gave undue importance to population trends at only two locations, Delaware Bay and Tierra del Fuego, and that maximum percent declines at these two sites are not sufficient for an evaluation of the severity of the apparent [rangewide] population decline. Further, because the red knot is highly mobile and individual birds and flocks appear to be capable of using different locations as stopover points from year to year, a more rigorous approach than subsampling should be used to assess population changes. Another commenter believes 40 years of data are not enough to show a trend in red knot populations and the Service

should look at hundreds of years of data.

Our Response: As discussed in the Supplemental Document (Population Surveys and Estimates), we conclude that we do not have sufficient reliable data on which to base a precise rangewide population estimate. Thus, we have instead considered the best available data, which consists of survey data for specific regions. In the proposed rule, we limited our conclusions to trends within each regional data set (Rufa Red Knot Ecology and Abundance, pp. 53–54), though we did note a temporal correlation between declines at Tierra del Fuego and Delaware Bay (Rufa Red Knot Ecology and Abundance, p. 48). Although we lack sufficiently robust data to conclude if other wintering and stopover areas also declined, we conclude it is likely that declines at Tierra del Fuego and Delaware Bay drove an overall population decline (*i.e.,* lower total numbers), because these two sites are believed to have supported a large majority of rangewide knots (see *Our Response 38*). We note that our calculation of those regional declines (75 percent at Tierra del Fuego and 70 percent at Delaware Bay) are based on averages of early and late time periods, calculated to smooth out inherent variability in the data. In contrast, the maximum declines (*i.e.,* comparing only the single lowest count with the single highest count) were both recorded in 2011 and show an 81 percent decline at Tierra del Fuego and an 87 percent decline at Delaware Bay. Despite the above-mentioned limitations in producing a rangewide population estimate, we do note that several analyses conducted by others all concluded red knot numbers declined, probably sharply, in recent decades. While we did not rely on these other analyses, we do note that they are independently consistent with the conclusions we draw from the available (regional) data sets.

A more rigorous survey regime to estimate rangewide population changes over time may become available in the future. For example, mathematical population size estimates based on marked birds were begun in 2011 in Delaware Bay (J. Lyons pers. comm. September 3, 2013) and Georgia (GDNR 2013). This new method does not yet allow for trend analysis because only a few data points are available, and does not yet have the geographic coverage to permit a rangewide population estimate. However, the Act requires that we make listing determinations based on the best available data. The proposed rule identifies and evaluates the best available population information, which is associated with high confidence in those regions with long time series and consistent survey methods (*e.g.,* Delaware Bay, Virginia, Tierra del Fuego).

We disagree that these best available data cover an insufficient time period for trend analysis. Even with inherent annual variability, we conclude the available data are sufficient to document a sharp and prolonged period of decline in red knot counts in Delaware Bay and Tierra del Fuego in the 2000s. Further, we have gathered best available historical data dating back to the mid-1800s, as presented in the proposed rule (Rufa Red Knot Ecology and Abundance) and the Supplemental Document (Historical Distribution and Abundance, pp. 33–36). Although these historical data do not permit a quantitative analysis, they do convey a consistent qualitative account of historical declines and followed by, at least, a partial recovery.

(38) Comment: One State questioned the validity of applying the observed decline in Delaware Bay to the entire population since, despite its apparent importance, the bay represents only a small portion of the Atlantic coast and the potential stopover habitat available to migrating red knots.

Our Response: While, geographically, Delaware Bay represents only a small proportion of the total U.S. Atlantic coast, we conclude the bay supports a significant proportion of the total rufa red knot population during spring migration (Brown *et al.* 2001, p. 10), as discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, p. 29). Although no current, reliable, rangewide population estimate is available, reliable regional population data are available (see *Our Response 77;* Rufa Red Knot Ecology and Abundance, pp. 38–52; and Population Surveys and Estimates in the Supplemental Document). We have analyzed the most recent estimates of red knot numbers from each wintering region, Delaware Bay peak counts from the past 10 years, and Delaware Bay total passage population estimates from the past 3 years. Based on this analysis, we conclude that Delaware Bay continues to support the majority of red knots during spring.

That said, we agree that extrapolation of population declines in Delaware Bay to the rest of the red knot population should be conservative and undertaken only when supported by corroborating data. In the proposed rule, we presented data for specific regions (Rufa Red Knot Ecology and Abundance, pp. 38–52) and limited our conclusions to trends within each regional data set (Rufa Red Knot Ecology and Abundance, pp. 53–54). However, we also stated, ''the pattern and timing of these declines in Delaware Bay relative to Tierra del Fuego and other stopovers is suggestive of a decrease in the overall population'' (Rufa Red Knot Ecology and Abundance, p. 48). We agree that this statement was imprecise and have revised the Supplemental Document (Population Surveys and Estimates—Spring Stopover Areas—Delaware Bay) to clarify our conclusions drawn from best available data. We have also revised the Supplemental Document (Summary—Population Surveys and Estimates) to clarify, ''Although we lack sufficiently robust data to conclude if other wintering and stopover areas also declined, we conclude it is likely that declines at Tierra del Fuego and Delaware Bay drove an overall population decline (*i.e.,* lower total numbers), because these two sites supported a large majority of rangewide knots during the baseline 1980s period.''

(39) Comment: One State commented that the annual variation in the Delaware Bay peak counts suggests that knots are capable of altering their stopover behavior between years. It is unlikely that the actual population fluctuates at the high magnitude reflected in the Delaware Bay peak counts; therefore, year-to-year changes are probably related to variations in passage rates for birds moving through the region and variations in the use of multiple stopover sites.

Our Response: We agree that the Delaware Bay peak counts are highly variable, but conclude that much of the short-term (year-to-year) variation can be attributed to the fact that peak counts are only a proxy measure for the total passage population. Year-to-year differences in the month-long patterns of arrival and departure would affect the percentage of total passage population that is captured by each year's peak count (*e.g.,* some years more birds may depart early and be missed by the late-May peak count). It is also possible that the survey date has missed the true peak number of birds in some years, particularly after 2008 when weekly, season-long survey efforts were scaled back to focus only on the end of May. That said, we also agree that red knots may switch between mid-Atlantic stopovers between, and even within, years, and that this flexibility may explain part of the variability in the data from both Delaware Bay and Virginia (Supplemental Document tables 8 and 11). We noted this flexibility in spring stopovers in the proposed rule (Rufa Red Knot Ecology and Abundance, p.

20). Despite the high variability, we attach high confidence to the long-term trend evident in the Delaware Bay peak count data, based on the consistent methods and observers, particularly during the core years of 1986 to 2008.

(40) Comment: One State and several other commenters stated that recent population estimates calculated from resightings of banded knots using capture-recapture statistical methods should not be conflated with long-term data sets of maximum 1-day (peak) counts.

Our Response: The proposed rule (Rufa Red Knot Ecology and Abundance, pp. 47–51) did not conflate population estimates derived from these two different methods. As we explain in the Supplemental Document (Population Surveys and Estimates—Spring Stopover Areas), because birds pass in and out of a stopover area, the peak count (the highest number of birds seen on a single day) for a particular year is lower than the total passage population (*i.e.,* the total number of birds that stopped at that site over the course of that migration season). For this reason, we have not compared data sets estimating total passage population (from capture-recapture statistical methods) with those of peak counts (maximum 1-day counts). We present these data sets separately in tables 9 to 13 of the Supplemental Document, with data updates where available.

(41) Comment: One State concluded that peak red knot numbers in Delaware Bay have been stable to increasing since 2002, while another commenter concluded that red knot numbers in Delaware Bay continue to decline.

Our Response: We disagree with both of these conclusions. We find that peak counts from 2002 through 2008 continued to show a slight downward trend. Peak counts from 2009 through 2014 appear to have been stable to slightly increasing, despite lower confidence in these recent counts due to multiple shifts in methodology and surveyors. Average peak counts for the last decade (2005 to 2014) remain about 70 percent lower than during the baseline period of 1981 to 1983. See Supplemental Document, Population Surveys and Estimates—Spring Stopover Areas—Delaware Bay.

(42) Comment: One State and several other commenters noted that the ARM model established a threshold of red knot abundance (45,000 or half of the historical peak counts) which, when reached, will trigger female crab harvest. As this threshold was derived from peak counts, it must be adjusted upward to account for differences in methods before it can be judged against new estimates of total stopover population derived from mark-resighting data. One State also commented that the mark-resighting method is of limited value in trend assessment because population estimates cannot be made retrospectively, but did acknowledge that it is probably the most robust method of estimating actual stopover population numbers and, therefore, will be useful in developing future trend information.

Our Response: We agree that the threshold must be revised and note that this adjustment has already been made. This threshold, used in the ASMFC's management of the HSC fishery under the ARM, has now been adjusted upward to account for differences in methodology. In September 2013, the ASMFC's Delaware Bay Ecosystem Technical Committee adopted a ratio of 1.82, and adjusted the threshold from 45,000 to 81,900 red knots. This ratio may be refined when the ARM model is re-evaluated in the future (ASMFC 2013e, p. 1). We agree that this is a robust method of estimating stopover populations, but also agree that the mark-resighting method cannot yet be used for trend analysis because too few data points are available to date. No accurate estimates of the total stopover population using the methods of J. Lyons (pers. comm. September 3, 2013) can be calculated prior to 2011, when the required data began to be collected. However, estimates prior to 2011 are not needed to implement the ARM model as decisions on HSC harvest are based upon the current populations of HSCs and red knots. For red knot population trend analysis in Delaware Bay, we have relied on the peak counts (see *Our Responses 37* and *39*.)

(43) Comment: One State said that it had difficulty evaluating the geographic adequacy of the winter surveys in Tierra del Fuego and the southern coastline of Argentina, because these surveys may or may not cover a sufficiently large portion of the wintering range to develop a comprehensive population estimate. This State questioned if it is possible that red knots winter outside of the surveyed area further north along the coast lines of Argentina and Chile, or on the Falkland Islands.

Our Response: Much of what we know about the distribution of wintering red knots along the coasts of South America comes from Morrison and Ross (1989), who reported the results of aerial surveys conducted from 1982 to 1986. This survey effort covered nearly the entire Atlantic, Pacific, and northern coasts of South America (Morrison and Ross 1989, Vol. 1, p. 22). During these extensive surveys, *Calidris canutus* was observed only in Tierra del Fuego and the Patagonian coast of Argentina, the north coast of Brazil, and western Venezuela (Morrison and Ross 1989 Vol. 1, pp. 37, 40–41). Although Morrison and Ross (1989) did not observe *C. canutus* along the Pacific coast of South America, they recorded substantial numbers of unidentified medium-sized shorebirds in several locations, including some areas with reports of *C. canutus* from other sources (eBird.org 2014; Carmona *et al.* 2013, pp. 175, 180; Ruiz-Guerra 2011, p. 194; Morrison and Ross 1989 Vol. 1, p. 40; Hughes 1979, pp. 51–52). In the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 38–42), we presented the data of Morrison and Ross (1989) as well as all available results of more recent survey efforts for the known and possible range of *C.c. rufa,* which includes the east and north coasts of South America. These data have been updated in the Supplemental Document (Population Surveys and Estimates). Based on new information indicating that at least some of the *C. canutus* on the central Pacific coast of Chile are also *C.c. rufa,* we have also added best available abundance data for the west coast of South America (Population Surveys and Estimates—Central America and Pacific South America). We are unaware of any published or unpublished *C. canutus* reports from the Falkland Islands, there are no reports of these species for that area in eBird (eBird.org 2014), and no other datasets for the Falkland Islands were provided during the comment period. The lack of data may be explained by an apparent lack of survey efforts.

(44) Comment: One State commented that, based upon its review of the threats analysis published in the listing proposal, it does not find compelling evidence that the *rufa* subspecies of the red knot warrants listing as a federally threatened species throughout the eastern half of the United States. Other commenters stated that listing of the rufa red knot is not warranted based on a lack of compelling evidence in the proposed rule, and that the threatened determination relies on speculative future conditions. An additional commenter stated that a reasonable determination could also be made that adequate conservation measures already exist to reasonably protect red knot populations and that forecasting cumulative worst case scenarios to determine species risk does not meet the test of 50 CFR 424.4(a)(1) for adding a new species to the list of threatened and endangered species. Conversely, other commenters stated that we should list

the red knot as endangered or use our authorities for emergency listing, while another commenter mentioned that the previous change in the rufa red knot's listing priority number was no guarantee that it would be listed.

Our Response: See *Our Responses 27, 36, and 71* regarding how we satisfied the Act's information standard. The proposed rule and its underlying data were available for extensive public and peer review and comment. The commenters did not provide additional substantive information to refute our analysis or assumptions. We disagree that this listing determination relies on cumulative-worst case scenarios, and instead find that the red knot meets the definition of a threatened species based on several population-level threats. Particularly considering the cumulative effects of ongoing and emerging threats, and considering that several populations of red knots have already undergone considerable declines and remain at low levels, we conclude that the best available data constitute compelling scientific evidence that the red knot meets the definition of a threatened species.

As noted in the proposed rule (Previous Federal Actions, p. 2), the listing priority number was changed (from 6 to 3) in 2008. The commenter is correct that candidate species of any listing priority number are not guaranteed to be listed—new information may become available that causes us to change our conclusion that listing is warranted. However, this is not the case for the red knot. As for the need to emergency list, this request is moot because the red knot will become listed as threatened upon the effective date of this rule. As noted in the proposed rule (Previous Federal Actions, pp. 1–2), we previously determined that emergency listing was not warranted, and we had no new information to indicate emergency listing was warranted at the time of, or subsequent to, the proposed rule.

We have carefully reviewed all new information since the proposed rule, and continue to find that the red knot meets the definition of a threatened species under the Act. We do not find that the red knot warrants listing as endangered based largely on the fact that red knot populations in Tierra del Fuego and Delaware Bay, although still at historically low levels, appear to have stabilized since about 2009, suggesting that the red knot is not currently at risk of extinction, but is likely to become so in the foreseeable future.

(45) Comment: One State and an additional commenter expressed concerns that threats in other habitats outside of Delaware Bay are having a disproportionate effect on the red knot because the Delaware Bay remains in a ''depauperate state,'' at least as it pertains to shorebirds (*i.e.,* HSC population levels are too low to provide the ''super-abundance of eggs''). Because of this egg insufficiency, threats in other habitats used during the red knot's annual cycle will have a proportionately greater effect on red knot population viability. Thus, addressing the HSC egg food supply in the bay must remain at the forefront of red knot recovery efforts.

Our Response: We disagree that the bay is currently ''depauperate'' for shorebirds, but agree that the HSC egg supply should remain a focus of red knot recovery work. As noted in the proposed rule (78 FR 60024, p. 60063), most data suggest that the volume of HSC eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. This conclusion seems to be holding, as red knot weight gain was good during spring 2014, for a third consecutive year (A. Dey pers. comm. July 23, 2014). However, it is not yet known if the egg resource will continue to adequately support red knot population growth over the next decade. Thus, we agree that sustained focus on protecting the red knot's food supply is vital to the recovery of the red knot, and will be addressed during the recovery planning process. Further, we intend to continue our active role in the ASMFC's management of the HSC fishery. Under the ARM we do not anticipate the bait harvest will slow red knot population growth (see *Our Response 48*) (Smith *et al.* 2013, p. 8).

We also agree that a number of other threats are likely contributing to habitat loss, anthropogenic mortality, or both, and thus contribute to the red knot's threatened status, particularly considering the cumulative effects of these threats, and that populations of this species have already undergone considerable declines in key areas.

(46) Comment: One State and several other commenters stated that the Delaware Bay HSC population has not recovered and concluded that management of this fishery to date has not accomplished its objectives and has proven inadequate to reverse declines. Several commenters noted that no class of HSC (by sex or age) has shown any recovery as measured by the Virginia Tech Horseshoe Crab Trawl Survey or the Delaware Bay 16-foot Trawl Survey. Further, positive trends in female HSC populations are absent, even after 7 years of male-only harvest, which is consistent with significant unaccounted losses of female crabs, for example, from mortality caused by biomedical harvest, poaching, and bycatch. In addition, one State commented that the 2013 defunding of the Virginia Tech Trawl Survey adds to uncertainty that the data sources relied upon in the ARM models will be consistently available. In contrast, one commenter stated that, while the benthic trawl survey is the best survey to support the ARM, a sound strategy has been developed to use the NEAMAP data to support the 2014 modeling efforts for the 2015 fishery, and the ASMFC Horseshoe Crab Management Board and ARM Working Group anticipate the continued use of the ARM framework for management.

Our Response: Numerous data sets are available regarding the Delaware Bay HSC population. We rely on ASMFC's periodic stock assessments to appropriately weigh and statistically analyze these data sets to draw conclusions regarding HSC population trends, as discussed in the proposed rule (78 FR 60024, p. 60066). The Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) has been updated to include the results of the 2013 stock assessment update. The 2013 stock assessment update concluded that, in the Delaware Bay Region, there is evidence of increases in certain age or sex classes, but overall population trends have been largely stable (neither increasing nor decreasing) since the previous stock assessment in 2009 (ASMFC 2013b, p. 22). These 2013 stock assessment findings are consistent with our conclusions in the proposed rule (78 FR 60024, p. 60066) that HSC population declines were observed during the 1990s, increases (though not a full return to 1980s levels) and stabilization occurred in the early 2000s, and various data sets have differed with no consistent trends since 2005. We note that the ARM framework does not define a ''recovery'' population level for Delaware Bay HSCs, but instead seeks to set the crab harvest at a level that does not slow the achievement of an agreed-upon red knot population target.

We disagree that ASMFC's regulatory approach has been inadequate. In addition to restricting harvests through the Fisheries Management Plan (including the most recent iteration, the ARM), the ASMFC has taken several proactive steps including establishment of a Technical Committee to focus on shorebirds, requesting the establishment of an HSC reserve in Federal waters, supporting work on alternative baits, and reducing demand by promoting bait-saving devices. These efforts

reduced reported landings (ASMFC 2009a, p. 1) from 1998 to 2011 by more than 75 percent (78 FR 60024, p. 60064). We believe it is premature to state that the ASMFC's regulatory approach has not accomplished its objectives. Rather, we anticipate that this regulatory approach, currently reflected in the ARM framework, will allow for HSC and red knot population growth to meet ASMFC objectives. However, even highly successful harvest management under the ARM will only meet its objectives to the extent that the HSC population remains limited by harvest. For example, food resources, habitat conditions, and other conditions that affect growth, survival, and carrying capacity of HSCs in the Delaware Bay Region may have changed over time and cannot be affected by management of the fishery.

Regarding when to expect female HSCs to show an increase based upon existing monitoring programs, several areas need to be considered including the ability of the monitoring programs to detect change in the populations, our understanding of how the population may respond, and other factors such as food availability for HSCs, as well as bait and biomedical mortality. Horseshoe crabs take 9 to 12 years to reach breeding age, and modeling suggests that it will likely take longer than one generation for adult abundance to increase. See *Our Response 49* below regarding possible sources of HSC mortality not explicitly accounted for in the ARM models.

We agree that the Virginia Tech survey is the best benthic trawl survey to support the ARM. In the absence of the Virginia Tech survey, we support the ongoing efforts of the ASMFC to adapt the NEAMAP data for use in the models. However, efforts to date have not identified a method by which the NEAMAP data can allow for the functioning of the ARM models (ASMFC 2014b). Stable funding sources for the other baywide monitoring programs are also a concern. Insufficient monitoring has already impacted the ability of the ASMFC to implement the ARM as intended (ASMFC 2014b; ASMFC 2012c, p. 13). If the ARM cannot be implemented in any given year, the ASMFC would choose between two options based on which it determines to be more appropriate—either use the previous year's harvest levels (as previously set by the ARM), or revert to an earlier management regime (ASMFC 2012e, p. 6). Although the HSC fishery would continue to be managed under either of these options, the explicit link to red knot populations would be lost. Absent the necessary HSC monitoring data to use the ARM models for the 2015 season, ASMFC (2014b) has opted to use the 2014 harvest levels which we considered at the time to adequately ensure the red knot's food supply. We have revised the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management) to reflect this new uncertainty about the future of the ARM.

(47) Comment: One State commented that recent efforts to develop an artificial bait for the conch and eel fisheries could reduce demand for HSCs as bait and reduce the HSC harvest, thereby benefitting HSC (and red knot) rebuilding. However, to realize a significant benefit to the HSC population, the use of artificial bait would need to reduce harvest/demand for HSCs to a level below quota levels.

Our Response: We agree that HSC alternatives offer the possibility of substantial conservation benefits to the red knot. In the proposed rule (78 FR 60024, p. 60067), we noted efforts to develop an artificial bait to replace HSCs, as well as work toward alternatives to the biomedical HSC product Limulus Amebocyte Lysate. We have updated the Supplemented Document (Factor E—Reduce Food Resources—Horseshoe Crab Harvest—Link A, Park 2) with new information on artificial bait from the University of Delaware (Wakefield 2013). We support these efforts, which would reduce or eliminate the demand for harvesting HSCs. However, until bait or lysate alternatives are widely adopted, we anticipate that management of HSC harvests under the ARM will continue to adequately abate the food supply threat to red knots from HSC harvest in the Delaware Bay. (However, see *Our Response 46* regarding new uncertainty about the future of the ARM.)

(48) Comment: One State and several other commenters expressed concern that, under the ARM, Delaware Bay HSC populations are not expected to recover for 60 years. One State indicated that the carrying capacity of Delaware Bay for female crabs is estimated at 14 million individuals while the current female population estimate is 4.5 million, and growth to carrying capacity would take more than 100 years according to simulations by Smith *et al.* (2013). Another commenter stated that the number of crabs must return to the levels of the early 1990s to support the recovery of the red knot. Several of these commenters believed that the ARM models value harvest (give it ''utility'') above a speedy recovery of HSCs. Another commenter stated that it remains to be seen if the HSC population will respond to recent harvest quotas set by the ASMFC and that the food supply for red knots in Delaware Bay remains uncertain for at least the near term. Conversely, one commenter stated that assertions that the HSC population must increase by an order of magnitude to have a beneficial impact on survival of the red knot population are not supported by defensible data.

Our Response: We disagree with these conclusions regarding HSC population growth rates and target population levels. In a recent study, Smith *et al.* (2013, entire) ran computer simulations to test how uncertainty affects the management of the Delaware Bay HSC population under the ARM. These authors presented charts with simulated population trajectories of both HSCs and red knots. However, these simulations were intended to illustrate the role of uncertainty in the ARM framework, not to predict recovery times. Because it is adaptive in nature (*i.e.,* each year's harvest limits are based on the previous year's crab and knot population estimates), the ARM is not designed to answer the question of how long it will take to achieve any particular HSC or red knot population size in Delaware Bay. The findings of Smith *et al.* (2013) have been incorporated into the Supplemental Document (Factor E—Reduce Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management).

As explained above in *Our Response 46,* the ARM framework does not define a ''recovery'' population level for Delaware Bay HSCs. We do not assert that any particular HSC population level is necessary to have a beneficial impact on the red knot stopover population in Delaware Bay. Further, we do not have any information to indicate that the HSC population must reach carrying capacity—or must return to early 1990s levels, or increase by an order of magnitude—to support the full recovery of the Delaware Bay's red knot stopover population. Instead, we rely on the adaptive, scientific modeling of the ARM framework to determine the appropriate HSC harvest level necessary to maximize red knot population growth.

We disagree that the ARM framework values harvest over maximum HSC population growth. Under the ARM framework, utility is given to harvest (*i.e.,* harvest is ''valued,'' and, therefore, allowed) only when knot and crab populations are above a threshold. Although the simulations by Smith *et al.* (2013, p. 8) are not intended to predict actual timeframes for population

growth, they did show that the bait harvest levels allowed by the ARM did not slow red knot population growth relative to a complete moratorium (see *Our Response 121*). The simulations by Smith *et al.* (2013) suggest these species will take a long time to rebuild (although we cannot predict how long) due to their inherent biology (long time to maturity and low survival in early life stages), not due to the ARM utility values.

We agree that food supply for red knots in Delaware Bay remains a point of concern. As long as the ARM is in place and functioning as intended (see *Our Response 46* regarding new uncertainty about the future of the ARM), we anticipate future quotas will continue to be set at levels that ensure the bait harvest does not impede progress toward achieving maximum red knot population growth. However, even with highly successful harvest management under the ARM, the HSC population will continue to grow only to the extent that it remains limited by harvest; other factors affecting crab populations cannot be affected by management of the fishery (see *Our Response 46* and Supplemental Document section Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2). Our assessment of the best available data concludes that the volume of HSC eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size; but because of the uncertain trajectory of HSC population growth, it is not yet known if the egg resource will continue to adequately support red knot population growth over the next decade. This conclusion is unchanged from the proposed rule (78 FR 60024, p. 60063).

(49) Comment: One State and several other commenters stated that the ARM model is based on a number of assumptions that the ASMFC has not adequately tested, and includes a high degree of uncertainty in many of the data inputs. These include a lack of information on crab mortality to sufficiently inform the adaptive management process. These assumptions and sources of uncertainty render the model less risk-averse than the commenters find acceptable given the dependence of red knot recovery on a sufficient growth in Delaware Bay's spawning HSC population. Assumptions and uncertainties noted by the commenters include (a) the boundary (geographic extent) of the Delaware Bay Region (which, if incorrect, could allow for harvest of Delaware Bay crabs that would not be accounted for in the models); (b) illegal harvest; (c) crabs harvested and used at sea (not landed in any State); (d) crabs harvested in Federal waters; (e) bycatch; (f) underreporting, inaccurate or missing reporting of the sex of harvested crabs; and (g) mortality from the biomedical harvest.

Our Response: While we agree that there is good correlation between declines in red knots and declines in HSC abundance based on the best data available, we note that late arrivals of red knots in Delaware Bay (for unknown reasons) was a key synergistic factor accounting for the knot's decline in the 2000s (Baker *et al.* 2004, p. 878). We recognize the uncertainties and assumptions raised by the commenters. Such uncertainties were one reason the ARM was developed, as the purpose of adaptive management is to allow decisions under uncertainty. The uncertainties and assumptions, many of which are common to all managed fisheries, mentioned by the commenters were taken into account when the ARM was developed. We have reviewed the ARM framework at length and have spoken with the authors of the modeling. We conclude that the ARM is risk averse and deals explicitly with uncertainties, and that these uncertainties do not preclude effective decision-making, a conclusion supported by Smith *et al.* (2013).

Updates regarding our previous analysis of each uncertainty or assumption are presented below. While the ARM framework does not currently account for these factors explicitly, mortality from sources other than the bait harvest is potentially reflected in the survival parameters used in the ARM. Based on best available information, we conclude that explicit addition of these factors to the models would not change the harvest levels set by the ARM process. However, we have revised the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management) to clarify that we expect the ARM framework will continue to adapt as substantive new information becomes available about important factors (other than the bait harvest) that may limit the continued growth of the Delaware Bay HSC population (see *Our Response 50*). In addition, we note that, since New Jersey has a full moratorium in place, the actual harvest of HSCs is less than that recommended by the ARM models.

(a) *Delaware Bay Region boundary.* In the proposed rule (78 FR 60024, p. 60070), we concluded that the ASMFC's current delineation of the Delaware Bay Region HSC population is based on best available information and is appropriate for use in the ARM modeling, but we acknowledged some uncertainty regarding the population structure and distribution of Delaware Bay HSCs. The commenters have not provided any new data to help resolve this uncertainty, or alternate boundaries for consideration. In documenting the technical underpinnings of the ARM, the ASMFC (2009b, p. 7) acknowledged that the proportion of Maryland and Virginia landings that come from Delaware Bay is currently unresolved, but stated that their approach to estimating this proportion, based on genetic analysis, was conservative. We have revised the Supplemental Document (Factor E—Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management) to state that we anticipate the ARM process will adapt to substantive new information that reduces uncertainty about the Delaware Bay HSC population structure and geographic distribution. See *Our Response 114.*

(b) *Illegal harvest.* In the proposed rule (78 FR 60024, pp. 60066–60067), we evaluated available information regarding illegal harvest (poaching) of HSCs. We have revised the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) to update the poaching discussion with new findings from the ASMFC (2014a). Although notable poaching has been reported outside the Delaware Bay Region, we have no data to indicate that poaching in the Delaware Bay Region is occurring at levels that would have population-level effects. See also *Our Response 52* below.

(c) *Crabs used at sea.* In the proposed rule (78 FR 60024, p. 60067), we discussed the unregulated harvest of HSCs from Federal waters that are not landed in any State, but exchanged directly to a dependent fishery. We have updated the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) with new information from the ASMFC (2014a) regarding the possibility of such crabs, mainly crabs caught as bycatch, being harvested and used at sea. While there is no indication of the extent or amount of this activity or whether it exceeds the legal bycatch allowances that are set by each State, there is also no direct evidence of significant illegal activity and no enforcement cases (ASMFC 2014a, p. 2; M. Hawk pers. comm. May 27, 2014). We continue to conclude that the level of any such unreported and unregulated harvest (*i.e.,* that does not result in landings) is small and unlikely to have population-level effects (M. Hawk pers. comm.

April 29, 2013; G. Breese pers. comm. April 26, 2013).

(d) *Harvest from Federal waters.* Horseshoe crabs caught in Federal waters and landed in any State count toward the quotas established by the ASMFC. Horseshoe crabs caught in Federal waters and not landed in any State (used at sea) were discussed under item (c), above.

(e) *Bycatch.* Bycatch was discussed in the proposed rule (78 FR 60024, p. 60067). We have updated the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) with new information about bycatch as well as commercial discard. Horseshoe crabs caught as bycatch that are landed in any State count toward the quotas established by the ASMFC and may be kept only if the harvester holds a permit (M. Hawk pers. comm. May 27, 2014). Horseshoe crabs caught as bycatch that are not landed in any State (used at sea) were discussed under item (c), above.

(f) *Reporting problems.* We have no data that underreporting and inaccurate or missing reporting of the sex of harvested crabs is impeding the functioning of the ARM process.

(g) *Biomedical harvest.* See *Our Response 50* below regarding biomedical harvest of HSCs.

(50) Comment: One State and several other commenters expressed concern that the mortality of HSCs bled for biomedical use is not included in the ARM models, and that mortality rates have been documented well above those used by the ASMFC (*e.g.,* for assessing if the biomedical threshold has been surpassed). In addition, sublethal effects on bled crabs are not considered, and the biomedical harvest is expected to continue growing. Further, it is unclear if bled crabs captured in Delaware Bay are released near the location of their capture or nearer to the bleeding facilities, all of which are outside of the Delaware Bay region and would represent a loss of these crabs to the Delaware Bay population. One commenter noted that the ASMFC's Delaware Bay Ecosystem Technical Committee recommended in September 2013 that the ASMFC investigate options to incorporate biomedical data into future stock assessments, which has not been possible to date due to confidentiality issues.

Our Response: In the proposed rule (78 FR 60024, pp. 60064–60065), we noted that biomedical collection is currently not capped, but the ASMFC may consider implementing action to reduce mortality if estimated mortality exceeds a threshold of 57,500 crabs. This threshold has been exceeded several times, but thus far the ASMFC has opted only to issue voluntary ''best practices'' guidelines to the biomedical industry (ASMFC 2009a, p. 18). We also noted that, using a constant 15 percent mortality of bled crabs, the estimated contribution of biomedical collection to total (biomedical plus bait) mortality coastwide rose from about 6 percent in 2004 to about 11 percent in 2011. We have updated the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) with new information on sublethal effects from bleeding (Anderson *et al.* 2013), and to note that, despite a recommendation by the ASMFC's Horseshoe Crab Technical Committee to use of a range of 5 to 30 percent mortality (ASMFC 2013c, p. 8; ASMFC 2012a, p. 6), the ASMFC continues to assume a constant 15 percent mortality rate for bled crabs (M. Hawk pers. comm. May 28, 2014; ASMFC 2013b, p. 9; ASMFC 2009a, p. 3). Available data suggest the biomedical industry generally returns bled crabs to their waters of origin.

As shown in the Supplemental Document (table 23), the 2012 estimate of coastwide biomedical mortality (about 80,000 crabs) remains small compared to the coastwide bait harvest (about 730,000 crabs) (note that these figures are not specific to the Delaware Bay Region). Given the relative magnitude of biomedical mortality, we conclude that even considerable uncertainty around this estimate would not currently prevent the ARM framework from functioning as intended. However, we support the recommendation of the Technical Committee for ASMFC to investigate options to incorporate biomedical data into future stock assessments while avoiding breaches in confidentiality (ASMFC 2013e, p3). Further, we have revised the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management) to clarify that we expect the ARM framework will continue to adapt as substantive new information becomes available about any important factors (other than the bait harvest) that may limit the continued growth of the Delaware Bay HSC population. Such factors are not currently well known, but could include demographic and ecological constraints on population growth, as well as sources of direct mortality that are not currently captured by the ARM models (*e.g.,* biomedical, poaching, bycatch). In particular, accounting for biomedical mortality may become important if the contribution of the biomedical harvest to total mortality continues to increase. It should be noted, however, that much of the biomedical harvest occurs outside the Delaware Bay Region and would, therefore, fall outside of the ARM framework.

(51) Comment: One State commented that removing Mispillion Harbor from the analysis of annual Delaware Bay egg density estimates has no biological or statistical justification and introduces bias. The Delaware Bay Ecosystem Technical Committee reviewed these data and determined that the high egg densities observed in Mispillion Harbor are not an outlier because they are consistently high from year to year and play a significant role for red knots in the Delaware Bay ecosystem. Furthermore, HSC egg densities in Delaware are increasing since 2005 (see Kalasz 2013 interim report).

Our Response: In the proposed rule (78 FR 60024, p. 60068), we stated that Mispillion Harbor consistently supports a substantial portion of the red knots in Delaware Bay, and that exclusion of Mispillion Harbor from statistical analyses is problematic. Thus, we discussed the statistical relationship between egg density and red knot weight gain both with and without Mispillion Harbor, as reported by Dey *et al.* (2013, pp. 18–19). We have added the findings of Kalasz (2014) to the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link B, Part 2).

(52) Comment: One State commented that the proposed rule contains an unsubstantiated allegation of HSC poaching as a factor impacting HSC populations, which is unreasonable given that the current HSC population is likely no less than the estimated 20 million HSCs in the Delaware Bay in 2003, indications that the spawning HSC population in the Delaware Bay has been stable or increasing, the scrutiny and capabilities of State enforcement officials, the fact that HSC bait prices have increased tremendously in response to restrictions put in place (as evidenced by the import of Asian HSCs), and the difficulty in concealing large quantities of [illegal] HSCs. Conversely, another commenter stated that they have witnessed HSC harvest in a salt marsh on the North Shore of Long Island, New York, and found that oversight of harvest regulations is lacking. In addition, this commenter also believes that the harvest limit is too high.

Our Response: We disagree with this characterization of our conclusions in the proposed rule. In the proposed rule (78 FR 60024, p. 60066), we reported that the ASMFC's Delaware Bay

Ecosystem Technical Committee had speculated about possible factors that may explain the lack of recent HSC population growth in the Delaware Bay Region, but committee members did not reach consensus regarding which factors are more likely (ASMFC 2012c, p. 12; ASMFC 2012d, p. 2). The possibility of excessive documented and undocumented mortality was among these factors (ASMFC 2012d, p. 2). Therefore, we further investigated several possible sources of additional mortality outside the authorized bait harvest quotas, including biomedical mortality, poaching, bycatch, and unregulated harvest (*i.e.,* from Federal waters and not landed in any State) (see *Our Response 49*). Specific to poaching, we presented documented instances of enforcement actions in New Jersey and New York. We have updated the poaching discussion in the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A—Part 2) with new findings from the ASMFC (2014a), which further document notable levels of illegal harvest outside of Delaware Bay, but which have not changed our conclusion that minimal poaching (well below the levels that would cause population-level effects) has been observed in the Delaware Bay Region. Specific to oversight in New York, officials are aware of significant harvest pressure in the spring, and anticipate possible illegal activity by implementing significant spring enforcement details (ASMFC 2014a, p. 1). We agree that the best available estimate of the HSC population in Delaware Bay is about 20 million crabs and that spawning HSC abundance has been stable, though not increasing (see *Our Response* 109). We also agree that poaching is receiving appropriate scrutiny from enforcement officials (ASMFC 2014a). See *Our Responses 2* and *120* regarding the price of bait and the import of Asian HSCs.

(53) Comment: One commenter stated that dredging beginning in the 1960s has degraded HSC habitat.

Our Response: In the proposed rule (78 FR 60024, p. 60039), we addressed effects to HSC spawning habitat from shoreline stabilization including hard structures and beach nourishment, but not from dredging. We do not doubt that dredging has and continues to degrade HSC habitat in some locations. However, we do not address this issue in the Supplemental Document because we have no information that dredging is impacting HSC habitat in Delaware Bay, which is the only region in which red knots are highly reliant on HSC eggs as a food resource. That said, we have revised the Supplemental Document (Migration and Wintering Food) with new information that HSC eggs are eaten, and often preferred, by red knots along other parts of the U.S. Atlantic coast, and may be a locally important component of the knot's spring diet. Thus, we anticipate that the recovery planning process will include evaluating threats to the HSC egg supply in other areas outside Delaware Bay.

(54) Comment: One State commented that the recent reduction in food availability in Delaware Bay was identified as the most detailed and persuasive threat, but this threat affects only those birds that migrate along the Atlantic coast, and it may not affect all migrating birds equally. The birds wintering along the northern coast of South America or along the Florida peninsula should have a lesser need to gain as much weight because of their shorter migration and may be minimally affected by food reduction. Another commenter stated that the Tierra del Fuego wintering population, which relies most heavily on HSCs, has declined disproportionately.

Our Response: We agree that best available data suggest southern-wintering red knots (from Argentina and Chile) are more reliant on Delaware Bay than are northern-wintering birds (*e.g.,* from northern Brazil and the Southeast), as discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 31–33). We have revised the Supplemental Document (Wintering and Migration Food—Possible Differential Reliance on Horseshoe Crab Eggs) to more clearly present these data, and to emphasize observed differences between red knots that winter in Argentina and Chile versus knots that winter farther north (Wintering—Northern Versus Southern Wintering Regions; Migration—Differences in Migration Strategy by Wintering Area). However, we conclude that the best available data are insufficient to evaluate effects of the HSC harvest on northern-wintering red knots over recent decades, and we cannot conclude they were ''minimally affected'' by food reduction in Delaware Bay. We presented information about the Tierra del Fuego wintering population decline in the proposed rule (Rufa Red Knot Ecology and Abundance pp. 39–45; 53) and have revised the Supplemental Document (Wintering—Northern Versus Southern Wintering Regions) to clarify and emphasize this point.

(55) Comment: One State commented that the 70 percent loss of HSC spawning habitat in Delaware Bay reported in the proposed rule due to Hurricane Sandy is only reflective of New Jersey and not, necessarily, Delaware. The State said it is also difficult to determine how the 70 percent loss was quantified or how much of any such loss can actually be attributed to that one event. Another commenter agreed with the estimate of a 70 percent decrease in HSC spawning from Hurricane Sandy and noted that, while the beach was restored in time for the red knot spring stopover because of successful fundraising efforts, a similar winter or early spring storm could result in beaches stripped of sand with no time or funds for restoration.

Our Response: As noted in the proposed rule, biologists found a 70 percent decrease in optimal HSC spawning habitat in New Jersey following Hurricane Sandy (Niles *et al.* 2012, p. 1), and beach nourishment is being pursued as a means of restoring this habitat (Niles *et al.* 2013a, entire Niles *et al.* 2013b, entire). We have revised the Supplemental Document (Factor A—Accelerating Sea Level Rise—United States—Northeast and Mid-Atlantic—Delaware Bay Horseshoe Crab Habitat) to clarify that the 70 percent loss refers to the New Jersey side of Delaware Bay only, and that this loss is relative to 2002 but was identified by Niles *et al.* (2012) to be mostly a result of Hurricane Sandy.

We agree that changes in storm patterns may be a threat to the red knot. While variation in weather is a natural occurrence and is normally not considered a threat to the survival of a species, persistent changes in the frequency, intensity, or timing of storms at key locations where red knots congregate (*e.g.,* key stopover areas) due to climate change can pose a threat. Storms impact migratory shorebirds like the red knot both directly and indirectly, including through changes in habitat suitability. Beach losses accumulate over time, mostly during storms, and even the long-term coastal response to sea level rise depends on the magnitudes and timing of stochastically unpredictable future storm events (Ashton *et al.* 2007, pp. 7, 9). Should storm patterns change, red knots in Delaware Bay would be more sensitive to the timing and location of coastal storms than to a change in overall frequency. Changes in the patterns of tropical or extra-tropical storms that increase the frequency or severity of these events in Delaware Bay during or just prior to May would likely have dramatic effects on red knots and their habitats (Kalasz 2008, p. 41) (*e.g.,* through direct mortality, delayed HSC spawning, delayed departure for the breeding grounds, and short-term habitat loss) (78 FR 60024, pp. 60028–

60029, 60032, 60034, 60037, 60073). This information is presented, unchanged and under the same headings, in the Supplemental Document.

(56) Comment: One State commented that the potential near-term threat posed by sea level rise is reduced by the fact that coastal habitats are likely to shift and re-form as sea level changes, except in those areas that are armored or constrained by coastal infrastructure (78 FR 60024, p. 60032).

Our Response: We agree. However, as noted in the proposed rule (78 FR 60024, p. 60035), if shorelines experience a decades-long period of high instability and landward migration, the formation rate of new beach habitats may be slower than the rate at which existing intertidal habitats are lost. In addition, low-lying and narrow islands may disintegrate rather than migrate, representing a net loss of red knot habitat. Furthermore, the extent to which habitat migration is constrained by human activity is extensive—about 40 percent of the U.S. coastline within the range of the red knot is already developed (78 FR 60024, p. 60042). These conclusions are supported by new studies evaluating the vulnerability of shorebirds (including *Calidris canutus*) to sea level rise (Galbraith *et al.* 2014, p. 7; Iwamura *et al.* 2013, p. 6; National Wildlife Foundation 2013, p. 28; Whitman *et al.* 2013, pp. 2, 19, 64); we have added these updates to the Supplemental Document (Factor A—Sea Level Rise).

(57) Comment: One State commented that, within the listing proposal, all of the potential impacts that are predicted to occur as a result of sea level rise are based upon geomorphic modeling that assumes a 1-meter (m) increase in sea level. At the current rate of sea level rise, which ranges from 2.5 to 3.5 millimeters (mm)/year (78 FR 60024, pg. 60030), the 1-m threshold will not be reached for another 140 to 300 years. Even the low end of this range is well beyond the temporal scope that should be applied to a listing decision.

Our Response: We disagree with the commenter's projected rate of sea level rise, and conclude that appreciable effects to red knot habitats from accelerating rates of rising sea levels are likely to begin over the next few decades, not centuries (Iwamura *et al.* 2013, p. 6; Miller *et al.* 2013, pp. 3, 14; Vargas *et al.* 2013, pp. 22, 80; Galbraith *et al.* 2002, pp. 177–178). In fact, erosion has already led to loss of roost habitat in Delaware Bay (Niles *et al.* 2008, p. 97) and we expect ongoing erosion due to sea level rise to accelerate. As discussed in the proposed rule (78 FR 60024, p. 60029), and updated in the Supplemental Document (Factor A—Sea Level Rise—Rates), the rate of sea level rise has accelerated and is ''very likely'' to increase further (IPCC 2013a, p. 25). Although estimated future rates remain rather uncertain, some research suggests that sea levels could potentially rise another 2.5 to 6.5 ft (0.8 to 2 m) by 2100. The IPCC (2013a, p. 26) recently concluded there is ''low confidence'' in sea level rise projections over 3.3 ft (1 m) by 2100. However, for the most recent National Climate Assessment (Melillo *et al.* 2014), Parris *et al.* (2012, p. 2) evaluated various sea level rise scenarios and have ''very high confidence'' that global mean sea level rise will be between 0.7 and 6.6 ft (0.2 and 2.0 m) by 2100, which is generally the range we considered in this listing determination.

(58) Comment: Several States noted the beneficial effects of beach nourishment in maintaining habitat for red knots and other shorebirds. These States urged the Service to use caution when discussing the detrimental impacts of hard structures and beach nourishment as restoration or coastal protection strategies. These States commented that experience clearly demonstrates the value of such techniques to red knot beach habitats in Louisiana, and that beach nourishment is the best and only method to maintain and prevent the loss of suitable HSC spawning habitat due to erosion and sea level rise in a hydrologic system with limited sediment input, such as Delaware Bay. Likewise, one commenter noted that not all portions of the coast are equally impacted by erosion (*i.e.,* from sea level rise); thus, restrictions stemming from listing should be allowed to vary geographically and should leave open management options for habitat and beach restoration projects.

Our Response: We make a distinction between beach nourishment and beach stabilization structures (*i.e.,* hardening structures). With few exceptions, we have concluded that hard structures are detrimental to red knot habitat (Winn *et al.* 2013, p. 22). In contrast, beach nourishment may be either detrimental or beneficial depending on the circumstances (Nordstrom and Mauriello 2001, entire; Defeo *et al.* 2009, p. 4; Rice 2009, entire; Peterson *et al.* 2006, entire; Peterson and Bishop 2005, entire; Greene 2002, p. 5). The effects of beach nourishment are expected typically to be short in duration. Human attempts to harden the shoreline are considered generally a threat to the red knot, because hardening curtails the natural coastal processes that create and maintain the most suitable red knot habitats. Notwithstanding our overall conclusion on stabilization, we noted in the proposed rule (78 FR 60024, p. 60037) that, in a few isolated locations, hard structures may enhance red knot habitat, or may provide artificial habitat. We also noted that, where shorebird habitat has been severely reduced or eliminated by hard stabilization structures, beach nourishment may be the only means available to replace any intertidal habitat for as long as the hard structures are maintained (78 FR 60024, p. 60037). Further, wholesale reorganizations of barrier systems and the loss of some low-lying islands may occur under scenarios of rapid sea level rise, and shorelines may experience a decades-long period of high instability during which the formation rate of new red knot habitats may be slower than the loss of existing habitats, as indicated in the proposed rule (78 FR 60024, pp. 60032, 60035).

We agree with the commenters that, under such circumstances, human intervention in coastal processes may be the only means of maintaining shorebird habitat. Due to local and regional factors, Louisiana is already experiencing extreme rates of land loss and barrier island disintegration; we acknowledge that Louisiana's stabilization efforts may be maintaining habitat in areas where it would otherwise be lost. We likewise acknowledge the benefits of beach nourishment to red knot foraging habitat in Delaware Bay. Thus, we have revised the Supplemental Document (Factor A—U.S. Shoreline Stabilization and Coastal Development) to further note that both hard and soft (beach nourishment) stabilization efforts may also benefit red knots under circumstances of rapid erosion and land loss due to accelerating rates of sea level rise, locally or regionally exacerbated by limited sediment inputs. Coastal management projects generally involve Federal funding or authorization and may, therefore, be reviewed on a case-by-case basis under section 7 of the Act, thus ensuring flexibility for geographic differences.

(59) Comment: One State and several other commenters stated that the loss or impairment of other migration staging areas (outside of Delaware Bay) is of great importance to the red knot especially at low population levels. Geolocator data show that red knots spend considerable portions of their life cycle along the Atlantic coast, and that their habitat use and needs during fall migration demand greater attention. July and August are the months when the

greatest numbers of red knots occur along the Atlantic coast. This period is also the time when beaches and other coastal areas are under the most pressure from human activities, thus creating the greatest potential for disturbance to migrating red knots. Wintering areas used by red knots, particularly in the Southeast, also are subject to intense and persistent recreational use.

Our Response: We agree. In the proposed rule and in the Supplemental Document, we present a comprehensive analysis of threats to the red knot from habitat loss (Factor A) and disturbance (Factor E) throughout its range. Conservation actions to abate these threats will be evaluated during the recovery planning process.

(60) Comment: One State and several other commenters noted that red knots are part of one of the largest congregations of migrating shorebirds in North America, a congregation that converges along the shores of the Delaware Bay and contributes significantly to the local economy (*e.g.,* through ecotourism). The threatened status of the red knot is substantiated by the similar decline in a long list of other Arctic-nesting shorebirds, including other species that use Delaware Bay as a primary staging area during spring migration and rely on HSC eggs during the spring staging period. Further, listing the red knot and creating the basis for recovery will improve the situation for all of these shorebirds. Likewise, some commenters concluded that listing the red knot will benefit other shorebirds that share its wintering habitat in the United States. Conversely, some commenters suggested that listing the red knot may not be necessary because this species already receives incidental protections due to its geographic overlap with other protected species and protected areas.

Our Response: The Service recognizes the importance of Delaware Bay to other shorebird species besides the red knot, and the importance of the bay's ecosystem to local communities. We also recognize that listing the red knot may bring incidental conservation benefits to other species that share its habitats in Delaware Bay and rangewide. However, the Act requires that we use only the best available scientific and commercial data to evaluate whether a species meets the definition of a threatened or endangered species based on the five ''listing'' factors (section 4(a)(1)(b)). Thus, in making a listing determination, we may not consider the implications of possible listing for other species, the broader ecosystem, or local communities. (Once a species is listed, however, conservation of its supporting ecosystems is a principal focus of our recovery planning, and a central purpose of the Act.) We evaluated the conservation efforts that are already benefitting the red knot, including those that accrue from its overlap with other listed species and its occurrence in some protected areas. Notwithstanding several important ongoing conservation efforts, we conclude that the rufa red knot meets the definition of a threatened species, based on best available data. See *Our Response 2* regarding other implications of listing that we may not consider in evaluating whether a species meets the definition of a threatened or endangered species under the Act.

(61) Comment: Juvenile red knot survival and recruitment into the adult population may currently be the most significant factor facing the species. Over the past decade, juvenile survival has been low and recruitment into the adult population has been limited. Little is known about where juveniles spend their first 2 years or their survival rate. Given the suggestion that their range is in the Caribbean or northern South America, there is potential that hunting could impact survival, as juveniles would be more vulnerable to hunting pressure.

Our Response: We agree it is possible that low juvenile survival and recruitment may be limiting population growth, and that juvenile survival may be impacted by hunting (*e.g.,* if juveniles spend a large percent of their annual life cycle in regions where shorebirds are hunted, if juveniles are naïve to hunting, or both). Because we find these theories plausible and worthy of further investigation, we have mentioned them in the Supplemental Document (Longevity and Survival; Factor B—Hunting—Caribbean and South America). However, we note that these theories currently lack supporting documentation. We have also updated the Supplemental Document (Breeding—Nonbreeding Birds; Wintering—Juveniles; Migration) with the first two available geolocator results from juvenile birds showing where they spent their first years.

(62) Comment: Several States and other commenters stated that wind energy development was an unlikely threat to the red knot in the interior United States because research by Newstead *et al.* (2013) indicates that midcontinental migrating birds travel at a rate of approximately 58 km per hour. It is unlikely that birds could migrate this rapidly by flying at low altitude. Most likely, these birds are migrating at a height of several thousand feet and are passing well above all wind turbines and communications towers. Conversely, one commenter rebutted that the referenced speed is an average of the minimum flight speeds of those individuals. In reality, birds experience both headwinds and favorable tailwinds over the duration of a 2- or 3-day nonstop flight, which would effectively reduce or increase their speed, respectively. It is also likely that the birds would increase or decrease their altitude in response to those conditions, so it is not appropriate to infer that all flights follow the same trajectory or altitude. Further, red knots and other shorebirds are capable of considerable speeds in still air, approaching or exceeding 58 km per hour. Thus, red knots would not necessarily need the wind assistance found at high altitudes to achieve the estimated (average, minimum) flight speed.

Our Response: As discussed in the proposed rule (78 FR 60024, p. 60090), some experts estimate the normal cruising altitude of red knots during migration to be in the range of 3,281 to 9,843 ft (1,000 to 3,000 m), well above the estimated height of even a 10-MW turbine (681 ft; 207.5 m). However, much lower flight altitudes may be expected when red knots encounter bad weather or high winds, on ascent or descent from long-distance flights, during short-distance flights if they are blown off course, during short coastal migration flights, or during daily commuting flights (*e.g.,* between foraging and roosting habitats) (Burger *et al.* 2012c, pp. 375–376; Burger *et al.* 2011, p. 346). Supporting evidence for these expert opinions comes from other *Calidris canutus* subspecies and other shorebirds in Europe (see Supplemental Document section Factor E—Wind Energy Development—Offshore). Although the aforementioned sources constitute best available information, we lack any direct empirical data to verify the typical migration altitude of rufa red knots, or the degree to which they adjust their migration altitudes in response to weather or other factors. We agree that, typically, red knots on long-distance, nonstop flights likely migrate at high altitudes of 3,281 feet (1,000 m) or more (Burger *et al.* 2011, p. 346). However, we disagree with the interpretation that the minimum flight speed calculated by Newstead *et al.* (2013) indirectly indicates the migration altitude of red knots along the Central Flyway; thus, we have not incorporated this interpretation into the Supplemental Document. (Also see *Our Response 22.*)

(63) Comment: One State commented that the proposed rule failed to include the dwarf surf clam (*Mulinia lateralis*)

as an important food resource to fall migrating red knots in Georgia. This State noted densities of dwarf surf clam vary widely from year to year, appearing to drive the number of red knots using certain areas, and they are concerned that a number of predicted changes associated with global climate change (ocean acidification and warming) may negatively affect this important prey item.

Our Response: In the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 26–27), we noted that the spatial distribution of red knots has been correlated with prey availability in Georgia, and that the dwarf surf clam is a prey species in Georgia during winter. We have revised the Supplemental Document (Migration and Wintering Food) to indicate that the dwarf surf clam is also a primary prey species for knots during fall. We have also revised the Supplemental Document (Factor E—Reduced Food Availability—Ocean Acidification; Temperature Changes) to include new information provided by the commenter regarding the likely impacts of climate change on the dwarf surf clam in Georgia.

(64) Comment: Several States and other commenters provided new information regarding habitat and prey in inland areas (*e.g.,* some knots may use saline lakes in southern Canada, such as Reed, Chaplin, and Quill Lakes, that are known to support large, mixed-species shorebird concentrations due to abundant invertebrate resources), while other commenters contend that red knots may not use inland stopover sites during migration because of the unpredictable availability of appropriate prey. Within the interior portion of the Central Flyway, water levels fluctuate dramatically; therefore, few sites have reliable gastropod resources, and none support freshwater mussels at a depth that would be available to red knots.

Our Response: We agree that new information available since the proposed rule was published suggests that some red knots likely use inland saline lakes as stopover habitat in the Northern Great Plains. We have no information to indicate whether red knots may also use inland freshwater habitats during migration, but some of the new information discussed under *Our Response 29* suggests that certain freshwater areas may warrant further study as potential stopover habitats. We have added this new information to the Supplemental Document (Migration—Midcontinent; Migration and Wintering Habitat—Inland). We also agree that inland prey resources may be unpredictable. Newstead *et al.* (2013, p. 57) supported the idea that inland prey resources may be unpredictable, but showed inland stopovers are used by red knots in some years. At least on smaller geographic scales (*e.g.,* stopover areas in Argentina, Georgia, South Carolina, Virginia, the Atlantic coast of New Jersey, and Delaware Bay), knot distribution has been shown to follow areas of high prey availability, suggesting some plasticity in migration strategy as prey resources vary in time and space (Musmeci *et al.* 2011). Likewise, Newstead *et al.* (2013, pp. 57–58) have suggested that knot use of the Northern Great Plains may vary from year to year based on water levels. Geolocator data indicate the midcontinental flyway is consistently used by some birds, but the stopovers within this migratory route may vary depending on environmental conditions. These conclusions continue to be borne out by many more geolocator tracks that have yet to be published (D. Newstead pers. comm. May 8, 2014).

(65) Comment: Several States and other commenters suggested the Service should conduct a thorough literature review of all available resources to determine where the red knot occurs regularly because the species' conservation and recovery will be most effective if they remain focused on the important coastal habitats that are used by all individuals.

Our Response: We agree with this conclusion, but assert that we have already conducted a thorough review of the literature available. Identifying and protecting the network of important red knot sites is work that has been ongoing by an international community of shorebird researchers and conservationists since the late 1970s and continues today. The results of this extensive work were reviewed in depth for the proposed rule and the Supplemental Document, and will be further utilized and built upon during recovery planning.

Public Comments

(66) Comment: A commenter stated that the proposed rule does not comply with applicable law because the ''foreseeable future'' used by the Service in this instance is not expressly identified or otherwise explained. Upon reconsideration, should the Service decide to proceed with a threatened listing, it must issue a new proposed rule that clearly identifies the applicable ''foreseeable future,'' explains the Service's bases for identifying that foreseeable future, and describes how the Service's interpretation is consistent with the language and intent of the Act. The best available scientific data and information, previous findings by the Service, and applicable case law all dictate that a foreseeable future premised upon climate change impacts does not extend past mid-century.

Our Response: The Act does not define the term ''foreseeable future,'' and the Act and its implementing regulations and policies do not require the Service to quantify the time period of foreseeable future. For each threat evaluated in the proposed rule and in the Supplemental Document, we have specified, when possible, the time horizon over which we conclude likely effects to the red knot can be reasonably foreseen.

(67) Comment: A commenter stated that if the Service proceeds with a determination to list the rufa red knot as threatened, the Service must issue a special rule pursuant to section 4(d) of the Act that exempts from the section 9 take prohibition all lawful activities that have not been found to directly and adversely impact the rufa red knot species. To avoid unnecessary and unintended burdens, or the misuse of the Act, the Service should propose a special 4(d) rule. Further, the Service's rationale in support of the polar bear 4(d) rule applies equally to the red knot.

Our Response: The Act does not specify particular prohibitions for threatened species. Instead, under section 4(d) of the Act, the Secretary of the Interior was given the discretion to issue such regulations as she deems necessary and advisable to provide for the conservation of such species. Exercising this discretion, the Service has developed general prohibitions (50 CFR 17.31) and exceptions to those prohibitions (50 CFR 17.32) under the Act that apply to most threatened species. At this time, we have no information to suggest that the take prohibitions are not ''necessary and advisable to provide for the conservation'' of the rufa red knot to justify a species-specific 4(d) rule that exempts certain activities from the take prohibition. However, we will reevaluate this decision in the future if new information becomes available that indicates a change in the 4(d) regulations may be necessary and advisable for the red knot's conservation.

(68) Comment: One commenter requested clarification regarding how the public comments are evaluated by the Service, and how different comments are weighed, so that the analysis and decision-making are based on the input received.

Our Response: We have reviewed all the public comments for substantive new information and for any

substantiated alternative interpretations of information we previously considered. To the extent that such new information and new interpretations represent best available data, we have incorporated them into the Supplemental Document and evaluated them in light of our threats assessment using the five listing factors set forth in section 4 of the Act. Oral testimony on a proposed rulemaking given at a public hearing is given the same weight as written comments received during the open public comment period.

(69) Comment: One commenter stated that the Service failed to conduct, and provide for comment on, analysis required by the Act in its proposal to list the rufa red knot.

Our Response: We disagree. As stated above, the proposed rule to list the red knot as threatened under the Act was published in the **Federal Register** on September 30, 2013 (78 FR 60024) and made available for public comment for a total of 133 days (78 FR 60024; 79 FR 18869; 79 FR 27548). In addition, three separate public hearings were held on the proposal, which exceeded the requirement to hold one hearing if requested. As explained above under numerous responses to comments, we appropriately evaluated whether the red knot meets the definition of a threatened or endangered species under sections 4(a) and 4(b) of the Act.

(70) Comment: Several commenters expressed concern about how we conduct peer review or use peer-reviewed documents, stating that scientific peer review should happen before proposing a species for listing, not during the public comment period, and that the Service should include the peer review results next to any cited information that it disseminates to the public in hearings, documents, and the **Federal Register**. Likewise, one commenter stated that designation of a species as threatened must be based on unquestionable scientific evidence gathered and analyzed before the designation, not after.

Our Response: As detailed in *Our Response 71* below, we use several sources of data in our listing determinations, including articles from peer-reviewed journals. In addition, the Service's 1994 Interagency Cooperative Policy for Peer Review in Endangered Species Act Activities (59 FR 34270) specifies that we will ''(a) Solicit the expert opinions of three appropriate and independent specialists regarding the pertinent scientific or commercial data and assumptions . . . (b) Summarize in the final decision document (rule or notice of withdrawal) the opinions of all independent peer reviewers received.'' We have complied with the Policy by soliciting peer review during the open public comment period so that any peer review comments received would be transparently available to the public; peer reviewer comments were posted in the proposed rule's docket at *www.regulations.gov* along with all other received comments. In addition, we made the list of references reviewed and cited for the proposed rule available via the proposed rule's docket at *www.regulations.gov,* properly identified those citations in the proposed rule, and made it clear in the proposed rule (78 FR 60024, p. 60025) that these references, along with other information in the decision record, were available for public inspection by appointment at the Service's New Jersey Field Office. Information about the proposed rule summarized in presentations at the public hearings may not have explicitly identified the citations due to size limitations on the PowerPoint© slides, but hearing participants could obtain this information by reading the proposed rule and supporting documents, visiting *www.regulations.gov,* or making an appointment with the New Jersey Field Office. As required by the Act, we relied on best available data in determining that the red knot meets the definition of a threatened species in both the proposed and final rules. We disagree that listing requires ''unquestionable scientific evidence.'' Rather, as discussed in *Our Response 27,* the Service is required to rely solely upon the ''best available'' science, even if that science is uncertain. New information that becomes available after listing will be considered during recovery planning and implementation, and in the course of status reviews we conduct every 5 years to determine if the species continues to meet the definition of a threatened or endangered species.

(71) Comment: One commenter suggested that the quality of the data in the proposed rule was undermined by the number of personal communications and unpublished sources cited in the document. The reliance on unpublished data and personal communications suggest a link to falsified data. Likewise, one commenter stated that the information contained in the proposal and in supporting documents does not meet the scientific standards, and another commenter found that the best available science is poor and incomplete science at best.

Our Response: We disagree. The Service is required to make listing determinations based on the best scientific and commercial data available. Sources of data include peer-reviewed journal articles; field notes and other unpublished data; and personal communications from species, habitat, and policy experts. We analyze all available sources of data and use our best professional judgment to determine their credibility, in accordance with applicable data standards (Interagency Policy on Information Standards Under the Endangered Species Act (59 FR 34271); Information Quality Act (P.L. 106–554, section 515); Information Quality Guidelines and Peer Review (USFWS 2012f, entire)). As required by the Interagency Policy on Information Standards Under the Endangered Species Act, all sources we reviewed have been retained as part of the decision record, and all sources we relied upon are listed in the Literature Cited section of the Supplemental Document and were available for public review. We are not aware of any documented instances of falsification or any other scientifically unethical practices associated with any of the data we cited in the proposed rule, this final rule, or the Supplemental Document. As discussed in *Our Response 27,* the ''best available science'' requirement does not equate to the best possible science. Although we acknowledge certain data gaps (78 FR 60024–60025) and uncertainties, some of which are inherent in all natural systems and all evaluations of future conditions, we conclude that overall the best available data are sufficient to document several population-level threats to the red knot, as well as its reduced population size relative to the early 1980s, and thus conclude that the red knot meets the definition of a threatened species.

(72) Comment: One commenter suggested that some red knot researchers inappropriately published the same data in two or more publications; designed research to give inaccurate results; and excluded, altered, or manipulated data. Further, vague or ambiguous language in the red knot data may rise to falsification, fabrication, and scientific fraud. This commenter states that the inclusion of flawed data in the 2007 red knot status assessment prepared for and disseminated by the Service violates the Service's information quality standards; the Service was informed during peer review of the 2007 status review that several of the citations were in error, including inappropriate interpretation of data as evidence of red knot declines.

Our Response: We disagree. We are not aware of any documented instances of falsification or any other scientifically unethical practices associated with any of the data we cited in the proposed rule, this final rule, or the Supplemental

Document. See *Our Response 71* above on our data standards. The 2007 document ''Status Review of the Red Knot (*Calidris canutus rufa*) in the Western Hemisphere'' was prepared for the Service by a group of independent red knot experts and made available on our Web site. An updated version was published independent of the Service in 2008 (Niles *et al.* 2008, entire). While some of the information in Niles *et al.* (2008) has been subsequently updated with new information and improved insights, we have used appropriate information from Niles *et al.* (2008) in our listing determination whenever we consider it reliable, current, and best available.

(73) Comment: One commenter stated that the Service has red knot bird banding data from North and South America and will not release these data, citing privilege to authors.

Our Response: This comment is incorrect. Most data regarding the marking and resighting of red knots are housed and maintained by BandedBirds.org, which is affiliated with the New Jersey Audubon Society. Although the Service has provided support to BandedBirds.org, we do not operate this database, nor set the policies regarding the dissemination of the data it contains. Throughout the proposed rule and the Supplemental Document, we present summary information, analysis, and conclusions drawn from BandedBirds.org data. This is possible because we obtained limited excerpts from the database through a data sharing agreement with BandedBirds.org, and we coordinated with the database manager to ensure that we obtained all necessary permissions from the individual contributors of the data, as per the policies of BandedBirds.org. These excerpts have been and remain available to the public by appointment at the Service's New Jersey Field Office. Certain red knot resightings data are also available to the public directly at BandedBirds.org, and access to additional data can be requested from the database administrator.

(74) Comment: One commenter noted that there are six subspecies of *Calidris canutus* and that the Service needs to know more about the other five subspecies to make a decision about *C.c. rufa.* This commenter contends that all the subspecies migrate to the same area, albeit by different routes, and breed in the same area. However, no one knows for certain if they interbreed or not.

Our Response: We disagree with this assessment. In the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 4–7, 9), we presented best available data that the three recognized North American subspecies do not interbreed. We have updated the Supplemental Document (Subspecies Nonbreeding Distributions) with new information regarding the nonbreeding ranges of *Calidris canutus rufa* and *C.c. roselaari.* There are a few areas of known overlap and additional regions of potential overlap between the nonbreeding distributions of these two subspecies. However, all newly available information supports our previous conclusions that the breeding areas of these two subspecies are distinct, with *C.c. roselaari* breeding in Alaska and eastern Russia, and *C.c. canutus* breeding in the central Canadian Arctic. Although *C.c. islandica* breeds in Canada just north of *C.c. rufa,* the *islandica* subspecies migrates and winters in Europe and does not occur in the United States. The other three subspecies do not occur in North America.

(75) Comment: One commenter stated that the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, cited by the respected Cornell University Lab of Ornithology, lists the conservation status of the red knot as one of ''Least Concern'' and, therefore, concludes the science does not support the Service's proposal.

Our Response: Under section 4 of the Act, a species shall be listed if it meets the definition of a threatened or endangered species because of any of the five factors, considering solely best available scientific and commercial data. We may not adopt the conservation classification criteria of other agencies or organizations, such as the IUCN. However, we do evaluate and consider the underlying data other agencies or organizations have relied upon in making their own conservation classifications. Thus, we have reviewed the IUCN Red List (BirdLife International 2012), and found that the data presented by this source are for the entire global population (all six subspecies) of *Calidris canutus,* and are not specific to the rufa red knot, and are thus not relevant to this listing determination for the *rufa* subspecies. However, based on this review of the IUCN's underlying data sources, we have made a minor revision to the Supplemental Document, specifically, the addition of a new reference (Goldfeder and Blanco *in* Boere *et al.* (2006, p. 193)), which supports several of the threats that were already detailed in the proposed rule.

(76) Comment: One commenter stated that many threats to red knots are pervasive across the Gulf coast. For example, habitat loss is occurring across the Gulf Coast (from alteration of hydrology to development and from sea level rise to mismanagement of the Mississippi River), and disturbance of migrating and wintering birds is common.

Our Response: We agree that these and other threats are likely contributing to habitat loss, anthropogenic mortality, or both, along the Gulf coast, and thus contribute to the red knot's threatened status, particularly considering the cumulative effects of these and other threats rangewide.

(77) Comment: Several commenters expressed concern over the apparent contradiction between the Service justifying a threatened status for red knot while acknowledging difficulty in estimating the total population of red knots and recognizing that knot numbers have been stable in recent years.

Our Response: First, we disagree that there is a contradiction. While a precise estimate of a species population is an ideal piece of information to have, it is not a required piece of information for a listing determination. Under section 4 of the Act, a species shall be listed if it meets the definition of a threatened or endangered species because of any (one or more) of the five factors (threats), considering solely best available scientific and commercial data. Although many species proposed for listing have undergone, or are undergoing, a population decline, declining numbers are not required for listing if a species is facing sufficient threats, now or in the foreseeable future, to meet the definition of a threatened or endangered species. Based on our analysis of the five factors, we conclude the red knot meets the definition of a threatened species, particularly considering the cumulative effects of ongoing and emerging threats, and considering that several populations of red knots have already undergone considerable declines and remain at low levels. Second, although we have concluded that no current, reliable, rangewide population estimate is available, we disagree that no reliable population statistics are available. We have evaluated the best available population data, consisting of survey data for specific regions (Rufa Red Knot Ecology and Abundance, pp. 38–52; Population Surveys and Estimates in the Supplemental Document); see *Our Responses 37, 38,* and *44* for additional information.

(78) Comment: One commenter stated that the threat identified by the Service as driving the recent population decline has been addressed by management of

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the HSC fishery. Therefore, the red knot may already be on a course to recovery without listing.

Our Response: We disagree with this conclusion. Although the threat from HSC harvest is adequately managed under the ARM and red knot populations have stabilized, knot numbers remain at low levels. We continue to conclude that reduced food availability at the Delaware Bay stopover site due to commercial harvest of the HSC—combined with late arrival of birds in Delaware Bay for unknown reasons—were the primary causal factors in the decline of rufa red knot populations in the 2000s (78 FR 60024, pp. 60063, 60076). The threat of late arrivals has not been abated, and further asynchronies are likely in the future due to climate change. In addition, we conclude that a number of other threats are likely contributing to habitat loss, anthropogenic mortality, or both, and thus contribute to the red knot's threatened status, particularly considering the cumulative effects of these threats, and that several populations of this species have already undergone considerable declines. (Also see *Our Response 46* regarding new uncertainty about the future of the ARM.)

(79) Comment: Several commenters stated that there are insufficient data to draw credible conclusions about the possible adaptation and recovery of this species. One commenter stated that the species having existed for at least hundreds of years is evidence that it has adapted and survived many previous cycles of natural change without human intervention. Likewise, another commenter stated that, in the millions of years red knots have been in existence, extreme variance in predation, climate, food sources, and other factors have surely occurred, yet, the birds have survived and thrived at times.

Our Response: We disagree that the red knot's ability to survive past cycles of natural change—or even past anthropogenic threats like hunting—are evidence that its adaptive capacity is adequate to survive the threats it currently faces. First, population declines in the 2000s demonstrate the red knot's vulnerability to inadequate food resources and asynchronies. Second, the nature and extent of current threats are unprecedented, as are the scope and rates of some changes that are likely to occur over coming decades. For example, the extent of coastal development and shoreline stabilization has likely never been greater, rates of sea level rise continue to accelerate, and arctic ecosystems are projected to change more in the next 100 years than they did over the last 6,000 years, which is longer than the rufa red knot is thought to have existed as a subspecies. We also disagree that the rufa red knot has been in existence for millions of years. As discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, p. 4), the rufa red knot is thought to have diverged from other subspecies within the past 1,000 to 5,500 years. However, we agree that information is quite limited regarding the adaptive capacity of the rufa red knot. Where we have such information, we stated it in the proposed rule (78 FR 60024, pp. 60028, 60035, 60047–60049, 60054, 60057, 60061, 60071, 60072, 60074, 60075, 60093, 60095).

(80) Comment: One commenter stated that there is no upward trend in rufa red knot populations as measured by any consistently applied methodology.

Our Response: As discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 53–54), we generally concur with this conclusion. One shorter-term data set (2007 to 2013) based on ground counts in Virginia did show an upward trend through 2012 but was down sharply in 2013, and a 2013 count from Brazil was markedly higher but this was likely due, at least in part, to favorable tidal conditions during the survey. However, two data sets associated with high confidence (Tierra del Fuego, Delaware Bay) show stabilization at low levels in recent years following sharp declines in the 2000s. Two other data sets (South American and Virginia spring stopovers) suggest declines in the 2000s relative to the 1990s. All other available data sets are insufficient for trend analysis. Our conclusions regarding trends in available population data are presented, with only minor updates, in the Supplemental Document (Summary—Population Surveys and Estimates).

(81) Comment: One commenter stated that the apparent red knot decline is based on the inconsistent methodologies, geographic areas, dates, and times of day, and compares multiple years' estimates against a single day. Further, total rangewide population estimates reported by some authors in certain years (*e.g.,* 2004, 2005) have been lower than counts at individual migration stopovers. Likewise, one commenter stated that data are insufficient to draw credible conclusions about the decline of this species.

Our Response: We disagree. We did not rely upon or cite the total rangewide population estimates mentioned by the commenter. In the proposed rule (Rufa Red Knot Ecology and Abundance, p. 53), we concluded that substantial declines occurred in two key red knot areas in the 2000s: The Patagonia and Tierra del Fuego wintering area and the Delaware Bay stopover area. We associated these trends with higher confidence levels based on consistency of methods, coverage, and observers (Rufa Red Knot Ecology and Abundance, pp. 39, 48).

(82) Comment: Several commenters expressed concern with the Service's apparent reliance on eBird data because it is citizen science and not considered scientifically rigorous, is skewed towards recreational birders and easily accessible locations, and is not representative of all the places, known or unknown, red knots utilize. The red knot population does not breed in colonies, which makes gathering credible population data beyond the reach of recreational birders. There are certain areas where red knot counts are made, mostly where birdwatchers are. Many more red knots may be utilizing unknown habitats and thus may be missed by surveys.

Our Response: First, we disagree that citizen science cannot be scientifically rigorous. Specific to eBird, we have reviewed the quality control protocols, which include vetting to minimize the risk of mistaken bird identification. Second, we conclude that, for some parts of the red knot's range (*e.g.,* interior States) during some seasons (*e.g.,* migration), eBird data represent the best available information. However, we agree that eBird data include reports from recreational birdwatchers, which are likely skewed toward those times and places that birdwatchers are active. The data are also temporally skewed, with far more recent than historical records, likely due to the growing access and popularity of recording observations electronically. For these reasons, we have not interpreted eBird records as a complete geographic representation of the range, nor have we relied upon these data for trend analysis. We did consider eBird, along with other data, for certain purposes relevant to listing, such as documentation or seasonality of occurrence in a particular area. We note that eBird records for *Calidris canutus* do not distinguish among subspecies; see *Our Response 35* and the Supplemental Document (Subspecies Nonbreeding Distribution) regarding how we have delineated the nonbreeding ranges of *C.c. rufa* versus *C.c. roselaari* based on best available data.

Third, we have relied on numerous data sets for our analysis of population trends (see Population Surveys and

Estimates in the Supplemental Document). Long-term professional (as opposed to volunteer) surveys have been conducted in several key areas because these areas are known to support important concentrations of red knots and other shorebirds, not based on convenient locations. Sharp and protracted declines in two of these areas (Tierra del Fuego and Delaware Bay) in the 2000s were an important consideration in our listing determination, although declining numbers (rangewide or in portions of the range) are not necessary for listing if a species is facing population-level threats (see *Our Responses 27* and *77*). We agree that the vast and remote breeding range of the rufa red knot, along with its solitary nesting habits, largely preclude any comprehensive surveys on the breeding grounds, either professional or volunteer. Nonetheless, we conclude that credible population data can and are collected in certain nonbreeding areas through consistent ground and aerial counts and, more recently, have been calculated by mathematical modelling based on resightings of marked birds.

Finally, we agree that not all red knot habitats are fully known, and some portions of the range are difficult to access or accurately survey. Although new information continues to emerge about such areas, new information available since the proposed rule has not changed our assessment of red knot population declines in Delaware Bay and Tierra del Fuego in the 2000s, or our evaluation of threats facing this species.

(83) Comment: One commenter stated that no controlled studies have been done to compare current red knot populations to prior red knot populations for the same area. In addition, the two areas (breeding and wintering) where this species spends most of the year are remote and not conducive to accurate population and biological studies.

Our Response: We disagree. While the size and remoteness of the breeding grounds have generally precluded comprehensive surveys, red knots typically spend only about 4 to 6 weeks per year in the Arctic. The rest of the year the birds use migration and wintering habitats. Repeated annual counts are available for several nonbreeding areas, some of them remote. Some of these counts date back to the early 1980s (see Population Surveys and Estimates in the Supplemental Document). In addition, we have gathered best available historical data dating back to the mid-1800s, as presented in the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 33–36) and the Supplemental Document (Historical Distribution and Abundance). Although these historical data do not permit a quantitative analysis, they do convey a consistent qualitative account of historical population trends.

(84) Comment: One commenter stated that the notion that Delaware Bay is the only place used by rufa red knots omits Virginia's red knot counts, which the commenter states represent 74 percent of the red knot population in some years.

Our Response: We agree that Delaware Bay is not the only important spring stopover area. However, due to the HSC egg resource, we conclude that no single stopover area is more important for the red knot than the Delaware Bay (Harrington 1996, p. 73). As discussed under *Our Response 38,* we have analyzed more recent population data and conclude that Delaware Bay continues to supports the majority of red knots each spring. Notwithstanding the importance of Delaware Bay, the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 17–23) and the Supplemental Document (Migration) also present information about numerous other stopover areas across the species' range, including Virginia. We agree that Virginia is an important spring stopover site, but disagree that it supports 74 percent of the total red knot population. We do not have an estimate of the percent of the total rufa red knot population that uses Virginia. However, by comparing late-May peak counts from Virginia and Delaware Bay, we can estimate how the total mid-Atlantic stopover population is typically distributed between these two areas in spring. Across those years with available data (1995, 1996, 2005 to 2014), average peak counts in Virginia were about 40 percent as large as those in Delaware Bay.

(85) Comment: Several commenters noted that annual counts of red knots stopping at Delaware Bay dropped from around 95,000 in 1982 and 1989 to fewer than 15,000 in 2007, 2010, and 2011. Peak counts in 2009, 2012, and 2013 were higher, between 24,000 and 25,000.

Our Response: We agree that the size of the red knot population stopping in Delaware Bay has declined substantially since the 1980s. However, we note that 1982 and 1989 were the all-time high counts in the bay and, therefore, not typical of annual peak counts recorded during this time period. From 1981 to 1983, average peak counts were 59,946, and from 1986 to 1994, average peak counts were 46,886. (See *Our Response 37* regarding the extent of the decline.) We also agree that, on average, counts since 2009 have increased somewhat, and we conclude that the population has apparently stabilized at a relatively low level (compared to baseline data from the 1980s), or slightly increased over this period. The proposed rule (Rufa Red Knot Ecology and Abundance, pp. 48–50) and Supplemental Document (Population Surveys and Estimates—Spring Stopover Areas—Delaware Bay) present the best available data regarding population trends in Delaware Bay.

(86) Comment: One commenter stated that data collection methods in North Carolina are incomplete. Only birds sighted within Cape Hatteras National Seashore are counted and not the birds on surrounding land or the dredge islands in the sound.

Our Response: We agree that data collection in North Carolina is incomplete, but we disagree that surveys occur only in Cape Hatteras National Seashore. While Cape Hatteras staff only survey areas within the National Seashore, additional areas are monitored by others. A public comment letter from North Carolina Wildlife Resource Commission (NCWRC 2013) summarized all red knot data that could be obtained in a timely manner, and shows numbers of red knots along North Carolina's coast, not only in the Cape Hatteras area. Survey efforts outside of Cape Hatteras include aerial surveys of the North Carolina coast, surveys at Cape Lookout National Seashore, surveys at shoals in the New Drum Inlet area, contract shorebird surveys at beach nourishment project areas, shorebird surveys at a storm-created inlet, and red knot observations incidental to other surveys (NCWRC 2013). Although data collection in North Carolina already goes well beyond the Cape Hatteras area, additional survey improvements can be made to increase understanding of the seasonal locations and numbers of red knots in the State (S. Schweitzer pers. comm. June 29, 2014). We anticipate that a holistic, rangewide review of data collection efforts and gaps will be an important component of the recovery planning process.

(87) Comment: Several commenters noted information about red knots along the Gulf Coast. One commenter stated that although several data sets do exist to provide some red knot abundance data, rigorous surveys that are typically used to detect long-term species trends are lacking for many parts of the Gulf coast. Other commenters provided new data, including some anecdotal, regarding declines in the population of red knots wintering on the Gulf of

Mexico from Florida to Texas. Likewise, one commenter stated that long-term data show significant declines of rufa red knots across the Gulf of Mexico.

Our Response: We agree that long-term data sets for the Gulf Coast are lacking and anticipate that a holistic, rangewide review of data collection efforts and gaps will be an important component of the recovery planning process. However, we consider the existing and new data received to be the best available data and have used it appropriately to draw conclusions in the Supplemental Document (Population Surveys and Estimates). Available information is quite limited and localized for Louisiana and Texas, but suggest that declines may have occurred (D. Newstead pers. comm. May 8, 2014; Johnson 2013, p. 1). In eastern parts of the Gulf, any declines likely reflect (at least in part) the shifting of some southeastern knots to the Atlantic coast.

(88) Comment: One commenter stated that the red knot marked with flag B95 has lived at least 20 years. Thus, red knots have a very slow repopulation rate.

Our Response: We do not dispute the age of B95, but we disagree with the conclusion the commenter derives from it. We agree red knot reproductive rates are likely low, but note that little information is available on this issue. First, B95 is the oldest known rufa red knot, and thus believed to be not typical of the average life span. In the proposed rule (Rufa Red Knot Ecology and Abundance, p. 7), we stated that few red knots live for more than about 7 years. We have revised this section of the Supplemental Document (Longevity and Survival) with new information about long-lived individuals, such as B95, that suggests the typical life span may be somewhat longer than 7 years, but 20 years is still considered an outlier. Second, although long life spans can be related to slow reproductive rates in some groups of animals, we have little data to indicate typical reproductive rates in rufa red knots. The Supplemental Document (Breeding Chronology and Success) presents what little data we have regarding red knot reproductive rates. Although there is much uncertainty around typical reproductive rates, certainty is high that the red knot's reproductive success varies widely among areas and years and is highly sensitive to predation and weather, as discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 11–12).

(89) Comment: Several commenters stated that the United States serves only as a migration corridor twice a year. What little bit of time the red knot spends in the eastern United States is a situation that has not been fully studied.

Our Response: We disagree. First, red knots winter along parts of the U.S. coast, mainly from North Carolina to Florida and from Louisiana to Texas. Geolocator data show that red knots wintering in the Southeast-Caribbean and in Texas spent about 60 and 78 percent of their year, respectively, along the U.S. coasts (Newstead *et al.* 2013, p. 55; Burger *et al.* 2012b, p. 1). Second, red knots would be unable to complete their annual migrations without a network of high-quality stopover sites at which to rest and gain weight, as discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, p. 23) and the Supplemental Document (Migration—Stopover Areas).

(90) Comment: One commenter stated that virtually the entire North American population of red knots uses the shores of the Delaware Bay during their migration in the spring. Likewise, another commenter stated that the red knot in North Carolina is at the extremity of its range because 90 percent of the entire population can be found in a single day in Delaware Bay.

Our Response: We disagree. The range of the rufa red knot extends from the central Canadian Arctic to the southern tip of South America. We acknowledge that no single stopover area is more important for the red knot than the Delaware Bay (Harrington 1996, p. 73). However, as discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, p. 29), Delaware Bay provides the final Atlantic coast stopover each spring for the majority of the red knot population, but not the entire population (see *Our Response 38* above). The proposed rule (Rufa Red Knot Ecology and Abundance, pp. 17–23) and the Supplemental Document (Migration) present information about numerous other stopover areas across the species' range. Specific to North Carolina, habitats in this State support wintering red knots, and provide stopover during spring and fall migration (see Population Surveys and Estimates in the Supplemental Document). Some of the same birds that stop in Delaware Bay also winter or stopover in North Carolina (BandedBirds.org 2012; Niles *et al.* 2012a, entire), and new geolocator data from two juveniles show these birds spent much of their first (nonbreeding) year (winter and summer) in the Southeast between North Carolina and Georgia (S. Koch, L. Niles, R. Porter, and F. Sanders pers. comm. August 8 and 12, 2014).

(91) Comment: One commenter provided new geolocator results that several Texas-wintering knots followed a fall migration route along the Atlantic coast, rather than exclusively through the interior of the United States as stated in the proposed rule. While a midcontinental migration is probably the most common strategy, there are exceptions that are potentially important with respect to distinctness of the population, and the caveat about the inherent bias in geolocator studies should be given appropriate consideration. Further, high interannual variability in migratory strategy is illustrated by one individual red knot for which the commenter has 3 full years of migration data. Though some sites were used in multiple years, the actual routes and number of sites varied considerably among years.

Our Response: We thank the commenter, and have added this new information to the Supplemental Document (Migration—Midcontinent). We have also eliminated the referenced statement from the proposed rule, which we agree was an oversimplification, and we have noted the caveat about the inherent bias in geolocator studies (Research Methods). We referenced the new data about the migration of Texas-wintering knots along the Atlantic coast in *Our Response 31.*

(92) Comment: One commenter stated that red knots have not declined, but have instead changed their migratory path and habitat use. Red knots seem to be in smaller groups in many remote places in both North and South America.

Our Response: We agree there is evidence of changes in the use of particular migration stopover areas, both historically (Cohen *et al.* 2008) and more recently (Harrington *et al.* (2010a, pp. 188, 190). We also agree that many additional rufa red knot wintering and stopover areas have been documented in recent decades, some supporting relatively small numbers of birds. However, we attribute these recent findings to increased survey efforts, rather than a shift in migration strategy toward smaller and more widely distributed nonbreeding areas. In fact, there is evidence that, as numbers declined in the 2000s, red knot populations wintering in Argentina and Chile actually become more concentrated, contracting to the core sites on Tierra del Fuego and leaving few birds at the ''peripheral'' Patagonian sites (Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2007, p. 11). Further, we disagree that any such distributional

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changes can explain the observed declines in the 2000s in Delaware Bay in spring, and in Argentina and Chile in winter. We have revised the Supplemental Document (Population Surveys and Estimates—Spring Stopover Areas—Delaware Bay) to clarify that, although we cannot rule out the possibility that some or all of the decline in Delaware Bay could have been caused by birds switching to other U.S. Atlantic stopover areas, we consider this unlikely based on surveys from Virginia, and on similarities in the magnitude and timing of the declines in Delaware Bay relative to Tierra del Fuego and several South American stopover sites.

(93) Comment: Several commenters stated that the longest distance migrants (*i.e.,* those red knots that winter in Tierra del Fuego) are entirely reliant on HSC eggs since the extreme physiological changes that they undergo for migration, including to their digestive systems, restrict their diet to soft prey at stopover sites. While knots from the southeast U.S. wintering areas may still be able to consume small bivalves, the Tierra del Fuego birds cannot.

Our Response: We disagree with the conclusion that red knots from Tierra del Fuego cannot digest bivalves during spring migration. We do recognize that red knots from the Tierra del Fuego wintering area may be more reliant on HSC eggs than other migrating red knots during the spring stopover in Delaware Bay, as we discussed in the proposed rule (Rufa Red Knot Ecology and Abundance, pp. 31–33). However, this section of the proposed rule also discussed data from Virginia and the Atlantic coast of New Jersey, where knots from Tierra del Fuego are known to feed on small bivalves (P. Atkinson pers. comm. November 8, 2012; Smith *et al.* 2008, p. 16). The Supplemental Document (Wintering and Migration Food—Possible Differential Reliance on Horseshoe Crab Eggs) has been revised to more clearly present these data; see *Our Response 54.*

(94) Comment: One commenter stated that recent studies from Dr. Allan Baker at the Royal Ontario Museum in Canada show genetic differences between the rufa population that winters in Florida, the population that winters along the northern coast of Brazil, and the longest distance migrant population that winters in Chile and Argentina. This commenter cites conclusions from Buehler and Piersma (2008) that Argentina-Chile populations are more vulnerable to energy, nutritional, timing, and immune ''bottlenecks'' with potential fitness consequences than the shorter-distance migrant populations of red knots. The commenter believes the red knot is only one species with several populations, but shows that what happens on the tip of one continent can have effects across the flyway.

Our Response: We are aware of this study by Dr. Baker investigating possible genetic differences between red knots by wintering area, but we do not have permission to cite his preliminary results, which have not yet been published. Therefore, we do not consider it to be ''available,'' and thus, we may not consider its findings in our listing determination. We have reviewed Buehler and Piersma (2008) and conclude that both shorter- and longer-distance migrants face tradeoffs among the various ''bottlenecks'' they face throughout their annual cycles. However, we have also revised the Supplemental Document (Wintering—Northern Versus Southern; Migration—Differences in Migration Strategy by Wintering Region) to discuss more fully the observed differences between northern- and southern-wintering knots, including evidence of greater vulnerability of the southern-wintering group (the longest-distance migrants) to food supplies and arrival times in Delaware Bay. Based on the best available data, we agree that the rufa red knot represents one subspecies with several wintering populations. We also agree that substantial threats anywhere along the flyway can potentially result in population-level effects.

(95) Comment: One commenter stated that, while *Calidris canutus* is somewhat unique among shorebirds as being a specialized molluscivore during much of its annual cycle, consumption of prey aside from mollusks in nonbreeding areas is well-documented, especially during prolonged migratory stopovers (*e.g., C.c. rufa* and HSC eggs in Delaware Bay and *C.c. roselaari* and Pacific grunion eggs in the Gulf of California). The documented red knot stopovers in the Northern Great Plains and the seasonal emergence of insect populations in the Central Flyway, various invertebrates on riverine sandbars, and brine shrimp in the saline lakes of Saskatchewan may be an ecological correlate to HSC eggs in the Atlantic flyway.

Our Response: Because we find these ideas plausible, based on our knowledge of red knot biology, and worthy of further investigation during forthcoming recovery efforts, we have mentioned them in the Supplemental Document (Migration and Wintering Food—Inland). However, we note that these ideas currently lack supporting documentation and did not rely on this information for our analyses.

(96) Comment: One commenter stated that, in 2012, only 55 percent of red knots studied in New Jersey reached the departure weight necessary to ensure their chance to breed in the Arctic. The remaining birds likely fail to survive the journey or reproduce, which results in serious population declines.

Our Response: The proportion of red knots attaining the target departure weight in Delaware Bay should not be confused with the annual survival rate. Amanda Dey (pers. comm. October 12, 2012) reported that 54 percent of red knots in Delaware Bay reached the target weight by the end of May 2012. Although this metric fell to 46 percent in 2013, these 2 years continued an overall upward trend in the percentage of birds reaching the target departure weight since the mid-2000s (Dey *et al.* 2014, pp. 1, 4), and remained relatively high for a third consecutive year in 2014 (A. Dey pers. comm. July 23, 2014). Further, although we agree that adequate weight gain in Delaware Bay is vital to red knot conservation, we disagree that most birds under the target weight fail to survive the subsequent year (*i.e.,* most low-weight birds do not die). Using data from 1997 to 2008, McGowan *et al.* (2011a, p. 13) confirmed that heavy birds had a higher average survival probability than light birds, but the difference was small (0.918 versus 0.915), as discussed in the proposed rule (78 FR 60024, p. 60069). These survival rates, averaged over the period 1997 to 2008, could mask more pronounced effects of low departure weights on survival over shorter periods. For example, the lowest survival estimates occurred in 1998, just before the period of sharpest declines in red knot counts (McGowan *et al.* 2011a, p. 13). The 1998 to 1999 survival rate estimate was 0.851 for heavy birds and 0.832 for light birds (McGowan *et al.* 2011a, p. 9). Based on best available information, we agree that low departure weights (caused by insufficient food supplies and late arrivals) were a primary causal factor in the decline of the *rufa* subspecies in the 2000s.

(97) Comment: One commenter stated that, for the most part, the barrier islands along the Atlantic coast are in public ownership, not private, and are not frequently used for development.

Our Response: We disagree. Land ownership varies widely along the U.S. Atlantic coast. Past and ongoing coastal development in some areas is extensive (78 FR 60024, pp. 60038–60043).

(98) Comment: Several commenters expressed concern over how the Service

characterized threats to the red knot stemming from climate change and how that same climate information could be applied to other species. One commenter acknowledged that effects to the red knot from climate change could be significant in the future, but noted they are not currently. Other commenters stated that the proposed rule does not cite scientific data or information linking red knot population declines with any climate-related effects, nor does the proposed rule present a detailed analysis of how or whether climate-related impacts will result in either reductions in fitness to the red knot species or future population declines, nor are there models showing the expected effects of climate change on rufa red knot abundance. The proposed rule acknowledged that the effects of climate change on the rufa red knot are unknown, uncertain, and speculative. Further, the proposed rule purports to forecast the effects of a complex global issue (climate change) up to 100 years into the future. This approach requires the Service to rely upon controversial modeling projections of complex data to forecast a future that is well beyond our reasonable ability to predict, and to imagine what the speculative biological consequences of these forecasts will be for the rufa red knot. This is an exercise in speculation, not an analysis based on existing scientific evidence, and if used as such then virtually every species may be considered threatened and this establishes a precedent that renders the Act's listing process unworkable. These same commenters stated that many of the threats identified by the proposal (*e.g.,* sea level rise and other effects of climate change) are by no means unique to the rufa red knot and may, therefore, be an unreasonable basis for listing since so many other species would be likewise affected.

Our Response: We disagree with these conclusions. Based on our review of best available information, we conclude that threats to the red knot, including those stemming from climate change, are likely to place this species in danger of extinction in the next few decades (see *Our Response 66* regarding ''foreseeable future''). Not all threats contributing to a species' threatened or endangered status must be tied to past or ongoing population declines, if future declines are likely (see *Our Responses 27* and *77*). While we continue to conclude that reduced food availability and late arrivals at the Delaware Bay stopover site were the primary causal factors in the decline of rufa red knot populations in the 2000s (78 FR 60024, pp. 60063, 60076), climate-induced environmental changes likely to affect the red knot are already occurring and likely to intensify. We have updated the Supplemental Document (Overview of Threats Related to Climate Change) with information from recent assessments of the red knot's vulnerability to climate change indicating a large increase in extinction risk (Galbraith *et al.* 2014, p. 7; National Wildlife Federation 2013, p. 28; Whitman *et al.* 2013, pp. 2, 19, 64).

We disagree that this listing determination relies upon ''controversial modeling projections of complex data to forecast a future that is well beyond our reasonable ability to predict.'' Instead, we relied upon mainstream and thoroughly vetted climate science publications (*e.g.,* from the IPCC, the U.S. Global Change Research Program, the National Research Council, and the Arctic Climate Impact Assessment) that present scientifically based ranges of likely future climate conditions under various emissions scenarios. The IPCC (2013b) defines a scenario as a coherent, internally consistent, and plausible description of a possible future state of the world; it is not a forecast; rather, each scenario is one alternative image of how the future can unfold. Various levels of uncertainty are associated with all scientific data and with all analyses of future conditions. The uncertainty levels associated with different aspects of climate change have been standardized by the IPCC (see Supplemental Document table 14). We used this standardized terminology transparently and consistently in the proposed rule (Climate Change Background, p. 2) and in the Supplemental Document (Climate Change—Background). The key findings of climate science—that human-caused climate change is occurring and will continue to affect temperatures, precipitation patterns, sea levels, and ocean pH levels—continue to be associated with high levels of certainty (Melillo *et al.* 2014, pp. 20–49; IPCC 2013a, p. 7).

We also disagree that the effects of climate change on the rufa red knot are ''unknown, uncertain, and speculative'' and that the proposed rule does not present a detailed analysis as to ''how or whether climate-related impacts will result in either reductions in fitness to the red knot or future population declines.'' Throughout the proposed rule (and summarized at 78 FR 60024, pp. 60028–20029), we presented detailed analyses of best available data (and associated levels of uncertainty, when available) regarding how red knot habitats and populations are likely to respond to climate changes over the coming decades. While biological modeling showing the expected effects of climate change on rufa red knot abundance may be helpful in future recovery efforts, such models are not currently available and research to generate them is not required for the Service to make a listing determination under the Act's ''best available'' data standard. We acknowledge that climate change is a complex global issue and that uncertainties exist. However, the best available science indicates climate change is expected to affect red knot fitness and, therefore, survival through direct and indirect effects on breeding and nonbreeding habitat, food availability, and timing of the birds' annual cycle. Ecosystem changes in the arctic (*e.g.,* changes in predation patterns and pressures) may also reduce reproductive output. Together, these anticipated changes will likely negatively influence the long-term survival of the rufa red knot.

Finally, we disagree that virtually every species may be considered for listing due to the effects of climate change, or that climate-related threats are equally applicable to all species within the coastal zone. The Act requires the Service to evaluate each species of concern or petitioned species individually to assess whether listing as threatened or endangered is warranted. Not all species will be affected by the effects of climate change in the same manner; each species' biological traits and population dynamics will make it more or less resilient to any stressor. That said, it is likely that additional species will be found to meet the definition of a threatened or endangered species based on threats stemming from climate change as its effects intensify in the future.

(99) Comment: One commenter stated that climate change has affected the red knot because wintering zones have moved farther up in South America than in the past.

Our Response: We agree that climate change effects are a primary threat to the red knot, but disagree that such effects have caused a range shift to date. Although we anticipate that changing climatic conditions will likely cause latitudinal shifts in the position of some red knot habitats, we expect such habitat shifts will primarily affect the red knot within its breeding range (78 FR 60024, pp. 60047–60049), because the nonbreeding range already spans the entire latitudinal gradient from Tierra del Fuego to southern Canada. We have no evidence that red knots have shifted their winter ranges in response to climate change. We do note that the

Argentina-Chile wintering area has contracted by about 1,000 mi (1,600 km) poleward (south), which is the direction that would be consistent with the effects of climate change (Root *et al.* 2003, p. 57). However, we conclude that this contraction was not primarily caused by climate change, but instead a result of an overall decreasing winter population size in this region (COSEWIC 2007, p. 11). Population declines are often accompanied by abandonment of ''peripheral'' habitats and a geographic contraction into only the best (''core'') habitats. A similar phenomenon was noted for HSCs within Delaware Bay (Lathrop 2005, p. 4).

(100) Comment: One commenter stated that Congress did not intend for the Act to be used to regulate greenhouse emissions or climate change. This commenter is concerned that a final listing rule may be misused or impose undue burdens on American industries or activities, particularly those that have greenhouse gas emissions. Another commenter stated that the Service has previously recognized there is insufficient evidence to establish a causal connection between greenhouse emissions from particular activities and impacts to certain species.

Our Response: As stated in the proposed rule (78 FR 60024, p. 60097), a determination to list the rufa red knot as a threatened species under the Act will not regulate greenhouse gas emissions. Rather, it will reflect a determination that the rufa red knot meets the definition of a threatened species, thereby establishing certain protections for it under the Act.

(101) Comment: One commenter stated that no field data have been gathered or analyzed to compare the status of red knot populations that are isolated from human activity to those that are exposed to human activity.

Our Response: We disagree that field data are not available regarding the effects of disturbance. In the proposed rule (78 FR 60024, pp. 60076–60079), we presented several studies that include field data on the effects of human disturbance on red knots and other shorebirds. We are not aware of any comparative studies of red knot population trends in high-disturbance versus low-disturbance areas, but conclude that such studies would be confounded by the migratory connectivity of red knot sites (*i.e.,* factors affecting survival in any part of the range may affect populations rangewide), and by other site-specific factors (*e.g.,* habitat quality, food availability, predation rates) influencing local or regional population trends.

(102) Comment: Several commenters stated that anecdotal data from long-term barrier island residents suggest that red knots feed and carry on unaffected by the presence of some human activity (*e.g.,* surf fishing) and that operation of offroad vehicles (ORVs) driving within 10 yards of a cluster of red knots that are feeding does not cause them to be disturbed or fly. Further, drivers of ORVs do not drive in the same part of the beach used by red knots for feeding, and if there is any reaction, the flock goes up while the vehicle goes by only to land again either in the same spot or a little farther away. Thus, the birds are not being harassed to the point their life cycle is being threatened. These commenters also contend that cannon netting by researchers causes a higher degree of disturbance than these recreational activities.

Our Response: We disagree that red knots are unaffected by human activity. We agree that red knots may have a minimal response to low levels of disturbance, and that reaction distances and durations likely vary with the type and intensity of the disturbance, as well among sites and among seasons. We also agree that no one particular disturbance event is likely to impact a red knot's fitness or survival. However, the cumulative effects of repeated or prolonged disturbance have been shown to preclude shorebird use of otherwise preferred habitats and can impact the birds' energy budgets (*i.e.,* their ability to gain and maintain adequate weight) (78 FR 60024, p. 60079). We disagree that ORV drivers always remain out of the wet sand of the intertidal zone where red knots feed. On some beaches, driving on the dry beach is restricted to prevent damage to dunes and wrack, and in some areas drivers avoid the dry sand to prevent getting stuck. Even where driving is restricted to the dry beach, ORV use may disturb roosting, instead of foraging, red knots.

We agree that certain research methods are highly disturbing to red knots. Therefore, we anticipate that any recovery permits issued under the Act will include conditions to strictly limit the extent and duration of disturbance to red knots from research activities, typical of the best practices that are already generally followed by the research community.

(103) Comment: Several commenters stated that the Delaware Bay-wide HSC egg densities show no upward trend. Another commenter stated that the decline in HSC egg density on New Jersey's Delaware Bay beaches as described in the 2007 status assessment is deceptive, there are no data supporting a problem of egg availability for the red knots on the Delaware Bay beaches, and the Delaware Bay egg density data and studies should not be used for management or listing of red knots.

Our Response: We concur that the Delaware Bay-wide HSC egg densities show no upward trend, but note that we have only moderate confidence in this data set. We recognize the importance of surface egg availability to red knots in Delaware Bay, and egg densities have been statistically correlated with red knot weight gain (Dey *et al.* 2013, pp. 18–19; H. Sitters pers. comm. April 26, 2013). However, methodological concerns with the egg density surveys are described in the proposed rule and in the Supplemental Document, and limit our confidence in this data set. The ASMFC recently dropped the requirement for the States of New Jersey and Delaware to conduct the egg density surveys, largely because these data are not used in the ARM framework; however, New Jersey plans to continue the survey on its side of Delaware Bay (M. Hawk pers. comm. April 8, 2014; ASMFC 2013e, p. 4).

We did rely partly, but not solely, on the egg density analysis as presented in the 2007 status assessment (which was later updated and published independent of the Service as Niles *et al.* 2008). Based on our own analysis of the egg density data (78 FR 60024, pp. 60067–60068 and Supplemental Document section Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link B, Part 2), and considering several different data sources, we regarded trends in egg density data as a secondary line of supporting evidence that insufficiency of food resources was an important factor (along with late arrivals) contributing to the decline of the Delaware Bay stopover population. Thus, Delaware Bay egg density data were a relatively minor consideration in our determination of the threatened status of the red knot. Despite the lack of upward trends in baywide egg densities, our assessment of the best available data from several lines of evidence concludes that the volume of HSC eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. However, because of the uncertain trajectory of HSC population growth, it is not yet known if the egg resource will continue to adequately support red knot population growth over the next decade. This conclusion is unchanged from the proposed rule (78 FR 60024, p. 60063).

(104) Comment: One commenter stated that the number of HSC eggs on Delaware Bay shores dropped from

40,000 eggs per square meter (m^2) in the 1990s to only 1,500 eggs per m^2 in 2005.

Our Response: In the proposed rule (78 FR 60024, pp. 60067–60068), we discussed methodological concerns with the HSC egg density data, particularly prior to 2005. We attached somewhat higher confidence to trends since 2005 because methodologies have been more consistent over that period—there was no significant trend in baywide egg densities from 2005 to 2012. However, the Delaware Bay egg density data were a relatively minor consideration in our determination of the threatened status of the red knot, and are not used in management of the HSC fishery under the ARM (see *Our Response 103* above).

(105) Comment: One commenter stated that the early (1981 through 2000) declines in red knot counts in Delaware Bay were not reflected in the Argentina-Chile wintering area, which contradicts the assertion that later (after 2000) declines in this wintering area were caused by inadequate weight gains in Delaware Bay. Conversely, another commenter stated that, with fewer eggs to feed on, up to 75 percent of red knots surveyed on the Delaware Bay suffered a year-on-year decline in their rate of weight gain between 1990 and 2006. Further, lower weight birds have been shown to have lower survival rates, and scientific models predicted that the red knot may become extinct by 2010.

Our Response: We agree there may have been declines in the Delaware Bay's red knot stopover population prior to 2001, but we also note considerable variability in the peak count data set that makes it difficult to detect trends. In contrast, the decline in peak counts in the 2000s was sufficiently pronounced and sustained that we have confidence in the downward trend over this time period despite the variability of the data set. We agree that a number of data sets have been used to draw conclusions about the correlation between HSC harvest and red knot population trends. Not all of the data sets agree completely, suggesting that other factors likely contributed to the red knot decline (*e.g.,* late arrivals in Delaware Bay, other threats discussed in the proposed rule). Keeping in mind the limitations of the various data sets and the biology of HSCs and red knots and looking at the general trends, we find a temporal correlation between high harvest levels leading up to the year 2000, and a relatively sudden decline in the red knot Argentina-Chile wintering population around that same time period, concurrent with a pronounced decline in Delaware Bay. Moving from correlation to causation, our conclusion is based on a detailed analysis (78 FR 60024, pp. 60063–60071 and Supplemental Document section Factor E—Reduced Food Availability—Horseshoe Crab Harvest): Although the causal chain from HSC harvest to red knot populations has several links associated with various levels of uncertainty, the weight of evidence supports these linkages, points to past harvest as a key factor in the decline of the red knot, and underscores the importance of continued HSC management to meet the needs of the red knot.

In the proposed rule (78 FR 60024, p. 60069), we discussed trends in red knot weight gain, relying mainly on the percentage of red knots greater than the target weight at the end of May. This metric for weight gain showed a downward trend in the percentage of heavy birds starting in 1997, which started to reverse by the late 2000s. In the proposed rule (78 FR 60024, pp. 60069–60079), we also evaluated the best available data regarding the link between red knot spring weight gain in Delaware Bay and the birds' subsequent survival. In this analysis, we relied primarily on Baker *et al.* (2004) and McGowan *et al.* (2011a), both of which found a link between spring weight gain in Delaware Bay and survival. We acknowledge the following statement by Baker *et al.* (2004, p. 879), ''if the 1997/1998 to 2000/2001 levels of annual survival prevail, the population is predicted to approach extremely low numbers by 2010 when the probability of extinction will be correspondingly higher than it is today.'' However, we did not evaluate this statement in the proposed rule because the newer results of McGowan *et al.* (2011a) indicate those earlier (and lower) survival rates were no longer prevailing.

(106) Comment: One commenter suggested that other threats such as disease and research activities may have been responsible for red knot and HSCs declines, rather than overharvesting of HSCs. Conversely, another commenter believes gross mismanagement of the HSC fishery has dramatically decreased the availability of HSC eggs for the red knot and other migratory shorebirds.

Our Response: As discussed in the proposed rule (78 FR 60024, p. 60063), we completed a detailed analysis of all three threats (disease, research, HSC harvest) and recognize the effect that formerly excessive harvesting of HSCs had on the red knot's food resources and the contribution this activity had to the knot's population decline. See *Our Responses 45* and *46* regarding egg availability and the ASMFC's regulation of the HSC fishery, respectively.

(107) Comment: Several commenters suggested that supplemental feeding of red knots in Delaware Bay may be needed until HSC populations return to levels that provide adequate egg supplies for the birds.

Our Response: As noted in the proposed rule (78 FR 60024, p. 60063), most data suggest that the volume of HSC eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. However, ensuring the future HSC egg supply will be addressed during the recovery planning process, and we intend to continue our active role in the ASMFC's management of the HSC fishery. We acknowledge considerable uncertainty around the future food supplies for red knots, in Delaware Bay and in nonbreeding habitats rangewide. We would not rule out direct human intervention (*e.g.,* supplemental feeding) as an appropriate conservation response if food supplies in any part of the range should someday become so depleted as to present an imminent, population-level threat. However, we would consider such a step only as a last resort because it fails to fulfill a central purpose of the Act, ''to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved.'' Although supplemental feeding of wild birds is not the same as controlled propagation, it has similar conservation implications (*e.g.,* direct human intervention as opposed to the conservation of the supporting ecosystem). Thus, we feel this excerpt from the Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act (65 FR 5690) would also apply to supplemental feeding: ''Controlled propagation is not a substitute for addressing factors responsible for an endangered or threatened species' decline. Therefore, our first priority is to recover wild populations in their natural habitat wherever possible, without resorting to the use of controlled propagation.''

(108) Comment: One commenter stated that since the ARM framework establishes a conservative HSC harvest level for the Delaware Bay spawning population of HSCs, significant threats are more likely to occur at other points along the migratory flyways.

Our Response: We agree that, as long as the ARM is in place and functioning as intended, the ongoing HSC bait harvest should not be a threat to the red knot (see *Our Responses 46* and *48*). We also agree that a number of other threats throughout the knot's range are contributing to habitat loss, anthropogenic mortality, or both, and

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that these threats are likely to increase in the future. Thus, new attention to these emerging threats will be imperative for red knot recovery. However, we also conclude that a sustained focus on protecting the red knot's food supply—in Delaware Bay and throughout the range—will also be vital to red knot recovery (see *Our Responses 45, 78,* and *126*).

(109) Comment: One commenter stated that the HSC population in Delaware Bay has fluctuated between 1.5 and 2 million since 2007. Several commenters stated that there have been no increases in the number of female HSCs, or of total crabs, spawning in Delaware Bay.

Our Response 109: We disagree that the HSC population in Delaware Bay has fluctuated between 1.5 and 2 million. This estimate of 1.5 to 2 million crabs is for spawning adults, and is not the same as the size of the total baywide HSC population. As indicated in the proposed rule (78 FR 60024, p. 60065), Smith *et al.* (2006, p. 461) estimated the population of HSCs in the Delaware Bay Region in 2003 at about 20 million adults, based on modeling of marked HSCs. We have updated the Supplemental Document (Factor E—Food Availability—Horseshoe Crab Harvest—Link A, Part 1) with newer estimates from Smith (2013), based on a different methodology but showing similar results. Smith (2013, p. 2) reported annual estimates of the baywide population size from 2002 to 2012, with an average over this period of about 19 million and consistently more males than females.

Specific to spawning crab counts, Swan *et al.* reported season-long total counts of roughly 1.3 to 2 million spawning adults along the Delaware Bay shoreline from 2007 to 2012 (Swan *et al.* 2012, p. 1; Swan *et al.* 2011, p. 1; Swan *et al.* 2010, p. 1; Swan *et al.* 2009, p. 1; Swan *et al.* 2008, p. 1; Swan *et al.* 2007, p. 1). We reviewed but, for methodological reasons, did not rely on this data set from Swan *et al.* (2007 to 2012) to evaluate trends in numbers of spawning adult crabs. Instead, we have relied on spawning HSC density reports prepared for the ASMFC. We agree there have been no increases in the number of female HSCs spawning in Delaware Bay. The most recent report of the density data concluded that baywide spawning activity shows no statistically significant trends from 1999 through 2012 (Zimmerman *et al.* 2013; p. 1). This is a change from Zimmerman *et al.* (2012, pp. 1–2), which reported that, although there was no trend in females, numbers of spawning males showed a statistically significant increase from 1999 through 2011. This new information has been incorporated into the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link B, Part 1). See *Our Response 46* for more discussion of female HSC population trends.

(110) Comment: One commenter stated that, due to the bait harvest, the Delaware Bay population of HSCs declined by 90 percent between 1990 and 2006.

Our Response: We disagree that the percent decline for the HSC population in the Delaware Bay Region can be determined over this time period, because there are no estimates of the size of this population prior to 2003 (done by Smith *et al.* 2006). As no population size estimates are available prior to the 1990s increase in harvest levels, we rely on the ASMFC's periodic stock assessments to appropriately weigh and statistically analyze available data sets to draw conclusions regarding HSC population trends, as discussed in the proposed rule (78 FR 60024, p. 60066) and the Supplemental Document (Factor E— Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2); see *Our Response 46.*

(111) Comment: One commenter stated that females are the limiting sex within the HSC population and have a direct ecological link to migratory shorebirds through their eggs. Under the ARM, female HSCs in the Delaware Bay region are fully protected for the benefit of migratory shorebirds. The ARM does not authorize the harvest of females until the HSC population reaches 80 percent of its carrying capacity, which is well beyond the realm of traditional fishery management parameters, reflecting the ecological importance of the resource, and the risk-averse characteristics of the current management plan. The ARM model builds upon a male-only or male-biased regulatory strategy for Delaware Bay HSCs that was adopted by the ASMFC in 2006. The biological and ecological basis for the male-only harvest is based on the best available science for the species; males are not limiting within the HSC population dynamics, and are not ecologically limiting with respect to HSC egg availability for shorebirds. Well before the adoption of the male-only harvest strategy in 2006 and the ARM implementation in 2012, the ASMFC had already reduced the coastwide harvest of HSCs by approximately 70 percent from reference period landings, through a series of increasingly restrictive addenda. The HSC quotas in the Delaware Bay region have been specified by the ASMFC at very low rates of removal that are fully consistent with both population growth and ecological sustainability. The 2009 HSC stock assessment indicated the fishing mortality rates for HSCs in the Delaware Bay region were consistent with population growth.

Our Response: We agree with this assessment of the importance of female HSCs. We agree that the strongly male-biased fishery management was appropriate prior to adoption of the ARM, and a male-only harvest continues to be warranted based on the current ARM outputs. We conclude that the ARM provides adequate protection for females from the bait harvest, but we note that some female mortality does occur as a result of the biomedical harvest. Other commenters noted that positive trends in female HSC populations are absent, even after 7 years of male-only harvest, possibly suggesting losses of female crabs from unregulated or undocumented sources including biomedical mortality. We discuss this and other possible explanations for the lack of growth in measures of female abundance under *Our Responses 46* and *49.* In the proposed rule (78 FR 60024, pp. 60064–60065), we noted the shift to a strongly male-biased harvest, and the successive harvest restrictions that reduced reported landings from 1998 to 2011 by over 75 percent. We also discussed the findings of the 2009 stock assessment (78 FR 60024, pp. 60064–60065). The Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) has been updated to include the results of the 2013 stock assessment update.

(112) Comment: One commenter stated that the 2009 HSC stock assessment indicated the mortality rates were approximately 70 to 75 percent below the fishing mortality rate associated with maximum sustainable yield (FMSY). Even without the benefit of the subsequent ARM model, these removal rates were already well below conservative levels for important forage species. The 2012 Lenfest report included a comprehensive examination of marine ecosystems and concluded that fishing at half of traditional FMSY values results in a low probability of collapse for forage fish and lower risk for dependent species. The quotas set by the ASMFC under addenda IV, V, and VI were already well below these guidelines, and were specifically male-biased to ensure the ecological sustainability of the fishery.

Our Response: We agree that the 2009 stock assessment reflects substantial reductions in harvest levels, from their peak at 2 to 3 times FMSY in 1998 and 1999 to 23.2 percent of FMSY (both

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sexes combined) in 2008 (ASMFC 2009a, pp. 25, 57). However, we disagree that the findings of the 2012 Lenfest report can be extrapolated to HSCs (e.g, to suggest a harvest level relative to FMSY that is adequate for dependent species such as red knot and other shorebirds). The authors of the Lenfest report (Pikitch *et al.* 2012, p. 4) defined forage fish characteristics, some of which are not shared by HSCs (*e.g.,* provide energy flow from plankton to higher trophic levels, relatively small body size, fast growth, early maturity). Instead, we rely on the ARM to establish conservative harvest limits that ensure an adequate supply of HSC eggs to support red knots in Delaware Bay.

(113) Comment: One commenter stated that under addenda IV, V, and VI to the ASMFC's fishery management plan, HSC harvests in Delaware and New Jersey were limited, by quota, to 100,000 male HSCs annually per State. New Jersey's legislature closed its HSC fishery. If both States utilized their quotas at that time, total harvest would have been less than 2 percent of the adult male HSC population, which was estimated at 12 million.

Our Response: We agree with this estimate of the percentage of the male population annually authorized for harvest under these addenda. In the proposed rule (78 FR 60024, p. 60065), we noted that recent annual harvests of roughly 200,000 HSCs from the Delaware Bay Region (which reflects New Jersey's moratorium as well as harvest from the other three States in the Region) represent about 1 percent of the total adult (male and female) population. Our estimate of 1 percent is unchanged in the Supplemental Document (Factor E—Food Availability—Horseshoe Crab Harvest—Link A, Part 1) even upon updating the landings and estimated population size with new data.

(114) Comment: One commenter stated that the analysis of HSC tagging data by the ASFMC's Technical Committee has suggested that approximately 13 percent of Maryland's catch of HSCs and approximately 9 percent of Virginia's catch, east of the COLREGS line (which delimits internal from ocean waters), are of Delaware Bay origin. A line of genetic evidence suggested that 51 percent of Maryland's catch and 35 percent of Virginia's catch, east of the [International Regulations for Preventing Collisions at Sea] COLREGS line, is of Delaware Bay origin. When the ASMFC implemented the ARM model in 2012, it required all of Maryland's catch and all of Virginia's catch east of the COLREGS line to be male-only, as a precautionary measure, to ensure the ecological sustainability of these fisheries in waters adjacent to the Delaware Bay Region.

Our Response: In the proposed rule (78 FR 60024, p. 60070), we concluded that the ASMFC's current delineation of the Delaware Bay Region HSC population is based on best available information and is appropriate for use in the ARM modeling, but we acknowledged some uncertainty regarding the population structure and distribution of Delaware Bay HSCs. In documenting the technical underpinnings of the ARM, the ASMFC (2009b, p. 7) acknowledged that the proportion of Maryland and Virginia landings that come from Delaware Bay is currently unresolved, but stated that their approach to estimating this proportion was conservative. We have revised the Supplemental Document (Factor E—Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management) to state that we anticipate the ARM process will adapt to substantive new information that reduces uncertainty about the Delaware Bay HSC population structure and geographic distribution. See *Our Response 49.*

(115) Comment: One commenter stated that table 9 (reported Atlantic coast landings) in the proposed rule does not describe the conversion between pounds and numbers of HSC harvested; thus reviewers cannot provide meaningful comment on the data.

Our Response: As explained in the proposed rule (78 FR 60024, p. 60064), the HSC landings data given in pounds come from the National Marine Fisheries Service (NMFS), but should be viewed with caution as these records are often incomplete and represent an underestimate of actual harvest (ASMFC 1998, p. 6). In addition, reporting has increased over the years, and the conversion factors used to convert crab numbers to pounds have varied widely (ASMFC 2009a, p. 2), thus we are unable to convert the pounds to numbers of crabs. (For this same reason, the ASFMC also retains these data in pounds in its stock assessments.) Despite these inaccuracies, the reported landings show that commercial harvest of HSCs increased substantially from 1990 to 1998 and has generally declined since then (ASMFC 2013b, p. 8; ASMFC 2009a, p. 2). The ASMFC (1998, p. 6) also considered other data sources to corroborate a significant increase in harvest in the 1990s. Despite the known problems with this data set, no other data are available regarding harvest levels prior to 1998; thus, we have considered these data only to document the very sharp increase in harvest levels that occurred in the mid-1990s. The ASMFC relies on these data for the same purpose in its periodic stock assessments (ASMFC 2013b; ASMFC 2009a; ASMFC 2004)—we consider these stock assessments the best available information regarding trends in harvest levels. We have revised the Supplemental Document (added a footnote to table 23) to clarify that the landings reported to NMFS are provided for context only and cannot be converted to numbers of crabs and thus cannot be directly compared to the data reported to the ASMFC.

(116) Comment: One commenter stated that the proposed rule does not make clear in the discussions of egg availability or harvest pressure that female HSC harvest in the Delaware Bay bait fishery has been prohibited since 2006.

Our Response: We have revised the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A) to clarify this point.

(117) Comment: One commenter stated that efforts to restrict the HSC fishery are inconsistent from State to State, and that restrictions imposed by individual States are being successfully challenged and overturned by the commercial fishing industry. One commenter stated that other States (besides New Jersey) still do not have a ban on HSC harvesting, and this needs to be changed. Another commenter stated that the New Jersey moratorium on HSC fishing in its portion of Delaware Bay is insufficient to protect the red knot from continued population decline in the face of coastal development and constant disturbance at migratory stopover sites and with climate change affecting food availability in the Arctic.

Our Response: Regulation of the HSC fishery by the ASMFC is consistent coastwide, in that all member States follow the same Fisheries Management Plan. However, due to regional and local differences (*e.g.,* status and trends of HSC populations; nature and intensity of harvests), each State ends up with different quotas. In addition, each member State within the ASMFC is required to establish and enforce its own harvest regulations that ensure compliance with the Fishery Management Plan, and the specifics of these regulations vary from State to State. Each ASMFC member State may opt to adopt harvest limits that are more restrictive than those mandated by the ASMFC, but these limits would be subject to legal challenges within the regulatory framework of that State. New

Jersey's moratorium, which is more restrictive than required by the ASMFC, results in implementation of the ARM being more conservative (see *Our Response 49*), but has also raised concerns about unintended consequences (see *Our Response 120*). Notwithstanding the potential risks and benefits of New Jersey's moratorium, we continue to conclude that management of HSC harvests under the ARM is adequate to abate the food supply threat to red knots from HSC harvest in Delaware Bay. However, even with highly successful harvest management under the ARM, the HSC population will continue to grow only to the extent that it remains limited by harvest; other factors affecting crab populations cannot be affected by management of the fishery. (See *Our Response 46* regarding these other factors, as well as new uncertainty about the future of the ARM). In addition, we agree that, beyond the supply of HSC eggs, there are other substantial and widespread threats to the red knot (see *Our Response 108*).

(118) Comment: One commenter stated that New Jersey's moratorium on HSC harvest does not appear to have a scientific basis.

Our Response: Each ASMFC member State may opt to adopt harvest limits that are more restrictive than those mandated by the ASMFC. We factored New Jersey's moratorium into our analyses of current harvest levels and management practices, but we recognize that the New Jersey legislature could decide to lift the moratorium at any time. If that happens, New Jersey would be required to abide by the ASMFC harvest recommendations set forth by the ARM process. We conclude that harvest levels set through the ARM process are adequate to manage the threat to red knots from insufficient food resources in Delaware Bay.

(119) Comment: One commenter doubted that overharvest of HSCs could have occurred based on the successively restrictive harvest regulations implemented in New Jersey from 1993 through 1997.

Our Response: We disagree. No definitions of ''overfishing'' or ''overfished'' have been adopted by the ASMFC for HSC (ASMFC 2013b, p. 21). That said, Delaware Bay's HSC population is affected by harvests in Delaware and parts of Maryland and Virginia, as well as in New Jersey. Our evaluation of best available data (78 FR 60024, pp. 60064–60067 and Supplemental Document section Horseshoe Crab—Harvest and Population Levels) shows that coastwide harvest levels grew sharply from 1993 through 1997, and that the 2004 stock assessment found a clear preponderance of evidence that HSC populations in the Delaware Bay Region declined from the late 1980s to 2003 (ASMFC 2004, p. 27).

(120) Comment: One commenter stated that the State of New Jersey still maintains its ultraconservative HSC management strategy of a moratorium when the ARM framework would allow commercial fishermen to harvest 162,000 male HSCs from New Jersey outside of the spawning season. New Jersey's insistence of maintaining a moratorium has led to some negative biological consequences in redirecting fishing effort to New York and Massachusetts spawning populations of HSCs, which are now in decline. The HSC bait shortage has also led to the dangerous importation of Asian HSCs, all species of which are highly depleted, to meet the bait needs of the domestic whelk/conch and eel fisheries.

Our Response: We are aware of the finding that decreased harvest of the Delaware Bay population has redirected harvest to other parts of the Atlantic coast that now may be at unsustainable levels (ASMFC 2013b, p. 22). As discussed in the proposed rule (78 FR 60024, p. 60067; Factor D: The Inadequacy of Existing Regulatory Mechanisms, p. 12), we also agree the importation of Asian HSCs is a threat to both the native HSC and the red knot. We have updated the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link A, Part 2) with new information regarding efforts by individual States to restrict the import of Asian HSCs. The Service will evaluate the need to expand Lacey Act restrictions on the import of Asian HSCs at the Federal level. In addition, a Service biologist was recently selected by the IUCN as one of six scientists to assess and make recommendations on the status of the HSC throughout its range, with a counterpart team assessing the Asian species. The Service shares the concern of this commenter for the coastwide management and conservation of the HSC, and we intend to continue our active role in the ASMFC's management of the HSC fishery that considers the Delaware Bay population in a coastwide context.

We are aware that some ASMFC members have expressed concern that harvest levels in the Delaware Bay Region, which are set by the ASMFC and further reduced by New Jersey's moratorium, have raised the price of bait crabs and thus contribute to both the redirecting of harvest to other parts of the coast and the increasing interest in importing Asian crabs as alternative bait (ASMFC 2013f, p. 1). We lack data to determine the relative roles, if any, of the New Jersey moratorium versus the coastwide regulation by the ASMFC in driving these trends. We continue to support the ARM as a scientifically sound mechanism for managing Delaware Bay's HSC fishery that adequately abates the threat to red knots from food supply issues in the bay. See *Our Responses 117* and *118* regarding New Jersey's moratorium.

(121) Comment: Several commenters disagreed with our conclusion that, as managed under the ARM, current HSC harvest levels are not a current threat to the red knot. Conversely, several other commenters stated that the ARM framework adopted by the ASMFC appears to be an effective approach to managing harvest in Delaware Bay so that conservation of red knots and other shorebirds and HSCs are balanced with societal demands. In addition, since the model was favorably peer-reviewed in 2009, its management strategy prioritizes the needs of migratory shorebirds, and it is based on the best available science, it should fully satisfy section 9 of the Act if the listing is approved.

Our Response: We have reviewed information and analyses of the ARM provided by several commenters, but continue to conclude based on the best available data that, as long as it is functioning as intended, the ARM framework adequately abates the threat to the red knot from the HSC bait harvest. We agree that the ARM is based on best available science and is a sound process. The Supplemental Document (Factor E—Reduce Food Availability—Horseshoe Crab Harvest—Adaptive Resource Management) has been updated to clarify that our conclusions about the ARM are based on (1) the technical soundness of the peer-reviewed models; (2) the explicit linking of HSC harvest quotas to red knot population targets; and (3) the adaptive nature of both the models and the framework, which are intended to regularly adjust as new information becomes available. Our conclusion is supported by recent computer simulations by Smith *et al.* (2013, entire). Although these simulations are not intended to predict actual timeframes for population growth, they did show that simulated red knot population trajectories under HSC harvest scenarios governed by the ARM almost matched simulated red knot population trajectories under a fixed HSC moratorium scenario; thus, the bait harvest levels allowed under the ARM are expected to have a negligible effect

on the red knot's Delaware Bay stopover population.

In the proposed rule (78 FR 60024, p. 60097), we concluded that the harvest of HSCs in accordance with the ARM, provided the ARM is implemented as intended (*e.g.,* including implementation of necessary monitoring programs) and enforced, is not likely to result in a violation of section 9 of the Act. Thus, we do not anticipate recommending additional HSC harvest restrictions in Delaware Bay (beyond the ARM) as a result of listing the red knot. (However, see *Our Response 46* regarding new uncertainty about the future of the ARM.) We intend to continue our active role in the ASMFC's management of the HSC fishery, and will provide recommendations and technical assistance to ensure that future harvests of HSCs do not result in take of red knots under section 9 of the Act.

(122) Comment: One commenter stated that both the HSC trawl survey and spawning survey have generally experienced difficulty detecting changes in the regional HSC population, although the trawl survey measured some significant increases in response to management, and both surveys have shown some improvement since the early 2000s. The temporal and spatial extent of the spawning survey may be inadequate to detect population growth, and it may not be able to accommodate changing shoreline conditions caused by erosion and flooding. Similarly, the Virginia Tech trawl survey did not originally sample any stations within the Delaware Bay, and the scale and design of the survey may not be sufficient to detect population changes consistently. With quotas that have been specified at levels consistent with population rebuilding since Addendum III, the power of the existing surveys to detect population changes warrants review.

Our Response: We disagree. Evaluations of these surveys and their methods have been done in the past and continue to be done by the ASMFC. See *Our Response 46* regarding discontinuation of the Virginia Tech trawl survey.

(123) Comment: One commenter stated that existing data to evaluate trends in red knot weight gain at Delaware Bay are flawed. This commenter cited statements from a peer-reviewed report prepared for the ASMFC: ''existing data . . . are not adequate to evaluate their relative importance [late arrivals versus insufficient food supply] for any year of record . . . attempts to estimate growth rate based on independent samples of body mass are inherently flawed'' (USFWS 2003, p. 6). Based on these statements, this commenter concluded that all the weight gain data from 1997 to 2002 are flawed.

Our Response: While we agree that these statements appear in a USFWS report (2003, p. 6), we disagree with the conclusion of the commenter. On the previous page, this report states, ''there is agreement that a smaller percentage of rufa red knots are making threshold departure weights by the end of May in recent years,'' and goes on to discuss the two possible explanations (late arrivals and insufficient food supply), as well as different analytical methods for determining weight gains (USFWS 2003, p. 5). Although the available weight gain data set could not be used to determine the relative importance of late arrivals versus insufficient food supply, USFWS (2003, p. 6) concluded, ''the two hypotheses forwarded to explain changes in weight gain in Delaware Bay red knots are not mutually exclusive, but instead represent two factors which operate in tandem to affect departure weights from Delaware Bay.'' That these two factors (late arrivals and insufficient food supplies) worked synergistically to cause a decline in red knot departure weights was the same conclusion we reached in the proposed rule (78 FR 60024, pp. 60072, 60094). We agree that attempts to estimate growth rates (*i.e.,* rates of weight gain) from samples of birds taken over the course of the stopover period are problematic for the same reason cited by USFWS (2003, p. 6) (*i.e.,* uncertainty in arrival times of the birds in each sample), as we noted in the proposed rule (78 FR 60024, p. 60068). That said, we did not rely on this parameter (rates of weight gain over the course of the season) in our analysis. Instead, we relied on a different analytical parameter, the proportion of red knots above a threshold weight at the end of May, which we conclude is an appropriate index for trends in red knot weight gain since 1997, as discussed in the proposed rule (78 FR 60024, p. 60068) and in the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest—Link B, Part 2).

(124) Comment: One commenter, citing comments of individual Service representatives at meetings of various ASFMC bodies, concluded that Service managers find the basic red knot science is flawed.

Our Response: Various levels of uncertainty are associated with all scientific data. As an active participant in the ASMFC's management of the HSC fishery, Service representatives routinely engage in robust discussions regarding the strengths and weaknesses of available HSC and red knot data sets. Our current agency conclusions, based on a detailed analysis, are presented in the proposed rule (78 FR 60024, pp. 60063–60071) and the Supplemental Document (Factor E—Reduced Food Availability—Horseshoe Crab Harvest). Our key conclusion is that, although the causal chain from HSC harvest to red knot populations has several links associated with various levels of uncertainty, the weight of evidence supports these linkages, points to past harvest as a key factor in the decline of the red knot, and underscores the importance of continued HSC management to meet the needs of the red knot.

(125) Comment: One commenter reported anecdotal information that no red knots had been observed by mid-May 2014 in Delaware Bay, and that HSCs were unusually small and few.

Our Response: Red knot distribution and abundance within Delaware Bay vary considerably from year to year, and within years, based on weather, food availability, disturbance patterns, and other factors. Likewise, spatial and temporal patterns of HSC spawning are highly dependent on weather (especially water temperature) as well as habitat conditions. We may consider anecdotal data when no other data sets are available. However, in Delaware Bay, other data sets (*e.g.,* red knot peak counts, red knot total passage population estimates, red knot weight gain data, HSC spawning and trawl surveys) are available that are based on consistent methodologies, such that these data sets can be evaluated for long-term trends despite the naturally high variability in these natural systems. Preliminary reports from two of these data sets show both red knot abundance and weight gain in Delaware Bay continued at a somewhat improved level in 2014, for a third consecutive year (A. Dey pers. comm. June 30 and July 23, 2014).

(126) Comment: Several commenters stated that commercial fishermen from Maine through Florida have made great sacrifices for well over a decade of increasing regulation of the HSC bait fishery. Some fishermen went out of business, not only because the allowable harvest for bait was severely restricted, but also because the other fisheries that relied on HSCs as bait (*e.g.,* whelk/conch, eel, and minnow) experienced a bait shortage and spiraling bait costs. The Service maintains that a serious red knot population decline occurred in the 2000s caused primarily by reduced food availability from increased harvests of HSCs, but the Service also

acknowledges that red knot numbers appear to have stabilized in the past few years. Since knot numbers have stabilized, the restrictions placed on the HSC harvests (*i.e.,* the Fishery Management Plan and subsequent addenda, most recently the ARM framework), appear to have been effective in providing sufficient food resources for the shorebirds. The regulatory regime for the HSC fishery was designed to meet the feeding needs of migratory shorebirds. Based on the success of these harvest restrictions in stabilizing the knot population, the commercial industry has done its part. The commercial fishermen and related industries have borne a disproportionate share of protecting these migratory shorebirds.

Our Response: We agree that the actions of the ASMFC and the commercial fishing industry have been instrumental in halting the decline of the red knot's stopover population in Delaware Bay. In addition to restricting harvests through the Fisheries Management Plan (including the most recent iteration, the ARM), the ASMFC has taken several proactive steps to substantially reduce landings (see *Our Response 46* and proposed rule 78 FR 60024, p. 60064). We recognize and appreciate these efforts. As noted in the proposed rule (78 FR 60024, p. 60063), most data suggest that the volume of HSC eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. However, it is not yet known if the egg resource will continue to adequately support red knot population growth over the next decade. Further, the red knot population in Delaware Bay appears to have stabilized at a notably low level. Therefore, sustained focus on protecting the red knot's food supply continues to be vital to the recovery of the red knot, and will be addressed during the recovery planning process. We intend to continue our active role in the ASMFC's management of the HSC fishery and do not anticipate recommending additional HSC harvest restrictions in Delaware Bay (beyond the ARM) as a result of listing the red knot (however, see *Our Response 46* regarding new uncertainty about the future of the ARM). Also see *Our Response 2* regarding economic and other implications of listing that we may not consider in listing determinations, and *Our Response 120* regarding bait prices.

(127) Comment: One commenter suggested that focusing efforts on the many foreign countries that continue to allow the legal and illegal hunting of red knots would be more productive in producing tangible results for the long-range survival of the species than imposing further restrictions in the United States where red knot hunting is no longer permitted.

Our Response: We agree that the effects of legal and illegal hunting on the red knot should continue to be assessed and minimized through international conservation partnerships. Work in this area has already begun and changes are in progress, as noted in the Supplemental Document (Factor B—Hunting). As noted in the proposed rule (78 FR 60024, p. 60053), we have no evidence that hunting was a driving factor in red knot population declines in the 2000s, or that hunting pressure is increasing. However, while not currently a threat in the United States, hunting is one of many threats affecting the knot. The Service will continue to enhance our work with partners across the range of the knot to reduce or ameliorate all ongoing or emerging threats.

(128) Comment: Several commenters believe that legal and illegal hunting of shorebirds is a major issue facing red knots and other shorebirds that migrate through the Caribbean basin and winter along the northern coast of South America, and that the proposed rule understates the overall importance of direct mortality from hunting on driving population change in shorebird populations. These commenters cite recent evidence suggesting that at least 2,000 red knots pass through the Guianas during southbound migration and that many birds likely stage in this area and coastal Venezuela during northbound migration. Further, documented hunting pressure is significant in Suriname, with estimates that between 20,000 and 100,000 shorebirds are taken annually. While the proposed rule suggests that Suriname is not likely an important area for red knot, there are suitable habitats and observations of hundreds of birds from this country. Likewise, another commenter asked how the Service can find that individual hunting mortality does not seem to affect the population as a whole if there are no data on hunting anywhere, especially illegal hunting.

Our Response: We appreciate this new information and have incorporated it into the Supplemental Document (Migration and Winter Habitats; Population Surveys and Estimates; Factor B—Hunting—Caribbean and South America). We have made minor changes to our conclusions regarding the overall importance of hunting as a threat to the red knot. While only low to moderate red knot mortality is documented, we acknowledge that additional undocumented mortality is likely. The findings of Watts (2010) suggest that even moderate (hundreds of birds) direct human-caused mortality may begin to have population-level effects on the red knot. However, we do not have adequate information to reasonably know if hunting mortality is or was previously at this level in the Guianas (CSRPN 2013; Niles 2012b; D. Mizrahi pers. comm. October 16, 2011; Harrington 2001, p. 22), though we conclude that it was likely much lower (tens of birds) in the Caribbean islands (G. Humbert pers. comm. November 29, 2013; W. Burke pers. comm. October 12, 2011; A. Levesque pers. comm. October 11, 2011; Hutt and Hutt 1992, p. 70). We expect mortality of individual knots from hunting to continue into the future, but at stable or decreasing levels due to the recent international attention to shorebird hunting.

(129) Comment: One commenter stated that red knots are still heavily hunted in many places and in many places are called ''snipe.'' Snipe are legally hunted, but the average person in the field cannot tell the difference between a red knot and a snipe. This commenter contends that the Service has data on hunted red knots from the bands returned during snipe hunts, and the August 13, 2011, shorebird hunting workshop summary shows close to 500,000 shorebirds, including snipes and red knots, have been killed by hunters in the Caribbean and South America in just a few years. Further, one red knot researcher has in the past (2005) publicly denied any hunting of shorebirds, but has full knowledge of the hunting.

Our Response: We disagree with the conclusions of the commenter. In the proposed rule (Rufa Red Knot Ecology and Abundance, p. 4), we discussed the numerous common names for red knot that were historically used by hunters in the United States. We agree that red knots have been historically called snipe, and that hunting of Wilson's snipe (*Gallinago delicata*) (previously called common snipe (*Gallinago gallinago*)) is still legal in the United States (USFWS 2012c); however, we have no data to suggest that red knots are being killed in the United States incidental to the legal hunting of Wilson's snipe. Lowery (1974, p. 309) notes that, even in winter plumage, the red knot's shape and bill make this species comparatively easy to distinguish from common snipe and other similarly sized shorebirds. Snipe occupy different habitats (flooded, shallow emergent marsh) than do red knots (exposed flats), and snipe are

solitary while red knots tend to occur in flocks (C. Dwyer pers. comm. July 18, 2014). Although the margins of error are large, the best available estimates (Raftovich *et al.* 2014, p. 54) show very few snipe hunters in the Atlantic Flyway States (C. Dwyer pers. comm. July 18, 2014).

We agree that a rough understanding of red knot mortality levels from hunting in South America has come from band returns, as discussed in the proposed rule (78 FR 60024, pp. 60050–60052) and the Supplemental Document (Factor B—Hunting). Throughout our analysis of hunting, we relied heavily on the 2011 shorebird hunting workshop report (USFWS 2011e), and agree that this report documents high levels of shorebird hunting in some parts of the Caribbean and South America. However, much of the information in this report is not specific to red knot. Thus, we supplemented this information with data from other sources. We cannot respond to comments about the public statements of any particular red knot researcher. However, based on our review, we conclude that most of the international red knot research and conservation community has become gradually aware of the hunting issue over the past decade, and now regard it as an important area for conservation actions, many of which are underway. See *Our Responses 127* and *128* above for additional information on our conclusions regarding hunting as a threat to red knot.

(130) Comment: Several commenters contend that the Service must revise its oil- and gas-related findings in the proposed rule to more accurately state that (1) based upon the best available data and information, oil spills and leaks have had, at most, minimal impacts, and there is no available information to suggest that the risk of future oil spills is likely to be other than minimal; and (2) there is no available information demonstrating that permitted oil and gas activities have had any adverse effects on the rufa red knot, and such activities do not pose a threat to the species. Further, based upon the current record, there is no information available to support a conclusion that potential future spills are ''likely'' to impact red knots.

Our Response: We agree that documented effects of oil and gas extraction and transport on red knots and their habitats to date have been minimal, as stated in the proposed rule (78 FR 60024, p. 60087). However, we disagree that the future risk is minimal. Based on the review and analysis we presented in the proposed rule (78 FR 60024, pp. 60083–60087), we found that red knots are exposed to large-scale petroleum extraction and transportation operations in many key wintering and stopover habitats. We also found that a number of spills and leaks have occurred in red knot areas. The minimal effects to red knots from these past incidents is attributable to fortunate (for the knots) timing or weather conditions, and we conclude that such fortunate circumstances are unlikely to accompany all future spills and leaks affecting red knot habitats. Thus, we continue to conclude that high potential exists for small or medium spills to impact moderate numbers of red knots or their habitats, such that one or more such events is likely over the next few decades, based on the proximity of key red knot habitats to high-volume oil operations. A major spill affecting habitats in a key red knot concentration area while knots are present is less likely but would be expected to cause population-level impacts.

(131) Comment: Several commenters stated that the proposed rule relied on inappropriate and nonscientific sources to erroneously associate mosquito control adulticides (specifically the pesticide fenthion) with adverse effects to birds, and that there is no scientific evidence to link the bird deaths referenced in the proposed rule to a particular pesticide or mosquito control operation. In addition, the proposed rule erroneously stated that fenthion had been banned by the U.S. Environmental Protection Agency (USEPA), when actually the USEPA regulates, but does not ban, pesticides. In fact, the manufacturer of fenthion voluntarily cancelled its label for mosquito control, thereby withdrawing it from the mosquito control market. Labels for other uses of fenthion were not affected by the withdrawal of the mosquito control label.

Our Response: Although we believed the data to be accurate at the time we reviewed and used them in the proposed rule (78 FR 60024, p. 60088), we could not, upon further review, verify that fenthion caused the mortality of piping plovers. We agree that we erroneously misstated that fenthion had been banned by the USEPA. We have withdrawn the Contaminants—Florida section entirely from the final rule and Supplemental Document.

(132) Comment: One commenter asked what data support the emerging threat on the breeding grounds since the Service states that comprehensive counts from the breeding grounds are not available because nesting knots are thinly distributed across a huge and remote area of the Arctic.

Our Response: First, we conclude that changing relationships between red knots and their predators are likely a part of overall ecosystem changes due to rapid arctic warming. Although there is high uncertainty about how such ecosystem changes will unfold, there is high certainty that ecosystem changes are already occurring and will continue. We have updated the Supplemental Document (Factor A—Arctic Warming) with the IPCC's new findings of early warning signs that arctic ecosystems are already experiencing irreversible regime shifts (Summary for Policymakers *in* IPCC 2014, p. 12). Given the sensitivity of red knots to predation rates on the breeding grounds (78 FR 60024, p. 60057), we conclude that these ecosystem changes constitute a threat to the red knot.

Second, Fraser *et al.* (2013, entire) found preliminary evidence for one mechanism by which ecosystem changes may have already impacted red knot populations—through rodent-mediated changes in predation pressure. Additional studies would be needed to support this hypothesis (Fraser *et al.* 2013, p. 13). However, we have updated the Supplemental Document (Factor C—Predation—Breeding Areas) with new information that, although factors other than climate change may also be important, the documented collapse or dampening of rodent cycles in some parts of the Arctic over the last 20 to 30 years can be attributed to climate change with ''high confidence'' (Chapter 28 *in* IPCC 2014, p. 14). Thus, we conclude that the geographic extent and duration of future interruptions to these rodent cycles is likely to intensify as the arctic climate continues to change. Disruptions in the rodent-predator cycle pose a substantial threat to red knot populations, as they may result in prolonged periods of very low red knot reproductive output. Red knot counts from the breeding grounds are not necessary to reach this conclusion.

(133) Comment: One commenter asked how confident the Service is in dismissing predation in the geographically large nonbreeding portion of the red knot's range.

Our Response: We disagree that we have ''dismissed'' predation in nonbreeding areas (see proposed rule 78 FR 60024, pp. 60055–60057 and Supplemental Document section Factor C—Predation—Nonbreeding Areas), and conclude that predation in these areas is likely to exacerbate other threats to red knot populations.

(134) Comment: Several commenters noted that areas offshore of Delaware Bay are being studied for potential installation of wind turbines. The Wind

Energy Areas (WEA) proposed for the States of Delaware and Maryland appear to be placed precisely in the path of the red knots arriving in May after flying nonstop from northeast South America.

Our Response: We have updated the Supplemental Document to reference these WEAs, as well as leases that have been, or are scheduled to be issued for development of offshore wind energy. Our analysis of risks to red knots from the likely future development of wind energy in the Atlantic OCS is presented in the Supplemental Document, with only minor changes from the proposed rule (see *Our Responses 21* through *25*).

(135) Comment: One commenter stated that, while the Service may ''expect ongoing improvements in turbine siting, design, and operation [to] help minimize bird collision hazards'' in the future, there is no indication this has happened or will happen. There is no Federal, State, or local ability or willingness to regulate wind energy projects in Texas or to deter poor siting decisions through prosecution of Migratory Bird Treaty Act violations. Thus, projects continue to be built in areas where risk to avian resources, including red knots, is potentially high.

Our Response: The commenter is correct that the Service cannot control or regulate the development of projects that lack a Federal nexus, including wind energy projects in any State. However, we do work with project developers to find locations that pose less of a risk to migratory birds and other species, and to find methods to reduce the risk of collisions during operation. This voluntary process is informed by an improved understanding, through research, of migratory bird behavior and project design. Researchers from a wide variety of government agencies, academic institutions, and nongovernmental organizations continue to study factors related to birds' wind turbine collision risks. As the science evolves and our understanding of these risk factors increases, measures are developed and implemented to help minimize bird fatalities. Specifically, research and post construction observations have led companies to strictly control lighting at their projects, thus reducing the collision risk for night migrating birds. More information is available on our Web site at *http://www.fws.gov/windenergy/.*

(136) Comment: One commenter stated that, though the Service is ''not aware of any documented red knot mortalities at any wind turbines to date,'' it is not appropriate to make any conclusion based on a lack of data. This commenter contends that the wind energy projects along the Texas coast may represent the highest risk exposure red knots face from wind energy anywhere, yet data are either not being gathered or not being shared by these projects. In either case, effectively zero data are available on which to base a conclusion, and a precautionary principle should apply since it is well known that wind energy installations have the potential to be sources of mortality. Further, without data it seems unjustifiable to assume that this is either currently insignificant or that the cumulative impacts from current and future buildout in the area will be insignificant.

Our Response: We have revised the Supplemental Document (Factor E—Wind Energy Development—Terrestrial) with new findings from Loss *et al.* (2013, pp. 201, 202, 207) that accessibility to relevant data remains a problem, particularly for the tallest (greater than 262 ft (80 m)) turbines, because most of the mortality data are in industry reports that are not subjected to scientific peer review or available to the public. We have also revised the Supplemental Document to conclude that, based on the higher frequency and lower altitudes of red knot flights along the coasts, as well as the coastal location of most large, known U.S. nonbreeding red knot roosting and foraging areas, collision and displacement risks per turbine (notwithstanding differences in specific factors such as turbine size, design, operation, siting) are likely higher along the coasts than in areas either far offshore or far inland. In the Supplemental Document (Factor E—Wind Energy—Summary) we state that we do not believe any turbine related mortality is causing subspecies level effects. However our primary concern is that as buildout of wind energy infrastructure progresses, especially near the coasts, mortality from turbine collisions may contribute to a subspecies-level effect due to the red knot's modeled vulnerability to low levels of mortality (Watts 2010, p. 1).

(137) Comment: One commenter stated that red knots will not be killed by wind turbines. The claim of red knot mortality will be used to stop the placement of wind turbines at a time when clean energy is needed.

Our Response: We disagree that red knots will not be killed and that risks to red knots will prevent wind energy development (see *Comments 21* and *22*). The Department of the Interior supports the development of wind energy, and the Service works to ensure that such development is bird- and habitat-friendly (USFWS 2012d; Department of Energy and Bureau of Ocean Energy Management, Regulation, and Enforcement 2011; Manville 2009).

(138) Comment: Several commenters requested that we recognize North Carolina's proactive coastal oversight at the State and local levels, which has resulted in the construction and maintenance of high-quality sandy shorelines via beach nourishment and inlet relocation. These commenters contend that North Carolina has done a great deal to create the right balance between use of beaches and protection of wildlife and that the State's regulatory approach to coastal storm damage reduction projects, borrow source and native beach compatibility, and inlet location management is ensuring these sandy habitat areas continue functioning in multispecies resilient manners. One commenter stated that North Carolina does not allow hard structures.

Our Response: We recognize that North Carolina is working to sustainably manage sandy habitats to meet multispecies resiliency. We have revised the Supplemental Document (Factor D—United States—Coastal Management) to recognize North Carolina's Technical Standards for Beach Fill (15A NCAC 07H .0312), which address sediment compatibility of material proposed to be placed on beaches. We have also revised the Supplemental Document (Factor A—U.S. Shoreline Stabilization—Hard Structures) to recognize that, as a result of a 1985 State prohibition on new hard structures, there are only a few permanent, hard stabilization structures along North Carolina's beaches. Despite such measures, however, some red knot habitats in North Carolina are vulnerable to degradation due to beach hardening practices. For example, 2011 legislation authorized an exception for construction of up to four new terminal groins in North Carolina (Rice 2012a, p. 8, discussed at 78 FR 60024, p. 600369), and some of North Carolina's coastal communities have begun seeking authorization from the State legislature for additional hard structures. Although the construction of new hard stabilization structures remains highly restricted in North Carolina, extensive temporary structures have been utilized including sand tube groins, sand tube bulkheads, and approximately 350 sandbag revetments (Rice 2012a, p. 9). Finally, beach nourishment and beach bulldozing are prevalent in North Carolina. Most of these beaches are nourished at least every 3 years, some as often as every year (K. Matthews pers. comm. May 2, 2014). Even with State regulations to ensure sediment

compatibility, such frequent nourishment can interfere with natural coastal processes and affect shorebird habitat (*e.g.,* benthic prey availability) (K. Matthews pers. comm. May 2, 2014; Zajac and Whitlatch 2003, p. 101; Greene 2002, p. 25; Peterson and Manning 2001, p. 1; Hurme and Pullen 1988, p. 127). However, it is noted that beach nourishment can be important in establishing or maintaining beachfront red knot habitat in some areas. Depending on the site and situation, beach nourishment can be beneficial or detrimental to red knot habitat (see *Comment 58*). The negative effects to habitat associated with beach nourishment are expected typically to be short term, though repeated renourishing may prolong the adverse effects to habitat.

Determination

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the rufa red knot. We have identified substantial threats to the red knot attributable to Factors A, B, C, and E. The primary driving threats to the red knot are from habitat loss and degradation due to sea level rise, shoreline hardening, and Arctic warming (Factor A), and reduced food availability and asynchronies (mismatches) in the annual cycle (Factor E). Other factors may cause additive red knot mortality. Individually these other factors are not expected to have subspecies level effects; however, cumulatively, these factors could exacerbate the effects of the primary threats if they further reduce the species' resiliency. These secondary factors include hunting (Factor B); predation in nonbreeding areas (Factor C); and human disturbance, oil spills, and wind energy development, especially near the coasts (Factor E). All of these factors affect red knots across their current range and are expected to continue or intensify into the future.

Conservation efforts are being implemented in many areas of the red knot's range (see Factors A, B, C, and E in the Supplemental Document—Summary of Factors Affecting the Species). For example, in 2012, the ASMFC adopted the ARM (ASMFC 2012e, entire) for the management of the HSC population in the Delaware Bay Region to meet the dual objectives of maximizing crab harvest and red knot population growth. In addition, regulatory mechanisms exist that provide protections for the red knot directly (*e.g.,* MBTA protections against take for scientific study or by hunting) or through regulation of activities that threaten red knot habitat (*e.g.,* section 404 of the Clean Water Act, Rivers and Harbors Act, Coastal Barrier Resources Act, Coastal Zone Management Act, and State regulation of shoreline stabilization and coastal development) (see Supplemental Document—Summary of Factors Affecting the Species—Factor D). While these conservation efforts and existing regulatory mechanisms reduce some threats to the red knot (see Factor D discussion in the Supplemental Document—Summary of Factors Affecting the Species), significant risks to the subspecies remain.

Red knots migrate annually between their breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast United States, the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. During both the spring and fall migrations, red knots use key staging and stopover areas to rest and feed. This life history strategy makes this species inherently vulnerable to numerous changes in the timing of quality food (Factor E) and habitat resource availability (Factor A) across its geographic range. While a few examples suggest the species has some flexibility in migration strategies, the full scope of the species' adaptability to changes in its annual cycle is unknown.

The Act defines an endangered species as any species that is ''in danger of extinction throughout all or a significant portion of its range'' and a threatened species as any species ''that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' We find that the rufa red knot meets the definition of a threatened species due to the present and likely continued destruction and modification of habitat and curtailment of the species' range driven by the effects of climate change, and reduced food resources and further asynchronies in its annual cycle that result in the species' reduced redundancy, resiliency, and representation. We base this determination on the immediacy, severity, and scope of the threats described above. Therefore, on the basis of the best scientific and commercial data available, we are listing the rufa red knot as a threatened species in accordance with sections 3(6) and 4(a)(1) of the Act. We find that an endangered species status is not appropriate for the rufa red knot because, while there is uncertainty as to how long it may take some of the climate-induced changes to manifest in population-level effects to the rufa red knot, we find that the best available data suggest the rufa red knot is not at a high risk of a significant decline in the near term such that it is currently in danger of extinction and, therefore, meeting the definition of an endangered species under the Act. However, should the reduction in redundancy, resiliency, or representation culminate in an abrupt and large loss, or initiation of a steep rate of decline, of reproductive capability and success (corresponding to Factor E) or we subsequently find that the species does not have the adaptive capacity to adjust to shifts in its food and habitat resources (corresponding to Factor E), then the red knot would be at higher risk of a significant decline in the near term and we would reassess whether it meets the definition of an endangered species under the Act.

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. The rufa red knot is wide-ranging, and the threats occur throughout its range. Therefore, we assessed the status of the subspecies throughout its entire range. The threats to the survival of the subspecies are not restricted to any particular significant portion of that range. Accordingly, our assessment and proposed determination applies to the subspecies throughout its entire range.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness, and conservation by Federal, State, tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed

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species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan identifies site-specific management actions that set a trigger for review of the five factors that control whether a species remains endangered or may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (composed of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from the New Jersey Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (*e.g.,* restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands. We also recognize that for some species, measures needed to help achieve recovery may include some that are of a type, scope, or scale that is independent of land ownership status and beyond the control of cooperating landowners.

Following publication of this final listing rule, additional funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost-share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the States of Alabama, Arkansas, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming and Puerto Rico and the U.S. Virgin Islands would be eligible for Federal funds to implement management actions that promote the protection or recovery of the rufa red knot. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Please let us know if you are interested in participating in recovery efforts for the rufa red knot. Additionally, we invite you to submit any new information on this species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. If a species is listed subsequently, section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

Federal agency actions within the species' habitat that may require conference or consultation or both as described in the preceding paragraph include management and landscape-altering activities on Federal lands administered by the Department of Defense, the Service, and NPS; issuance of section 404 Clean Water Act permits and shoreline stabilization projects implemented by the U.S. Army Corps of Engineers; construction and management of gas pipeline rights-of-way by the Federal Energy Regulatory Commission; leasing of Federal waters by BOEM for the construction of wind turbines; and construction and maintenance of roads or highways by the Federal Highway Administration.

Under section 4(d) of the Act, the Service has discretion to issue regulations that we find necessary and advisable to provide for the conservation of threatened species. The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to threatened wildlife. The prohibitions of section 9(a)(1) of the Act, as applied to threatened wildlife and codified at 50 CFR 17.31, make it illegal for any person subject to the jurisdiction of the United States to take (which includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt any of these) threatened wildlife within the United States or on the high seas. In addition, it is unlawful to import; export; deliver, receive, carry, transport, or ship in interstate or foreign commerce in the course of commercial activity; or sell or offer for sale in interstate or foreign commerce any listed species. It is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to employees of the Service, NMFS, other Federal land management agencies, and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving threatened wildlife under certain circumstances. Regulations governing permits are codified at 50 CFR 17.32. With regard to threatened wildlife, a permit may be issued for the following purposes: for scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities. There are also certain statutory exemptions from

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the prohibitions, which are found in sections 9 and 10 of the Act.

(1) It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a final listing on proposed and ongoing activities within the range of a listed species.

Based on the best available information, the following activity is unlikely to result in a violation of section 9, if this activity is carried out in accordance with existing regulations and permit requirements; this list is not comprehensive: Harvest of HSC in accordance with the ARM, provided the ARM is implemented as intended (*e.g.,* including implementation of necessary monitoring programs), and enforced.

Based on the best available information, the following activities may potentially result in a violation of section 9 the Act; this list is not comprehensive:

(1) Unauthorized collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act;

(2) introduction of nonnative species that compete with or prey upon the rufa red knot, or that cause declines of the red knot's prey species;

(3) unauthorized modification of intertidal habitat that regularly supports concentrations of rufa red knots during the wintering or stopover periods; and

(4) unauthorized discharge of chemicals or fill material into any waters along which the rufa red knot is known to occur.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the New Jersey Field Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Endangered Species Permits, 300 Westgate Center Drive, Hadley, MA, 01035 (telephone 413–253–8615; facsimile 413–253–8482).

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship with Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes. We coordinated with applicable Tribes throughout the U.S. range of the rufa red knot, but received no information indicating that the species is known to occur on Tribal lands.

References Cited

A complete list of references cited in this rulemaking is available on online at *http://www.regulations.gov* under Docket Number FWS–R5–ES–2013–0097 and upon request from the New Jersey Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this final rule are the staff members of the New Jersey Field Office (see **FOR FURTHER INFORMATION CONTACT**).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; and 4201–4245, unless otherwise noted.

■ 2. In § 17.11(h), add an entry for ''Knot, rufa red'' to the List of Endangered and Threatened Wildlife in alphabetical order under Birds to read as set forth below:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

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Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	*
BIRDS.							
*	*	*	*	*	*	*	*
Knot, rufa red.	*Calidris canutus rufa*.	Argentina, Aruba, Bahamas, Barbados, Belize, Brazil, British Virgin Islands, Canada, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, El Salvador, France (Guadeloupe, French Guiana, Martinique), Guatemala, Guyana, Haiti, Jamaica, Mexico, Panama, Paraguay, Suriname, Trinidad and Tobago, Uruguay, Venezuela, U.S.A. (AL, AR, CO, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, WV, WY, Puerto Rico, U.S. Virgin Islands).	Entire	T	855	N/A	N/A
*	*	*	*	*	*	*	*

* * * * *

Dated: November 21, 2014.

Matthew Huggler,

Acting Director, U.S. Fish and Wildlife Service.

[FR Doc. 2014–28338 Filed 12–10–14; 8:45 am]

BILLING CODE 4310–55–P

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Topeka Shiner (*Notropis topeka*) Management Plan for the State of South Dakota

Summer 2003

South Dakota Department of Game, Fish & Parks
Wildlife Division Report No. 2003-10

007881

Topeka Shiner (*Notropis topeka*) Management Plan for the State of South Dakota

Approved / Date: 5/19/03
Secretary, Department of Game, Fish & Parks

Approved / Date: 6/10/03
Secretary, Department of Environment and Natural Resources

Approved / Date:
Secretary, Department of Agriculture

Approved / Date:
Secretary, Department of Transportation

Topeka Shiner (*Notropis topeka*) Management Plan for the State of South Dakota

This management plan is a cooperative effort between various local, state, and federal entities. Funding for this plan was provided by the U.S. Fish & Wildlife Service through an Endangered Species Act Section 6 grant to the South Dakota Department of Game, Fish & Parks. Jeff Shearer (SD GF&P) drafted most portions of this management plan. Steve Wall (SDSU) provided the Topeka shiner distribution map. The following individuals were involved in providing ideas and comments during planning meetings:

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Eileen Dowd Stukel – SD GF&P
David Lucchesi – SD GF&P
Tim Olson – SD GF&P
Chad Switzer – SD GF&P
Chad Tussing – SD GF&P
Connie Vicuna – NRCS
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Dennis Clarke – SD DENR
Vernon Tabor – USFWS
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Dr. Craig Milewski – DSU
George Cunningham – UN-Omaha
Andy Mitzell – USCOE
John Deppe – Lower James RC&D
Michael Held – SD Farm Bureau
Steve Willard – SDCA

Suggested citation:
Shearer, J.S. 2003. Topeka shiner (*Notropis topeka*) management plan for the state of South Dakota. South Dakota Department of Game, Fish and Parks, Pierre, Wildlife Division Report No. 2003-10, 82 pp.

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List of Abbreviations

This document was written according to the style suggested by the American Fisheries Society. Acronyms that are used throughout this document are defined below.

BHSU.....Black Hills State University
BMP ..... best management practice
CAFO.....confined animal feeding operation
CRP .....Conservation Reserve Program
CSP .....Conservation Security Program
CWA .....Clean Water Act
DSU..... Dakota State University
EPA .....Environmental Protection Agency
EQIP.....Environmental Quality Incentives Program
EROS.....Earth Resources Observation Systems
ESA .....Endangered Species Act
EWP .....Emergency Watershed Program
FEMA..... Federal Emergency Management Agency
FHA.....Federal Highway Administration
FSA ..... Farm Services Agency
GIS .....Geographic Information Systems
GRP .....Grasslands Reserve Program
HCP.....Habitat Conservation Plan
IBI.....index of biotic integrity
NPDES .....National Pollution Discharge Elimination System
NRCS .....Natural Resource Conservation Service
NRI.....National Resource Inventory
NWI..... National Wetlands Inventory
RC&D..... Resource Conservation and Development
SDCA.....South Dakota Cattlemen's Association
SDCGA .....South Dakota Corn Grower's Association
SD Dept. of Ag. ..... South Dakota Department of Agriculture
SD DENR.....South Dakota Department of Environment and Natural Resources
SD DOT..... South Dakota Department of Transportation
SD GF&P .....South Dakota Game, Fish & Parks
SDSU..... South Dakota State University
TMDL.....Total Maximum Daily Load
UN-Omaha .....University of Nebraska - Omaha
USCOE..... United States Army Corps of Engineers
USFWS ..... United States Fish and Wildlife Service
USGS.....United States Geological Survey
WHIP.....Wildlife Habitat Improvement Program
WRP .....Wetland Reserve Program

Introduction

The U.S. Fish and Wildlife Service (USFWS) listed the Topeka shiner (*Notropis topeka*) as endangered under the Endangered Species Act (ESA) in January 1999 (USFWS 2001). Prior to listing, limited survey data suggested the shiner only occupied 10% of its historic range (USFWS 1998). Recent studies in South Dakota have documented the Topeka shiner in 80% of historically known streams, along with many streams where Topeka shiners were not previously reported. These recent findings suggest Topeka shiners are more abundant in South Dakota than other states within its range.

This state management plan is a cooperative effort between various local, state, and federal entities within South Dakota. While South Dakota Game, Fish and Parks (SD GF&P) took the lead in drafting this plan, entities, such as the USFWS, Natural Resource Conservation Service (NRCS), U.S. Army Corps of Engineers (USCOE), South Dakota Department of Environment and Natural Resources (SD DENR), South Dakota Department of Transportation (SD DOT), South Dakota Department of Agriculture (SD Dept. of Ag.), conservation districts, state universities, and private organizations (SD Cattlemen's Assoc., SD Farm Bureau), provided input at various levels. Local groups and private landowners will have opportunities for participation through outreach activities.

The goals of this state management plan are to:

- Maintain habitat integrity in Topeka shiner streams.
- Establish a point-based management goal for the State of South Dakota in contribution towards national recovery efforts.

Specific objectives needed to meet these plan goals include:

- Management actions that address stream hydrology, geomorphology, and water quality.
- Establishment of a monitoring and assessment protocol to evaluate South Dakota's point-based recovery goal.
- Development of public outreach and education strategies to inform all entities involved about Topeka shiner management in South Dakota.

> A short-term intended purpose of this plan is to exclude the need to designate critical habitat in South Dakota by identifying and enacting those conservation strategies listed in this plan.

The State of South Dakota considers a flexible, adaptive, and proactive management approach to be an appropriate and effective means of achieving continued conservation of the Topeka shiner in South Dakota while contributing to national recovery efforts. Flexible management of the Topeka shiner will best be directed through a Habitat Conservation Plan (HCP), which may alleviate certain consultation procedures currently required under Section 7 of the ESA. This state management plan will provide a crucial component in establishing an HCP. Specific functions of this plan are: 1) to provide a planning framework from which specific operational plans or tools can be developed and implemented; 2) to provide a basis upon which legal agreements, such as an HCP, can be

developed; 3) specific to South Dakota Game, Fish & Parks to fulfill endangered species commitments made in the Cooperative Agreement for the Conservation of Endangered and Threatened Animals; and 4) to make use of the state expertise related to fish communities, their related habitats, and existing programs designed to promote and restore healthy ecosystems. This plan takes a watershed-level approach to identify needs and strategies for the long-term conservation of Topeka shiner habitat. A watershed-level approach will allow for a greater number of options in implementing conservation strategies to address major concerns that may impact Topeka shiner populations.

Description

The Topeka shiner is a small minnow (family Cyprinidae) first discovered by C.H. Gilbert in Shunganunga Creek near Topeka, Kansas (Minckley and Cross 1959). This shiner averages 1.5 to 2 inches in length with a maximum length of 3 inches. Distinguishing characteristics include a chevron-shaped black spot at the base of its caudal fin, a dusky stripe along the lateral line, a dark, olivaceous colored body, and a distinct dark stripe preceding the dorsal fin. Dark pigment gives the body a crosshatch pattern above the lateral line while the body is white below the lateral line. Breeding males have an orange-tinted head and fins (Pflieger 1997, USFWS 1998).

Life History

Topeka shiners spawn from late-May to mid-August, depending on water temperature. Spawning occurs over gravel nests of green sunfish (*Lepomis cyanellus*) and orangespotted sunfish (*L. humilis*). Topeka shiner males occupy a small territory around the periphery of the nest. Hatch (2001) reported breeding males and females occurring over silt-covered rubble and concrete rip-rap as well. Topeka shiners are sexually mature by their second summer and few individuals live to three years of age (Pflieger 1997). The diet of the shiner is quite diverse, ranging from plant material to zooplankton. However, small aquatic insects, especially midges (family Chironomidae), make up a large portion of the Topeka shiner's diet (Dahle 2001, Kerns and Bonneau 2002).

Habitat

Topeka shiners generally occupy small, prairie streams with groundwater inputs, high water quality, and sand or gravel substrates (Pflieger 1997). Some Topeka shiner locations in South Dakota reported by Wall et al. (2001) and Cunningham (2002) were degraded streams with silt substrates, off-channel backwater areas, borrow pits, and sloughs connected to occupied streams. Recruitment potential in these habitat types is unknown. Other studies (Clark 2000, Dahle 2001, Hatch 2001) have reported this species in backwater areas as well. Topeka shiners have also been collected in varying abundance from streams with incised channels, high bank erosion, and intensive grazing pressure along the riparian zone (Jeff Shearer, SD GF&P, personal observation). Regardless of the habitat selected, groundwater flow is especially important to Topeka shiners during dry conditions. Based on a GIS model developed by Wall et al. (2001), the potential of Topeka shiner presence increased as the potential for groundwater delivery to streams increased. Groundwater inputs into streams help lower water temperatures and maintain water levels in isolated pools. These isolated pools provide

important habitat during periods of intermittency and act as a dispersal source when more perennial flows return to the stream (Kerns and Bonneau 2002).

Range

Historically, the Topeka shiner was widespread throughout the central prairie region of the Missouri, Mississippi, and Arkansas River drainages. The species' range included eastern South Dakota, southwestern Minnesota, Iowa, Nebraska, Kansas, and Missouri (Bailey and Allum 1962, Gilbert 1980). Currently, highly disjunct populations of Topeka shiners occupy 10% of the species' historic habitat (USFWS 1998). However, recent studies in South Dakota indicate the Topeka shiner still occupies a high percentage of known historic locations (Cunningham and Hickey 1997, Cunningham 1999, Blausey 2001, Wall et al. 2001, Cunningham 2002). With the exception of the Elm River all other historic locations fall within the boundaries of the shiner's current range in South Dakota.

Reasons for Range-wide Decline

Declines in Topeka shiner populations can not be isolated to a single factor; moreover, any combination of changes at the systemic and local levels may have contributed to a reduction in the species' range and abundance. Alterations at the systemic level, such as conversion of the prairie landscape and wetland drainage and more localized impacts, such as point source discharges, most likely acted in combination to reduce individual populations and negatively affect the Topeka shiner rangewide.

Habitat alterations may have the most pronounced impact on Topeka shiner populations. Land use changes (e.g., urbanization, development, and intensive agriculture) that alter stream hydrology and geomorphology lead to changes in sediment load and water regime. Watershed activities, such as tributary impoundment, water withdrawals, and stream channelization, often result in channel erosion, siltation, and altered water levels, potentially impacting Topeka shiner habitat (Tabor 1993, Pflieger 1997). Reduction in groundwater inputs due to wetland loss and water withdrawal may further reduce stream reaches inhabited by Topeka shiners (Wall et al. 2001). Drought may also reduce the number of stream reaches inhabited by Topeka shiners. However, the effect of drought on stream hydrology is not the same as the effects of human alterations. Topeka shiners, as well as other native prairie fish, have adapted to natural stream flow fluctuations. Human-induced changes to stream hydrology rarely mimic natural flow disturbances in timing, frequency and magnitude. Other impacts include stocking of predatory game fish (e.g., largemouth bass *Micropterus salmoides*) in impounded streams (Layher 1993, Schrank et al. 2001, Winston 2000, 2002) and introduction of non-native species (e.g., blackstripe topminnow *Fundulus notatus*, western mosquitofish *Gambusia affinis*; Pflieger 1997).

Legal Status

The Topeka shiner was proposed as a federally endangered species in the Federal Register on October 24, 1997 by the USFWS (USFWS 1997). On January 14, 1999, the Topeka shiner became officially listed as endangered under the ESA (USFWS 1998). The Topeka shiner is state-endangered in Missouri and Nebraska. Kansas and Iowa list the species as state-threatened, and Minnesota listed the Topeka shiner as a species of

concern. The shiner is not state-threatened or endangered in South Dakota. The abundance and distribution of the Topeka shiner in South Dakota precludes the need for state listing. A recent downgrade in the Topeka shiner's state rank from S2 (imperiled) to S3 (vulnerable) reflects new knowledge regarding distribution and abundance in South Dakota. The global rank of the Topeka shiner is G3 (vulnerable; SD GF&P 2003). The South Dakota Natural Heritage Program monitors and recognizes the Topeka shiner as a sensitive species. Entities that are required to address federal- and state-listed species use the South Dakota Natural Heritage database extensively during environmental review of federally funded projects.

Topeka Shiner Research in South Dakota

Research concerning the Topeka shiner in South Dakota has focused primarily on species' distribution and associated habitat. Woolman (1896 cited in Bailey and Allum 1962) reported Topeka shiners in South Dakota in 1892. However, no surveys have extensively documented Topeka shiner distribution prior to 1997. Cunningham and Hickey (1997) and Cunningham (1999) documented Topeka shiner distribution and provided a qualitative assessment of habitat in various tributaries of the James, Vermillion, and Big Sioux basins. Cunningham (2002) documented additional Topeka shiner locations and conducted a population estimate in three streams. Blausey (2001) quantitatively measured water quality and physical habitat attributes at the reach scale and compared these measurements with fish community data collected at 61 tributary sites. Regression models from this study indicate that Topeka shiners were associated with areas of low livestock use, overhanging vegetation, low siltation, and run/glide habitats composed of fine gravel and cobble substrates. Wall et al. (2001) developed a GIS model that classified the probable occurrence of Topeka shiner presence based on habitat and land use features. The GIS model was 89% accurate in predicting Topeka shiner presence and absence at high and low probability sites (i.e., the model correctly predicted whether shiners would be present or absent 89% of the time). Stream size, flow regime (i.e., intermittent to perennial), groundwater potential, gradient, and stream size discrepancy (i.e., position within the watershed or stream network) significantly influenced Topeka shiner presence (Wall et al. 2001).

Development of microsatellite markers through genetics research conducted at Black Hills State University (BHSU) is being used to estimate genetic diversity and determine genetic population structure for Topeka shiners in South Dakota (Sarver 2001). A survey for microsatellite variability for Topeka shiner populations in primary recovery units, development of a non-invasive method for collecting tissue samples for DNA extraction, and development of major histocompatability complex markers are the foci of current research. Genetics research will allow resource managers to determine the best source of broodstock for fish propagation, thus providing critical information in other states where reintroduction efforts might be needed. Furthermore, genetics information will identify specific populations in need of special management considerations.

The SD DOT has funded two studies to examine the impacts highway construction projects may have on Topeka shiner populations. Wall and Berry (2002) measured a variety of dimensions on pipe culverts for 232 culverts at 81 sites on stream segments

with a high potential for Topeka shiner presence (see Wall et al. 2001). These measurements were used to determine potential problems to fish movements, such as blockage, gradient, water velocity, embeddedness, and degree of perch (i.e., drop between culvert lip and water surface). This study found that 9% of sites posed an immediate risk to fish passage, 27% of sites were of moderate risk, and 64% of sites had low priority for mitigation (Wall and Berry 2002). Cunningham (2002) compiled a set of bridge and highway best management practices (BMPs) that would minimize on-site erosion and impact to the stream. These BMPs should meet permit regulatory requirements for construction projects in Topeka shiner streams.

The SD DOT has also been working with USFWS and other agencies to further refine these BMPs for bridges and box culvert replacements and culvert extension construction. The Topeka shiner-spawning period restriction prohibits instream work from May 15th to July 31st. This work restriction period causes major conflicts as it is also the prime construction season for SD DOT activities. Ongoing pilot projects and discussions are aimed to alleviate construction conflicts while satisfying regulatory requirements. A box culvert extension pilot project in eastern South Dakota is currently testing BMPs for winter construction in Topeka shiner streams. Further refinement of BMPs while establishing greater flexibility for instream work is the intent of this pilot project. Furthermore, the SD DOT is providing training to department administration and field staff, consultants, and contractors of the importance of implementing and monitoring erosion and sediment controls on all waterbodies in the state while emphasizing the need for special measures to be taken on Topeka shiner streams. The BMPs for Topeka shiner streams are included as Appendix A.

Goal Statement

All entities involved in developing and implementing this plan have an interest in protection and restoration of the Topeka shiner and its habitat. These interests may be inherent in the agency's mission or bound by obligations under state or federal law. For example, South Dakota Codified Law 34A-8-6 reads: "The Department of Game, Fish and Parks and the Department of Agriculture shall perform those acts necessary for the conservation, management, protection, restoration and propagation of endangered, threatened and nongame species of wildlife."

The overall goal of this plan is to establish guidelines to maintain habitat integrity in Topeka shiner streams in South Dakota. The State of South Dakota feels the best way to maintain the current abundance and distribution of Topeka shiners is to maintain the existing stream habitat. The intent of these guidelines is to work towards future delisting of the species pursuant to the ESA. The purposes of the ESA are to "provide a means whereby the ecosystems upon which the endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section." Given the relative abundance and intact distribution of Topeka shiners in South Dakota, the State of South Dakota feels a point-based system sets a more realistic management

goal than that proposed in the draft Federal Topeka Shiner Recovery Plan. This state plan proposes the following point-based management goal for each basin within eastern South Dakota: James River Basin, 900 points; Vermillion River Basin, 600 points; Big Sioux River Basin, 1300 points. These point values were based on approximately 70% of all known stream occurrences of the Topeka shiner between 1997 and 2002 in eastern South Dakota. Point values do not allow for a reduction in Topeka shiner populations or stream quality, but are designed to account for the natural variability of stream fish populations (see Population Monitoring and Assessment for justification and further details). These stream numbers exceed those occurrences reported in the final rule to list the Topeka shiner as endangered (USFWS 1998) and to establish recovery criteria of the draft Federal Topeka Shiner Recovery Plan (USFWS 2001).

Relationship to Federal Recovery Plan

The draft Federal Topeka Shiner Recovery Plan (Federal Plan) developed by the Topeka Shiner Recovery Team lists recovery criteria that must be met in order to downlist or delist the Topeka shiner. A draft of the Federal Plan was under internal review during the time this state management plan was developed. The Federal Plan divides the shiner's range into primary and secondary recovery units. The James, Vermillion, and Big Sioux River basins along with the Rock River watershed in Minnesota comprise Primary Recovery Unit 3 (PRU 3). In order to downlist or delist the Topeka shiner, populations must meet the recovery criteria of "stable or increasing over a period of 10 years" in PRU 3. The State of South Dakota feels the point-based management criteria (discussed in the Goal Statement) provides a more tangible value to work towards rather than the recovery criteria proposed in the Federal Plan. Point-based management criteria establish a baseline population and provide a measurable value that can be monitored and assessed. Point-based management criteria also take into account the natural variability (e.g. drought / flood cycles) that influence Topeka shiner populations. Even in undisturbed watersheds, stream fish populations can not consistently maintain a "stable or increasing" status due to the natural variability of prairie streams (see Factor E and Population Monitoring and Assessment). Furthermore, the Federal Plan does not provide a baseline population; measurable value to determine if populations are increasing, stable, or decreasing; or methodology for assessing population status.

Past activities in South Dakota and actions set forth in this state management plan are consistent with those activities recommended in the Federal Plan. The Federal Plan recommends implementing the following actions in order to downlist or delist the Topeka shiner: 1) conduct studies on the biology and life history requirements of the Topeka shiner, 2) monitor populations and habitat of the Topeka shiner, 3) reestablish Topeka shiner in suitable stream or off-channel habitats within its historic range, 4) design and implement a public awareness and education program, and 5) implement and maintain an adaptive management program and ensure appropriate research and management activities are carried out in order to attain recovery of the Topeka shiner (USFWS 2001). Past and on-going research regarding the biology and life history of the Topeka shiner in South Dakota is previously discussed (see Topeka Shiner Research in South Dakota). Future research will focus on further documenting shiner occurrences in unsurveyed

watersheds, population genetics, and determining proper BMPs for projects that may impact the Topeka shiner and its habitat. Population and habitat monitoring is discussed under the Population Monitoring and Assessment section. The Topeka shiner's current distribution in South Dakota does not necessitate reintroduction at historic locations. Those historic locations without a recent documented occurrence of the Topeka shiner are located in close proximity to currently known Topeka shiner locations; therefore, the potential for natural recolonization exists. The Public Outreach and Education section will discuss current and future outreach activities. The Management Actions section will address adaptive management activities.

Distribution of Topeka Shiners in South Dakota

The Topeka shiner occupies tributaries of the James, Vermillion, and Big Sioux rivers in South Dakota. Meek (1892 cited in Bailey and Allum 1962) was the first to report Topeka shiners in South Dakota in the Big Sioux River near Sioux City (Union County). Bailey and Allum (1962) and Nickum and Sinning (1971) also reported Topeka shiners in the mainstem Big Sioux River, presumably during periods of extended drought when tributaries were dry. The Topeka shiner was reported in 7 watersheds in the James, 5 watersheds in the Vermillion, and 4 watersheds in the Big Sioux River basins before 1997, and observed in 13 watersheds in the James, 8 watersheds in the Vermillion, and 17 watersheds in the Big Sioux River basins since 1997. In recent years (1997-2002) new occurrences of Topeka shiners have been reported in 9 watersheds in the James, 5 watersheds in the Vermillion, and 17 watersheds in the Big Sioux River basins. Topeka shiners have not been documented in 3 watersheds in the James, 1 watershed in the Vermillion, and 3 watersheds in the Big Sioux River basins since 1990 (Table 1). These numbers do not indicate a range expansion since all historic sites were not sampled recently, and vice versa. Furthermore, sampling intensity has varied between study periods.

Threats vs. Effects Analysis for Topeka Shiner Populations in South Dakota

This plan addresses the five factors utilized by the USFWS in listing, delisting, or downlisting actions:

A. Present or threatened destruction, modification, or curtailment of habitat or range.
B. Overutilization for commercial, recreational, scientific, or educational purposes.
C. Disease or predation.
D. Inadequacy of existing regulatory mechanisms.
E. Other natural or manmade factors.

By meeting the definition of a threat for at least one of these factors, a species meets the definition of threatened or endangered as described in Section 4(a)(1) of the ESA. Each factor is evaluated based on its potential as a threat or effect to Topeka shiner populations in South Dakota. For the purposes of this report a threat is an impact that, if uncorrected, will likely result in further decline or extirpation of the species from a significant portion of its range. An effect is an impact that may reduce localized populations, but will not

result in the overall decline or extirpation of Topeka shiner populations from South Dakota.

A. The present or threatened destruction, modification, or curtailment of habitat or range

Information on the historic range of the Topeka shiner in South Dakota is somewhat lacking. The historic distribution of the Topeka shiner and most other nongame fish in South Dakota was determined through a compilation of various surveys and reports from past fisheries investigations. Range estimations are complicated by the qualitative, and sometimes incomplete, nature of historic data. However, these records are the only source lending insight into the historic distribution of Topeka shiners.

Evermann and Cox (1896) conducted the first fisheries survey of the upper Missouri River basin reporting Topeka shiners in 4 streams in the James River basin. Churchill and Over (1933) provided a description of the Topeka shiner and stated that "these minnows are found occasionally in the small creeks of the eastern and southern part of the state." Churchill and Over (1933) go on to state that Topeka shiners are not "sufficiently numerous to be of particular importance" as a baitfish, suggesting that the abundance of this species has always comprised a small percentage of the overall fish community. Bailey and Allum (1962) reported the Topeka shiner at 5 locations in the Big Sioux and Vermillion River basins. Bailey and Allum (1962) stated that the Topeka shiner "…was formerly common in the Big Sioux, Vermillion, and James river drainages of South Dakota, but is now rare;" however, no sources were cited documenting the shiner's once common occurrence. Beckman and Elrod (1971) reported Topeka shiners in the embayments of the Cheyenne, Moreau, and Grand rivers in Lake Oahe. This finding is questionable as these sample locations were in a large reservoir, not a small prairie stream. Furthermore, Beckman and Elrod (1971) documented no occurrences of the sand shiner *Notropis stramineus*, a ubiquitous species similar in appearance to the Topeka shiner. This finding is not recognized as a viable Topeka shiner occurrence in the South Dakota Natural Heritage database and will not be included as part of the shiner's historic range for this report. The only evidence suggesting a reduction in the species' range is the failure of recent surveys (Cunningham and Hickey 1997, Blausey 2001) to record Topeka shiners in the Elm River. The Elm River is the northernmost documented occurrence of the Topeka shiner (Elsen 1977). All other historic locations are within the boundaries of the species' current distribution in South Dakota. No data currently exist to demonstrate an increase or decrease in the Topeka shiner's range in South Dakota.

Land use practices that alter the hydrologic and geomorphic processes of streams can have detrimental effects to aquatic habitat. Habitat impacts, such as wetland loss, sedimentation, channelization, and resource extraction, are often cited as reasons for declines of Topeka shiner populations throughout its range. The relevancy of each impact as it relates to Topeka shiner populations in South Dakota is discussed.

Wetland Drainage

The ecological functions of wetlands are diverse, but their influence on stream hydrology and groundwater inputs is especially critical to Topeka shiners.

Wetlands buffer stream flows by reducing flood peaks and maintaining base flows during periods of drought. Groundwater discharge into streams also provides a thermal refuge for fish during periods of intermittency. Higher peak flows increase streambed scouring, channel incision, and bank erosion, and hence channel degradation. Wetland loss alters stream hydrology, thus potentially creating an environment unsuitable for Topeka shiner inhabitance through elevated flow velocities, loss of groundwater inputs, and decrease of habitat heterogeneity. Blausey (2001) and Kuitunen et al. (2000) suggest that Topeka shiners prefer streams with low velocities (0 m/s - 0.3 m/s). Wall et al. (2001) identified groundwater potential and flow regime as positive indicators of Topeka shiner presence. The probability of Topeka shiner presence increased as potential for groundwater delivery to streams increased and flow regime moved from temporary to perennial. South Dakota is one of the few prairie states to still retain the majority, approximately 65%, of its wetland resources (Johnson and Higgins 1997) with wetland densities still commonly exceeding 100 wetlands per square mile in eastern South Dakota (Higgins et al. 2002). Prevention of wetland loss would aid efforts to maintain stream hydrology as close to unaltered conditions as possible.

Sedimentation

Sedimentation from natural sources has always occurred in stream systems; however, alterations to the landscape can change a stream's sediment load. A primary reason for increased sedimentation to aquatic systems in the Midwest is loss of native prairie (Menzel et al. 1984, Karr et al. 1985, Cross and Moss 1987). Streams with increased sediment loads often become shallower and wider, leading to a loss of habitat, warmer waters, and more frequent flooding. Loss of spawning substrate by siltation may reduce Topeka shiner recruitment. Siltation of gravel substrate may greatly reduce invertebrate productivity, especially in riffles (Berkman and Rabeni 1987), and potentially limit the shiner's food source. Hatch and Besaw (2001) classified Topeka shiners as opportunistic omnivores; however, insect (especially midges) larvae comprised a large portion of the shiner's diet. The loss of pool habitat through siltation would reduce critical areas required by the shiner to sustain periods of intermittency (Wall et al. 2001). While sedimentation continues to impair stream reaches in South Dakota (SD DENR 2002b), these problems are being address through various Total Maximum Daily Load (TMDL) projects (SD DENR 2002a).

Stream Channelization

Channelization alters stream hydrology and geomorphology. Stream systems are dynamic, but channel type remains at equilibrium under natural conditions (Leopold et al. 1964, Leopold 1994). Channelization leads to upstream degradation and downstream aggradation, resulting in an unstable channel type and altered fish habitat (Rosgen 1996). Upstream head cutting, bank slumping, and channel incision, which disconnect a stream from its floodplain and backwaters, are all forms of channel degradation. Downstream aggradation results from increased sediment loads in the channel. Monotony in habitat (i.e.,

dominated by runs) often characterizes channelized streams. However, the presence of Topeka shiners in pools, backwaters, and side channels (Pflieger 1997, Blausey 2001, Hatch 2001) suggests the need for a diversity of habitat types. Regression models indicate shiner association with stable, well-vegetated banks that are low in height. Topeka shiners are also associated with low incision channels with gravel substrates (Blausey 2001). Three percent of eastern South Dakota streams have been modified (Johnson and Higgins 1997); however, future channelization for municipal, urban, or other land use projects would be subject to endangered species review during permitting process required by Section 404 of the Clean Water Act (CWA). High water years, such as those of the mid- to late-1990s, may present the need for greater flood control measures in eastern South Dakota (FEMA 1994). Caution should be exercised so that flood control measures do not present long-term ecological changes to stream systems.

Resource Extraction

Resource extraction, such as water withdrawals and gravel mining, for municipal, agricultural, and domestic uses have the potential to impact aquatic systems when conducted improperly. Irrigation and municipal water withdrawal can lower water tables and groundwater delivery to streams, causing streams to experience longer periods of intermittency. As previously stated, positive indicators of Topeka shiner presence include groundwater potential and flow regime (Wall et al. 2001). Topeka shiners show a tendency to inhabit clear, cool prairie streams (Pflieger 1997), thus groundwater percolation through the streambed plays a critical role in sustaining water temperature and dissolved oxygen levels during periods of low flow, especially drought. The preference of perennial flows by Topeka shiners indicates the importance of groundwater percolation and springs in maintaining base flow conditions. Observations of irrigation withdrawal alterations to stream flow have been reported (Wall et al. 2001). Stream miles impacted by irrigation dewatering are unknown, though believed to be small. Of greater impact may be the groundwater aquifer withdrawals from urban areas, specifically Sioux Falls, South Dakota. Although the Sioux Falls area represents a small portion of the overall Topeka shiner range in South Dakota, this urban area consists of approximately 124,000 people (16% of the state population; U.S. Census Bureau 2002). Instream gravel mining operations can pose a threat to streams through direct alteration of stream channels and downstream sedimentation problems. SD GF&P and SD DENR authorize permits for mining operations, most of which occur outside the stream channel.

The present destruction, modification, or curtailment of range or habitat is not a threat to Topeka shiners in South Dakota. The threatened destruction, modification, or curtailment of range or habitat is difficult to assess, but the State of South Dakota feels this impact is not a threat to Topeka shiner populations. Impacts to the Topeka shiner's habitat have not occurred in South Dakota to the extent that these impacts have affected habitat in other parts of the shiner's range. Agriculture remains the primary landuse throughout the Topeka shiner's range. The loss of native prairie and resulting sedimentation and eutrophication of streams resulting from intensive agricultural production is often cited as

a primary reason for declines in Topeka shiner populations (Minckley and Cross 1959, USFWS 1998, Mammoliti 2002). Until recently, agricultural receipts for livestock have been higher than agricultural receipts for crops in South Dakota (USDA 2000a). Thus, South Dakota's agricultural economy has operated on a grass-based system (i.e. more land is reserved for grazing as opposed to row crop production). A grass-based system has noticeable benefits (e.g. retention of wetland basins, unaltered stream reaches, untilled riparian zones) to Topeka shiner watersheds in South Dakota. Recent data suggest South Dakota's agricultural economy is moving towards a production-based system (USDA 2000b, Higgins et al. 2002, Kurt Forman, USFWS, *personal communication*). Potential impacts this shift towards production agriculture may have on Topeka shiner populations are difficult to predict and unknown. However, efforts to preserve a grass-based land use (i.e. grazing) along flood plains and riparian areas combined with good stewardship practices should mitigate for many threats land use changes may present to Topeka shiner populations in South Dakota.

Table A. Potential / Actual Threats, due to Factor A, Influencing Topeka Shiner Populations in South Dakota.

Factor			Magnitude Of Threat	Immediacy of Threat	Comments
A.1. present	destruction	habitat	no threat	no threat	trends do not support
A.2. present	modification	habitat	no threat	no threat	trends do not support
A.3. present	curtailment	habitat	low	non-imminent	due to groundwater withdrawals
A.4. threatened	destruction	habitat	unknown	unknown	
A.5. threatened	modification	habitat	unknown	unknown	landuse changes, impacts unknown
A.6. threatened	curtailment	habitat	unknown	unknown	

B. Overutilization for commercial, recreational, scientific, or educational purposes

This impact is of little threat to Topeka shiners in South Dakota. Most commercial bait dealers within the state collect baitfish (e.g., fathead minnow *Pimephales promelas*) from rearing ponds or isolated wetland basins, not streams. The incidental take of Topeka shiners during bait collection by individual anglers may occur on occasion. However, South Dakota's fishing rules and regulations prohibit the use or take of state or federally listed species as bait. South Dakota Codified Law 34A-8-9 also prohibits the possession of a threatened or endangered species. The collection of endangered fish species for educational or scientific purposes requires a scientific collector permit issued by SD GF&P and USFWS. Only under special circumstances does this permit allow take of Topeka shiners.

The impacts of overutilization for commercial, recreational, scientific, or educational purposes do not present a threat to Topeka shiner populations in South Dakota. Any incidents resulting in take of Topeka shiners from these purposes occurs on a limited or isolated basis and would only have minor effects to the entire Topeka shiner population within South Dakota.

Table B. Potential / Actual Threats, due to Factor B, Influencing Topeka Shiner Populations in South Dakota.

Factor		Magnitude of Threat	Immediacy of Threat	Comments
B.1. overutilization	commercial	no threat	no threat	
B.2. overutilization	recreational	no threat	no threat	
B.3. overutilization	scientific	no threat	no threat	
B.4. overutilization	educational	no threat	no threat	

C. Disease or predation

The impacts of disease on Topeka shiner populations are relatively unknown. Occurrences of scoliosis (deformity of the vertebrae) were reported in Missouri (USFWS 1998). No reports exist in South Dakota of Topeka shiner specific diseases or abnormalities. Most diseases incurred by Topeka shiners are likely stress-induced resulting from degraded habitat conditions (e.g., elevated water temperatures, organic pollution, low dissolved oxygen levels). Mitigation of impacts to Topeka shiner habitat will address any stress-induced diseases resulting from poor habitat conditions. The lack of data regarding diseases incurred by Topeka shiners prevents further evaluation of this impact.

Predation is not as significant an impact on Topeka shiners in South Dakota as in southern parts of the shiner's range. Predation by introduced game fish, such as largemouth bass *Micropterus salmoides*, white bass *Morone chrysops*, or crappie *Pomoxis* spp., is often associated with tributary impoundment (impoundments discussed in further detail under Factor E). Several studies (Layher 1993, Schrank et al. 2001, Winston 2000, 2002, Mammoliti 2002) have documented impacts of introduced game fish on Topeka shiner populations following stream impoundment in Kansas and Missouri. Hatch (2001) also noted the extirpation of Topeka shiners from several off-channel habitats following the introduction of largemouth bass in Minnesota. Blausey (2001) reported largemouth bass and black crappie *Pomoxis nigromaculatus* in relatively high abundance, but no Topeka shiners, near a historical site on the Elm River below Elm Lake. Introduced game fish were uncommon in the vast majority of tributaries sampled by Cunningham and Hickey (1997), Cunningham (1999), Blausey (2001), and Cunningham (2002). Berry and Kolander (1994) noted that first-winter mortality of stocked largemouth bass was high (85% - 100%). High mortality rates were attributed to depletion of energy reserves and cold stress during long winter periods (Berry and Kolander 1994). Most streams in eastern South Dakota remain unimpounded. Without impounded areas, the harsh physicochemical nature of prairie streams may make these systems unsuitable for introduced game fish (Shearer and Berry 2003).

The impacts of disease and predation do not threaten Topeka shiner populations in South Dakota. The lack of information on diseases in Topeka shiner populations makes assessment of the magnitude or immediacy of this factor difficult; however, no surveys or genetics research has reported a disease specific to this species. Predation by introduced game fish may occur on an isolated basis, especially where private individuals have intentionally introduced game fish. The extent of these introductions is unknown, though presumed to be small due to the rarity of game fish in recent stream surveys. SD GF&P

is the agency charged with managing the recreational fisheries in South Dakota's public waters; however, SD GF&P does not stock game fish into Topeka shiner streams or any other streams of similar size in eastern South Dakota. Therefore, the State of South Dakota considers the impact of game fish predation on the overall Topeka shiner population to be low, especially given the low occurrence of large-scale impoundments on Topeka shiner streams (discussed under Factor E).

Table C. Potential / Actual Threats, due to Factor C, Influencing Topeka Shiner Populations in South Dakota.

Factor	Magnitude of Threat	Immediacy of Threat	Comments
C.1. disease	unknown	unknown	no data to support
C.2. predation	low	non-imminent	likely occurs in isolated areas

D. Inadequacy of existing regulatory mechanisms

Special measures protect the Topeka shiner and its habitat in South Dakota. The South Dakota Natural Heritage Program monitors and tracks Topeka shiner locations and reviews all federally funded projects that may impact sensitive species, including the Topeka shiner. Scientific collector permits, administered by SD GF&P, only allow take of Topeka shiners under special circumstances. Bait regulations outlined in South Dakota's fishing rules and regulations prohibit the take of state or federally listed species. The SD DOT has developed BMPs (Appendix A) for use during highway construction projects in Topeka shiner watersheds. These BMPs should prevent fish blockage due to improper culvert placement and reduce sedimentation problems due to on-site erosion. The SD DENR regulates water quality (water quality standards, wastewater discharge, confined animal feeding operations) and water quantity (municipal water withdrawal, crop irrigation) impacts through various permits. The Topeka shiner receives special protection as a federally listed species under the ESA. Accordingly, the USFWS reviews all projects with a federal nexus that may impact the Topeka shiner or its habitat. The NRCS is developing guidelines for project development and implementation that may impact endangered species. Projects involving the dredging or filling of waterways (e.g., impoundments) require a CWA Section 404 permit issued by the USCOE. As long as Topeka shiners maintain their current distribution and abundance in South Dakota, existing regulatory mechanisms should be adequate.

This factor does not pose a threat to Topeka shiner populations in South Dakota. Those agencies involved directly with Topeka shiner management or projects / activities that may impact Topeka shiners and their associated habitat have enacted procedural and regulatory mechanisms to protect the species in compliance with state and federal laws. The design of these mechanisms is not necessarily to protect every individual Topeka shiner, but to prevent the long-term destruction or loss of stream habitat. Further regulatory mechanisms may not result in increased protection for the Topeka shiner or its habitat in South Dakota.

Table D. Potential / Actual Threats, due to Factor D, Influencing Topeka Shiner Populations in South Dakota.

Factor			Magnitude of Threat	Immediacy of Threat	Comments
D.1. inadequate	existing	regulations	no threat	no threat	

E. Other natural and manmade factors

No other natural (species competition, niche overlap, hybridization) or manmade (urbanization, impoundments) factors are known to pose an imminent threat to Topeka shiners in South Dakota. The only exotic fish throughout the Topeka shiner's range is the common carp *Cyprinus carpio*. Other exotic fish (e.g., bighead carp *Hypophthalmichthys nobilis*, grass carp *Ctenopharyngodon idella*, rudd *Scardinius erythrophthalmus*) in South Dakota do not currently occupy the same streams as Topeka shiners, but range expansion is difficult to predict. Cunningham (2002) reported two possible incidents of hybridization between Topeka shiners and sand shiners. Fish that share phenotypic characteristics with Topeka shiners and sand shiners have also been observed in Minnesota streams as well. However, sand shiners have a great deal of intraspecific variation within the species (Dr. Jay Hatch, University of Minnesota, *personal communication*). No reports of hybridization in the southern extent of the Topeka shiner's range exist. Potential Topeka shiner hybridization and influencing factors is an area warranting further research. Currently, data are lacking regarding potential hybridization between sand and Topeka shiners; therefore, the status of this impact can not be assessed.

Flooding and drought are not a threat to the overall viability of Topeka shiners in South Dakota. Streams in the Northern Glaciated Plains naturally experience cyclical weather patterns ranging from extended drought to prolonged flooding (Milewski 2001, Shearer and Berry 2003), as evidenced by long-term stream flow records (USGS 2000). Topeka shiners, and other native prairie fish, have adapted to these naturally variable systems. In fact, Minckley and Cross (1959) indicated that Topeka shiner spawning success was among the highest of any species during periods of intermittency. Kerns and Bonneau (2002) noted that Topeka shiners, especially juveniles, were the last fish to succumb in drying pools. While native fish populations may fluctuate with changes in annual stream flow, the species will remain persistent (Shearer and Berry 2003). However, adaptation of native fish to natural disturbance should not be interpreted as the ability to tolerate all levels of human-induced disturbance.

Past impacts of point source pollution (e.g., wastewater discharge, industrial effluent) on streams in eastern South Dakota have been documented (Dieterman and Berry 1998), and most likely had adverse effects to Topeka shiner populations. Since enactment of the Clean Water Act in 1977; however, the SD DENR and U.S. Environmental Protection Agency (USEPA) have closely monitored point source impacts. Currently, municipal wastewater treatment and confined animal feeding operations are much improved over past methods and wastewater discharge must not violate designated use criteria for the receiving stream. Conflicts may arise in the future given the close proximity of urban areas, such as Sioux Falls, to Topeka shiner streams (see Figure 1). Nonpoint source pollution from urban areas will soon be addressed as urban areas and the SD DOT are

required to initiate storm water management programs under the National Pollution Discharge Elimination System (NPDES) Phase II storm water regulations. The SD DENR Section 319 and TMDL programs also address nonpoint source pollution problems (SD DENR 2002a). Urban storm water runoff is now required to meet regulatory requirements and will be less of an issue. While point and nonpoint sources may still effect Topeka shiner populations in isolated areas, there is no evidence to suggest this impact currently poses a threat to shiner populations within South Dakota.

Impoundments can be either detrimental or beneficial to Topeka shiners depending on many variables, such as impoundment size, location within watershed, and watershed condition, etc. The presence of large-scale impoundments can pose a threat to Topeka shiner populations. These types of impoundments severely alter a stream's natural hydrology. Furthermore, recreational interests often result in the stocking of non-native piscivores (impacts discussed under *disease and predation*). Large-scale impoundments exist on eight Topeka shiner streams in eastern South Dakota. These impoundments include Elm Lake, Elm River; Ethan Lake, 12-Mile Creek; Staum Dam, Shue Creek; Lake Mitchell, Firesteel Creek; Lake Cavour, Redstone Creek; Wilmarth Lake, West Branch Firesteel Creek; Centerville Dam, Vermillion River; and Lake Vermillion, East Fork Vermillion River). The Centerville Dam (Vermillion River) does not impede fish movement due to a breach in the dam structure. These impoundments may have adverse effects on Topeka shiner populations within their respective streams. The State of South Dakota feels this threat is moderate in magnitude within South Dakota, especially given its relation to Factor A (modification of habitat) and Factor B (predation). However, given the low occurrence (8 dams on 38 streams) of large-scale impoundments within Topeka shiner watersheds, this threat should be considered non-imminent.

Small-scale impoundments, such as those created by the USFWS Partners for Fish and Wildlife Program, can be beneficial to prairie stream hydrology if strategically placed throughout their associated watersheds to help sustain and restore historic watershed functions. With 35% of wetland acreage lost (Dahl 1990) and 75% of native grassland converted (USDA 2000b) to predominately agricultural use in eastern South Dakota, runoff rates have greatly increased into receiving streams. Impoundments, created to function like natural wetlands (i.e., trap sediment, capture overland runoff, recharge groundwater, filter nutrients, etc.), have a positive effect on prairie stream hydrology and associated native species. Some small-scale impoundments may have adverse effects to individual shiner populations; however, early consultation during the planning stages of these projects can alleviate negative impacts to Topeka shiners.

Overall, other natural and manmade factors do not pose a threat to Topeka shiner populations in South Dakota. Impacts, such as point source pollution and large-scale impoundments, may have adversely affected Topeka shiner populations in the past, but given the shiner's current distribution and abundance it appears these impacts do not pose an imminent threat to the species. The State of South Dakota is not aware of any synergistic effects to Topeka shiner populations.

Table E. Potential / Actual Threats, due to Factor E, Influencing Topeka Shiner Populations in South Dakota.

Factor		Magnitude of Threat	Immediacy of Threat	Comments
E.1. other	flood / drought cycles	no threat	no threat	
E.2. other	hybridization	unknown	unknown	
E.3. other	point source impacts	low	non-imminent	likely effects from isolated incidences
E.4. other	urbanization	low	non-imminent	only occurring in small portion of total range within South Dakota
E.5. other	small-scale impoundments	no threat	no threat	
E.6. other	large-scale impoundments	moderate	non-imminent	relates to Factor B (predation) and Factor A (modification of habitat)
E.7. other	synergistic effects	unknown	unknown	potential adverse impacts, but not demonstrable

Management Actions

The overall goal of this management plan is to maintain habitat integrity in Topeka shiner streams, thus management objectives will focus on those primary issues that influence habitat integrity: hydrology, geomorphology, and water quality. Given the current abundance and distribution of Topeka shiners in South Dakota, meeting the objectives of this plan proves more feasible than those recovery efforts required to restore shiner populations in other states. Strategies and tasks presented under each objective should maintain and enhance habitat in Topeka shiner streams through local- and watershed-level BMPs, conservation programs, and regulatory incentives. A combination of local- (e.g., riparian zone restoration) and watershed-level BMPs (e.g., grassland easements) may provide the best means for improving site-specific stream habitat and watershed integrity as a whole (Roth et al. 1996, Wang et al. 2002). The objectives below address those habitat effects discussed under *Present or threatened destruction, modification, or curtailment of habitat or range*. Order of listing or numbering does not denote level of importance or priority. However, it is important to note that the three issues (hydrology, geomorphology, and water quality) discussed below are interconnected in the context of watershed integrity and impacts or improvements to one may result in changes (negative or positive) to the others.

The conservation of existing habitat will provide the best option in meeting the goal of this plan. Since the vast majority of streams in eastern South Dakota flow through private land, landowner involvement will be a crucial aspect in maintaining Topeka shiner populations. However, landowner participation in any programs listed in this plan is strictly voluntary. This plan does not establish any new or additional regulations or restrictions for private landowners with regards to endangered species, but provides interested landowners and land users with a variety of conservation program options. Options may include cost share programs (e.g., Conservation Reserve Program or

Environmental Quality Incentives Program) or endangered species programs (e.g., Safe Harbors Agreements or HCPs). Appendix B provides a description of relevant programs.

Many strategies discussed in this plan relate to practices and programs already implemented throughout eastern South Dakota. Topeka shiner watersheds with few protected acres or stream reaches with high erosion would best benefit from additional conservation enrollments. The South Dakota Gap Analysis Program at South Dakota State University has identified these areas for all Topeka shiner watersheds in South Dakota. Appendix C provides an example of Gap analysis for Topeka shiner watersheds.

Hydrology

Objective 1.1: Maintain and restore the natural hydrology of streams containing Topeka shiners.

Discussion:
Stream hydrology refers to the precipitation, evaporation, runoff, and infiltration of water that occurs within a watershed. Stream systems, in the strictest sense, can be recognized as self-adjusting conveyors of water and sediment. Alterations to stream hydrology disrupt the transport of water and sediment, ultimately impacting aquatic habitat. Those land use activities that alter water delivery to streams, retention time within the basin, and infiltration rates change the natural hydrology of stream systems. The resulting effects on Topeka shiners may range from sedimentation due to increased erosion or surface runoff, longer periods of intermittent flows, and loss of groundwater inputs. Those practices that restore and maintain the natural flow regime are critical for the persistence of native fish species (Poff et al. 1997).

Strategy 1.1A: Utilize wetlands (both created and restored) to enhance groundwater recharge and reduce overland runoff in historic areas of high wetland loss.

Task: Conduct research on optimal wetland design, placement, and function in relation to stream hydrology and Topeka shiner habitat parameters.

Programs / tools:

- GIS Modeling
- Field research
- USFWS – NWI
- USGS gauging stations

Task: Provide technical and financial assistance to landowners interested in creating or restoring wetland areas.

Agencies / organizations:

- Conservation districts
- NRCS
- USFWS - Partners for Fish and Wildlife

SD GF&P
Ducks Unlimited

Programs / tools:

Grass waterways – CRP
USFWS – Wetland Easements
WRP
WHIP
DENR Section 319 Program

Task: Inform the public on the importance of wetlands to wildlife and watershed quality.

Programs / tools:

Demonstration sites
SDSU Extension
Classroom presentations
Terry Redlin Fresh Water Institute
DENR Information and Education Outreach

Strategy 1.1B: Identify and restore those Topeka shiner watersheds whose hydrographs have been most altered from historic conditions.

Task: Develop and use existing computer models to 1) assess land use alterations to stream hydrology, 2) assess which conservation measures would be most practical and effective for restoring stream hydrology.

Programs / tools:

GIS Land use Analysis – NRI, EROS Landsat imagery
Streamflow modeling
USGS gauging stations

Task: Provide landowner incentives to increase native vegetative cover and other conservation measures in areas identified by hydrologic models.

Programs / tools:

CRP
GRP
WHIP
Grassland Easements – USFWS
Dense nesting cover – GF&P
Native warm season grass establishment – GF&P
USFWS grassland easements
DENR Section 319 Program

Task: Maintain current levels of grassland resources by ensuring viability of agricultural herbivory.

Agencies / organizations:

Agricultural associations

NRCS
Grassland Managed Intensive Grazing
USFWS - Partners for Fish and Wildlife
SD Dept. of Ag.
SD DENR
USFWS

Programs / tools:

DENR Section 319 Program
Grassland Easements
Conservation Commission Grants

Task: Provide technical assistance to urban, residential, and development planners in designing storm water systems that minimize runoff "peaks" into streams following precipitation events.

Agencies / organizations:

SD DENR
SD DOT

Geomorphology

Objective 1.2: Reduce those impacts that adversely alter the geomorphology of Topeka shiner streams.

Discussion: Geomorphology refers to the physical features (e.g., channel dimensions, substrate, gradient) that characterize a stream. Geomorphology and riparian vegetation are the principle factors influencing aquatic habitat. Land use practices and manmade structures (e.g., large-scale impoundments) often have direct and / or indirect impacts to a stream's geomorphic features. The resulting channel degradation (i.e., erosion) or aggradation (i.e., sedimentation) changes the aquatic habitat to which native fish have adapted. Impacts to Topeka shiner streams may include loss of instream pool habitat, loss of spawning substrate, channel incision, and increased stream velocities.

Strategy 1.2A: Encourage erosion control measures along riparian zones and slopes adjacent to Topeka shiner streams. Encourage minimal disturbance of these areas during construction projects.

Task: Work with government agencies to develop BMPs that minimize erosion from construction / project activities.

Agencies / organizations:

SD DOT
USCOE
NRCS
SD DENR
SD GF&P
USFWS

Task: Provide financial and technical assistance to landowners interested in reestablishing native vegetation along riparian zones, especially along areas with high erosion potential.

Agencies / organizations:
USFWS - Partners for Fish and Wildlife
Conservation Districts
NRCS

Programs / tools:
CRP
Habitat fence construction
WHIP
GRP
EQIP
Grassland Easements
Conservation Commission Grants
Small watershed program
EWP
DENR Section 319 Program

Task: Minimize riparian disturbance in areas with high erosion potential.

Programs / tools:
Alternate watering sources for livestock – EQIP
Conservation Commission Grants
Habitat fence construction
Stream bank stabilization
Provide livestock shelter / wintering areas outside riparian areas – tree plantings
DENR Section 319 Program

Strategy 1.2B: Restore altered habitat in stream reaches critical to Topeka shiners.

Task: Identify those stream reaches in Topeka shiner watersheds that have been most altered by land use changes.

Programs / tools:
GIS Modeling
Field research – habitat assessments

Task: Provide technical and financial assistance to landowners interested in restoring habitat in degraded stream reaches.

Agencies / organizations:
SD GF&P
NRCS
SD DENR

USCOE
Conservation Districts
USFWS

Strategy 1.2C: Review stream mitigation projects and inform government agencies, the public, and landowners about the adverse impacts of stream channelization to watershed health.

Task: Review projects that may adversely alter habitat in Topeka shiner streams.

Agencies / organizations:
SD GF&P
SD DENR
USCOE
USFWS
SD DOT

Programs / tools:
Terry Redlin Fresh Water Institute

Task: Inform all entities involved with stream projects on the adverse impacts of channelization to stream habitat and associated fish and wildlife species.

Agencies / organizations:
SD GF&P
SD DENR
USCOE
SD DOT
Conservation Districts
NRCS
USFWS

Programs / tools:
Terry Redlin Fresh Water Institute

Water Quality

Objective 1.3: Minimize non-point source water quality impacts in streams containing Topeka shiners.

Discussion:
Point source impacts (e.g., wastewater discharge) to stream systems have been greatly reduced since enactment of the Clean Water Act in 1977; however, non-point source impacts (e.g., habitat loss) are often cited for the continued decline of aquatic resources (Karr and Chu 1999). One of the main impairments to South Dakota streams is sediment and nutrient runoff (SD DENR 2002b). Impacts to Topeka shiner streams may range from altered trophic structure due to excessive nutrient inputs to stress-induced mortality due to elevated water temperatures. Non-point source impacts to stream hydrology and geomorphology are previously discussed.

Strategy 1.3A: Reduce nutrient inputs into Topeka shiner streams from urban and agricultural sources.

Task: Provide technical assistance to urban, residential, and development planners to improve water quality from storm water discharge systems.

Agencies / organizations:

SD DENR

Task: Continue routine inspections of sewage treatment facilities to ensure compliance with water quality standards.

Agencies / organizations:

SD DENR
State and county health departments

Task: Continue technical assistance for permitting and designing confined animal feeding operations.

Agencies / organizations:

SD DENR
EPA
SD Dept. of Ag.
USDA
Animal Waste Team

Task: Provide incentives for landowners to establish riparian buffers or filter strips along agricultural fields with high runoff potential.

Agencies / organizations:

USFWS - Partners for Fish and Wildlife

Programs / tools:

EWP
CRP
WHIP
EQIP
Small watershed program
CSP
DENR Section 319 Program

Task: Continue to provide technical assistance to farmers and ranchers interested in developing and implementing BMPs on their land.

Agencies / organizations:

SD Dept. of Ag.
SD DENR
USFWS - Partners for Fish and Wildlife
SD GF&P
Conservation Districts
NRCS

Programs / tools:
DENR Section 319 Program

Population Monitoring and Assessment

Population monitoring is an important component in the management of any fish species; however, the physical nature of certain stream systems presents challenges to monitoring efforts. The stochastic nature of prairie streams, such as those in the Northern Glaciated Plains (Omernik 1987), leads to systems predominantly influenced by abiotic (e.g., climate, geology, etc.) controls that foster persistent fish communities with variable populations (Poff and Ward 1989, Milewski 2001, Shearer and Berry 2003). For example, fish populations in eastern South Dakota streams naturally fluctuate on an intra- and inter-annual basis (Walsh 1992, Braaten and Berry 1997). Population changes for fish species, such as the Topeka shiner, that are rare, have a patchy distribution, and have variable recruitment (Minckley and Cross 1959, Wall et al. 2001) are especially difficult to assess. For these reasons, multi-metric indices that monitor change at the community level combined with physical habitat and land use assessments would be a better approach to evaluating the viability of Topeka shiners and their habitat as opposed to statistical evaluations of population surveys.

Multi-metric indices, such as the index of biotic integrity (IBI), measure structural and functional attributes of the fish (or other faunal) community while integrating information from the individual to the ecosystem level. These indices are sensitive to a broad range of environmental disturbances, robust to incorporate natural variation, and adaptable for regional application (Karr and Chu 1999). Habitat assessments, such as those used by Wang et al. (1998) and Goldstein et al. (2002), evaluate geomorphic and hydrologic changes resulting from systemic- (e.g., land use) and local-level (e.g., riparian conditions) alterations. A change in a stream's geomorphic and hydrologic features, such as substrate, channel width, and flow velocities, ultimately means altered fish habitat. Land use changes alter aquatic habitat, which is the principle determinant of a stream's biological potential (Goldstein et al. 2002). Therefore, a direct assessment of the fish community, physical habitat, and land use changes should provide a thorough analysis of biological integrity for a given stream.

This monitoring protocol will evaluate South Dakota's recovery goal at two levels: the species (i.e., Topeka shiner), and overall fish community. We recognize the need to specifically evaluate Topeka shiner populations within watersheds. Given the natural variability of individual populations we feel it is important to consider the overall fish community as well. For example, the absence of Topeka shiners from a site should not count against a basin's recovery goal point total when physical habitat and the overall fish community improve.

Baseline Data

The recent surveys by Cunningham and Hickey (1997), Cunningham (1999, 2002), Blausey (2001), Wall et al. (2001), and the East Dakota Water Development District (SD GF&P 2002) represent the most comprehensive information available on Topeka shiner

distribution in South Dakota. Baseline streams will be those with a Topeka shiner occurrence reported between 1997 and 2002 in the South Dakota Natural Heritage database. This includes 13 streams in the James, 8 streams in the Vermillion, and 17 streams in the Big Sioux River basins (Table 1). Topeka shiners in disconnected oxbow channels, riverine wetlands, and dugouts are considered individuals of the same population inhabiting the adjacent stream. The first several years of monitoring fish community composition and stream habitat will provide initial Topeka shiner population, biotic integrity, and habitat conditions.

Wetland resources, grassland resources, and drainage activity are three land coverage components critical to the assessment of Topeka shiner watersheds. This information will provide a direct assessment of those issues addressed in the management actions that influence stream habitat. Techniques will be developed to assess these three components, establish baseline conditions, and monitor any changes in future years. National Wetland Inventory (NWI), Farm Service Agency slides, USGS topographical maps, NRCS wetland inventory maps, National Resource Inventory (NRI), Earth Resources Observation Systems (EROS) Landsat imagery, and other Geographic Information System (GIS) databases will be used to assess land use changes.

Monitoring Site Selection

Three sampling sites per watershed will be established (114 total sites) with each site sampled once every three years. Three sites per watershed should be a fair compromise between obtaining a representative sample of the watershed and considering time restraints. Smaller watersheds (e.g., unnamed tributary to 12-Mile Creek) may require fewer sites, large watersheds (e.g., Firesteel Creek) may require more sites. Monitoring sites will be located at known Topeka shiner locations or stream reaches with a high probability of Topeka shiner presence (see Wall et al. 2001). Site access and landowner cooperation will determine final site location.

Monitoring Protocol

Those methods used by Blausey (2001) and Milewski (2001) will be used to sample fish communities and physical habitat. These methods will provide a measure of fish community composition and relative abundance, channel features, and surrounding land use. A modification to these methods will be the use of multiple seine hauls, thus allowing confidence intervals and depletion estimates to be calculated. The monitoring protocol will allow a crew of two people to sample one site per day. Sampling will take place between mid-June and late-September when stream flows are most stable.

A modified IBI will analyze fish community data. The modified IBI will be similar to those indices used by Milewski et al. (2001) and Shearer and Berry (2002). The IBI assigns an index score to a site or stream and classifies the stream into categories (e.g., good, fair, poor). Biotic integrity changes when the IBI score changes categories (e.g., fair to poor) between sampling visits. Watersheds with continually low or declining IBI scores should be the focus of conservation efforts. The draft Federal Plan recommended the development of a monitoring protocol similar to the IBI to assist and management of

the Topeka shiner (USFWS 2001). The monitoring protocol proposed for South Dakota streams is consistent with those recommendations.

Topeka shiner populations will be evaluated on a presence / absence basis. The natural variability of streams in South Dakota and associated fluctuations in fish populations may hamper statistical analyses. The Missouri Dept. of Conservation (1999), through the use of population modeling software (Gibbs 1995), determined that at least 12 sample sites per watershed were needed to detect a 15-year trend in Topeka shiner populations with 90% accuracy. Given the same statistical power, error rate, and coefficient of variation, 456 sites sampled annually would be required to detect a 15-year trend in South Dakota's Topeka shiner watersheds. Thus monitoring efforts designed to detect a statistically relevant trend would not be feasible.

Physical habitat measurements will be used to assess changes in channel geomorphology, such as width / depth ratio, substrate composition, and stream classification (Rosgen 1996). A watershed-, basin-, county-, and / or state-level analysis of landuse will provide a systemic-level assessment, lending insight into possible reasons for the decline or improvement in fish communities and physical habitat.

Monitoring Funding and Implementation

The Division of Wildlife within SD GF&P will be the primary funding agency for monitoring and assessment of Topeka shiner populations. Funding from the Division of Wildlife is contingent upon revenue generated from the sale of hunting and fishing licenses in combination with federal funds and following approval by the SD GF&P Commission. SD GF&P currently does not have the available staff to carry out annual monitoring of Topeka shiner populations; therefore, monitoring efforts will be contracted to an outside entity or conducted by seasonal employees. Monitoring efforts should begin during the summer of 2004 or 2005. SD GF&P will seek cooperation from other state agencies in funding for Topeka shiner monitoring as well.

Management Goal Evaluation

Each basin will receive baseline point totals as follows:

	James River basin	Vermillion River basin	Big Sioux River basin
Baseline Conditions*	1300	800	1700
Management Goal	900	600	1300

* baseline conditions based on those Topeka shiner streams documented between 1997 – 2002 at 100 points / stream.

The management goal for each basin does not propose a decline in stream condition. Baseline and management goal point totals differ because of natural variation in annual stream flows. Baseline Topeka shiner populations (1997-2002) were measured following a period (1993-1999) when stream flows were above the historic mean for each basin in eastern South Dakota (USGS 2000). These elevated stream flows allow fish to extend their range and create additional habitat that may not be available during drought years.

As habitat fluctuates with changes in annual stream flows fish species' abundance and distribution may vary from year to year (Poff and Ward 1989, Shearer and Berry 2003). Therefore, a management goal based on data collected during high flow conditions may establish unattainable standards during low flow or drought years. The degree to which Topeka shiner populations fluctuate between wet and dry years is unknown. Thus, management goal criteria may require adjustment following annual monitoring between high and low flow years.

South Dakota's management goal will be evaluated every three years. The following six scenarios will evaluate each stream's contribution towards the basin management goal:

Scenario	Rank	Point Value*
Topeka shiners present / IBI scores increase	1	+ 100
Topeka shiners absent / IBI scores increase	2	+ 50
Topeka shiners present / IBI scores stable	3	+ 50
Topeka shiners absent / IBI scores stable	4	0
Topeka shiners present / IBI scores decrease	5	- 50
Topeka shiners absent / IBI scores decrease	6	- 100

* point value assessed based on three-year change.

Example: Medary Creek initial point value for 2003, 100 points
Medary Creek 2006 scenario – shiner present / IBI increases, contribution to basin management goal 150 points.

A stream's overall point value will be the average of sampling site values. The scoring system weights point values based on biotic integrity, thus the presence or absence of Topeka shiners does not influence each basin's management goal as much as watershed health.

Public Outreach / Education

Public outreach and education will play a critical role in informing the citizens of South Dakota about the Topeka shiner. Cooperating agencies, landowners, and the general public need to be informed about the state management plan as well as the Topeka shiner in general. Outreach efforts will focus on the past and present status of the Topeka shiner, why the species was federally listed, why a state Topeka shiner management plan is important, and what South Dakota has done in managing the shiner and in working towards delisting.

Outreach Objective: Develop an awareness program that informs the public on the status of the Topeka shiner, the importance of maintaining watershed health, the management efforts in South Dakota, and the importance and function of the Topeka shiner state management plan.

Task: Continue coordination with federal, state, and local entities through the

Topeka shiner advisory group to identify potential problems and management options for the shiner.

Task: Provide biannual press releases to various agricultural (e.g., SD Cattlemen's Assoc., SD Farm Bureau) and conservation (e.g., conservation districts) groups on current state and federal activities involving the Topeka shiner. Appendix D is the first press release concerning the state management plan.

Task: Utilize media sources to inform the public about Topeka shiner recovery efforts in South Dakota. Several articles have already appeared in newspapers throughout eastern South Dakota and a feature on South Dakota Public Radio.

Task: Establish at least one demonstration site in each basin that provides a good example of land management BMPs and associated stream health. Demonstration sites can be established cooperatively with other watershed and conservation commission projects.

Task: Develop and maintain a state Topeka shiner website that presents information and documents concerning the Topeka shiner in South Dakota. Website is currently maintained at:
http://www.state.sd.us/gfp/DivisionWildlife/Diversity/index.htm
http://www.sddot.com/pe/projdev/environment_topshiner.asp

Task: Publish an annual article in the South Dakota Conservation Digest regarding the Topeka shiner and / or watershed related topics. Appendix E is a copy of the 2002 Conservation Digest article.

Task: Prepare and deliver a presentation on the Topeka shiner and state management plan at professional society meetings and workshops. Four presentations are currently scheduled for Winter / Spring 2003.

Task: Develop a handout and poster on the Topeka shiner for public display at area nature centers (e.g., Sioux Falls Outdoor Campus) and quantities for general distribution.

Evaluation

Activities in South Dakota that contribute to national recovery efforts of the Topeka shiner will be summarized in an annual progress report. Annual progress reports will include a list of projects completed, status of current projects, other relevant activities, and a summary of monitoring and assessment data. These reports will be submitted to the local and regional USFWS office. Further evaluation may include an annual meeting between those entities involved in developing this state management plan.

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Table 1. Identified Topeka shiner sites within the James, Vermillion, and Big Sioux River watershed basins. This table only provides county locations of Topeka shiner sites and should not be used for regulatory interpretation.

Historic Locations (pre-1997)

Stream	Basin	County	Year(s) observed
Shue Creek	James	Beadle	1989
Elm River	James	Brown	1975
Enemy Creek*	James	Davison	1896
Firesteel Creek*	James	Davison	1896, 1975
Prairie Creek	James	Yankton	1896
Rock Creek*	James	Miner	1896
Redstone Creek	James	Sanborn	1989
Vermillion River*	Vermillion	Clay, Turner	1934, 1991, 1992
West Fork Vermillion River*	Vermillion	McCook, Turner	1991, 1992
East Fork Vermillion River	Vermillion	McCook, Turner	1991, 1992
Swan Lake	Vermillion	Turner	1943
Turkey Ridge Creek*	Vermillion	Turner	1991, 1992
Big Sioux River	Big Sioux	Brookings, Lincoln, Union, Moody	1892, 1958, 1970
Lake Tetonkaha Inlet	Big Sioux	Brookings	1949
Willow Creek	Big Sioux	Minnehaha	1939
Flandreau Creek*	Big Sioux	Moody	1970

Current Locations (1997 – 2002)

Stream	Basin	County	Year(s) Observed
West Branch Firesteel Creek	James	Aurora	1998
Pearl Creek	James	Beadle	1997 - 1999
Middle Pearl Creek	James	Beadle	1997, 1999
Shue Creek	James	Beadle	1999
Unnamed Trib. to 12-Mile Creek	James	Davison	2002
12-Mile Creek	James	Davison, Hanson	1998, 1999, 2002
Enemy Creek*	James	Davison	1998, 1999
Firesteel Creek*	James	Davison	1997, 1999
Dry Creek	James	Hutchinson	2000
North Branch Dry Creek	James	Hutchinson	2000
South Branch Lonetree Creek	James	Hutchinson	2000
Wolf Creek	James	Hutchinson	1997
Rock Creek*	James	Miner	2000
Vermillion River*	Vermillion	Clay, Turner	1999
Blind Creek	Vermillion	Lincoln	1999
Long Creek	Vermillion	Lincoln	1999
Saddle Creek	Vermillion	Lincoln	1999
West Fork Vermillion River*	Vermillion	McCook, Turner	1998, 1999
Camp Creek	Vermillion	Turner	2000
Outlet of Silver Lake	Vermillion	Turner	2000
Turkey Ridge Creek*	Vermillion	Turner	1999, 2001, 2002
Medary Creek	Big Sioux	Brookings	1997 – 2000
North Deer Creek	Big Sioux	Brookings	2000
Tributary to Deer Creek	Big Sioux	Brookings	2000
South Fork North Deer Creek	Big Sioux	Brookings	1998
6-Mile Creek	Big Sioux	Brookings	1997, 1999, 2000
Peg Munky Run	Big Sioux	Deuel	2002
Hidewood Creek	Big Sioux	Deuel	1999

Table 1 continued.

Current Locations (1997 – 2002)

Stream	Basin	County	Year(s) Observed
Stray Horse Creek	Big Sioux	Hamlin	2002
4-Mile Creek	Big Sioux	Minnehaha	1999, 2002
Beaver Creek	Big Sioux	Minnehaha	1999
Slip-up Creek	Big Sioux	Minnehaha	1999
Split Rock Creek	Big Sioux	Minnehaha	1998, 1999
Springwater Creek	Big Sioux	Minnehaha	1999
West Pipestone Creek	Big Sioux	Minnehaha	1999, 2001
Pipestone Creek	Big Sioux	Moody	1998 - 2002
Spring Creek	Big Sioux	Moody	2000
Brookfield Creek	Big Sioux	Moody	1999

Sources: Evermann and Cox 1896, Bailey and Allum 1962, Wall et al. 2001, South Dakota Natural Heritage Program 2002

* Indicates those historic stream locations where Topeka shiners have been documented recently (Topeka shiners recently documented in Flandreau Creek in Minnesota, Hatch 2001). Note that all historic locations were not sampled recently and some current Topeka shiner streams were not historically sampled.

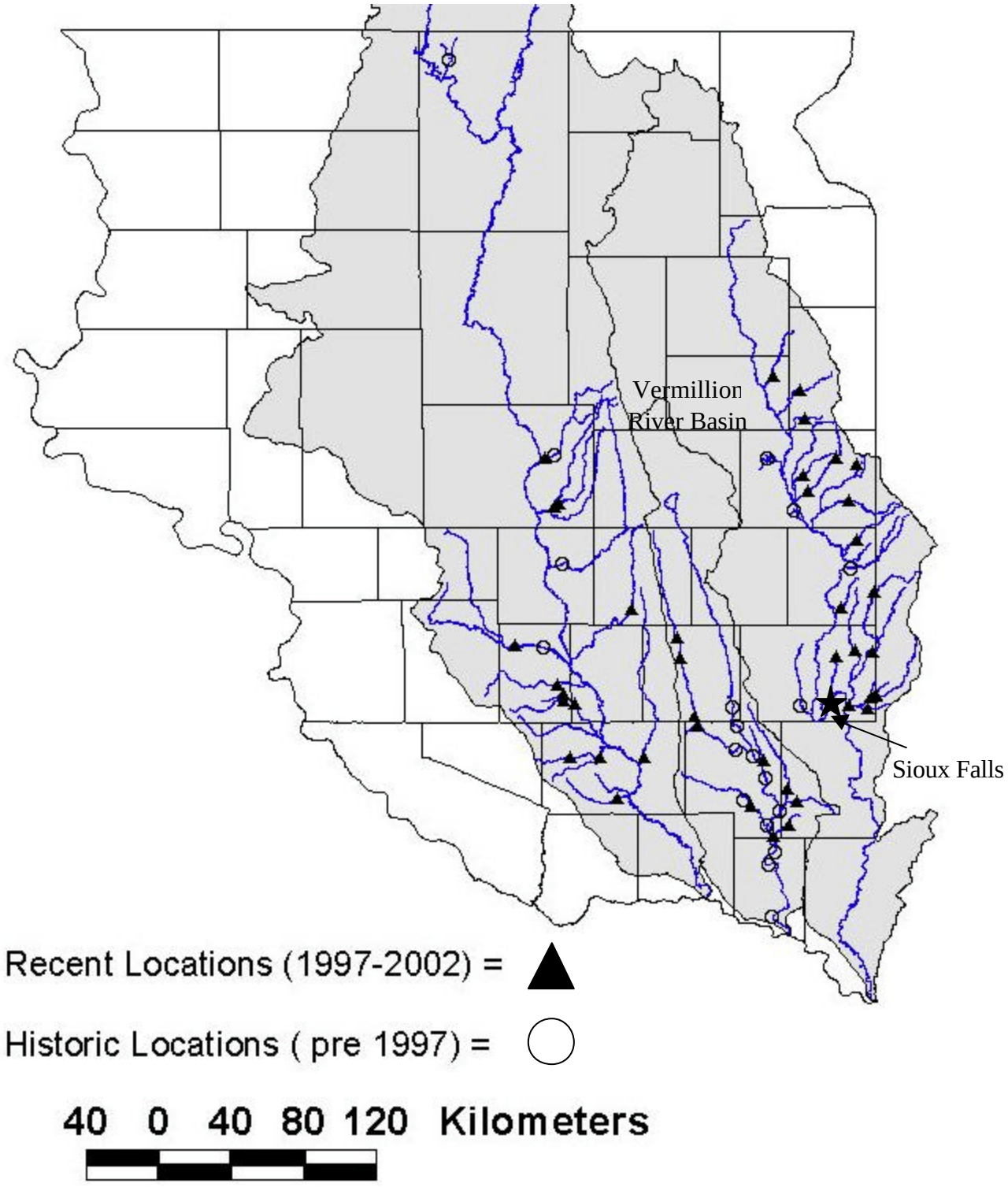


Figure 1. Map of documented Topeka shiner locations within eastern South Dakota. Locations based on those occurrences reported in the South Dakota Natural Heritage Database. Figure should not be used for regulatory interpretation.

Appendix A. Best management practice guidelines used by the Department of Transportation for highway construction activities that involve Topeka shiner streams.

STATE OF SOUTH DAKOTA
DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION
FOR
CONSTRUCTION PRACTICES IN STREAMS
INHABITED BY THE TOPEKA SHINER

APRIL 2, 2003

I. DESCRIPTION

This project crosses a stream inhabited by the Topeka Shiner, a federally endangered species. In order to maintain the habitat necessary to support the Topeka Shiner, several conditions shall be met by the Contractor during construction. The conditions are outlined in the following paragraphs.

II. MATERIALS (None Required)

III. CONSTRUCTION REQUIREMENTS

A. GENERAL CONSTRUCTION

Construction activities within the stream are prohibited from May 15 to July 31, unless the stream is completely separated from construction areas by a Temporary Water Barrier or cofferdam. If work is to be done behind a Temporary Water Barrier or cofferdam between May 15 and July 31, the barrier must be in-place and initially de-watered prior to May 15. Temporary Water Barriers and cofferdams shall also be in-place and initially de-watered prior to ice up if winter work is planned. Construction activities at all times along the stream banks, and in areas that drain into the stream will not be permitted unless comprehensive and effective erosion and sediment controls, that will prevent sediments from entering into the stream, are in-place and functioning properly. Erosion and sediment controls shall be left in place and maintained in good working condition until these areas are stabilized and re-vegetated.

The Contractor shall minimize disturbance of the work area by limiting the working pad surface area, and limiting removal of riparian vegetation to the greatest extent possible. Exposed surfaces shall not be left exposed for greater than one day if work is not occurring daily at that location. Exposed work areas shall be protected at the end of each workday with erosion control mats, plastic sheeting or other approved methods. All areas disturbed by construction activities shall be stabilized and restored with native vegetation when work in those areas is complete. Disturbed construction areas left for more than a day without continuous work that are not permanently seeded and mulched shall be covered with temporary mulch.

The Contractor shall perform monitoring of erosion and sediment controls on a continuous basis, with thorough inspections during rainfall events, and immediately make needed repairs or adjustments.

All temporary storage facilities for petroleum products, other fuels, and chemicals must be located and protected to prevent accidental spills from entering streams within the project area. Cement sweepings, washings, treatment chemicals, or grouting and bonding materials are prohibited from entering into the stream directly or from any locations where they can be washed into the stream by storm water runoff, as these materials are toxic to aquatic life.

No mechanized equipment will be allowed in the stream. If equipment cannot access the work area from shore, work platforms supported by piling driven into the channel bottom shall be constructed. Work berms shall not be constructed in the stream and erosion control measures shall be added to work berms adjacent to the stream.

Unrestricted fish passage must be provided at all times. Construction of temporary dams or diversions using earthen material is not allowed within the stream. Excavated material from the streambed shall not be released back into the stream. Every effort must be made to limit the extent of streambed disturbance and to isolate and capture sediment released during all phases of construction. In-stream dredging and disturbance of the streambed, not provided for in the plans, will not be allowed. This includes no removal of stream bottom substrate for construction materials. If modifications to the streambed cannot be avoided, the physical habitat features (pool-riffle-run sequences) must be restored to pre-construction conditions. Photo documentation of the stream before, during, and after construction must be provided. Water from wet materials excavated and removed from within a Temporary Water Barrier or cofferdam shall have sediment removed prior to the effluent reentering the stream. Sediment removal methods may include a detention pond, complete filtration at an upland site or trickling through vegetation.

The Contractor shall submit a detailed Construction Plan, a minimum of 14 days prior to starting work, to the Engineer for approval. The plan shall include an Erosion and Sediment Control Plan with a complete description of products, materials and methods of installation and removal. The plan shall also include products, materials and methods of construction for Temporary Water Barriers and cofferdams including de-watering, handling, storage, and disposal of excavated material and pumped effluent. The Construction Plan shall include all necessary information to provide assurance that the special environmental conditions are adequately addressed. The plan will be forwarded to the Environmental and Bridge Offices for review and approval with a copy forwarded to the US Fish & Wildlife Service. Work shall not proceed without approval of the construction plan by the Environmental and Bridge Offices.

Oversight for final water enclosures, de-watering, fish seining and any fish transfer or movement shall be conducted by a Biologist under contract to SDDOT.

A pre-construction meeting shall be held with the Contractor, all Sub-Contractors, Project Engineer and personnel from the Environmental Office to ensure all permit conditions and plans are clearly understood.

The Contractor shall be familiar with provisions of the 404 Permit. The Contractor shall notify the Engineer if in-stream construction methods or material will be used that are not covered in the 404 Permit, so an amendment to the 404 Permit can be processed if necessary. The contractor shall provide an estimated date at the pre-construction meeting when the Biologist will be needed on site to monitor final water enclosures, de-watering, fish seining or any fish transfer. The contractor shall notify the Biologist two days before he is needed on site. The telephone number and name of the Biologist will be supplied to the Contractor at the pre-construction meeting.

The project will be inspected and evaluated daily by the Engineer to ensure that all construction requirements and environmental conditions are being met and that the stream and habitat are being protected. The Engineer has the authority to recommend that different or

additional controls be implemented to more effectively protect the stream. Construction methods that result in fish mortality shall cease and may resume only after the Engineer, in consultation with the Biologist, approves an acceptable plan. The Engineer shall be notified immediately if field conditions change, or if the project must be modified, so that coordination of permits and approvals can be expedited.

B. TEMPORARY WATER BARRIERS

Temporary water barriers can consist of sheet piling, water filled bladders, portable cofferdams, sand bag dikes, or similar acceptable methods that completely and effectively isolate the stream from the work area. Temporary Water Barriers shall be clean and free of contaminants and sediments that can effect water quality. They shall also be installed by methods that minimize the introduction of sediments and contaminants into the water. Barriers that are constructed in the water shall be enclosed at the upstream side first and every effort shall be made to move any trapped fish out the downstream side before the downstream side is enclosed. If Temporary Water Barriers are overtopped after initial de-watering, every effort shall be made to move or remove trapped fish from within the enclosure before completely de-watering again. Movement of fish must be supervised by the biologist.

Any excavation or removal of muck and debris from behind a Temporary Water Barrier enclosure shall be done by such methods that sediment and debris do not enter into the stream. The use of temporary platforms may be required to catch any materials that may fall into the stream during removal.

C. COFFERDAMS

Where cofferdams are required for deep foundations, the same provisions given for Temporary Water Barriers shall apply for cofferdams with the following exceptions:

The contractor shall provide a walkway along the inside perimeter of cofferdams, within one foot of the water surface, to provide access for seining operations. The last sheet piling to be installed shall be at the downstream end. A net or seine shall be used, vertically, inside the sheet pile cofferdam beginning at the upstream end to gradually force fish out the open downstream end. The cofferdam may then be completely enclosed by driving the last sheet pile.

Design of cofferdams shall be as specified in Section 423 of the Standard Specifications.

D. DE-WATERING

De-watering and construction activities within water enclosures shall not be done until the Biologist has confirmed that all the fish have been moved from within the enclosure. The intent is to ensure that no fish remain trapped within the enclosure after it is closed and de-watered.

Initial de-watering or de-watering after overtopping has occurred shall be done by an approved pumping method and shall not occur unless the Biologist is present or has cleared the enclosure for de-watering. Initial de-watering or de-watering after overtopping has occurred shall be done with pumping methods that will not transport fish through pumps or trap fish against intakes.

Effluent from the de-watering operation shall be pumped to an upland site and the sediment removed prior to the effluent reentering the Stream. Sediment removal methods may include a detention pond, complete filtration at an upland site or trickling through vegetation.

E. TEMPORARY WORKS (FALSEWORK AND WORK PLATFORMS)

Falsework or work platforms shall conform to section 423 of the Standard Specifications and any applicable requirements of this provision.

Temporary piling shall be cutoff at or driven flush with the streambed, or extracted when no longer needed.

The Contractor shall consider how falsework or work platforms will be installed and removed when preparing the Construction Plan and include any special construction methods or sequencing that may be required to protect the Topeka Shiner.

Design of temporary works shall be as specified in Section 423 of the Standard Specifications.

F. REMOVAL OF STRUCTURES & OBSTRUCTIONS

Removal of structures and obstructions shall conform to section 110 of the Standard Specifications and any applicable requirements of this provision.

Construction, demolition and/or removal operations conducted over or in the vicinity of the stream, shall be controlled to prevent materials from falling in the waterway. Any materials that do fall into the waterway or into areas below the ordinary high water elevation (2-year flow) must be removed promptly by hand or with equipment located above the stream bank. A platform suspended below the bridge shall be constructed to prevent material from entering the Stream during demolition of the superstructure. A platform or similar device shall be constructed around the piers located in the Stream to prevent material from entering the water during demolition of those piers. A Temporary Water Barrier shall be constructed around areas of removal that are below the waterline.

G. BOX CULVERTS

Construction of box culverts shall comply with all applicable requirements of this provision.

Temporary diversion channels for box culverts shall be constructed according to standard plate number 734.10. Temporary diversion channels shall be complete and in place prior to May 15 for work between May 15 and July 31 and shall also be in-place prior to ice up if winter work is planned. The contractor shall construct the temporary diversion channel to allow unrestricted fish passage even if the channel is dry at the start of construction.

The contractor shall include details of products, materials and methods of construction for temporary diversion channels with his Construction Plan.

H. BOX CULVERT EXTENSIONS

Construction of box culvert extensions shall comply with all applicable requirements of this provision.

The contractor shall divert the stream and use phased construction to maintain unrestricted fish passage during construction activities. The contractor shall use phased construction and construct the stream flow diversion even if the channel is dry at the start of construction.

The temporary stream diversion for box culvert extensions shall be constructed according to the plan details. Temporary stream diversions shall be complete and in place prior to May 15 for work between May 15 and July 31 and shall also be in-place prior to ice up if winter work is planned.

The contractors detailed Construction Plan shall include stream diversion layout for each phase, box extension construction joints, bar splicing details, diversion sequence, and any other special construction methods or sequencing that may be required to protect the Topeka Shiner.

IV. METHOD OF MEASUREMENT

A. Temporary Water Barriers: Temporary water barriers will be measured to the nearest foot.

B. Cofferdams: Measurement for cofferdams will be as per Section 423.4 of the Standard Specifications.

C. Dewatering: Measurement for dewatering will not be made.

D. Temporary Works: Measurement for temporary works will be as per Section 423.4 of the Standard Specifications.

E. Removal of Structures and Obstructions: Measurement for removal of structures and obstructions shall be as per Section 110.4 of the Standard Specifications.

F. Temporary Diversion Channel for Box Culverts: Measurement for temporary diversion channel for box culverts shall be in accordance with Standard Plate number 734.10.

G. Temporary Stream Diversion for Box Culvert Extensions: Measurement for temporary stream diversions for box culvert extensions will be on a per each basis.

H. Erosion Control for Box Culvert Extension: Measurement for erosion and sediment control for box culvert extensions will not be made.

V. BASIS OF PAYMENT

A. Temporary Water Barriers: Temporary water barriers will be paid for at the contract unit price per foot. Payment for this bid item shall be made only once at each plan shown location, regardless of the number of times the barrier is changed or moved. Payment will be full compensation for labor, equipment, materials, and all incidentals necessary for constructing the temporary water barrier.

B. Cofferdams: Payment for cofferdams shall be as specified in Section 423.5 of the Standard Specifications.

C. Dewatering: Payment for Dewatering will not be made. All costs associated with dewatering shall be incidental to the other bid items.

D. Temporary Works: Payment for temporary works shall be as specified in Section 423.5 of the Standard Specifications.

E. Removal of Structures and Obstructions: Payment for removal of structures and obstructions shall be as specified in Section 110.5 of the Standard Specifications.

F. Temporary Diversion Channel for Box Culverts: Payment for temporary diversion channels for box culverts shall be in accordance with Standard Plate number 734.10.

G. Temporary Stream Diversion for Box Culvert Extensions: Temporary stream diversion for box culvert extensions will be paid for at the contract unit price per each. Payment for this bid item will be made only once, regardless of the number of times the diversion is changed or moved at this site. Payment will be full compensation for labor, equipment, materials, and all incidentals necessary for constructing the temporary diversion channel.

H. Erosion Control for Box Culvert Extension: Erosion control for box culvert extension will be paid for at the contract lump sum price. The contract lump sum price shall be full compensation for all labor, equipment, materials, and incidentals necessary to install and maintain erosion and sediment control measures for box culvert extensions.

* * * * *

Appendix B. Conservation programs for landowners. Program descriptions were adopted from agency websites, website links are provided below.

Conservation Reserve Program (CRP) - FSA / NRCS
The Conservation Reserve Program (CRP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The voluntary program provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement.

The Conservation Reserve Program reduces soil erosion, protects the Nation's ability to produce food and fiber, reduces sedimentation in streams and lakes, improves water quality, establishes wildlife habitat, and enhances forest and wetland resources. It encourages farmers to convert highly erodible cropland or other environmentally sensitive acreage to vegetative cover, such as tame or native grasses, wildlife plantings, trees, filterstrips, or riparian buffers. Farmers receive an annual rental payment for the term of the multi-year contract. Cost sharing is provided to establish the vegetative cover practices.

Wetland Reserve Program (WRP) - NRCS
The Wetlands Reserve Program is a voluntary easement program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial support to help landowners with their wetland restoration efforts. The NRCS goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

Environmental Quality Incentives Program (EQIP) - NRCS
The Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Persons who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent.

Wildlife Habitat Incentive Program (WHIP) - NRCS
The Wildlife Habitat Incentives Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed. WHIP has proven to be a highly effective and widely accepted program across the country. By targeting wildlife habitat projects on all lands and aquatic areas, WHIP provides assistance to conservation minded landowners that are unable to meet the specific eligibility requirements of other USDA conservation programs.

Small Watershed Program - NRCS
The Small Watershed Program, including River Basin operations, works through local government sponsors and helps participants solve natural resource and related economic problems on a watershed basis. Projects include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, wetlands creation and restoration, and public recreation in watersheds of 250,000 or fewer acres. Both technical and financial assistance are available.

Conservation Security Program (CSP) - NRCS
The Conservation Security Program (CSP) is a voluntary program that provides financial and technical assistance for the conservation, protection, and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private lands. The program provides payment for producers who practice good stewardship on their agricultural lands and incentives for those who want to do more. CSP assistance was authorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) and the program may be available in fiscal year 2003.

Grassland Reserve Program (GRP) - NRCS
The Grassland Reserve Program is a new voluntary program in which landowners receive financial incentives to restore and protect grasslands. Eligible land includes restored, improved, or natural grassland, rangeland, pastureland and prairie. Practice cost share will be up to 75% on restored grasslands, 90% on virgin grasslands (prairies).

Emergency Watershed Program (EWP) - NRCS
The Emergency Watershed Protection (EWP) program helps protect lives and property threatened by natural disasters such as floods or wildfires. EWP provides funding to project sponsors for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. NRCS provides up to 75 percent of the funds needed to restore the natural function of a watershed. The community or local sponsor of the work pays the remaining 25 percent, which can be provided by cash or in-kind services.

Partners for Fish and Wildlife - USFWS
The Partners for Fish and Wildlife program is a cooperative effort between the Fish and Wildlife Service, private landowner, and other interested entities to restore and improve degraded or marginal habitat. The Partners program improves fish and wildlife habitat on private land, contributes to the land's health and rural quality of life, restores habitat through voluntary partnerships with private landowners, emphasizes landowner choice and control, and offers advice and funding for habitat projects on private lands.

Grassland and Wetland Easements - USFWS
Perpetual easements purchased from willing landowners for grassland or wetland habitat. Grassland easements allow the landowner to continue grazing the land and hay after a certain data, but prohibit the conversion of grassland into row crop production. Wetland easements restrict the dredging, burning, or filling of wetlands. Easements purchased on previously drained or filled wetlands may be restored through USFWS funding and technical assistance.

Safe Harbor Agreements - USFWS
Safe Harbor Agreements are voluntary arrangements between the USFWS and cooperating non-Federal landowners. The agreements benefit endangered and threatened species while giving the landowners assurances from additional restrictions. Following development of an agreement, the USFWS will issue an “enhancement of survival” permit, to authorize any necessary future incidental take to provide participating landowners with assurances that no additional restrictions will be imposed as a result of their conservation actions.

Habitat Conservation Plan (HCP) - USFWS
Habitat Conservation Plans (HCPs) are an agreement between the USFWS and non-Federal entities designed to protect a species while allowing development. An HCP allows the U.S. Fish and Wildlife Service to permit the take of endangered or threatened species incidental to otherwise lawful activities, when the taking is mitigated by conservation measures. This process should reduce conflicts between listed species and private development and provide a framework that would encourage "creative partnerships" between the private sector and local, state and federal agencies in the interest of endangered and threatened species and habitat conservation.

Conservation Commission Grants - SD Dept. of Ag
Grants from the Coordinated Soil & Water Conservation Grant Fund are available for projects that show a natural resource conservation benefit to the state. Any organized conservation district within the state may make an application to the State Conservation Commission. These grants are competitive in nature and there is limited funding for these grants. The following examples are projects that have received funding in the past: windbreak tree planting establishment and renovations including windbreaks for wildlife habitat, field erosion control, farmstead and livestock protection, water development to provide for livestock water needs away from the riparian area to promote healthy regeneration of those areas for erosion control benefits, waterway construction and seeding, rangeland / pastureland improvement projects, water quality improvement

projects including some of the above practices as well as overall assessment of the condition of the watershed and to identify sources of water quality impairments, and no-till cropping system incentives.

Dense Nesting Cover - GF&P
Dense nesting cover, or DNC, is a mixture of cool season grasses (those that green up early in the spring) and legumes, like alfalfa and yellow sweet clover. DNC is the cornerstone habitat type for many species of wildlife. Species, like pheasant, use it for nesting, rearing their broods, roosting and loafing. DNC is high quality nesting cover designed to maximize nesting activity and reproductive success. A lot of the Conservation Reserve Program lands in South Dakota are established with a DNC mixture.

Wetland Restoration - GF&P
Wetlands are the most dynamic ecosystem in South Dakota. Wetlands are important for flood control, water purification and wildlife habitat. GF&P is keenly interested in protecting and restoring wetlands. Through this practice, landowners that have wetlands that have been drained can receive a cost-share and technical assistance to have them restored.

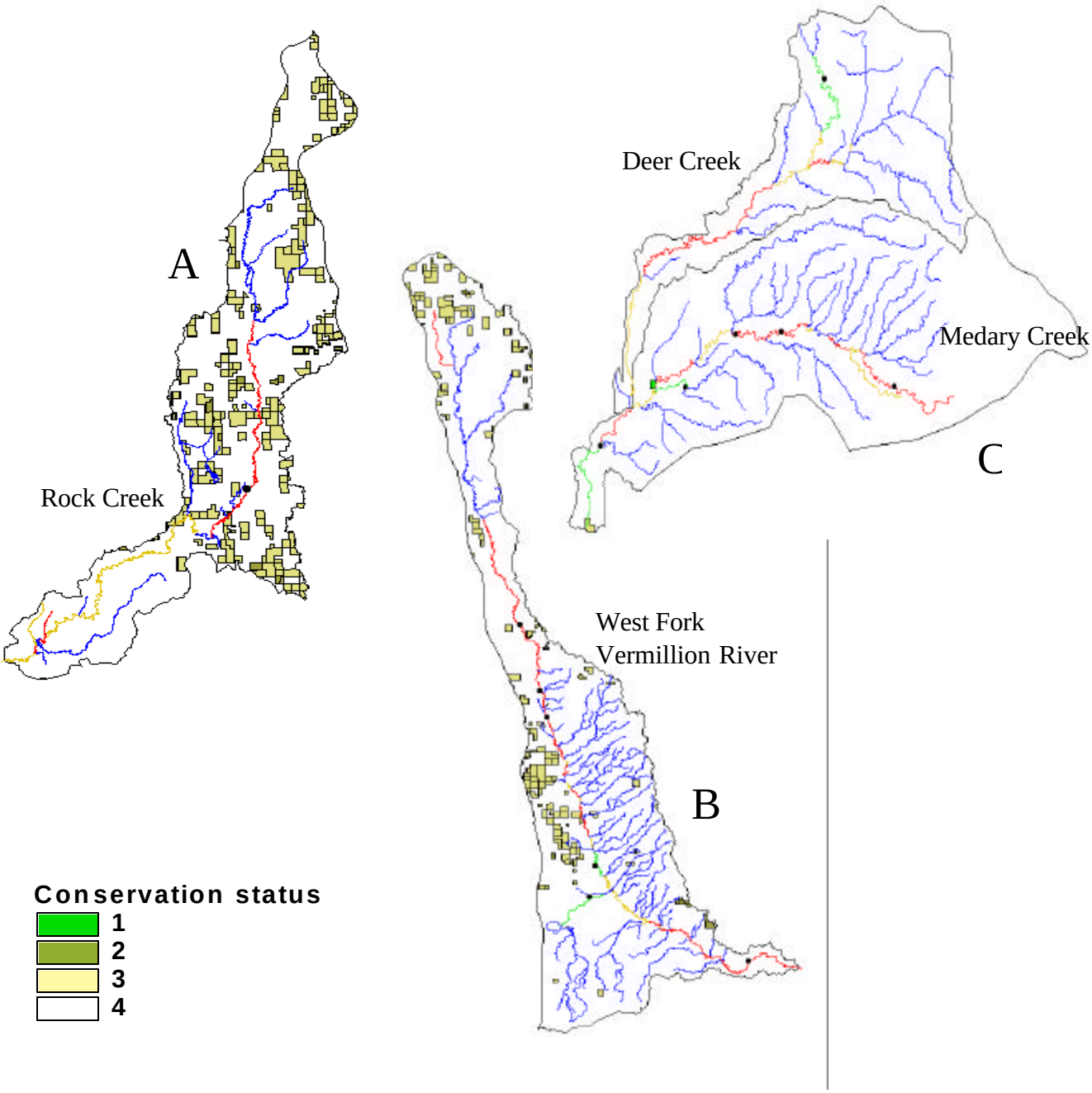
Habitat Fence Construction - GF&P
Important habitats often require protection from livestock. In special cases GF&P will help landowners protect these habitats by helping to pay for the cost of constructing a fence.

Native Warm Season Grass Establishment - GF&P
Once, a large portion of eastern South Dakota consisted of a grassland community that was very tall and did most of its growing in the middle of summer. It's hard to find better winter roosting habitat for resident wildlife than native warm season grasses. The stems are rigid and tend to stand up to a lot of weight from snow. NWSG plantings are also important to some species for nesting, brood rearing, loafing and even as a source of food.

Sources:
http://www.nrcs.usda.gov/
http://partners.fws.gov/
http://endangered.fws.gov/
http://www.state.sd.us/doa/forestry/state_conservation_programs.htm
http://www.state.sd.us/denr/DFTA/WatershedProtection/wpprg.htm
http://www.state.sd.us/gfp/privatelands/

Appendix C. Example of Gap analysis application to three Topeka shiner watersheds in eastern South Dakota. Figure and text from Berry et al. (2002). Figure not intended for regulatory interpretation.

Figure description:
Three sub-basin maps showing three types of gaps between land parcels in four conservation classes and stream segments in four classes of habitat priority for the Topeka shiner (red = high, green = moderate to high, orange = low to moderate and blue = low priority habitat). A = some headwaters and high-priority segments touch protected parcels; B = gaps between protected land and high priority habitat and headwaters; C = little to no protected land. Black dots = Topeka shiner locations. Sub-basins are not to scale.



Status Code Description:
We assigned one of four status codes for the intensity of land protection in each conservation parcel. Status One denoted permanent protection from land cover conversion, such as that found in most national parks. Status Two denoted permanent protection but with uses that might degrade existing natural communities somewhat (e.g. wildlife food plots in a state park). Status Three denoted permanent protection but with extractive uses that were low intensity (e.g. logging) or localized (e.g. mining). The Status three group was larger than others because of the many permanent conservation easements in wetlands, grasslands, and riparian areas that the US government has on private land. We probably underestimated this group because the most recent data are for years before 1995. Status Four was usually assigned to private lands that had no legal mandates to prevent conversion of natural habitat types or only short-term conservation easements (e.g. 10-yr grassland reserve easements). Much private land is well managed, but the intent of the Gap analysis program is long-term habitat conservation.

Appendix D. Press release from GFP News regarding state management plan.

TOPEKA SHINER STATE MANAGEMENT PLAN BEING DEVELOPED

PIERRE - South Dakota's Dept. of Game, Fish and Parks (GFP) is collaborating with other local, state, and federal entities in South Dakota to develop a state management plan for the Topeka shiner, a federally endangered minnow.

"The primary purpose of this state plan is to have a working document that identifies land and stream stewardship opportunities through interagency coordination," said GFP Aquatic Ecologist Jeff Shearer. "In addition, the state plan will determine landowner interest in a variety of partnership programs through public outreach activities. The development and implementation of this plan may also avoid the need for the U.S. Fish and Wildlife Service to list critical habitat for the Topeka shiner in South Dakota."

Topeka shiner management plans have been implemented elsewhere, such as Missouri and Fort Riley, Kansas; however, South Dakota's situation is unique.

"Currently, the shiner's distribution and population status are very similar to historic levels in South Dakota," Shearer noted. "For this reason, South Dakota has the opportunity to establish more flexible guidelines in managing the Topeka shiner, an option not available in other states where drastic population declines have occurred."

"The Topeka shiner state management plan will provide South Dakota with a prime opportunity to address specific state needs while still supporting national recovery efforts," said Game, Fish and Parks Secretary John Cooper.

The planning process will continue through the spring of 2003. A draft of the management plan should be available for public comment by late Feb. 2003.

To receive information regarding planning meetings, contact Jeff Shearer (605)

773-2743 or visit the GFP website at www.state.sd.us/gfp/Diversity/index.htm.

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Appendix E. Topeka shiner article published in South Dakota Conservation Digest.

Upon first glance the Topeka shiner looks like just another minnow one would find in a typical prairie stream. But when the U.S. Fish and Wildlife Service (USFWS) listed the Topeka shiner (*Notropis topeka*) as a federally endangered species in January 1999, this otherwise ordinary minnow started receiving much greater attention. Outside South Dakota, various human impacts to the landscape caused drastic declines to the shiner's range and population. Within South Dakota, however, the Topeka shiner tells a different tale.

The Topeka shiner is a small minnow (family: Cyprinidae) native to the prairie streams of the Great Plains. Named after the town near which it was first discovered (Topeka, KS), this shiner can reach three inches in length and live up to three years. While easily confused with the sand shiner, a common minnow found throughout much of South Dakota, the Topeka shiner can be identified by a dark stripe in front of its dorsal fin and a distinct wedge-shaped spot at the base of its tail. Males are more easily distinguished during the spawning season by their colorful, orange fins, as they occupy a small territory over gravelly substrate often around the periphery of sunfish nests. Food items range from zooplankton to plant material, though small aquatic insects are an important source.

Topeka shiners prefer small, quiet prairie streams with cool temperatures and good water quality. This shiner occupies a variety of habitats, such as runs, pools, and backwater areas. Preferred stream types tend to have clean gravel or sand substrates with vegetated banks of grasses and forbs. Groundwater flow into streams is especially important to Topeka shiners and other stream fish during late summer months to maintain cool, perennial flows. Though the Topeka shiner is a schooling fish, it is often associated with red shiners, bigmouth shiners, sand shiners, orangespotted sunfish, and black bullhead.

Eastern South Dakota lays on the northwestern edge of the Topeka shiner's range. Other states within the specie range include southwestern Minnesota, Iowa, Nebraska, Missouri, and Kansas, where studies suggest the shiner now occupies only 10% of its historic range. The picture is much brighter in South Dakota. The Topeka shiner occupies tributaries of the James, Vermillion, and Big Sioux rivers in eastern South Dakota. Recent studies by South Dakota State University, East Dakota Water Development District, and the South Dakota Department of Game, Fish and Parks have documented Topeka shiners in 80% of tributaries where the shiner was historically documented along with many new sites.

So how could a fish that has declined throughout most of its range be doing so well in South Dakota? Though a difficult question to answer, a closer examination of watershed-level activities may lend some insight. Human activities, whether intensive agriculture, construction and development, or point source pollution (e.g. wastewater discharges), often result in multiple impacts to aquatic systems. As is the case with many imperiled fish in the Midwest, declines in Topeka shiner abundance have been linked to habitat degradation, tributary impoundment, water withdrawals, sedimentation, and other water quality problems. Indeed, South Dakota streams face many of these problems, but perhaps to a lesser degree than streams have suffered elsewhere. Many streams in southwestern Minnesota and Iowa are channelized with row crop fields leading to the

edge of the stream's bank. Most streams in South Dakota are not channelized, and while row crop agriculture is a major industry, most land adjacent to streams is reserved for grazing. Tributary impoundments and stockdams are extensive throughout many Kansas watersheds. Although stockdams are prevalent throughout central and western South Dakota, the vast majority of eastern streams remain free flowing. While these are just some of the differences between South Dakota and the rest of the shiner's range, the demise of a species is often a result of a complex interaction of many variables.

Why should the plight of this small minnow concern us? After all, the shiner is not a game fish and most people have never seen one. But it's the message the Topeka shiner, and other "indicator" species, relay that's of importance. Eventually, all organisms (including people) are affected when a system becomes degraded, indicator species just respond sooner. The shiner can tell a story of a watershed's past health and warn us of future problems. Luckily, the story portrayed in South Dakota is one of optimism. Early indications suggest that shiner populations are at least stable. The current status of the shiner in South Dakota is, in part, a testimony of good stewardship practices by landowners. Sustainable management of the land has, in turn, sustained the natural diversity of streams.

Some landowners are concerned about having endangered species on their land, often citing fear of government restrictions. However, landowners should not feel apprehensive about having Topeka shiners on their land, but rewarded in knowing they've preserved a part of the watershed's integrity. The USFWS reviews federally funded projects and works with all parties involved to avoid impacts to species protected by the Endangered Species Act. Activities involving a federal permit, license, or funding require consideration of endangered species. Since the vast majority of day-to-day activities on private lands do not involve these federal ties, the presence of Topeka shiners, or any other federally listed species, should not unduly concern landowners.

Conservation and management activities for the Topeka shiner are taking place at both the federal and state level. The USFWS is drafting a Topeka shiner recovery plan, which will list potential threats, recovery goals, and conservation programs for the shiner. The USFWS is also designating critical habitat for the Topeka shiner. Critical habitat is an area deemed essential for the conservation and recovery for a particular species. Activities at the state level in South Dakota are more region specific for our own management goals.

South Dakota Game, Fish and Parks is currently working with other entities, including local, state, and federal interests, in the state to develop a Topeka shiner state management plan. The plan will allow for management of the Topeka shiner at the state level while still supporting national recovery efforts. The plan would identify habitat enhancement opportunities and landowner interest in partnership programs through local, state, and federal cooperation. Additionally, a completed plan should allow South Dakota to be excluded from critical habitat designation. Overall, South Dakota's goal is to maintain current populations and habitat, a much easier task than that faced by other states within the Topeka shiner's range.

On a national scale, the Topeka shiner has a long road to recovery that will require extensive efforts by many interest groups. Despite this long road, there are bright spots along the way. Good stewardship and conservation practices have allowed South Dakota to set an example for other states. By following South Dakota's lead, other states

will not only witness a recovery in their Topeka shiner populations, but improvements to their watersheds as a whole.

Appendix F. Management plan briefing developed by SD GF&P.

Topeka Shiner State Management Plan

What is it?
The state management plan is a document that will establish conservation guidelines for the Topeka shiner in South Dakota. The plan will discuss the current status of Topeka shiners, relevant research on the Topeka shiner, list possible impacts to the shiner and its habitat in SD, and address conservation strategies and tools (e.g. CRP, WRP) to mitigate potential impacts.

Several tasks of the state management plan will include:
- identify state-specific activities that support national recovery needs;
- coordinate with local, state, and federal agencies to identify opportunities for habitat enhancement;
- avoid the need to list critical habitat for the Topeka shiner in South Dakota; and
- determine private landowner interest in various partnership programs that are compatible with Topeka shiner needs.

Why do we need a state management plan?
Topeka shiner populations are more abundant and widespread in South Dakota than in other parts of the shiner's range. Recent surveys have documented the Topeka shiner in 80% of historically occupied streams as well as many new locations. Despite relatively abundant populations, Topeka shiners in South Dakota are regulated by the same guidelines in the Endangered Species Act as Topeka shiners in other states. It is the State's intention to avoid the need to list critical habitat in South Dakota and establish more flexible guidelines for management of the species through a completed management plan. These guidelines would alleviate some of the conflicts that occur during various projects involving Topeka shiner streams.

Who is involved with the state management plan?
Part of SD Game, Fish & Parks' mission is to conserve, manage, and protect South Dakota's wildlife resources; therefore, it is GF&P's responsibility to take the lead in developing and implementing the state management plan. Local, state, and federal entities are involved in providing input and comments, as the state plan will affect a variety of interests.

Stage of development
Initial plan developments started in June 2002 where a multi-agency meeting was held to discuss planning efforts and involvement. Plan goals, objectives, and components will be discussed at the next meeting (Fall 2002). A final draft plan should be finished by August 2003. Public involvement activities are being developed, including a future website at: http://www.state.sd.us/gfp/Diversity/index.htm

Appendix G. Press release from GFP News regarding the 30-day comment period on draft Topeka Shiner Management Plan for the State of South Dakota.

TOPEKA SHINER STATE MANAGEMENT PLAN AVAILABLE FOR COMMENT

PIERRE – The South Dakota Topeka Shiner Management Plan is now available for public comment. Game, Fish and Parks officials invite interested individuals to review the document and offer comments and suggestions to improve upon it.

"The main purpose for this state management plan is to outline opportunities for inter-agency cooperation to maintain and improve Topeka shiner habitat and watershed health as a whole," said Aquatic Ecologist Jeff Shearer. "Given the relatively intact distribution of Topeka shiners in South Dakota, the best way to support national recovery efforts is by maintaining existing habitat in eastern South Dakota streams."

People who wish to comment on the draft plan must have written comments submitted by March 21. The draft plan is available online at www.state.sd.us/gfp/DivisionWildlife/Diversity/ index.htm, by contacting Jeff Shearer at (605) 773-2743 or by e-mail at jeff.shearer@state.sd.us. Submit comments to: Jeff Shearer, S.D. Game Fish and Parks, 523 E. Capitol Ave., Pierre, S.D. 57501.

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Appendix H. Summary of comments submitted on the draft copy of the management plan during comment period (February 21, 2003 – March 21, 2003). Comments are copied verbatim as submitted.

Agencies / organizations / individuals that submitted comments:
South Dakota Game, Fish & Parks
South Dakota Dept. of Environment and Natural Resources
South Dakota Department of Transportation
South Dakota Department of Agriculture
Natural Resource Conservation Service – Brookings Field Office
U.S. Fish & Wildlife Service – Brookings Wildlife Habitat Office
U.S. Fish & Wildlife Service – Pierre Ecological Services Office
Lower James RC&D
South Dakota Farm Bureau
South Dakota Grasslands Coalition
South Dakota Cattlemen's Association
South Dakota Stockgrower's Association
South Dakota Corn Grower's Association
South Dakota Izaak Walton League
Harold Kerns – Missouri Dept. of Conservation
Carmen Blausey
Robert Hemmer
Gordon Williamson
Wendy Lieberg-Lockwood
Kelly Lieberg
Arens Engineering

Comments relating specifically to the Topeka shiner management plan:
The following list addresses those comments relating specifically to the management plan. Comments are followed by a reply. The reply states whether or not the comment will be incorporated into the plan and the reason for doing or not doing so. Comments are not listed in any specific order.

- Various suggestions regarding formatting, style, and organization of the plan were submitted embedded within a copy of the draft plan. These changes were made to the best extent possible but are not listed below.

Comment 1: Regarding the first impact; the present or threatened destruction, modification, or curtailment of habitat or range, SDCGA believes land-use practices that alter the hydrologic and geomorphic process provide benefits to a safe environment. SDCGA cautions the Department to occupational, industry and municipal activities that occur with such land use practices regarding wetlands, sedimentation, stream channelization, and resource extraction.
Reply: These activities will be considered as well.

Comment 2: Specific to South Dakota farmers, the state's abundant rainfall gives producers a big advantage over growers in drier farm states. However, during "wet years" which results in an over abundance of precipitation and saturation of property, farmers need a sound field drainage system to remove excess water and ensure that conditions remain suitable for crop growth. Such drainage systems for wet or saturated lands provide benefits to South Dakota farmers and residents of the state.

Reply: The discussion of drainage in this plan is only intended to address the negative impacts drainage systems can have on stream hydrology.

Comment 3: SDCGA agrees that the impacts of sedimentation on stream systems are wide ranging and South Dakota producers reap the rewards of sound management practices. Specifically, the draft plan state, "The loss of native prairie is often cited as a primary reason for increased sedimentation to aquatic systems in the Midwest." However, South Dakota's sizeable shiner populations should be evident of producers' existing land management practices that have minimized sedimentation of stream systems in the state.
Reply: Sound management practices have benefits to both producers and streams. However, certain alterations to the landscape have the potential to alter a stream's sediment load if proper management practices are not implemented.

Comment 4: SDCGA agrees that channelization alters stream hydrology and geomorphology. In doing so, channelization provides civic municipalities with greater control to prevent property losses resulting from periodic flooding in flood plain zones. With most communities and towns settled on strategic waterways, stream channelization is a necessary flood control measure.
Reply: Stream channelization is addressed in this plan to point out the adverse effects such activities may have on a stream system. Other flood control measures exist that can benefit both the stream and communities.

Comment 5: Regarding resource extraction, the draft plan states, "Resource extraction such as water withdrawals and gravel mining, for municipal, agricultural, and domestic uses have the potential to impact aquatic systems when conducted improperly. Irrigation can lower water tables and groundwater delivery to streams…" SDCGA believes agricultural irrigation is not an issue in South Dakota since the state generally receives adequate rainfall and the cost benefit of irrigation on already rich farming soil fields yields only marginal return to producers. Instead, focus of this section should be directed specifically at urban municipal governments.
Reply: The threats analysis on resource extraction indicates that water withdrawals (whether for agricultural or municipal purposes) are not a threat to Topeka shiner populations in South Dakota.

Comment 6: Specifically, the City of Sioux Falls generates nearly all of it's water intake from water wells and pumping stations strategically located around the Big Sioux River and surrounding underground area aquifers to supply the water needs for a population of over 120,000 residents. SDCGA believes more emphasis is needed for resource extraction from municipal governments instead of agricultural producers for resource extraction to be a valid point of consideration in the state's management plan.
Reply: This will be added.

Comment 7: Regarding the third impact: Disease and predation, SDCGA believes the state's draft plan is inconstant and incomplete. The draft plan states, "Little is known about the impacts of disease on Topeka shiner populations." If this wordage is correct, SDCGA believes a logical first step should be in-depth scientific studies on the impact of disease on shiner populations conducted by the U.S. Fish & Wildlife Service. Such basic information would provide information beyond stress-induced habitat conditions.
Reply: Suggested research will be added; however, this does not make the plan's assessment of disease incomplete.

Comment 8: The draft plan state, "Predation may not be as significant an impact on Topeka shiners in South Dakota as in other parts of the shiner's range." Such wordage does not guarantee however, that predation is not a threat. In the Department's own words, "Predation by introduced game fish most likely occurs, especially in areas where game fish have been intentionally introduced." This confirms that predation will occur and diminish shiner populations in the state. Furthermore, the draft plan state, "…the extent of these introductions is unknown" and indicates that the department does not entirely know the impact that predation will have on shiner populations in South Dakota.
Reply: The plan's assessment of predation and reasoning for predation not being a threat to Topeka shiner populations will be clarified.

Comment 9: SDCGA believes that more information needs to be collected on disease and predation before the Department can say for certain that disease and predation do not constitute a threat to the Topeka shiner populations in South Dakota.
Reply: No evidence exists to suggest disease or predation are threats to Topeka shiner populations in South Dakota. Topeka shiner populations have persisted throughout their historic range in South Dakota; therefore, we see no past or present evidence of threats from disease or predation.

Comment 10: Regarding the fifth impact: Other natural and manmade factors, the draft plan states, "No other natural (species competition, niche overlap, hybridization) or manmade (urbanization, impoundments) factors are known to threaten Topeka shiners in South Dakota," SDCGA believes such factors do exist that have the potential to threaten shiner populations in the state.
Reply: We respectfully disagree. There is no evidence that suggests other natural or manmade factors are currently threatening Topeka shiner populations in South Dakota. However, this does not mean that unforeseen future impacts will not develop.

Comment 11: SDCGA believes that shiner hybridization needs further research before concluding such action is not a threat. The Department's draft states, "Potential Topeka shiner hybridization and influencing factors is an area warranting further research" and as such, SDCGA believes further research should proceed regarding this possible threat.
Reply: We agree that potential hybridization between Topeka shiners and sand shiners warrants further research. However, only two occurrences of possible Topeka / sand shiner hybrids have ever been reported. Only observational data exist suggesting these individual fish were hybrids, there have been no genetics or morphometrics research to verify these findings.

Comment 12: SDCGA also has concerns for not including cyclical weather patterns for consideration as indicated by, "The natural effects of drought or floods should not be considered threats to Topeka shiner populations." SDCGA believes that adverse weather conditions have the potential to increase or decrease shiner population numbers. Such population changes could result in a skewed data at during the course of a population sampling in identified stream segments. As such, SDCGA suggests populations samplings should include a "factor" for dry years of drought that would impair shiner populations in the state.
Reply: The natural effects of drought or floods is in reference to the cyclical weather patterns, this section will be reworded for clarification. Fish populations do increase or decrease naturally with annual precipitation changes. Population monitoring protocols do take into account this natural variability so conclusions are not made based on skewed data.

Comment 13: SDCGA has concerns with the impacts of point source pollution such as wastewater discharge and other industrial effluents. Communities and industries that discharge the legally acceptable waste limits into river and stream segments impound a water body. Such impoundments impact those stream segments downstream from such sources. Other urbanization factors for consideration should include new developments and the potential for run-off resulting in rain downpours that infiltrate storm sewers and subsequent outflow into rivers. Consequently, SDCGA believes urban areas have the potential to impact areas downstream and severely diminish shiner populations. SDCGA asks the Department to reconsider the impacts of point source pollution as threats to the Topeka shiner in South Dakota.
Reply: Urban areas are still subject to the state water quality standards regulated by the SD DENR. These standards are designed to prevent significant impairment to state waters. We feel point source pollution is not a threat to Topeka shiner populations as long as these standards are upheld.

Comment 14: Regarding the Department's "Management Actions": The overall goal of this management plan is to maintain or improve habitat integrity in Topeka shiner streams. Thus, management objectives will focus on those primary issues that influence habitat integrity: hydrology, geomorphology, and water quality. SDCGA believes South Dakota's sizeable Topeka shiner populations can be attributed to existing land practices being utilized by producers who livelihood is tied to the productivity of their land. Additional funding sources and opportunities to combat sedimentation, erosion or surface runoff will not only benefit shiner populations in the state, but also the productivity of farmers with increased incentives offered through various governmental programs.
Reply: Agreed.

Comment 15: As such, SDCGA has concerns with some of the identified tasks for Objective 1.1: Maintain and restore the natural hydrology of streams containing Topeka shiners. SDCGA recommends including tiling as a beneficial option aimed at removing excess water and reducing overland runoff. Sound field drainage systems provide environmental benefits by removing excess water from fields and helping to reduce runoff. SDCGA recommends educating the public on the importance of tiling and other Best Management Practices such as stream stabilization, terraces, grass waterways and buffers.
Reply: Tiling may be beneficial to removing excess water and reducing overland runoff, but we respectfully disagree on the environmental benefits of tiling to the natural hydrology of stream systems.

Comment 16: SDCGA also expresses concern with tasks identified for Strategy 1.1B. Mainly the task to provide technical assistance to urban, residential, and development planners in designing storm water systems that minimize runoff "peaks" into streams following precipitation events." This is a concern since the Department did not list point source pollution as an impact to shiner populations in South Dakota nor the general threat of urbanization.
Reply: This strategy is designed to address the impacts runoff from impervious surfaces following storm events have on stream hydrology, not point source pollution.

Comment 17: Along the same thought, SDCGA is concern with Objective 1.3: Minimize non-point source water quality impacts in streams containing Topeka shiners. The Department lists non-point source water as an objective and even establishes a strategy to combat the objective with five tasks. However, the Department does not consider non-point sources as an identifiable threat to the Topeka shiner in South Dakota. If no such threat is listed, why has the Department developed strategies and tasks associated with non-point sources?
Reply: Tasks listed for this objective are being implemented throughout South Dakota. Listing of these tasks are to identify those actions needed to ensure non-point source pollution does not become a threat to Topeka shiner populations in the future.

Comment 18: Regarding the section on Population Monitoring and Assessment, SDCGA believes population monitoring is an important component in the management of any state plan. As such, the Department will face challenges to monitoring populations of the shiner.
Reply: Agreed.

Comment 19: Since the Department has chosen not to include weather patterns and conditions such as floods and droughts as threat to the shiner, SDCGA believes population samplings should include a "factor" for dry years of drought that would impair shiner populations in the state.
Reply: Conditions, such as drought, are taken into consideration when monitoring stream fish populations.

Comment 20: SDCGA also believes that for a proper monitoring protocol to be used, the current fifteen (15) year trend should be extended to include a thirty (30) year trend.
Reply: The monitoring protocol in this plan does not establish a 15-year trend. Monitoring the shiner on a 30-year basis is too long of a time frame for a species that has a maximum life span of 3 years.

Comment 21: Regarding the section on Public Outreach / Education, SDCGA believes producer groups and municipalities working with the Department will provide a critical role in informing citizens of South Dakota about the Topeka shiner. SDCGA is pleased to work with governmental agencies or departments to help educate and inform our producer members. SDCGA invites the Department to maintain its existing working relationship currently being displayed in the shiner issue.
Reply: Agreed.

Comment 22: The second sentence reads, "…landowner involvement will be an important aspect in maintaining Topeka shiner populations." I would change the word "important" to either critical or crucial. I don't believe we (whether in Missouri or South Dakota) can overemphasize the dependence we have on private landowners in the recovery of this species.
Reply: Agreed.

Comment 23: I was surprised to see your sampling protocol for Topeka shiner monitoring include their peak spawning period. With the critically low numbers of Topeka shiners in Missouri, we established our sampling protocol outside the spawning time for this species.
Reply: Stream sampling between June and September is the only feasible period in eastern South Dakota. Ice cover and spring floods prevent sampling earlier, stream intermittency and cold weather prevent sampling later.

Comment 24: The draft would have benefited from a review of the committee before release to the public.
Reply: Agreed, however, the short period of time between completion of the draft and submission a final draft prevented a longer review process.

Comment 25: This document seems to be indicating three conflicting paths for managing the Topeka shiner. The plan correctly states that the Topeka shiner population in South Dakota is in good shape. Maintenance of status quo should serve them well. The management actions include activities like research and funding programs to "improve" habitat which goes beyond maintaining status quo. Then a point system is proposed with baselines for current conditions followed by "recovery" goals for a point reductions in each drainage. We can't resolve the conflicted language.
Reply: Wording in the plan will be clarified. Recovery goals do not propose a reduction in the status quo. The management goal acknowledges that the established baseline conditions set after "wet" years can not be maintained during "dry" years. Maintaining the status quo of the Topeka shiner is the best option; however, Topeka shiner numbers are not stable. Thus management goal and baseline point totals differ.

Comment 26: Will the way future impoundment projects are discussed create some problems for constructing ponds through the fish and wildlife and NRCS small dams projects? We suggest you revisit the language. You may simply need to specify the reference is to large impoundments as it is seems to be in opposition statements made in the next paragraph.
Reply: Agreed, this point was clarified to refer to large impoundments.

Comment 27: We suggest that both watershed projects and conservation districts should be included as technical assistance providers. The Grassland Managed Intensive Grazing, Buffer Sales and Animal Waste Teams should be mentioned.
Reply: These will be added.

Comment 28: There is no mention of 319 (watershed) projects in the document as a source of funding for Best Management Practices. This should be added.
Reply: These will be added.

Comment 29: Outreach activities are rather weak. They are mostly target agency and organizations. More use should be made of the media to reach a greater segment of the population.
Reply: Media outlets have been used, these will be added to the plan.

Comment 30: We recommend that the demonstration sites be established cooperatively with watershed, conservation commission, etc. projects to maximize use of resources and eliminate duplication of effort.
Reply: Agreed.

Comment 31: If the incidents of altered stream flow have been observed why can't you determine the extent of dewatering.
Reply: One incident of stream dewatering was reported by Wall et al (2001). The total extent of stream miles impacted by dewatering would require a much more indepth study. Clarification will be made in the plan.

Comment 32: The extent of gravel mining is not unknown. These activities are permitted.
Reply: This will be added, however, some concern has been raised regarding activities without a permit.

Comment 33: Page 17, 1.1A Task 2 after WHIP add EPA 319 Projects. Task 3 after Classroom presentations add Terry Redlin Fresh Water Institute. 1.1B Task 2 after native warm season grass GFP add

EPA 319 Projects. Page 18, 1.2A Task 2 after NRCS add EPA 319 Projects. Page 19, 1.2C Task 1 after USFWS add Terry Redlin Fresh Water Institute. Task 2 after USFWS add Terry Redlin Fresh Water Institute. Page 20, 1.3A Task 3 to my knowledge EPA does not provide technical assistance. Dept. of Ag should read USDA and SDDA. Task 4 after CSP add EPA 319 Projects. Task 5 after NRCS add EPA 319 Projects.
Reply: These will be added.

Comment 34: Perhaps you could list those BMPs such as an Animal Nutrient Management System or riparian restoration etc. that do not require an on-site inspection for installation. Some conservation districts currently require all BMPs to undergo an on site inspection by the USFWS if OWs are present in the area while others do not.
Reply: These will be added.

Comment 35: Conservation Districts are county entities in grass roots management planning with producers. They are typically underfunded and short staffed. I would ask that they are not asked to extend any of their precious resources on a recovery program for a fish (topeka shiner), that is not threatened in this state. p 19&20.
Reply: Conservation districts are simply listed as one possible tool for certain tasks. This listing does not commit them to any new activities outside the day-to-day tasks conservation districts already carry out.

Comment 36: There is a huge demand for EQUIP funds by producers in South Dakota. These funds should not be redirected to a recovery program for the topeka shiner, whose "distribution and population status are very similar to historic levels…."
Reply: Listing of any conservation program in this plan does not redirect funding for recovery of the Topeka shiner. Programs are listed to point out various voluntary options that are available to interested entities.

Comment 37: Need to add in a section to state the overall goal of the document. Such as expanding on the first sentence from Page 16, Management actions section.
Reply: This change will be added to the introduction.

Comment 38: Life History, 1st paragraph. First sentence uses dates from late-May to mid-August. Should be end of July.
Reply: The Topeka shiner spawning period varies with water temperature. Shiners have been observed spawning during August. The late-May to end of July period refers to the spawning period restriction time for construction activities on shiner streams.

Comment 39: Life History, 1st paragraph. Clarify why believed few individuals live to three years or cite a reference.
Reply: Reference will be added.

Comment 40: Habitat, 1st paragraph, 2nd sentence. "Some Topeka shiner locations…streams with silt substrate…" Clarify in Life History section if there are expected recruitment possibilities in this habitat.
Reply: No information regarding expected recruitment, will be clarified.

Comment 41: Habitat continued, 1st paragraph, 2nd sentence. If it is based on the model wouldn't it be "potential presence"?
Reply: Statement based on data collected during field surveys, not model predictions.

Comment 42: Habitat continued, 1st paragraph, last sentence. Clarify that this assumes that there is a return of flows prior to dry down in an intermittent system or due to drought and that during this time the isolated pools maintain required habitat components. All within the short life span.
Reply: This will be clarified.

Comment 43: Topeka Shiner Research in South Dakota, 1st paragraph, 2nd sentence. State "…no surveys had taken place to specifically document Topeka shiner distribution prior to 1997." However, the Range

section, 1st paragraph, 3rd sentence refers to the historic range. These statements conflict and need clarification if earlier studies did not look at the basin / watersheds level to allow delineating historic ranges and thus separate from qualitative data later collected.
Reply: This will be clarified under Factor A of the Threats Analysis section.

Comment 44: Topeka Shiner Research in South Dakota, 1st paragraph, 2nd to last sentence. "This model was 89% accurate in predicting Topeka shiner presence." This statement is based on what? Does it mean that when the model predicted shiners would be present that upon field checking a certain percentage of them that shiners were only found 89% of the time? Or that when the model was applied to known sites only 89% of the sites showed up on the model?
Reply: This will be clarified.

Comment 45: Topeka Shiner Research in South Dakota, 2nd paragraph, last sentence. Refers to "This information will allow resource managers to determine the best source of broodstock for fish propagation…". This statement may be correct in regards to what is being researched. However, in context of the management plan that has the goals focusing around maintaining and improving habitat that statement is a bit misleading. The rest of the management plan does not incorporate the use of broodstock and propogation into it and this should be clarified at this point that it is not being researched as part of the implementation identified in this plan.
Reply: This will be clarified. There is not a need for propagation and stocking of Topeka shiners in South Dakota, however, this may be a required practice in other states. Genetics research was mainly justified to better understand the genetic distinctiveness of South Dakota populations. Identification of potential brood stock is a secondary benefit of this research.

Comment 46: Topeka Shiner Research in South Dakota, 3rd paragraph, 4th sentence. Study percentages stated 9% and 64%. What is the status of the other 27%?
Reply: This will be clarified.

Comment 47: Distribution of Topeka Shiners in South Dakota, last two sentences. The first of these sentences shows the breakdown of watersheds by basin. The recent year sentence also needs the basin breakdown for comparison and consistency. Clarify the "…have not been documented in 9 watersheds since 1990 (Table 1)." Table 1 shows only 8.
Reply: This will be clarified and changed.

Comment 48: Legal Status. States that "The species is not state-listed in Nebraska or South Dakota." It is stated why it is not in South Dakota but why isn't it in Nebraska?
Reply: The Topeka shiner was recently listed in Nebraska. This change will be made.

Comment 49: Goal Statement, 1st paragraph, 1st sentence. Use of term "vested interest" not recommended. By definition this means with goals for personal advancement or advantage at the expense of others. Not a message that should be sent on an issue that can already be viewed by some as subjective and political.
Reply: This change will be made.

Comment 50: Goal Statement, 1st paragraph. First paragraph may work better in the legal status section and then the Goal Statement section would start right off with the currently second paragraph that clearly contains goal information.
Reply: The group consensus was that the Goal Statement should start off with statement about agency obligations for wildlife and resource protection.

Comment 51: Goal Statement, 2nd paragraph, 1st two sentences. "The overall goal…streams in South Dakota *to maintain current population levels*", and "The intent of these….delisting of the *species pursuant to* the ESA."
Reply: This plan is designed to focus on stream habitat as opposed to species populations. By preserving current habitat, we feel current population levels will be maintained. Changes will be made to the second sentence.

Comment 52: Goal Statement, 2nd paragraph. When mentioning the recovery goal point system provide a reference to the Recovery Goal Evaluation section.
Reply: This change will be made.

Comment 53: Plan Development and Implementation, 1st paragraph. Nice paragraph but it belongs earlier in the plan in the Introduction section. Also be sure that all acronyms (SDSU, DSU, BHSU) have been spelled out at one point. In a document that utilizes several acronyms it is often recommended that an appendix listing them be utilized.
Reply: These changes will be made, a list of acronyms will be added towards the beginning of the plan.

Comment 54: Plan Development and Implementation, last paragraph. Areas that may best benefit need to indicate that the value of an adjacent buffer may balance out negative impacts identified further up the landscape. There is a reference to reaches with no protection with no definition of what those would be. Also, provide an appendix map showing what the Gap Analysis Program application identifies and how it looks.
Reply: These changes will be made.

Comment 55: Threats to Topeka Shiner Populations in South Dakota, 1st paragraph. Edits, "This plan address *all* five *factors* utilized…." Add sentence relating that a species may be determined to be a threatened or endangered species due to one or more of the five factors described in Section 4(a)(1) of the ESA. Also, after the first paragraph, provide a list to show what all five factors are.
Reply: These changes will be made.

Comment 56: List of five factors. List them by A, B, etc to be consistent with the way they are listed in the 50 CFR Part 17 Final Rule to List the Topeka Shiner as Endangered.
Reply: This change will be made.

Comment 57: Resource Extraction. 3rd sentence: Delete "As stated above" unless the above text clearly states the connections between the uses mentioned and groundwater/flow regime interactions. 4th sentence: Replace "evolved" with something such as "show tendencies or preferences". Evolved implies evolution and is generally should not used in this context for general public documents.
Reply: "As stated above" will be changed to "as previously stated." The term "evolved" will be replaced.

Comment 58: Disease or Predation, last paragraph. Move the last paragraph to be the first paragraph.
Reply: The last paragraph is intended to summarize the discussion regarding Disease and Predation.

Comment 59: Inadequacy of Existing Regulatory Mechanisms, 1st paragraph. 1st sentence, "…Topeka shiner location and reviews all federally funded projects…" How is this done? Is there an established protocol? 3rd from last sentence: "The NRCS has developed guidelines for project development and implementation…" should be changed to read "The NRCS is developing guidelines for project development and implementation…"
Reply: Each project is reviewed on a case by case basis. At a minimum, known locations of federal candidate and listed species are shared with the requesting entity. Additional information on state listed and state sensitive species and potential project impacts to rare species is often requested of the SD Natural Heritage Database. The second change will be made.

Comment 60: Other Natural and Manmade Factors, 2nd paragraph, last sentence. Future impoundment projects in Topeka shiner watersheds are highly unlikely…" Need to clarify large-scale due to Fish and Wildlife Service Partners for Fish and Wildlife Program activities. Large-scale projects however are also a very politically active issue in the upper Big Sioux watershed as being looked at by the Pelican Lake Water District and Upper Big Sioux Watershed Board. This same issue is stated in the last paragraph the last two sentences.
Reply: This will be clarified.

Comment 61: Management Actions, 1st paragraph. 1st sentence: Good sentence and it should also be utilized in the Introduction section. 4th sentence: Define the italics part as being the primary factor from the Threats to Topeka Shiner Populations in South Dakota.
Reply: These changes will be made.

Comment 62: Objective general comments: Make header larger, center, and bold to stand out. Clearly define them with a single word (hydrology, geomorphology, and water quality) as defined in Management Actions paragraph. Possibly include the rest of the text from the Objective statement as a "Purpose" statement for the objective.
Reply: These changes will be made.

Comment 63: Discussion. Define hydrology in the first sentence as is done for geomorphology in the discussion associated with the next section.
Reply: Hydrology will be defined.

Comment 64: Task and Tools sections general comments. Be consistent in utilizing all or no acronyms and make sure they are easily defined (i.e. in an appendix for acronyms). Do not mix NRCS programs (CRP, WRP, etc.) into lists that also contain agencies. Possibly use as a subhead list if needed under the appropriate implementing agency.
Reply: This will be clarified. Agencies and programs will be separated under different headings: Agencies/organizations and Programs/tools.

Comment 65: Objective 1.3 The 1st sentences states "non-point source" while the Management Actions introduction paragraph just lists it as water quality in general. Should be defined the same in both sections.
Reply: This will be clarified.

Comment 66: 1st paragraph, last sentence. "…groundwater sources, and change from rural to the urban landuse." Should read "…groundwater sources, and changes in landuse." Significant changes in farm or grassland management can have definite impacts and should be included in this category.
Reply: These changes will be made.

Comment 67: Monitoring Protocol. How and by whom will the sites be selected? 2nd paragraph, 4th sentence: Should state that the watersheds to be focused on would be known or historic location ones.
Reply: It has not been determined who will carry out monitoring activities.

Comment 68: Monitoring Site Selection. Section should be located before the protocol.
Reply: This change will be made.

Comment 69: Recovery Goal Evaluation: The baseline scores (1300, 800, 1700) indicate that not only the shiners were but the IBI scores increased for all locations. The 1300, 800, and 1700 correlate to the number of known watersheds since 1997 if all are given 100 points. If these baseline values are used, then the statement is being made that currently biotic integrity is increasing in all known shiner watersheds. Is it then assumed that stated recovery goals come from new locations? If so, then the goal of this management plan is actually being measured by increasing additional populations and habitat and not the protection of the existing populations and habitats. Thus the plan needs to be revised throughout to reflect that change.
Reply: This section will be clarified. Scores for assessing the recovery goal are set to monitor and evaluate year-to-year change. An example will be included to clarify this. Plan goal is still to maintain existing habitat, not to increase populations.

Comment 70: Table 1. Format to fit on one page. Expand out the "Stream" column to be sure only one line is needed per entry and then the document should easily fit.
Reply: Table will be reformatted, but still may not fit on one page.

Comment 71: Appendix general comments. Make "Appendix A" header larger and bold to stand out. Include page numbers in the Table of Contents or possibly number the pages (A-1, A-2, etc.) to indicate location in the Appendix and overall document.

Reply: Appendices and rest of the plan are formatted in accordance to those suggestions by the American Fisheries Society. Page numbers will be added to the Table of Contents.

Comment 72: Appendix A, WRP "The Wetland Reserve Program is a voluntary *easement* program."
Reply: This change will be made.

Comment 73: Appendix A, CSP "…the program *may* be available in fiscal year 2003 *pending funding*."
Reply: This change will be made.

Comment 74: Need to add the Grassland Reserve Program to the list since it is previously cited on page 18, Strategy 1.2A, Task, Tools.
Reply: This change will be made.

Comment 75: Overall this management plan seems to be a good general tool to assist in overall management goals of a watershed but it does not define specific actions or agencies that will implement them. The current Goal Statement says, "The intent of these guidelines is to work towards future delisting of the species from the ESA." However, this document is very broad and the Appendix B that would include the type of information listed is not included in the draft document.
Reply: Plan implementation will be discussed at a later date. Information to be included in Appendix B had not yet been submitted for inclusion in this draft document. This information has since been added.

Comment 76: Reasons for Decline: Farm Bureau recognizes the reasons in the section as potential reasons for decline in South Dakota. The second paragraph states the reduction in groundwater inputs due to wetland loss and irrigation withdrawal may further reduce stream reaches inhabited by Topeka shiners. It should also state that less-than-normal annual rainfall has the same effect.
Reply: This will be added. However, it is important to note that drought years are natural events, reduction in groundwater inputs due to wetland loss, irrigation withdrawal, and municipal water uses are manmade factors.

Comment 77: A paragraph should be added stating that South Dakota has no proof of a declining population on a statewide basis.
Reply: This is correct, currently no data exist to document a decline (or increase) in population levels. This will be clarified under "The present or threatened destruction, modification, or curtailment of habitat or range" rather than adding a new paragraph. "Reasons for Decline" is intended to state possible factors effecting Topeka shiners throughout their entire range, not necessarily those specific to South Dakota.

Comment 78: Goal Statement: Farm Bureau support the intent to work toward delisting of the species because of the lack of, or inaccurate, data used during the listing of the Topeka shiner. If delisting cannot be accomplished, down listing the Topeka shiner from endangered to threatened, and development of a workable 4d rule, is second best.
Reply: Agreed. However, delisting or downlisting of the Topeka shiner across its entire range is an action that is broader than this state plan. Actions throughout the entire range will require cooperation from all states within the shiner's range. SDGF&P currently is contracting genetics work that may help in delisting the Topeka shiner within South Dakota, although delisting and downlisting decisions are ultimately made by the USFWS.

Comment 79: We support the concept of a flexible management plan for the species because of the present excellent habitat and distribution of the species. Whether or not a 4d rule is put in place, we need a mechanism to substantiate data for delisting in the future.
Reply: Agreed. The intent of the Monitoring and Assessment portion of the plan is not only to assess recovery goal status, but also to collect the needed information to support delisting.

Comment 80: We support the concept of the point based recovery goal. Farm Bureau recommend applying a 30-year weather cycle to the point based system. In the dry years of the cycle the system should be able to average points or apply a weight factor to the scoring because of changes due to natural conditions.

Reply: Changes due to cycling wet / dry years will be factored into the point system.

Comment 81: Farm Bureau agrees with the statement "The present or threatened destruction of range or habitat is not a threat to Topeka shiners in South Dakota." There must be a balance reached in the reduction of sediment and clean water. We must use sound science in conservation practices that protect the environment and are economically feasible for the producer.
Reply: Agreed.

Comment 82: Management Actions: The terms maintain or improve habitat, maintain and enhance habitat, maintain or restore are used many times in this section. Maintaining current habitat is a useful term in management of the Topeka shiner. The use of restore, improve, or enhance may be beyond the scope of accomplishment due to economic and natural conditions. We should not overlook the species adaptation ability. If the species is adapting to the present conditions, restoring, enhancing, and improving habitat could have a negative effect on the species.
Reply: This will be clarified. Enhancement or restoration may only be necessary if the state is not meeting its recovery goal. Habitat improvements or enhancements that restore streams to their natural conditions should not, however, have negative impacts on the species.

Comment 83: Farm Bureau is concerned with where the money will come from to carry out the tasks. These management actions appear to be voluntary at present. Past history indicates they could become mandatory in the future. Our concern is another potential unfunded requirement placed on producers.
Reply: It is important to note that many tasks listed in the management actions are already being carried out by individual entities as part of their regular program activities (i.e. technical assistance provided for permitting and designing of confined animal feeding operations); therefore, these tasks already have funding mechanisms in place. Other tasks that are voluntary (i.e. establishing native grassland cover) are based on voluntary programs (e.g. CRP) that are not administered through this plan. Therefore, listing of any tasks can not add any additional mandatory requirements to producers.

Comment 84: We need to strive for balanced conservation practices. We must have flexibility in reduction of sediment by means of conservation practices. Large storm events can cause soil to move from one place to another. Removing the storm sediment from field deposition or dugouts needs to take place with a minimum of red tape or delay. Placement of terraces, filter strips, and closed drainage systems need to be used in the flexible conservation plan to obtain the needed balance.
Reply: This plan can not, however, substitute for any federal regulations during the Section 7 consultation process for projects that may involve endangered species. Agreements, such as a Habitat Conservation Plan, should aid in reducing the delays caused by federal regulatory requirements.

Comment 85: This section appears to be written from a biologist's point of view. We cannot save every shiner on every stream in South Dakota no matter what we do or do not do. Many of the tasks in this draft are carried out on private lands. The concern is will GF&P become another agency the producer must check with before they do anything on the land?
Reply: Agreed, we can not save every shiner every time regardless of the circumstances. The habitat approach taken by this plan should avoid the need to focus on individuals of a population. The logic being as long as the stream as a whole is taken care of, the shiner will persist. Since the Topeka shiner is not state-listed, SD GF&P does not need to be consulted by a producer on activities that may impact the shiner or its habitat. SD GF&P's role has been an advisory role from the perspectives of knowledge of fisheries management and stream hydrology.

Comment 86: South Dakota Farm Bureau believes that producers gain little or nothing in the draft management plan over the listing of critical habitat for Topeka shiners by USFWS. Our concern is that the voluntary tasks of the draft management plan could become mandatory tasks in the future. We do not need one more level of bureaucracy to deal with.
Reply: A Topeka shiner plan was drafted for South Dakota with the intention of avoiding the need to list critical habitat. The decision by the USFWS to no longer exclude critical habitat on the basis of Section 3(5)(a) of the ESA undermines those planning efforts. SDGF&P will continue to seek exclusion of critical

habitat. Tasks listed in this state management plan carry no legal or regulatory authority, but are part of a voluntary, alternative approach to the strict enforcement of the ESA.

Comment 87: We urge state agencies to request delisting of the species because of new data available. If delisting is refused by USFWS, we request that state agencies ask for down listing the species from endangered to threatened.
Reply: As stated previously, delisting or down listing will require cooperation by all states and the USFWS within the Topeka shiner's range. These actions are beyond the scope of any one agency within South Dakota; however, a comparable effort by all states within the Topeka shiner's range could facilitate downlisting or delisting.

Comment 88: The plan raises no significant concerns from our review. We are pleased to see an emphasis on stream geomorphology / hydrology, we like the monitoring planned, and the goal to establish demonstration sites in each basin.
Reply: None.

Comment 89: Baseline and Monitoring of Wetland Resources within Topeka shiner range: As pointed out in the Management Plan, streams with ground water inputs and high in water quality are important to the Topeka shiner. Also pointed out is that alteration at the systemic level, such as wetland drainage, is a reason for Topeka shiner decline. With this information in hand, it is imperative to have good baseline data regarding number and acreage amounts of wetlands in the present Topeka shiner range. I suggest you develop a method to quantify the number and amount of wetlands within the current range. Tools to be used for this baseline data gathering could include NWI, NRCS wetland determination and inventory maps, FSA slides, USGS topographical quadrangles, etc. Once the technique is created to determine wetland number and amount, the same technique can be used in respective years for monitoring. To paraphrase your goal, the overall goal is to maintain and improve habitat integrity in Topeka shiner streams. Unless good baseline information is known for Topeka shiner watersheds, determination of maintenance or improvement is occurring will be impossible.
Reply: Agreed, this will be added to the monitoring protocol.

Comment 90: Baseline and Monitoring of Grassland Resources within Topeka shiner range: Again, good baseline information of current grassland in the present range is needed. The plan states, landuse practices that alter the hydrologic and geomorphic processes of streams can have detrimental effects. Also stated in the plan is that the loss of native prairie is often cited as a primary reason for increased sedimentation to aquatic systems in the Midwest. To accurately quantify maintenance of grassland in the current Topeka shiner range, a baseline of grassland quantity and annual monitoring are needed. Potential tools to establish a baseline could include GIS landuse cover type, maps, NRCS National Resource Inventory data, etc. Again, unless accurate current information is determined about Topeka shiner habitat and their corresponding watersheds, the goal of maintaining habitat will not be quantifiable.
Reply: Agreed, this will be added to the monitoring protocol.

Comment 91: Monitoring of Drainage Activity: A reason stated for the decline of the Topeka shiner is habitat alteration. Landuse changes such as intensified agriculture have led to habitat alteration. Corresponding with intensified agriculture is intensified drainage be it either wetland drainage or pattern tiling of upland sites. Within the last several years, the landscape within the current range of the Topeka shiner has experienced an exorbitant amount of subsurface perforated drainage tile installation. It is well documented in peer reviewed journals that drainage tile alters natural rates of water discharge into receiving streams. The plan notes both good water quality and ground water influence are important to the Topeka shiner. A system of documenting both wetland drainage and upland pattern tiling within the current range of the Topeka shiner needs to be developed and implemented if the goal of habitat maintenance is to occur. DENR, SD Dept. of Agriculture, NRCS or other agencies could be involved in the development of a system and documentation of all drainage activity within the current Topeka shiner range.
Reply: Agreed, this type of monitoring should be developed and will be explored in the future.

Comment 92: In 1999, meetings to consider listing the Topeka shiner as threatened or endangered were held. The USF&WS reported that in South Dakota the shiner occupied only 20% of its native range in our state, causing great concern for the species. In September of 2002, the USF&WS reported that the shiner occupies 80% of its original habitat. Inaccurate figures were given then or are being used at this present date due to an 80% shiner occupation in the same basin acreage. This constitutes a 60% increase in 3+ years of an "endangered" species listing with no recovery plan in place. SDCA questions the need of any such plan due to the good stewardship of the landowners that have provided the habitat for the shiner since this land was settled in the late 1800s.
Reply: Any data that refer to a 20% range occupancy of the Topeka shiner in South Dakota in 1999 are inaccurate. Data collected between 1997 and 2000 by SDSU and surveys contracted by SDGFP demonstrate that the Topeka shiner occupies about 80% of historic locations along with many new locations not previously documented (some of these new locations were never before sampled, some were). Data are not available to show an increase or decrease in the Topeka shiner's range in South Dakota. Trends in range expansion or reduction can only be demonstrated following annual or periodic sampling at fixed locations. This type of sampling has not been previously conducted on eastern South Dakota streams.

Comment 93: We need to prove our state's environmental health to the rest of the nation thus justifying the de-listing of the shiner. Let's not allow other state's inequities cripple our state. Our goals need to redirect the USF&WS to worry about where the shiner is not rather than according to their own numbers, worry about a population located in a state environment capable of a 60% increase in a three year time period.
Reply: One way of delisting the Topeka shiner is for each state to meet its recovery goals. South Dakota has a much easier task of meeting our recovery goals than other states where the Topeka shiner has experienced large population declines. Data regarding increasing in Topeka shiner populations previously addressed. Listing and delisting actions are generally based on an analyses throughout the species' range, not based on one state's population numbers.

Comment 94: SDCA does not support the use of Farm Bill to finance any endangered species programs. As anyone involved in production agriculture can attest, one should not count on income from a government program until the check has cleared the bank. The federal programs (Conservation Reserve Program or Environmental Quality Incentive Programs) that the SDGF&P proposes to fund the "protection" of a population that has documentation of high numbers, still have not been appropriated and are in limbo in Washington, D.C. Let landowners use these possible resources for endeavors other than a quixotic chase. If you want to increase habitat acreages, pay for it. Current proposed cost-share for establishing habitat and associated practices in the EQIP program calls for 40 to 75 percent cost-share to establish practices associated with grassland habitat and related livestock use. If more Topeka shiner habitat includes grasslands, then offer incentives and practices at a higher rate. For example look at the increase in tree planting when programs were offered at 90% cost-share. It is not economically attractive to offer a planned grazing system to a producer along a Topeka shiner stream with 50% cost-share for the fencing and 50% for alternative water sources. Sound grassland management, and more of it, will result in more habitat for the Topeka shiner.
Reply: This plan does not propose the use of any Farm Bill program to finance an endangered species program. Farm Bill programs listed in this plan are simply suggestions as possible tools for meeting listed tasks. SDGFP does not administer the Conservation Reserve Program or Environmental Quality Incentive Program and therefore can not propose the funding of endangered species management with such programs. The goal of this management plan is to maintain the habitat Topeka shiner streams currently have; sound grassland management will play an important part in meeting this goal.

Comment 95: Perhaps funding could come from the USF&WS's ample budget, which is used to buy unpopulated Pacific islands and atolls from private corporations. That money could be redirected to support an endangered species recovery program in an area where the species needs a foothold, instead of asking one of the country's least populated states to finance a plan that supports a great deal of the whole country's minnow population. Our GF&P must address this situation. Safe harbor agreements and habitat conservation plans are better used where there is a legitimate concern and/or documented decline of an endangered species (e.g. Nebraska, Kansas, Missouri, Iowa, Minnesota and other places that have had shiners). Why spend money for conservation on a state with healthy populations?

Reply: Endangered Species Act programs, such as Habitat Conservation Plans and Safe Harbor Agreements, can have realized benefits to the landowner as well. These programs can alleviate the formal consultation process and other ESA restrictions when properly implemented. These benefits alone may be desirable in a state with an intact Topeka shiner distribution, but which still must comply with ESA guidelines that cover the shiner across its entire range.

Comment 96: Threats to the Topeka Shiner Populations in South Dakota: These should be real threats in South Dakota. Why use threats utilized by the USF&WS in areas were the fish is declined to extinction? Why not identify South Dakota's threats to the shiner? Could it be that there are not any currently to deal with?
Reply: The plan clearly states that those threats utilized by the USFWS in listing and delisting actions are not threats to Topeka shiner populations in South Dakota. If South Dakota wishes to become involved in petitioning to delist the Topeka shiner, these same threats must be addressed.

Comment 97: The SDCA would view a shift in balance of our state's land resources from the status quo to be detrimental not only to the shiner but also to our state's economic viability. A documented dependence on our current agricultural land use by the shiner is illustrated by the high sampling occurrence listed by the agencies tasked to initially assess the shiner's numbers in South Dakota.
Threats to our state's current land use model are:

1. unrealistic regulations that act as a parasite on our industry as we compete globally with foreign commodities.
2. non-scarcity of foreign resources due to slash and burn management practices.
3. a strong U.S. dollar due to a stable democracy.
4. less stringent food safety concerns due to the lack of resources and technology in underdeveloped countries. Foreign countries are able to carry on without these environmental and safety responsibilities, thus becoming more economically efficient as they enter the global market. This enables them to undercut our prices. If our USF&WS does not work to address or acknowledge these concerns, our country may gain ecological stability, but lose economic stability. Our goal should be a balance of both.

Reply: Addressing these threats is beyond the scope of this management plan.

Comment 98: The present or threatened destruction, modification or curtailment of habitat or range: Cattlemen and other agri-businesses have worked hard to atone for past management practices that were production-oriented, not sustainable production/conservation oriented. Cattlemen have identified the need to enact grazing management of current grasslands in order to match grazing times to grass species' production cycles. Heterosis enables more beef off of the same acres. This shift of management efficiency was started in the thirties with the dust bowl and continues today. Genetically Modified Commodities require less cultivation and chemical use. A variety of other practices, such as more carefully calculated grazing rotation schedules, also increase resource conservation.
The threats listed by the GF&P plan (Wetland drainage, Sedimentation, Stream Channelization and Resource Extraction) are not realistic threats for the level that the GF&P claims these occur across the range. We still have a robust, healthy shiner community in spite of the "threats." The SDCA puts forth that these actions are so rare now that they become moot, thus begging for more current, pertinent and realistic threat concerns in order to be pro-active in a plan, not reactive. List future possibilities that would affect what is working today to keep the shiners at such high numbers.
Reply: The draft plan clearly states that wetland drainage, sedimentation, stream channelization, and resource extraction are not threats to Topeka shiner populations in South Dakota.

Comment 99: Wetland drainage is no longer as grave a concern as it was prior to the swamp buster bill.
Reply: Wetland loss is no longer as extensive as in the past, this will be clarified in the plan.

Comment 100: Stream channelization occurs on a much greater level for urban purposes than agricultural use. Identify this and address it (ex. Sioux Falls' Phase III flood plan, which involves channelization of waters around Sioux Falls). Currently, urban areas impact the shiner with this threat 99.6% more than agricultural use ever does. Compare NRCS records and Army Corps of Engineers data to verify this.

Reply: A distinction between stream channelization for municipal and agricultural purposes will be made in the plan.

Comment 101: Sedimentation has occurred ever since the tall grass prairie was gifted with, on average, 12" of topsoil. Lewis and Clark noted the sedimentation on their travels. This land, although having no European influence on it, still had heavy sedimentation. The shiner evolved under these conditions.
Reply: Sedimentation has always occurred naturally in streams. Streams, such as the White River and historic Missouri River, have always had high sediment loads. However, other streams, such as the Big Sioux River and many headwater prairie streams, flowed clear most of the year. Sedimentation occurs naturally, but landuse changes can substantially alter (increase or decrease) a stream's sediment load.

Comment 102: Resource Extraction is minimal compared to other states due to our state's grass-based economy, which is not dependent on the huge quantities of water that other states utilize for crop irrigation and huge urban populations. SDCA encourages the GF&P to consult with the DENR to obtain current laws and usage records concerning the states waters.
Reply: The draft plan states resource extraction is not a threat in South Dakota.

Comment 103: The other states, according to Vernon Tabor, a biologist with the USF&WS in Manhattan, KS, have had very extensive non-native predator fish stocking programs in the past. Our state has never had enough conservation group/political group pressure put on it to stock these game fish, which prey on the shiner. We also have not had the state finances to have an extensive statewide stocking system as other states have had and currently have. The large mouth bass single-handedly may have been the worst management decision ever implemented as far as the shiner is concerned.
Reply: The effects of predatory game fish are discussed under Disease and Predation. For various reasons, game fish are not stocked into eastern South Dakota tributaries, and thus do not pose a threat to Topeka shiner populations in South Dakota.

Comment 104: Recreation has no threat to the shiner? Ask the biologists from the USF&WS about that statement.
Reply: There are no apparent recreational threats involving the Topeka shiner in South Dakota.

Comment 105: Along streams that originate out of state (Split Rock Water Body), be sure to hold those states accountable for headwater stocking of fish.
Reply: Game fish (e.g. largemouth bass) were rare and often absent from recent surveys of South Dakota streams whose headwaters originate out-of-state. These introduced game fish can not survive in these stream environments and therefore do not pose a threat to Topeka shiners in South Dakota.

Comment 106: Genetic identification of the initially identified shiner and its currently perceived species needs to be verified to ensure that the same species then is the same today.
Reply: Genetics research has been conducted on the Topeka shiner. There is no evidence to suggest a change in the genetic identify of the species.

Comment 107: Drought and floods have to be considered in the plan for the study of their effect on populations of shiners. A timeframe needs to be established for taking those events into consideration and allowing for recovery time. If this is not assessed, a false cause of takings could be identified and an unnecessary adjustment or action could occur, affecting the whole of the biotic community.
Reply: The natural variability of droughts and floods on Topeka shiner populations will be assessed as annual monitoring is conducted. These natural events will be considered to prevent any misevaluation of a watershed's status.

Comment 108: On page 15, paragraph 5, sentence 4, include "Confined Animal Feeding Operations" in that sentence right before or after "municipal wastewater treatment".
Reply: This change will be made.

Comment 109: The opening statement does not mention anything about maintaining the current integrity of the existing habitat that sustains the world's most vibrant, numerous populations of the Topeka shiner.

We should be proud of our current levels and be the example to other parts of the region in regard to what to do for proper shiner management.
Reply: This change will be made.

Comment 110: Once again, the SDCA cautions against using Farm Bill dollars to fund endangered species maintenance and development due to the fickleness of appropriations and the original intent and spirit of the Farm Bill to fund farm programs. This concept is very important to the continued success of South Dakota lands' health.
Reply: Use of Farm Bill dollars previously addressed.

Comment 111: The most important strategy we, as a group, can provide, has been stated by the evidence of Kurt Forman of the USF&WS and by the testimonies of myself and other cattlemen. This has also been supported by the DENR in my conversations with Jerry Miller of that office, our state's Department of Agriculture, and many others involved in this matter.

The SDCA puts forth the following objective in lieu of the current Objective 1.1. Due to the emphasis our state's government, industries and landowners have put on adding value to our current herbivory/commodity production balance we have thus far created in our state the biggest Topeka shiner population in the world. We feel the plan should address the biggest catalyst of shiner habitat, herbivory, and do what is needed to protect that industry on local, state and national levels, assuring shiners for years to come.
Objective 1.1 Recognize and expand the interdependence of herbivory and commodity agriculture production in order to maintain the healthy population status of the Topeka shiner.
Task: Ensure the viability of agricultural herbivory in order to maintain current levels of grassland resources.
Tools: SDGF&P
USF&WS
DENR
EPA 319money
NRCS
Agriculture associations
Task: Educate agencies and the public about the roles that herbivory and commodity agriculture play in maintaining and sustaining the populations of the Topeka shiner found in our state and the country.
Tools: SDGF&P
USF&WS
DENR
EPA
NRCS
Reply: The current strategies will be reworded to incorporate these ideas.

Comment 112: Under Strategy 1.1: Any student of grass production knows that retaining as much water as possible is important to rangeland/cropland success. If we can decrease horizontal movement of water and the involved soil of major storm events by implementing terracing and tiling to slow the movements of these events, we will increase water stores upland of water bodies.
Reply: The idea of strategy 1.1 is to restore stream hydrology in areas where groundwater influences have been severely altered, not necessarily increase water stores in upland areas.

Comment 113: Second Task: Non-land owner and land owner education on the importance of proper conservation best management practices, including but not limited to, tiling, terracing, buffer strips, waterways, stream bank stabilization and other management tools. Use soil/water retention indices to monitor results and provide monetary funding in the form of incentives for decreased runoff and increased soil conservation.
Tools: NRCS
FSA
Producer organizations
Private conservation groups

USF&WS
SDGF&P
Reply: The current strategies will be reworded to incorporate these ideas.

Comment 114: Under Strategy 1.2A: To best complete this task and successfully complete this endeavor (third task) include EPA 319 funding. EQIP would be better used for other conservation measures due to uncertain funding and intended usage.
Reply: 319 Program will be added.

Comment 115: Under Objective 1.3: Non-point source impacts have been addressed by the EPA, SD DENR, county agencies and producer groups for years. Our state DENR has gone on record stating that we have some of the cleanest waters since they began monitoring. If the shiner can survive to this point, and local, state, and federal agencies continue to manage this resource, the water, and subsequently the shiner, should increase in quality and number.
Reply: This objective is intended to support those activities that are currently addressing non-point source impacts (TMDL projects) as well as address those non-point source impacts that continue to impair state water designated use criteria. These impacts are listed by waterbody in the SD DENR 305(b) report to Congress that is submitted once every two years.

Comment 116: In the discussion of Objective 1.3: Karr and Chu identify the threats to a decreasing population, but fail to provide input on the factors contributing to the increasing or stable population South Dakota enjoys.
Reply: Karr and Chu (1999) only discuss watershed impacts in general terms, their discussion does not focus on South Dakota or the Topeka shiner. This citation is used to support the conclusion that non-point source impacts are still a threat to various waters throughout the Midwest.

Comment 117: Population Monitoring and Assessment: This is a very key component to the survival of the minnow. We as cattlemen are concerned with the fact that the monitoring of an endangered species will occur every three years when the streams that they haunt are so dynamic in form. A sampling site may be completely gone due to drought or successive flooding during the three-year interval. Money to fund this ongoing protection and subsequent study, of an endangered species, must come from the budget of the USF&WS.
Reply: Monitoring will be conducted on an annual basis. The state recovery goal will be evaluated once every three years. Monitoring strategies are able to incorporate the variability due to drought and floods in an annual assessment.

Comment 118: Multi-metric indices and index of biotic integrity (IBI) are open to interpretation of successive stages an ecosystems goes through.
Reply: Multi-metrics indices and the IBI have been repeatedly tested and verified in many aquatic systems throughout the U.S. These indices are designed to be robust to account for any natural changes to a stream system. Many state agencies throughout the U.S. utilize these indices for annual assessment of surface water conditions.

Comment 119: Regarding paragraph three of the Population Monitoring and Assessment: What happens if the predator fish that benefits from the increased shiner population is present when no shiners are? Why would we not want shiners and conducive habitat together? How will we measure the takings from native predator fish and be able to accurately credit the loss to the fish and not the landowners above the water.
Reply: This paragraph will be clarified. We would want Topeka shiners and conducive habitat together; however, absence of Topeka shiners from a site does not necessarily indicate degradation, especially when habitat conditions have not changed. It is important to consider the biological community, habitat, and surrounding landuse before determining a site has been degraded. Predation by native fish is a natural occurrence. Monitoring strategies are designed to distinguish between natural and anthropogenic occurrences.

Comment 120: Baseline Data: This is also very important to start with. The SDCA feels that if 20% sampling was found originally and used to list the shiner, now the 80% more found should show a great

national increase and be used to assess the species de-listing. Mapping, monitoring, modeling, soil profiling, erosion monitoring and any information used to determine the fate of people in a State in the United States of America should be ground proven data only.
Reply: Data relating to a 20% and 80% range occurrence was previously addressed.

Comment 121: Monitoring Protocol: This must take into consideration where we are in the 30-year weather patterns. We are currently coming down on the descending curve and must be careful to adjust the population on this when starting.
Reply: Annual stream flow changes due to drought or flooding will be taken into account.

Comment 122: Concern was stated about land-use data being unavailable. If data is needed to defend the justification of continued listing of the shiner, the SDGF&P and the USF&WS must be charged with its funding.
Reply: These data were not intended to justify listing of the species, this data will be used, in part, to assess South Dakota's recovery goal status. The data are available; however, the scale of different data sets is not consistent and may hinder analysis.

Comment 123: The evidence that has been compiled on this issues compels us to believe that the current management practices have been highly effective in the preservation and promotion of the Topeka shiner minnow. It has shown what those of us in the agricultural business have long believed, that the best choices for agriculture are often the best choices for the environment. The Topeka shiner minnow is a living example of that. We at SDCA believe that there are much more pressing uses of the time and resources of the state of South Dakota than further study and implementation of a management plan for a species that, by all appearances, needs no management plan. Therefore, we think the emphasis of this plan should be on the delisting of this species, rather than the management of it.
Reply: The overall goal of this plan is to maintain current habitat conditions. The intent of these guidelines is to work towards delisting of the Topeka shiner. If the Topeka shiner is to be delisted through the recovery process, each state must demonstrate that they are meeting their respective recovery goals. This plan lists those actions necessary for South Dakota to meet its state recovery goal, and thus work towards delisting of the Topeka shiner.

Comment 124: The plan needs to be more specific on what the overall goals are. The goals should be listed or bulleted in the introduction or executive summary and then appear again prior to the objectives.
Reply: Goals will be specified in the introduction.

Comment 125: On page 8 it appears that the goals are to maintain and improve habitat, delisting, and point-based management. When reading through the management actions, starting on page 16 it appears that the goals are maintaining and improving habitat, monitoring and assessment and public outreach/education. From a planning perspective shouldn't these be objectives or actions that would be used to meet the goals?
Reply: Correct, this will be clarified.

Comment 126: Instead of saying we are going to maintain and improve habitat the goal should be to:
Goal 1: Maintain 70% of baseline populations for the next 10 years
Objective 1: Maintain and restore the hydrology of 3 streams in each critical segment containing Topeka shiners.
Reply: South Dakota's recovery goal is to maintain roughly 70% of baseline populations based on 1997-2002 data. However, focusing on habitat rather than the species allows the plan to address watershed-level concerns.

Comment 127: In our last meeting it was our understanding that the overall goal was still to petition to de-list or down list. And that the plan should be designed to allow management activities to take place by maintaining a certain population level. Is this the intent of the current draft plan? Will this plan allow us to manage the Topeka Shiner on a watershed basis or species level? This needs to be clearly outlined in the plan.

Reply: The plan will allow South Dakota to manage the Topeka shiner on a watershed basis, this will be clarified. The plan will work towards delisting by setting a recovery goal in South Dakota. As long as this recovery goal is met, South Dakota is meeting its contribution towards the national recovery effort. Delisting or downlisting of the Topeka shiner; however, will require cooperation from the USFWS and state agencies throughout the shiner's range, not just those entities in South Dakota.

Comment 128: The plan should have a specific timeline for implementation.
Reply: Agreed, this will have to be discussed at a later time and incorporated into the plan. This is a strategic plan; however, and specific operational activities are not intended to be covered in this document.

Comment 129: The background information should be put in the appendix.
Reply: The background information will be combined and reformatted.

Comment 130: If the issue concerning listing of critical habitat is no longer an option, do we still need to complete the plan by August 2003? If not, this will give us more time to develop a plan that can be substituted for section 7 of the ESA and meet SD recovery goals.
Reply: The USFWS has indicated that the plan must demonstrate "functional equivalency" to substitute for section 7 of the ESA, and that this is a difficult task to accomplish. The plan will be completed as originally planned and SDGF&P will still pursue the possibility of excluding critical habitat in South Dakota.

Comment 131: I applaud your efforts at looking beyond the mere presence/absence of Topeka shiners as an assessment of the status of these prairie streams. The concern I have is the fact that the bottom line in dealing with an endangered species is that the habitat may appear to be great, if the species isn't present, you haven't fulfilled the obligation of protecting/maintaining/enhancing the species of concern.
Reply: Agreed. However, species presence / absence is also dictated by natural controls (e.g. drought), which are beyond any actions an agency can mitigate.

Comment 132: Page 27, Literature Cited – The Missouri Department of Conservation citation should list Jefferson City, Missouri instead of Columbia, Missouri.
Reply: This will be changed.

Comment 133: The William L. Pflieger citation for the Fishes of Missouri should list this as the Revised Edition and list Jefferson City, Missouri and not Columbia, Missouri.
Reply: This change will be made.

Comment 134: Table of Contents, Appendices. List the appendices separately with title and page number for ease in referencing.
Reply: This change will be made.

Comment 135: Under this plan unrealistic measures are identified to "protect" a species of fauna that is in great abundance in the waterways of eastern South Dakota.
Reply: Measures listed in this plan have been and are being implemented through South Dakota. This plan does not add any new measures to watershed protection outside those measures already implemented by local, state, and federal entities.

Comment 136: Our office has reviewed the draft Management Plan and has submitted comments to Mr. Jeff Shearer of your staff. We hope to review a new draft of the Management Plan if significant changes are made to the existing version. The current draft contains substantial information and obviously involved considerable effort within the time available. We believe that changes may be necessary to further focus the Management Plan's specific objectives and ultimately improve its utility. A focus on a more complete analysis of threats to the species in South Dakota with associated measurable management objectives to address each threat may create a more definitive and achievable conservation strategy. Some assurances of the State's ability to implement the Management Plan and to ensure its effectiveness will be necessary.
Reply: Further analysis of threats will be completed to the extent practically for inclusion in this management plan. Threat analysis beyond those presented in this plan can be completed at a later date.

Comments not relating specifically to the Topeka shiner management plan:
The following list addresses those comments not specific to the Topeka shiner state management plan. This does not mean these comments do not relate to the Topeka shiner or management of endangered species in South Dakota. These comments are not followed by a reply.

Comment 137: The South Dakota Stockgrowers Association agrees with Peter Gober, USFWS, that "The Topeka Shiner should not be a listed species." The situation being that the Topeka Shiner has already been added to the Endangered Species List, the South Dakota Stockgrowers Association concurs with the comments submitted by the South Dakota Cattlemen's Association concerning the Topeka Shiner Critical Habitat Management Plan.

Comment 138: We especially urge government agencies to rely on landowners, specifically ag producers, to manage private and publicly-held land. Private management will provide optimum benefits for both agricultural use and wildlife conservation.

Comment 139: Due to an untimely response to a request for information made to the FWS, I would like to express my concerns to the critical habitat designation assigned to Turkey Ridge Creek and those ramifications as they relate to the ongoing viability of Swan Lake located in Turner County, SD.

I ask that you consider the following paragraph in lieu of the associated link in your determination to the planning and management of the Topeka Shiner in South Dakota. I am contending that the present and future "human development" as it relates to all facets of recreation and property would be and has been "highly impacted" by the protection measures already taken and proposed concerning the Topeka Shiner. These comments will be filed with the Swan Lake Association. Thank you.

> " In accordance with sections 3(5)(C) of the Act, not all areas that can be occupied by a species will be designated critical habitat. Within the geographic area occupied by the species we designate only areas currently known to be essential. Essential areas should already have the features and habitat characteristics that are necessary to conserve the species. We will not speculate about what areas might be found to be essential if better information becomes available, or what areas may become essential over time. If the information available at the time of designation does not show that an area provides essential life cycle needs of the species, then the area should not be included in the critical habitat designation. We will not designate areas within the geographic area occupied by the species unless at least one of the primary constituent elements, as defined at 50 CFR 424.12(b), is present. Moreover, areas occupied by certain known populations of the Topeka shiner have not been proposed as critical habitat. For example, we did not propose critical habitat for some small scattered populations or habitat in areas highly impacted by human development. http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2002_register&docid=02-20939-filed"

Comment 140: The reasons supporting the critical habitat designation are reasons the species declined in other states, not South Dakota. This is not valid reasoning, since the practices in South Dakota have heretofore allowed for a strong population of Topeka shiners, while practices that other states have become dependent on have reduced their numbers. These states are not grass-based financially and must make sacrifices for the shiner like we have proven in South Dakota that we have and will continue to do so. Upon that justification, we must insist to the USF&WS that the shiner be de-listed based upon South Dakota's track record of successfully carrying on normal practices while supporting the nation's last remaining bastion of Topeka shiners.

Comment 141: P. 38 states "Currently, the shiner's distribution and population status are very similar to historic levels in South Dakota". I feel there should be no critical habitat designation in South Dakota based on a successful history of habitat management to date in South Dakota.

Comment 142: There is a great deal of confusion amongst the different agencies and even within agencies on what conservation practices may impair shiner habitat or which ones might improve habitat. People in the field need more expedient permit approval. There currently is not enough manpower in the COE or USFWS to handle the statewide workload. Sometimes BMP projects are delayed for months waiting for approval.

Comment 143: I want to express my opinion in regard to stream management in SD. What I have seen in the past 55 years is tremendous damage to streams from cattle producers. I could show you hundreds of winter feedlots situated on the "high ground" directly above natural drainages. I could show you hundreds of summer pastures that surround what were once nice streams but are now trampled into "seasonal wetlands", choked with cattails, bulrushes and other grasses. These "wetlands" were once well defined streams but as you know, cattle gravitate to the stream bed in the heat of summer and destroy the banks and bottoms. Until there is some protection of the waterways from direct and indirect effects of cattle, our streams are doomed. Of course water flows downhill, and as these streams cease to flow, or flow with strong levels of livestock pollutants, into our drinking water basins, the water supply for human survival is increasingly threatened.

Comment 144: I wish to make the following comments for your record. Turkey Ridge Creek is a known and valuable habitat for the Topeka Shiner in South Dakota. Turkey Ridge Creek flows adjacent to Swan Lake but does not naturally flow into the Lake. In the early 1900's, Swan Lake Association made provisions for a man made inlet structure which allowed for Turkey Ridge Creek stream flow into Swan Lake. Swan Lake has a relatively small natural drainage basin. As such, additional stream flow is normally required to maintain an adequate water depth in Swan Lake. For 90 years, Turkey Ridge Creek stream flow was used for maintaining the Swan Lake depth. During that time, the Topeka Shiner maintained a continual presence in Turkey Ridge Creek.

The Turkey Ridge Creek stream flow water quality was not always of the best water quality, thus at time had an detrimental effect on the Swan Lake water quality. In the mid 1990's, the existing Turkey Ridge Creek stream inlet structure to Swan Lake had been closed. Since 1990's, Swan Lake Association has been working with State and Federal agencies to develop an acceptable Swan Lake stream flow plan from Turkey Ridge Creek. The prime components of the plan included taking the stream flow during period of acceptable Turkey Ridge Creek water quality while maintaining adequate Turkey Ridge stream flow for the Topeka Shiner downstream of Swan Lake.

After the completion of the Topeka Shiner Management Plan for South Dakota, Swan Lake Association is interested in working with the State and Federal agencies to finalize the Swan Lake stream flow from Turkey Ridge Creek management plan and the construction of the new Turkey Ridge Creek inlet structure. The Swan Lake water depth has suffered since the closure of the existing Turkey Ridge Creek stream inlet structure to Swan Lake.

Comment 145: I am writing in response to your invitation for comments on the Topeka Shiner Management Plan for South Dakota. As a lifelong resident and longtime taxpayer of Moody County, my primary concern is with the added costs that are incurred with regard to the construction of bridges.

Normally one or two bridges are replaced each year within Moody County, and this is an activity which has been taking place for many years without the restrictions that have been put in place recently. If the Topeka Shiner has survived and even flourished under these conditions, it seems that it should be unnecessary to put bridge construction on hold for 2 ½ months each year during a time (May-June-July) when construction is most efficient. My other point is that the part of a stream or river that is impacted is usually quite small in comparison to the total length of the stream or river.

It seems to me that the amount of silt and other pollutants introduced into the water during bridge construction is small compared to what enter during heavy spring and summer rains. I have no objections to the goals of the management plan other than that I would like to have bridge construction allowed all year long.

Comment 146: I am commenting on the SD Topeka Shiner Management Plan. Please include exceptions in the plan for sources of recreation that are being detrimentally effected by the Topeka Shiner on the endangered species list. We own a cabin and land on Swan Lake, near Viborg, for the purposes of recreation and the lake is so dry now. We have spoken to many other property owners at Swan Lake and

something needs to be done soon. We invested our money, time, etc to Swan Lake and it now doesn't have water coming in. Please bring this to the attention of everyone involved in this process. SD has few lakes and we need to preserve what we have.

Appendix I. South Dakota Game, Fish and Parks letter requesting review of State Plan.

DEPARTMENT OF GAME, FISH AND PARKS
Foss Building
523 East Capitol
Pierre, South Dakota 57501-3182

December 11, 2003

Mr. Chuck Davis
U.S. Fish and Wildlife Service
Denver Federal Center
PO Box 25486
Denver, CO 80225-0486

Dear Chuck:

Please find enclosed a copy of the Topeka Shiner (*Notropis topeka*) Management Plan for the State of South Dakota (State Plan). South Dakota Game, Fish and Parks (SDGFP) outlined in an August 5, 2003 letter to the U.S. Fish and Wildlife Service (USFWS) our request to exclude South Dakota from the final designation of critical habitat based upon the conservation goals and objectives set forth in the State Plan. This cooperative plan was prompted by an offer from the USFWS to exempt lands from critical habitat designation upon approval of a species management plan. Our planning effort included representatives from local, state and federal agencies with the most potential to have long-term impacts on this species in South Dakota. We were also able to engage several highly influential organizations with strong ties to landowners and agriculture, a link that will be critical to the continued success of our cooperative, multi-agency Topeka shiner management approach.

As indicated in a December 9, 2003 conference call between SDGFP and USFWS personnel, we are submitting this letter requesting the prompt review of the enclosed State Plan relative to the evaluation criteria under the USFWS's Policy for Evaluation of Conservation Efforts (PECE). The focus of this letter is to highlight how the State Plan mitigates for potential threats, provides assurances that conservation efforts have been and will continue to be implemented, and highlights the effectiveness of past conservation efforts. It is imperative that the Service provide specific feedback to us if the Plan does not comply with the PECE criteria so that we can make adjustments as needed to ensure South Dakota is exempted from critical habitat designation when the final designation is published in 2004.

The State Plan provides an objective analysis of threats versus effects for the five factors utilized by the USFWS in listing, delisting, or downlisting actions. Large-scale impoundments (discussed under *other natural and manmade factors*) were the only threat considered to be moderate in magnitude within South Dakota. However, the immediacy was considered non-imminent due to the low occurrence of large-scale impoundments on Topeka shiner streams. Since the Topeka shiner became listed, no large-scale impoundments have been constructed on

Wildlife Division: 605/773-3381 Parks and Recreation Division: 605/773-3391 FAX: 605/773-6245 TTY: 605/773-3381

Topeka shiner streams. Working through the section 7 consultation process of the ESA, this threat has been effectively neutralized in the five years this species has been listed. Our agency cooperates extensively with the USFWS through the Section 6 program and other SDGFP programs to provide information, such as survey data, to facilitate the Section 7 consultation process. Our agency is also an active reviewer of all Corps of Engineers (Corps) permits issued under section 404 of the CWA.

This cooperation between the Section 6 and Section 7 programs of the ESA has worked in South Dakota to prevent construction of any impoundments on Topeka shiner streams since the species was listed. This clearly demonstrates that this threat, impoundments on Topeka shiner streams, has been curtailed effectively by the processes in place. Per the PECE Policy, these long established and fully functional processes have addressed the threat of impoundment construction on Topeka shiner streams in South Dakota. Furthermore, agencies that traditionally funded or authorized impoundments, such as the Natural Resource Conservation Service (NRCS), the USFWS, SDGFP, and the Corps have demonstrated a willingness to either not fund or not authorize impoundment construction on Topeka shiner streams.

All other threats were considered low in magnitude or not a threat to Topeka shiner populations in South Dakota. The low magnitude threats involved discharges into Topeka shiner streams relating to water quality issues in South Dakota.

State and federal laws provide assurances that many conservation efforts referenced in the State Plan will be implemented. The Natural Heritage Program within SDGFP recognizes the Topeka shiner as a species of concern. Subsequently, SDGFP provides an environmental review for projects that may impact the Topeka shiner. The South Dakota Department of Environment and Natural Resources (SDDENR) addresses low-impact threats, such as point source discharges, under the National Pollution Discharge Elimination System authorized by Section 402 of the Clean Water Act. Non-point source impacts are mitigated by the SDDENR through Clean Water Act Section 319 projects.

Both of those State programs have developed processes for the USFWS to review these actions for Section 7 ESA compliance. These existing and functional processes have satisfactorily met Section 7 compliance, which further demonstrates that these safeguards are eliminating this minor threat. Finally, the State also provides section 401 water quality certification for all projects proposed to be authorized by the Corps under the section 404 program. To date, the State has determined all such issued Corps permits on Topeka shiner streams meet water quality certification. That final oversight authority on Corps 404 permits is in statute. We believe these State programs have ensured water quality constraints have not to date nor will they rise to the level that would compromise Topeka shiner streams.

The South Dakota Department of Transportation in conjunction with the USFWS has developed best management practices (BMPs) for highway construction work that involves Topeka shiner streams. Similarly, the NRCS has developed BMPs and guidelines for project development and implementation that may impact Topeka shiner streams. The Corps has worked extensively with the USFWS on Section 404 activities involving Topeka shiner streams. All projects involving a

federal nexus require Section 7 consultation with the USFWS. In addition to those conservation efforts aimed at alleviating threats are the many habitat-based programs, such as the Conservation Reserve Program, offered by SDGFP, USFWS, and NRCS that provide net benefits Topeka shiners through improved watershed health.

Our review of the actual threats identified in the listing package for the Topeka shiner and elaborated upon in the State Plan indicate that the threats for this species have been and will continue to be effectively neutralized in South Dakota. Accordingly, we believe that sufficient measures are in place with an extensive track record that negate known threats for the Topeka shiner and the State Plan meets the intent of the PECE Policy. Therefore, South Dakota should be excluded from the need to list critical habitat. In addition, the State Plan outlines the many activities that are being undertaken by us and others that benefit Topeka shiners. For example, we have worked cooperatively with the NRCS, to ensure funding mechanism such as the Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentive Program (WHIP) place a higher priority on measures and projects that benefit Topeka shiner streams. These actions are in addition to the many ongoing conservation programs being undertaken by NRCS.

The current range and distribution of Topeka shiners in South Dakota is the best evidence we can provide towards that our activities and the mandated and cooperative activities of our conservation partners are effective Topeka shiner conservation efforts. With the addition of the Elm River following 2003 surveys, recent data indicates the Topeka shiner now occupies all of its historic range within South Dakota. As illustrated in the State Plan, South Dakota does not have the habitat threats that have greatly diminished Topeka shiner populations in other states.

The actions described above, when combined with ongoing actions undertaken to ameliorate the threats to the Topeka shiner, have resulted in high quality habitat and robust Topeka shiner populations in South Dakota. We believe that the ongoing programs and activities undertaken by a diverse group of individuals, organizations, and agencies have contributed to the presence of South Dakota's high quality aquatic habitats. There is considerable concern that critical habitat designation will have a chilling effect on the willingness of private landowners to participate in many of voluntary programs that benefit Topeka shiners in South Dakota. This negative impact has great potential to damage existing relationships with landowners and to discourage future partnerships that are so critical to endangered species recovery and management. The State Plan, if successful in eliminating the need for critical habitat designation, would eliminate this unintended and detrimental consequence. Furthermore, our multi-agency, multi-partner effort provides a much stronger recovery and management framework than a planning effort that depends on the commitment of a single agency.

Through the above outlined actions, which eliminate threats to Topeka shiners, further beneficial activities, maintain viable populations and institute a comprehensive monitoring program, we believe the State Plan and subsequent efforts satisfy the PECE Policy.

In addition to providing a strategic framework for Topeka shiner conservation, the State Plan also forms a basis for a Habitat Conservation Plan (HCP). An HCP will complement the State's adaptive management approach to meet goals and objectives as well as facilitate implementation of the point-based monitoring system. SDGFP is currently involved in development of an HCP for other listed species. Those experiences will provide a background for a potential Topeka shiner HCP.

As stated earlier, we ask that the USFWS provide a prompt analysis of the State Plan relative to its compliance with PECE criteria. Your feedback is critical to our continuing refinement of the State Plan and efforts towards Topeka shiner conservation. Thank you for your time in this matter.

Sincerely,

John L. Cooper
Department Secretary

cc: Ralph Morgenweck, USFWS Region 6 Regional Director
John Blankenship, USFWS Region 6 Deputy Regional Director
Pete Gober, USFWS, Pierre, South Dakota
Governor M. Michael Rounds

Appendix J. U.S. Fish and Wildlife Service reply letter to South Dakota Governor M. Michael Rounds.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

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MAR 0 8 2004

Honorable M. Michael Rounds
Governor of South Dakota
State Capitol
500 East Capitol Avenue
Pierre, South Dakota 57501-5070

Dear Governor Rounds:

Thank you for your letter of October 9, 2003, as well as letters dated August 5, 2003, and December 11, 2003, from the South Dakota Department of Game Fish and Parks Department (Department) related to Topeka shiner issues in your State. I apologize for the lateness of this formal response. The letters discussed a number of important subjects that have either been in flux due to recent litigation or raised important policy questions that required input from our Washington Office.

The primary issues outlined in the State's correspondence involved a 5-year status review, the Draft Recovery Plan, Critical Habitat designation of streams in South Dakota, and a review of South Dakota's Topeka Shiner Management Plan (Plan).

5-Year Review

The Endangered Species Act, under section 4(c)(2), requires the Service to review at least once every 5 years the information available respective to a species status. As you note in your October 9 letter, there is extensive new information on the Topeka shiner, including an increase in the number of known locations. This is largely due to the cooperation of State and Federal agencies and private landowners in conducting surveys.

The Service agrees with your recommendation to undertake a 5-year review for Topeka shiners and we will begin that process this year.

Draft Recovery Plan

The Service, States, and others have been working on a Recovery Plan for the Topeka shiner. We agree with your analysis that significant new information exists which may affect the Topeka shiner's listing status. We anticipate that completion of a Draft Recovery Plan will be delayed to incorporate this new information so that the draft Recovery Plan reflects the conclusions of the 5-year review.

Critical Habitat

Streams and stream segments in South Dakota were proposed as critical habitat on August 21, 2002. The Department developed a Topeka Shiner Management Plan to demonstrate that adequate management is occurring in South Dakota and, therefore, critical habitat designation in the State is unnecessary. We will soon publish an amended critical habitat proposal and a notice of availability for the draft economic analysis and draft environmental assessment in the Federal Register. We will make a final decision on the critical habitat designation by July 17, 2004. Your previous letters, conservation efforts, and comments will be part of the information used to make the final decisions on whether to designate critical habitat in South Dakota.

A fundamental consideration we must evaluate is whether excluding certain areas of critical habitat may cause the Topeka shiner to be in danger of extinction. Our review of the information for Topeka shiners in South Dakota indicates that significantly more populations are known to exist in 2004 than were known to exist when the species was listed 5 years ago. These discoveries provide evidence of the species' persistence in South Dakota.

Another consideration that will impact our final decision of designating critical habitat in South Dakota is whether the benefits of exclusion outweigh the benefits of including specific areas. This evaluation will be based on the best biological information available and an economic analysis. We recognize the many efforts that South Dakota currently undertakes or proposes in the State Plan provide conservation benefits to the Topeka shiner. Some of these State commitments involve partnerships that may be more difficult or impossible if critical habitat is designated. This is particularly germane given that the majority of Topeka shiner habitat is on private land or adjacent to private land, where many of the most effective recognized conservation efforts are built upon voluntary participation and minimization of regulatory burdens.

Management Plan for the State of South Dakota

Your December 11, 2003, letter and the State Plan outline the rationale for exempting South Dakota from critical habitat, as well as the multitude of ongoing beneficial activities that influence the status of the Topeka shiner in South Dakota. Principal to your rationale for exemption are the conservation efforts underway to address the threats to this species that were identified when the species was listed.

We have reviewed the State Plan and note that many of the conservation benefits arise from partnership efforts currently being implemented. We agree that the partnerships highlighted in your State Plan are among the best methods to further recovery of listed species. Those established, ongoing efforts, recognized by the many partners in the State Plan, give confidence that the State goal of maintaining habitat integrity by focusing on the hydrology, geomorphology, and water quality of Topeka shiner habitat can be achieved. Finally, the monitoring and reporting aspects of the State Plan will allow evaluation of the conservation efforts being undertaken in South Dakota and document status changes to the species, which is a critical part of the species' recovery process.

To further our evaluation of the State Plan, we developed a table of the Plan's action items (enclosed) that includes the status of such actions along with other conservation measures the State has undertaken. Many of these actions already are being implemented and have proven effective, while others, such as the monitoring and assessment portion of the plan, will allow ongoing evaluation and opportunities for refinement as needed.

We believe the various components of the State Plan, including an evaluation of the threats to the species in South Dakota, use of partnerships involving multiple entities to conserve this species, and monitoring, will benefit long-term conservation of the species.

Policy for Evaluation of Conservation Efforts (PECE)

We initially requested that your plan should comply with our PECE, which is used for listing decisions that are based on commitments in existing conservation plans. The PECE recognizes that formalized conservation efforts can offset or neutralize known threats to a species or its habitat and thereby affect listing decisions. The State Plan outlines a Topeka shiner population monitoring and assessment effort that will continue to document the status of this species in South Dakota. However, we will evaluate the potential exclusion of Topeka shiner critical habitat under section 4(b)(2) of the Act, which provides that the Secretary may exclude any area from designation if the benefits of such exclusion outweigh the benefits of designation. We will use, in part, the economic analysis we have prepared in our analysis of benefits.

Other Considerations for the State Plan

Secretary Cooper's December 11, 2003, letter provides additional information regarding threats analyses and measures being undertaken to reduce or eliminate threats to Topeka shiners. We recommend that letter and this response be appended to the State Plan as additional information.

Appendix B of the State Plan outlines Conservation Programs available to landowners. The Service also has an active wetland and grassland easement program that is available to landowners in eastern South Dakota. These programs would fit well with the other conservation programs outlined in Appendix B. Detailed information on these programs is best attained from one of the five Wetland Management Districts located in eastern South Dakota.

Honorable M. Michael Rounds 4

In summary, we agree that an updated status assessment for the Topeka shiner is warranted, and the results of that review will need to be included in the Draft Recovery Plan. The State Plan will provide significant conservation benefits to the Topeka shiner and we will give serious consideration to the State's request for exclusion from critical habitat designation. I also commend the Department for undertaking development of the State Plan. If I can be of further assistance please do not hesitate to contact me.

Sincerely,

Richard A. Coleman

ACTING Regional Director

Enclosure

ACTION ITEM	STATUS
Establish the South Dakota Topeka shiner working group.	Complete and Ongoing
Develop and implement the State Plan.	Complete (2003) and Ongoing
Conduct surveys to determine extent of Topeka shiner range in South Dakota.	Complete and Ongoing
Design long term monitoring and assessment plan.	Complete
Develop an education and outreach program to provide information on the Topeka shiner and watershed health.	Ongoing
Develop and maintain a Topeka shiner website for information on this species.	Complete and Ongoing
Complete genetic analyses of different Topeka shiner populations in South Dakota.	Complete
Incorporation of Topeka shiner recovery and conservation efforts in State strategic planning documents on different levels.	Ongoing
Secure matching funds from the Service and others to conduct surveys and ecological studies and for various habitat restoration and enhancement activities.	Complete and ongoing
Conduct research in relationship to stream hydrology and Topeka shiner habitat.	Ongoing
Provide technical and financial assistance to landowners interested in creating or restoring wetland areas.	Complete and Ongoing
Provide landowner incentives to increase native vegetative cover.	Complete and Ongoing
Work with government agencies to develop best management practices that minimize erosion.	Complete and Ongoing
Provide financial and technical assistance to landowners to reestablish native vegetation along riparian zones.	Complete and Ongoing
Provide technical and financial assistance to landowners and other agencies interested in restoring habitat in degraded stream reaches.	Complete and Ongoing
Review projects that may adversely alter Topeka shiner streams.	Complete and Ongoing
Continue working with the Service to provide information and assistance on section 7 consultation issues.	Ongoing
Continue working with section 6 funds to further identify and Topeka shiner areas and strategy for long term conservation.	Ongoing
Provide technical assistance to urban, residential and development planners to improve water quality from water discharge systems.	Complete and Ongoing
Work with Natural Resource Conservation Service to have Topeka shiner streams get higher priority for EQIP and WHIP funding.	Complete and Ongoing
Provide incentives for landowners to establish riparian buffers or filter strips along agricultural fields with high runoff potential.	Complete and Ongoing
Continue technical assistance for permitting and designing confined animal feeding operations.	Ongoing
Continue routine inspections of sewage treatment facilities to ensure compliance with water quality standards.	Ongoing

U.S. Fish & Wildlife Service

Revised RECOVERY PLAN

for the

Pallid Sturgeon (*Scaphirhynchus albus*)

Original Plan Approved: November 1993

Prepared by:
Pallid Sturgeon Recovery Coordinator
U.S. Fish and Wildlife Service
Montana Fish and Wildlife Conservation Office
Billings, Montana

For

Mountain-Prairie Region
U.S. Fish and Wildlife Service
Denver, CO

January 2014

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U.S. Fish & Wildlife Service

Revised RECOVERY PLAN

for the

Pallid Sturgeon (*Scaphirhynchus albus*)

Original Plan Approved: November 1993

Mountain-Prairie Region
U.S. Fish and Wildlife Service
Denver, CO

Approved: _____
Deputy Regional Director, Region 6, U.S. Fish and Wildlife Service

Date: 1·29·14

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DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect listed species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Plans are reviewed by the public and subject to additional peer review before they are adopted by the U.S. Fish and Wildlife Service. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not obligate other parties to undertake specific tasks. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species' status, and the completion of recovery tasks.

Copies of all documents reviewed in development of the plan are available in the administrative record, located at the U.S. Fish and Wildlife Service's Montana Fish and Wildlife Conservation Office, Billings, Montana.

Suggested literature citation:

U.S. Fish and Wildlife Service. 2014. Revised Recovery Plan for the Pallid Sturgeon (*Scaphirhynchus albus*). U.S. Fish and Wildlife Service, Denver, Colorado. 115 pp.

Recovery plans can be downloaded from: http://ecos.fws.gov/tess_public/SpeciesRecovery.do

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The Middle Basin Pallid Sturgeon Workgroup

The Lower Basin Pallid Sturgeon Workgroup

U.S. Army Corps of Engineers

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS: The Pallid Sturgeon was listed as endangered under the Endangered Species Act on September 6, 1990 (55 FR 36641-36647). Since listing, the status of the species has improved and is currently stable. New information related to habitat extent and condition, abundance, and potential recruitment in the Mississippi and Atchafalaya rivers has improved our understanding of the species in these areas. While the numbers of wild Pallid Sturgeon collected in the Missouri, Mississippi and Atchafalaya rivers are higher than initially documented when listed and evidence for limited recruitment exists for the lower Missouri and Mississippi rivers, the population has not been fully quantified. This increase in observations is the result of increased monitoring efforts, improvements in sampling techniques, and greater emphasis on research in the impounded portion of the range. Despite increased efforts, data regarding recruitment, mortality, habitat use, and abundance remain limited. Population estimates for wild Pallid Sturgeon within some inter-reservoir reaches of the Missouri River indicate the extant wild populations are declining or extirpated. To prevent further extirpation, a conservation propagation program has been established. The Pallid Sturgeon Conservation Augmentation Program (PSCAP) appears to be successful in maintaining the species' presence within the Missouri River basin. However, if supplementation efforts were to cease, the species would once again face local extirpation within several reaches.

HABITAT REQUIREMENTS AND LIMITING FACTORS: The Pallid Sturgeon is native to the Missouri and Mississippi rivers and adapted to the pre-development habitat conditions that historically existed in these rivers. These conditions generally can be described as large, free-flowing, warm-water, and turbid rivers with a diverse assemblage of dynamic physical habitats. Limiting factors include: 1) activities which affect in-river connectivity and the natural form, function, and hydrologic processes of rivers; 2) illegal harvest; 3) impaired water quality and quantity; 4) entrainment; and 5) life history attributes of the species (i.e., delayed sexual maturity, females not spawning every year, and larval drift requirements). The degree to which these factors affect the species varies among river reaches.

RECOVERY STRATEGY: The primary strategy for recovery of Pallid Sturgeon is to: 1) conserve the range of genetic and morphological diversity of the species across its historical range; 2) fully quantify population demographics and status within each management unit; 3) improve population size and viability within each management unit; 4) reduce threats having the greatest impact on the species within each management unit; and, 5) use artificial propagation to prevent local extirpation within management units where recruitment failure is occurring.

Achieving our recovery strategy will require: 1) increased knowledge of the status of Pallid Sturgeon throughout its range; 2) better understanding of Pallid Sturgeon life history, ecology, mortality, and habitat requirements; 3) improve assessments of all potential threats affecting the species; and 4) application of information gained through research and monitoring to effectively implement management actions where recovery can be achieved (see Recovery Outline/Narrative).

RECOVERY GOAL: The ultimate goal is species recovery and delisting. The intermediate goal is downlisting the species from endangered to threatened.

RECOVERY OBJECTIVES: The recovery objectives include the implementation of effective management actions that will reduce or alleviate the impacts from threats to the species within each management unit and across the species' range. Recovery actions to address threats within management units should be informed by adequate knowledge of pallid sturgeon abundance, population structure, life history, ecology, mortality, and habitat requirements specific to those units.

RECOVERY CRITERIA: Pallid Sturgeon will be considered for reclassification from endangered to threatened when the listing/recovery factor criteria (p. 54) are sufficiently addressed such that a self-sustaining genetically diverse population is realized and maintained within each management unit for 2 generations (20-30 years). Delisting will be considered when the listing/recovery factor criteria are sufficiently addressed and adequate protective and conservation measures are established to provide reasonable assurance of long-term persistence of the species within each management unit in the absence of the Endangered Species Act's protections.

In this context, a self-sustaining population is described as a naturally spawning population that results in sufficient recruitment of Pallid Sturgeon into the adult population at levels necessary to maintain a genetically diverse wild adult population in the absence of artificial population augmentation (see *Criteria for Reclassification to Threatened Status* p. 54). Additionally, in this context a genetically diverse population is defined as one in which the effective population size (N_e) is sufficient to maintain adaptive genetic variability into the foreseeable future. These criteria should be achieved and adequately demonstrated within each management unit prior to consideration for reclassification. Because the nature of threats to the species and impediments to recovery vary among management units, it is likely that individual units may achieve population sustainability criteria earlier than others. As populations recover and the inter-relationships of populations on the landscape are better known, the data will be reviewed to determine whether the designation of distinct population segments (DPSs) is warranted.

ACTIONS NEEDED (see *Recovery Outline/Narrative* pp. 58-74):

1. Conserve and restore Pallid Sturgeon individuals, populations, and habitats.
2. Conduct research necessary to promote survival and recovery of Pallid Sturgeon.
3. Obtain information on population genetics, status, and trends.
4. Maintain the Pallid Sturgeon Conservation Augmentation Program where deemed necessary.
5. Coordinate and implement conservation and recovery of Pallid Sturgeon.
6. Post downlisting or delisting planning.

ESTIMATED COST OF RECOVERY TASK IMPLEMENTATION (not adjusted for inflation): The estimated cost to implement this recovery plan and achieve species recovery is $239,170,000.

Of this amount, the estimated costs for downlisting from endangered to threatened is $221,820,000 and post reclassification costs are estimated to be $17,350,000. More detailed descriptions of the recovery tasks can be found in the *Recovery Outline/Narrative* (pp. 58-74) and a prioritized list of recovery tasks can be found in the *Implementation Schedule* (pp. 75-78).

DATE OF RECOVERY: The estimated earliest date for status reclassification from endangered to threatened is 2030 and from threatened to recovered is 2047 provided recovery tasks are implemented and recovery criteria are met. These estimates may change as new data become available.

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Abbreviated units used in this plan

cfs	cubic feet per second
ft	foot (feet)
ft/s	foot (feet) per second
km	kilometer(s)
m	meter(s)
m/s	meter(s) per second
mg/l	milligram(s) per liter
mi	mile(s)
NTU	nephelometric turbidity units
Rkm	River kilometer(s)
Rmi	River mile(s)

Acronyms used in this plan

CLMU:	Central Lowlands Management Unit
CPMU:	Coastal Plain Management Unit
DPS:	Distinct Population Segments
GPMU:	Great Plains Management Unit
IHMU:	Interior Highlands Management Unit
PCB:	Polychlorinated Biphenyls
PSCAP:	Pallid Sturgeon Conservation Augmentation Program
RSD:	Relative Stock Density
USFWS:	U.S. Fish and Wildlife Service

Part I: Background

History

Pallid Sturgeon (*Scaphirhynchus albus*), as well as other sturgeon species, are often referred to as "living dinosaurs". This moniker results from existence of fossilized sturgeon believed to be precursors to, or possibly common ancestors of, contemporary *Scaphirhynchus* species that coexisted with dinosaurs during the Cretaceous period of the Mesozoic era. Evidence for this coexistence is based on North American fossil sturgeon specimens (*Priscosturion longipinnis* and *Protoscaphirhynchus squamosus*) which date up to 78 million years before present (Grande and Hilton 2006; Hilton and Grande 2006; Grande and Hilton 2009). Today, eight species and one subspecies of sturgeon belonging to the family Acipenseridae inhabit North America; specifically these are:

- Pallid Sturgeon (*Scaphirhynchus albus*) – *E*;
- Shovelnose Sturgeon (*Scaphirhynchus platorynchus*) – *T-SOA*;
- Alabama Sturgeon (*Scaphirhynchus suttkusi*) – *E*;
- White Sturgeon (*Acipenser transmontanus*) – *E*;
- Green Sturgeon (*Acipenser medirostris*) – *T*;
- Lake Sturgeon (*Acipenser fulvescens*);
- Shortnose Sturgeon (*Acipenser brevirostrum*) – *E*;
- Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*); – *E (4 DPS) and T (1 DPS)*
- Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) – *T*;

Seven of these species are on the Federal list of endangered and threatened wildlife and plants, of which two species are listed as threatened (*T*), four are listed as endangered (*E*), one has DPSs that are either listed as threatened or endangered, and one is treated as threatened due to its similarity of appearance (T-SOA) to the listed Pallid Sturgeon (detail provided under Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes). While the Lake Sturgeon is not federally listed, it has declined throughout its native range and receives special protections in most states and provinces where it occurs.

The Pallid Sturgeon was listed as endangered on September 6, 1990 (55 FR 36641-36647).

Species Description and Taxonomy

The Pallid Sturgeon was first recognized as a species different from Shovelnose Sturgeon by S. A. Forbes and R. E. Richardson in 1905 based on a study of nine specimens collected from the Mississippi River near Grafton, Illinois (Forbes and Richardson 1905). They named this new species *Parascaphirhynchus albus*. Later reclassification assigned it to the genus *Scaphirhynchus* where it has remained (Bailey and Cross 1954; Campton et al. 2000).

General Description

Pallid Sturgeon have a flattened shovel-shaped snout; a long, slender, and completely armored caudal peduncle (the tapered portion of the body which terminates at the tail); and lack a spiracle (small openings found on each side of the head) (Forbes and Richardson 1905). As with other sturgeon, the mouth is toothless, protrusible (capable of being extended and withdrawn from its

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natural position), and ventrally positioned under the head. The skeletal structure is primarily composed of cartilage rather than bone.

Pallid Sturgeon are similar in appearance to the more common Shovelnose Sturgeon. Both species inhabit overlapping portions of the Missouri and Mississippi river basins. In their original description, Forbes and Richardson (1905) noted that Pallid Sturgeon differed from Shovelnose Sturgeon in size, color, head length, eye size, mouth width, barbel length ratios, ossification, gill raker morphology, number of ribs, and size of the air bladder. Bailey and Cross (1954) identified several additional differences between the two species, including barbel arrangement and position, barbel structure (i.e., diameter and papillae), and both dorsal and anal fin ray counts. They also developed a suite of diagnostic measurement ratios intended to eliminate the effects of size, age, and possibly geographic variation. In general, mature Pallid Sturgeon attain larger sizes than mature Shovelnose Sturgeon and they have longer outer barbels and shorter inner barbels with inner barbels originating anterior to outer barbels. Additionally, Pallid Sturgeon have wider mouths and naked bellies generally lack the mosaic of embedded scutes that armor the ventral surface of the Shovelnose Sturgeon.

Several of these diagnostic characters and ratios change with age of the fish (allometric growth), making identification of juvenile and subadult fish difficult. Fishery biologists have found that in most cases the seven morphometric ratios described in Bailey and Cross (1954) as well as subsequent indices developed by Wills et al. (2002) were not mutually exclusive when used to compare Pallid to Shovelnose sturgeon in the middle Mississippi River (Bettoli et al. 2009) or when used to compare both species from different geographic reaches (Murphy et al. 2007a). Also, these indices do not work well on smaller-sized specimens (Kuhajda et al. 2007). This lack of uniform applicability of morphometric indices may be attributable to greater morphological differences documented between upper Missouri River Pallid Sturgeon and Pallid Sturgeon samples in the middle and lower Mississippi and Atchafalaya rivers (Murphy et al. 2007a). Additionally, Pallid Sturgeon from the upper Missouri River live longer and grow larger than those found in the lower Missouri and Mississippi rivers (Figure 1).

Figure 1 Preserved adult Pallid Sturgeon: the larger specimen (background) is from the upper Missouri River and the smaller specimen (foreground) is from the lower Mississippi/Atchafalaya Rivers. Both specimens are among the larger specimens recorded from each region. (Photo courtesy Dr. Bernard Kuhajda, Tennessee Aquarium Conservation Institute).

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Historical Distribution and Abundance

The historical distribution of the Pallid Sturgeon (Figure 2) includes the Missouri and Yellowstone rivers in Montana downstream to the Missouri-Mississippi confluence and the Mississippi River possibly from near Keokuk, Iowa[1] downstream to New Orleans, Louisiana (Coker 1929; Bailey and Cross 1954; Brown 1955; Carlson and Pflieger 1981; Kallemeyn 1983; Keenlyne 1989 and 1995).

Pallid Sturgeon also were documented in the lower reaches of some of the larger tributaries to the Missouri, Mississippi, and Yellowstone rivers including the Tongue, Milk, Niobrara, Platte, Kansas, Big Sioux, St. Francis, Grand, and Big Sunflower rivers (Bailey and Cross 1954; Brown 1955; Keenlyne 1989; Ross 2001; Snook et al. 2002; Braaten and Fuller 2005; Peters and Parham 2008). The total length of the Pallid Sturgeon's range historically was about 5,656 River kilometers (Rkm) (3,515 River miles (Rmi)).

Because the Pallid Sturgeon was not recognized as a species until 1905, little detailed information is available concerning early abundance. Forbes and Richardson (1905) suggested that the lack of prior recognition of the species might have been attributable to scarcity, noting that Pallid Sturgeon accounted for about one in five hundred individuals of the *Scaphirhynchus* sturgeon collected from the central Mississippi River. The species was reported to be more abundant in the turbid lower Missouri River where some fishermen reported one in five sturgeon as Pallid Sturgeon (Forbes and Richardson 1905). However, it is probable that commercial fishermen failed to accurately distinguish the species in their sturgeon catches. As late as the mid-1900s, it was common for Pallid Sturgeon to be included in commercial catch records as either Shovelnose or Lake sturgeon (Keenlyne 1995). Although considered to be nowhere common, Bailey and Cross (1954) indicated that Pallid Sturgeon were considerably more abundant in larger turbid rivers than in clear or moderately turbid waters.

Correspondence and notes of researchers suggest that Pallid Sturgeon were often encountered in portions of the Missouri River as late as the 1960s (Keenlyne 1989). While there are fewer than 40 historical (pre-listing) records of Pallid Sturgeon from the Mississippi River (Kallemeyn 1983, Keenlyne 1989), this may be attributed to a lack of historical systematic fish collections from that portion of the range.

Present Distribution and Abundance

Since listing in 1990, wild Pallid Sturgeon have been documented in the Missouri River between Fort Benton and the headwaters of Fort Peck Reservoir, Montana; downstream from Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota; downstream from Garrison Dam, North Dakota to the headwaters of Lake Oahe, South Dakota; from Oahe Dam downstream to within Lake Sharpe, South Dakota; between Fort Randall and Gavins Point Dams, South Dakota and Nebraska; downstream from Gavins Point Dam to St. Louis, Missouri; in the lower Milk and Yellowstone rivers, Montana and North Dakota; the lower Big Sioux River, South Dakota; the lower Platte River, Nebraska; the lower Niobrara River, Nebraska; and the lower Kansas River, Kansas (Figure 3). Pallid Sturgeon observations and records have increased with

[1] Bailey and Cross (1954) considered the observation near Keokuk, Iowa as "dubious" and remark the species is likely represented by "stragglers from down river."

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sampling effort in the Mississippi River basin. In 1991, the species was identified in the Atchafalaya River, Louisiana (Reed and Ewing 1993) (Figure 3).

The contemporary downstream extent of Pallid Sturgeon ends near New Orleans, Louisiana (Killgore in litt., 2008). Additionally, the species has been documented in the lower Arkansas River (Kuntz in litt., 2012), the lower Obion River, Tennessee (Killgore et al. 2007b), as well as navigation pools 1 and 2, i.e., downstream from Lock and Dam 3, in the Red River, Louisiana (Slack et al. 2012) (Figure 3).

In 1995, a preliminary estimate found about 45 wild Pallid Sturgeon existed in the Missouri River upstream of Fort Peck Reservoir (Gardner 1996). More recent data suggest that substantially fewer wild fish remain today. For example only three wild Pallid Sturgeon were collected during 2007 – 2013, indicating wild Pallid Sturgeon numbers in the Missouri River upstream of Fort Peck Reservoir are too low for a reliable population estimate (Tews in litt., 2013). An estimated 125 wild Pallid Sturgeon remain in the Missouri River downstream of Fort Peck Dam to the headwaters of Lake Sakakawea including the lower Yellowstone River (Jaeger et al. 2009). While current abundance estimates are lacking for the entire Missouri River downstream of Gavins Point Dam, Steffensen et al. (2012) generated annual population estimates for both wild and hatchery-reared Pallid Sturgeon for the reach of the Missouri River extending from the Platte River confluence downstream 80.5 Rkm (50 Rmi). Their results estimated wild Pallid Sturgeon at 5.4 to 8.9 fish/Rkm (8.7 to 14.3fish/Rmi) and hatchery produced Pallid Sturgeon at 28.6 to 32.3 fish/Rkm (46.1 to 52.0 fish/Rmi). Extrapolating these estimates to the entire lower Missouri River suggests that the wild population may consist of as many as 5,991 mature individuals (Steffensen et al. 2013). This population may be stabilizing as a result of the Pallid Sturgeon Conservation Augmentation Program (PSCAP), but remains neither self-sustaining nor viable (Steffensen 2012; Steffensen et al. 2013). Garvey et al. (2009) generated an estimate of 1,600 (5 fish/Rkm, 0.8 fish/Rmi) to 4,900 (15.2 fish/Rkm, 24.5 fish/Rmi) Pallid Sturgeon for the middle Mississippi River (i.e., mouth of the Missouri River Downstream to the Ohio River confluence). In 2009, a sturgeon survey in the Upper Mississippi River captured a single Pallid Sturgeon below lock and dam 25 near Winfield, Missouri (Herzog in litt., 2009). No estimates are available for the remainder of the Mississippi River. Since 1994, the PSCAP has released hatchery-reared Pallid Sturgeon within the Missouri River, portions of the Yellowstone River, and sporadically in the Mississippi River. Supplementation data are summarized within the stocking plan (USFWS 2008).

Habitat Preferences

Pallid Sturgeon are a bottom-oriented, large river obligate fish inhabiting the Missouri and Mississippi rivers and some tributaries from Montana to Louisiana (Kallemeyn 1983). Pallid Sturgeon evolved in the diverse environments of the Missouri and Mississippi river systems. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and a dynamic main channel formed the large-river ecosystem that met the habitat and life history requirements of Pallid Sturgeon and other native large-river fishes.

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Figure 2 Map of prominent rivers in the Mississippi River Basin. Bold line approximates historical range of Pallid Sturgeon (Coker 1929; Bailey and Cross 1954; Brown 1955; Carlson and Pflieger 1981; Kallemeyn 1983; Keenlyne 1995).

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Figure 3 Post-development map of prominent rivers in the Mississippi River Basin. Bold line approximates current range of Pallid Sturgeon and includes both wild and hatchery-reared fish. (Data: National Pallid Sturgeon Database, U.S. Fish and Wildlife Service, Bismarck, North Dakota).

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Habitat Use

Research into habitat usage has produced some useful insights in many portions of the Pallid Sturgeon's range. However, it should be cautioned that much of these data are based on habitat characterizations in altered environments, in some cases substantially altered environments, including an altered hydrograph and temperatures, suppression of fluvial processes, stabilized river banks, loss of natural meanders and side channels, fragmented habitats, and increased water velocities. Thus, the following information and current understanding of habitat use may not necessarily reflect preferred habitats for the species, but rather define suitable habitats within an altered ecosystem.

Pallid Sturgeon primarily utilize main channel, secondary channel, and channel border habitats throughout their range. Juvenile and adult Pallid Sturgeon are rarely observed in habitats lacking flowing water which are removed from the main channel (i.e., backwaters and sloughs). Specific patterns of habitat use and the range of habitat parameters used may vary with availability and by life stage, size, age, and geographic location. In the upper portions of the species' range, juvenile hatchery-reared Pallid Sturgeon select main-channel habitats (Gerrity 2005). In the Yellowstone and Platte rivers, adult Pallid Sturgeon select areas with frequent islands and sinuous channels while rarely occupying areas without islands or with straight channels (Bramblett and White 2001; Snook et al. 2002; Peters and Parham 2008). While adult Pallid Sturgeon in the channelized lower Missouri River primarily use channel border habitats associated with engineered structures, they have been documented utilizing side channels, as well as newly inundated floodplain habitats with flowing water associated with historic discharges from Gavins Point Dam (Justin Haas in litt., 2013). In the middle Mississippi River, Pallid Sturgeon select for areas downstream from islands that are often associated with channel border habitats and select against main-channel habitats (Hurley et al. 2004). Other Mississippi River capture locations tend to be near the tips of wing-dikes (an engineered channel training structure), steep sloping banks, and channel border areas (Killgore et al. 2007b; Schramm and Mirick 2009).

Habitat requirements of larval and young-of-year Pallid Sturgeon remain largely undescribed across the species' range, primarily as a result of low populations of spawning adults and poor recruitment. However, some authors have postulated that early life-stage habitats in channelized river reaches may be similar among *Scaphirhynchus* species (Phelps et al. 2010; Ridenour et al. 2011). Young of year *Scaphirhynchus* in the lower Missouri River were found in habitats associated with the main channel border and moderate velocities (0.5-0.7 meters per second (m/s), 1.6-2.3 feet per second (ft/s)) (Ridenour et al. 2011). Age- 0 *Scaphirhynchus* sturgeon in the Middle Mississippi River were more often found in channel border and island-side channel habitats and positively associated with low velocities (~0.1 m/s, 0.33 ft/s), moderate depths (2-5 m, 6.6-16.4 ft), and sand substrate (Phelps et al. 2010). No Pallid Sturgeon were positively identified among the specimens collected in either study, thus, while these data offer useful insights, empirically derived larvae and young-of-year Pallid Sturgeon data are lacking.

Substrate

Pallid Sturgeon have been documented over a variety of available substrates, but are often associated with sandy and fine bottom materials (Bramblett and White 2001; Gerrity 2005; Snook et al. 2002; Swigle 2003; Peters and Parham 2008; Spindler 2008) and exhibit a selection

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for sand over mud, silt, or vegetation (Elliott et al. 2004). Substrate association appears to be seasonal (Koch et al. 2006a; Koch et al. 2012). During winter and spring, sand, sand and gravel, and rock substrates are used and during the summer and fall sand substrate is most often used (Koch et al. 2006a). In the middle Mississippi River, Pallid Sturgeon transition from predominantly sandy substrates to gravel during May which may be associated with spawning (Koch et al. 2012). In these river systems and others, Pallid Sturgeon appear to use underwater sand dunes (Bramblett 1996; Constant et al. 1997; Snook et al. 2002; Elliott et al. 2004; Jordan et al. 2006) which may serve as some form of holding, resting, or feeding area.

Depths and Velocity

Pallid Sturgeon are primarily benthic fishes, that is they spend the majority of their time at or near the river bottom. Across their range, Pallid Sturgeon have been documented in waters of varying depths and velocities. Depths at collection sites range from 0.58 m to > 20 m (1.9 to > 65 ft), though there may be selection for areas >0.8 m (2.6 ft) deep (Bramblett and White 2001; Carlson and Pflieger 1981; Constant et al. 1997; Erickson 1992; Gerrity 2005; Jordan et al. 2006; Peters and Parham 2008; Wanner et al. 2007). Despite the wide range of depths associated with capture locations, one commonality is apparent: this species is typically found in areas where relative depths (the depth at the fish location divided by the maximum channel cross section depth expressed as a percent) exceed 75% (Constant et al. 1997; Gerrity 2005; Jordan et al. 2006; Wanner et al. 2007).

Bottom water velocities associated with collection locations are generally < 1.5 m/s (4.9 ft/s) with reported averages ranging from 0.58 m/s to 0.88 m/s (1.9 ft/s to 2.9 ft/s) (Carlson and Pflieger 1981; Elliott et al. 2004; Erickson 1992; Jordan et al. 2006; Swigle 2003; Snook et al. 2002).

Turbidity

Pallid Sturgeon have been collected from a variety of turbidity conditions, including highly altered areas with consistently low turbidities (i.e., 5-100 nephelometric turbidity units (NTU)) to comparatively natural systems like the Yellowstone River with seasonally high turbidity levels (> 1,000 NTU) (Braaten and Fuller 2002, 2003; Erickson 1992; Jordan et al. 2006; Peters and Parham 2008). Currently, the effects from altered turbidity levels are poorly understood. Given their small eye structure, four barbels with taste buds, taste buds on lips, and ampullary electroreceptors on the underside of the snout, the species appears to be highly adapted to low-visibility environments. It is reasonable to infer that the historically high turbidity levels in the Missouri and Mississippi rivers was a component of the natural ecological processes under which the species evolved. Thus, rivers defined by high turbidity levels that fluctuate seasonally and annually are considered important because the species' life history traits (i.e., predator avoidance or feeding mechanisms) evolved in low visibility environments.

Life History

Pallid Sturgeon can be long-lived, with females reaching sexual maturity later than males (Keenlyne and Jenkins 1993). Based on wild fish, estimated age at first reproduction was 15 to 20 years for females and approximately 5 years for males (Keenlyne and Jenkins 1993). Like most fish species, water temperatures influence growth and maturity. Female hatchery-reared Pallid Sturgeon maintained in an artificially controlled hatchery environment (i.e., near constant

16 to 20° C, 61 to 68 ° F temperatures) can attain sexual maturity at age 6, whereas female Pallid Sturgeon subject to colder winter water temperatures reached maturity around age 9 (Webb in litt., 2011). Hatchery-reared Pallid Sturgeon in the lower Missouri River reached sexual material at ages 9 and 7 for males and females, respectively (Steffensen 2012). However, as of 2012, no 1997 year-class hatchery-reared Pallid Sturgeon, released in the upper Missouri River between Fort Peck Dam and Lake Sakakawea, have been found to be sexually mature. Thus, age at first reproduction can vary between hatchery-reared and wild fish and is dependent on local conditions.

Females do not spawn each year (Kallemeyn 1983). Observations of wild Pallid Sturgeon collected as part of the Pallid Sturgeon Conservation Augmentation Program (PSCAP) in the northern part of the range indicates that female spawning periodicity is 2-3 years (Rob Holm, USFWS Garrison Dam Hatchery, unpublished data).

Fecundity is related to body size. The largest upper Missouri River fish can produce as many as 150,000-170,000 eggs (Keenlyne et al. 1992; Rob Holm, USFWS Garrison Dam Hatchery, unpublished data), whereas smaller bodied females in the southern extent of the range may only produce 43,000-58,000 eggs (George et al. 2012). Spawning appears to occur between March and July, with lower latitude fish spawning earlier than those in the northern portion of the range. Adult Pallid Sturgeon can move long distances upstream prior to spawning; a behavior that can be associated with spawning migrations (U.S. Geological Survey 2007; DeLonay et al. 2009). Females likely spawn at or near the apex of these movements (Bramblett and White 2001; DeLonay et al. 2009). Spawning appears to occur adjacent to or over coarse substrate (boulder, cobble, gravel) or bedrock, in deeper water, with relatively fast, converging flows, and is driven by several environmental stimuli including day length, water temperature, and flow (U.S. Geological Survey 2007; DeLonay et al. 2009).

Incubation rates are governed by and dependant upon water temperature. In a hatchery environment, fertilized eggs hatch in approximately 5-7 days (Keenlyne 1995). Incubation rates may deviate slightly from this in the wild. Newly hatched larvae are predominantly pelagic, drifting in the currents for 11 to 13 days and likely dispersing several hundred km downstream from spawn and hatch locations (Kynard et al. 2002, 2007; Braaten et al. 2008, 2010, 2012a; Phelps et al. 2012).

Diets

Data on food habits of age-0 Pallid Sturgeon are limited. In a hatchery environment, exogenously feeding fry (fry that have absorbed their yolk and are actively feeding) will readily consume brine shrimp, suggesting zooplankton and/or small invertebrates are likely the food base for this age group. Data available for wild age-0 *Scaphirhynchus* indicate mayflies (Ephemeroptera) and midge (Chironomidae) larvae are important (Sechler et al. 2012).

Juvenile and adult Pallid Sturgeon diets are generally composed of fish and aquatic insect larvae with a trend toward piscivory as they increase in size (Carlson and Pflieger 1981; Hoover et al. 2007; Gerrity et al. 2006; Grohs et al. 2009; Wanner 2006; French 2013).

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Based on the above diet data and habitat utilization by prey items, it appears that Pallid Sturgeon will feed over a variety of substrates (Hoover et al. 2007; Keevin et al. 2007). However, the abundance of Trichoptera in the diet of fish studied in some reaches suggests that harder substrates like gravel and rock material may have become important feeding areas (Hoover et al. 2007), though it remains unknown if this was historically the case or a contemporary response to stabilization and channel maintenance activities increasing the abundance of localized rock material.

Population Genetic Structure

Genetic information suggests evolutionary differences across the range. Campton et al. (2000) used approximately 500 base pairs of the mitochondrial DNA control region to examine genetic variation within and among three Pallid Sturgeon groups; two from the upper Missouri River and one from the Atchafalaya River. The Pallid Sturgeon from the upper Missouri River and Atchafalaya Rivers did not share any haplotypes ($P < 0.001$), and the genetic distance between these two groups (0.14%) was nearly as great as the genetic distance between Pallid and Shovelnose sturgeon in the upper Missouri River (0.15%). The authors note that this may represent reproductive isolation and genetic divergence between these two populations of Pallid Sturgeon that is nearly as old as the isolation between Pallid and Shovelnose sturgeon.

Tranah et al. (2001) examined genetic variation within and among the same three Pallid Sturgeon groups as Campton (2000) using five microsatellite loci. The two upper Missouri River groups, separated by Ft. Peck Dam, did not differ significantly from each other. However, Pallid Sturgeon genetic samples from the upper Missouri River population did differ from samples collected from the Atchafalaya River ($F_{st} = 0.13$ and 0.25; both $P < 0.01$). Thus, Pallid Sturgeon collected from the Missouri River in Montana (the northern fringe of their range) are reproductively isolated from those sampled from the southern extreme of their range and likely represent genetically distinct populations (Tranah et al. 2001).

Subsequent work on allele frequencies at 16 microsatellite loci identified significant differences between upper Missouri River Pallid Sturgeon samples when compared with samples from the lower Missouri, Mississippi, and Atchafalaya rivers (Schrey 2007). While samples from the middle Missouri River (i.e., collected between Gavins Point Dam, South Dakota, downstream to Kansas City, Missouri) appeared to be genetically intermediate between the northern and southern samples (Schrey 2007).

These data indicate that genetic structuring exists within the Pallid Sturgeon's range consisting of two distinct groups at the extremes of the species' range with an intermediate group in the middle Missouri River (Campton et al. 2000; Tranah et al. 2001; Schrey 2007). These data suggest a pattern of isolation by distance, with gene flow more likely to occur between adjacent groups than among geographically distant groups, and thus, genetic differences increase with geographical distance. Additionally, data indicate that these genetic differences translate into biological differences (i.e., differences in growth rates, metabolic rates, and consumption rates) indicative of local adaptations (Meyer 2011). However, Pallid Sturgeon from the upper Missouri River are the most distinct from the other groups sampled (Schrey and Heist 2007). Anthropogenic changes to the upper Missouri River have affected migratory opportunities and, thus, gene flow; main-stem dams have reduced, altered, or eliminated both emigration and

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immigration. The genetic structuring detected within the range likely predates these anthropogenic features (Schrey and Heist 2007) suggesting that before the dams, historical reproductive isolating mechanisms were present within the range or at least portions of the range.

Reasons for listing/current threats

Section 4(a)(1) of the Endangered Species Act requires that reclassification decisions be based on the five factors outlined below. These threats are explained here to provide a context for actions necessary to restore the species to healthy population levels no longer meeting the definition of endangered, and ultimately, no longer meeting the definition of threatened. Section 3 of the Endangered Species Act defines a species as "endangered" if it is in danger of extinction throughout all or a significant portion of its range and as "threatened" if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Factor A: Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range

The following known and potential threats that affect the habitat or range of Pallid Sturgeon are discussed in this section, and include: 1) large river habitat alterations, including river channelization, impoundment, and altered flow regimes; 2) water quality; 3) entrainment; and 4) climate change.

RIVER CHANNELIZATION, BANK STABILIZATION, IMPOUNDMENT, AND ALTERED FLOW REGIMES

Modification and curtailment of Pallid Sturgeon habitat and range are attributed to large river habitat alterations, including river channelization, bank stabilization, impoundment, and altered flow regimes. Following is a brief summary of these activities by river system.

MISSOURI RIVER

Historically, the Missouri River was dynamic, ever-changing, and composed of multiple channels, chutes, sloughs, backwater areas, side channels, and migrating islands and sandbars. As early as 1832, Congress endorsed an act approving the removal of snags from the river (Funk and Robinson 1974). In 1884, the Missouri River Commission was formed to improve navigation on the river (Funk and Robinson 1974). Revetments of woven willow and rock were used to stabilize banks, and dikes were built to narrow the channel and close off chutes. However, commercial navigation declined with the expansion of railroad networks. In 1902 the Missouri River Commission was dissolved and responsibility for the Missouri River was given directly to the U.S. Army Corps of Engineers (Funk and Robinson 1974). In 1912, Congress approved a navigation channel 1.8 m (6 ft) in depth from Kansas City, Missouri downstream to the confluence with the Mississippi River near St. Louis, Missouri. Subsequently, the Rivers and Harbors Act of 1945 authorized an increase in channel depth to 2.7 m (9 ft) and width to 91.4 m (300 ft) from Sioux City, Iowa downstream to the confluence. A self-scouring channel was largely completed by 1967 (Funk and Robinson 1974).

During the last century, the Missouri River was altered as a result of the Flood Control Act of 1944 to address societal needs. The most obvious habitat changes were the installation of dams

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in the upper Missouri River and some tributaries (Figure 4) as well as channelization and stabilization of the lower Missouri River for navigation. These anthropogenic modifications greatly reduced the river's ability to satisfy the life history requirements of Pallid Sturgeon by: 1) blocking movements to spawning and feeding areas; 2) affecting historical genetic exchange among reaches, (i.e., reducing or eliminating emigration and immigration); 3) decreasing turbidity levels by trapping sediment in reservoirs; 4) reducing distances available for larvae to drift; 5) altering water temperatures; 6) altering conditions and flows in spawning areas; 7) altering flows and temperatures associated with spawning movements; and 8) possibly reducing food sources by lowering productivity (Hesse et al. 1989; Keenlyne 1989; USFWS 2000a; Bowen et al. 2003).

Flows in the Missouri and Yellowstone rivers between Fort Peck Dam and Lake Sakakawea influence Pallid Sturgeon spawning movements and migrations within this reach. In general, Pallid Sturgeon reside in the Missouri River downstream from the confluence of the Missouri and Yellowstone rivers during fall and winter months (Fuller and Braaten 2012). As discharge increases in the spring, adult Pallid Sturgeon respond by migrating upstream. Typically, radio-tagged adult Pallid Sturgeon migrate into the unregulated Yellowstone River (Fuller and Braaten 2012) to spawn. Spawning adults are believed to avoid the colder, less turbid flows in the Missouri River above the Yellowstone confluence. However, during the spring of 2011, a disproportionate number of adult Pallid Sturgeon migrated up the Missouri River and remained upstream of Wolf Point, Montana (Figure 4) during the spawning period (Fuller and Haddix 2012). This change in migration behavior coincided with exceptionally higher than normal releases at Fort Peck Dam, as well historically high discharge from the Milk River. Following this spawning migration, a genetically confirmed wild Pallid Sturgeon larva was collected (Fuller and Haddix 2012). This is the first documented confirmation of spawning success in the Missouri River downstream from Fort Peck Dam; confirming that suitable spawning areas exist in this reach of the Missouri River and that Pallid Sturgeon can and will utilize this reach for spawning if conditions are suitable.

Water levels in the reservoirs impounded by Fort Peck Dam (Fort Peck Reservoir) and Garrison Dam (Lake Sakakawea) (Figure 4) may be impediments to larval Pallid Sturgeon survival by limiting the amount of riverine habitat available for Pallid Sturgeon to complete the transition from free embryos to exogenously feeding larvae. Pallid Sturgeon free embryos and larvae can passively drift as much as 245 to 530 km (152 to 329 mi) depending on water column velocity and temperature (Kynard et al. 2002; Braaten et al. 2008). Studies to assess larval Pallid Sturgeon drift dynamics (Braaten et al. 2008, 2010) released hatchery-reared Pallid Sturgeon free embryos and larvae in 2004 and 2007. Subsequent sampling has collected juvenile Pallid Sturgeon derived from these releases (Braaten et al. 2012b). Survivorship of released embryos and larvae to age-1 is related to age at release (days post-hatch) and correlated with release location; survivorship of the younger free embryos (i.e., 5 days post hatch) to age-1 was only observed from the most upstream release site (Braaten et al. 2012b). These data indicate that free embryos, as young as five days post-hatch, are able to survive to age-1 in the Missouri River between Fort Peck Dam and Lake Sakakawea, provided they have adequate dispersal distance to complete the developmental transition to feeding larvae. These observations support the hypothesis by Kynard et al. (2007) which implicates total drift distance as a limitation on natural recruitment in this reach of the Missouri River. Thus, within a given reach of river the distance

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required to complete the early life history requirements is dependent on reach length, river discharge, velocity, habitat complexity, and temperature.

In addition to limiting drift distance and duration, affecting spawning cues for adults, and inundating habitats, an altered hydrograph also affects downstream temperature profiles and reduces sediment transport. Cold water releases from dams have been attributed to spawning delays in several native riverine fishes and changing fish community composition downstream (Wolf 1995; Jordan 2000). Canyon Ferry, Hauser, and Holter dams are upstream of Great Falls, Montana. Though they do not impose any migratory barriers for Pallid Sturgeon, these structures, like other main-stem Missouri River dams, can affect sediment and nutrient transport and maintain an artificial hydrograph. Thus, the main-stem and tributary dams upstream of Fort Peck Dam (Figure 4) affect downstream reaches by reducing both sediment input and transport. The results are a reduction of naturally occurring habitat features like sandbars. Discharge and sediment load, together with physiographic setting, are primary factors controlling the morphology of large alluvial rivers (Kellerhals and Church 1989). Seasonally high turbidity levels are a natural component of pre-impoundment ecological processes. Reduced sediment transport and the associated decrease in turbidity could affect Pallid Sturgeon recruitment and feeding efficiency.

The relationship between high turbidity levels and larval Pallid Sturgeon survival is unclear. In laboratory studies, increased predation on White Sturgeon yolk-sac larvae was observed at low turbidity levels, suggesting that high turbidity levels associated with a natural hydrograph and natural sediment transport regimes may offer concealment for free-drifting sturgeon embryos and larvae (Gadomski and Parsley 2005). Given that the diet of Pallid Sturgeon is generally composed of fish and aquatic insect larvae with some preference for piscivory as they mature (see *Life History* section, above), higher pre-impoundment turbidity levels may have afforded improved foraging effectiveness by providing older juveniles and adults some level of concealment. From the headwaters of Lake Sakakawea above Garrison Dam, North Dakota to Gavins Point Dam, South Dakota (Figure 4), the Missouri River retains little of its historical riverine habitat; most of this reach is impounded in reservoirs. However, some Pallid Sturgeon persist in the more riverine reaches within a few of these reservoirs, though successful spawning and recruitment is unlikely. Because of the presence of Pallid Sturgeon in some inter-reservoir reaches, those occupied reaches have been included in recovery efforts (Erickson 1992; Jordan et al. 2006; Wanner et al. 2007). Despite these data, most of these inter-reservoir reaches are poorly understood and further research is needed to evaluate and define their significance to species' recovery.

The Missouri River downstream of Gavins Point Dam is over 1,296 Rkm (800 Rmi) in length, is unimpeded by dams, and is biologically and hydrologically connected with the Mississippi River. However, this reach is highly impacted be past and present anthropogenic modifications. For example, in the unchannelized reach extending from Gavins Point Dam downstream for approximately 95 Rkm (59 Rmi) side channel and backwater habitats have changed (Yager et al. 2011). Changes include 77% and 37% reductions, respectively, in total and mean area of side channels, as well as decreases of 79% and 42%, respectively, in total and mean length of side channels (Yager et al. 2011). Channelization of the Missouri River downstream from this reach

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has reduced water surface area by half, doubled current velocity, decreased habitat diversity, and decreased sediment transport (Funk and Robinson 1974; USFWS 2000a).

Although the Missouri River downstream of Gavins Point Dam is not impounded, it is influenced by the operation of upstream dams. Additionally, nearly all major tributaries to this reach have one or more dams which cumulatively affect flows and sediment transport. Damming and channelizing the Missouri River and tributaries adversely affects Pallid Sturgeon (USFWS 2000a, 2003).

MISSOURI RIVER TRIBUTARIES

At the time of listing, few observations of Pallid Sturgeon occurred in waters outside of the main-stem Mississippi, Missouri, and Yellowstone rivers; tributary observations were attributed to special circumstances associated with high-flow conditions (55 FR 36641-36647). While historical captures of Pallid Sturgeon occurred near the mouths of tributaries or within close proximity to tributary confluences with the Missouri River, more recent observations indicate that Missouri River tributaries may be more important than originally recognized when the species was listed. These habitats appear to be important to the Pallid Sturgeon during certain times of the year or perhaps during certain life stages. Tributaries identified below are based on documented observations of Pallid Sturgeon and should not be considered a definitive list. This list may be revised if new data become available.

Marias River

Historically, the Marias River (Figure 4) influenced the Missouri River downstream from their merger. The influence of the Marias River on the Missouri River is not only limited to physical features but also affects the fish communities. Several large migratory species such as Paddlefish (*Polyodon spathula*), Blue Sucker (*Cycleptus elongatus*), and Shovelnose Sturgeon presently or historically were known to migrate up the Marias River, presumably to spawn (Gardner and Jensen 2007). It is possible that Pallid Sturgeon also may have historically migrated up the Marias River to spawn. Operations of Tiber Dam (Figure 4) on the Marias River at Rkm 132 (Rmi 82) have now altered the natural flow and sediment regime of the Marias River and may have affected its use by fish species including Pallid Sturgeon (Gardner and Jensen 2007). While historical data documenting occupation by wild Pallid Sturgeon are absent, hatchery-reared Pallid Sturgeon recently have been captured in the lower 1 Rkm (0.6 Rmi) (Gardner 2010).

Milk River

The Milk River (Figure 4) is ecologically important to the Missouri River downstream of Fort Peck Dam as it contributes flows, sediment, and warmer water temperatures. The Milk River is subject to irrigation diversions that can substantially alter the hydrograph in this system. Correspondingly, several barriers effectively block migrations within this system. The lowermost is Vandalia Diversion Dam (Figure 4) located near Rkm 188 (Rmi 117). In 2004, a radio-tagged wild adult Pallid Sturgeon was documented in the Milk River approximately 4 Rkm (2.5 Rmi) above the confluence with the Missouri River (Braaten and Fuller 2005; Fuller in litt., 2011). Additionally, a radio-tagged adult was reported entering the Milk River in 2010 (Fuller and Haddix 2012), and subsequently in 2011, 4 males and 1 female migrated into the Milk River;

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the furthest upstream location was approximately 57.9 Rkm (36 Rmi) (Fuller in litt., 2011; Fuller and Haddix 2012)

Yellowstone River

The Yellowstone River is the largest tributary to the Missouri River (Figure 4). While often referred to as "the last undammed river," this descriptor is a misnomer. At about the same time that Forbes and Richardson (1905) were describing Pallid Sturgeon as a species, the first and lowermost of six low-head diversion dams was being constructed across the river. This structure, Intake Dam (Figure 4), was constructed by the Bureau of Reclamation approximately 115 Rkm (71 Rmi) from the confluence with the Missouri River and effectively limits upstream movements of Pallid Sturgeon (Bramblett and White 2001) and entrains fish from the river into the irrigation delivery canal (Jaeger et al. 2005).

Adult Pallid Sturgeon use the lower Yellowstone River seasonally, moving upstream from the Missouri River in early spring as water temperatures rise and discharge increases (Bramblett 1996; Fuller and Braaten 2012). Aggregations of adult Pallid Sturgeon in the lower Yellowstone River during late June through mid-July have been attributed to spawning activity (Bramblett 1996; Bramblett and White 2001; Fuller and Braaten 2012). Recent evidence confirms spawning occurs in the lower Yellowstone River. Fuller et al. (2008) documented a gravid female Pallid Sturgeon released her eggs where a large congregation of males were present. However, no Pallid Sturgeon larvae were documented in sampling efforts. Subsequently, in 2012, reproductive success was confirmed with the collection of a wild Pallid Sturgeon larvae (Braaten in litt., 2013). While it is suspected that spawning occurs in the lower Yellowstone River in most years (Fuller and Braaten 2012), recruitment remains undetected.

Upstream movements of both adult and juvenile Pallid Sturgeon are affected by Intake Dam. This barrier appears to be prohibiting adult fish from accessing upstream habitats which may be suitable for spawning (Bramblett and White 2001; Jaeger et al. 2005). However, to date, two hatchery-reared juvenile Pallid Sturgeon, released below Intake Dam, have been documented upstream of the dam (Backes in litt., 2013). While the specific mechanisms of migration over or around the dam are unknown, these collections suggest that Pallid Sturgeon may utilize habitats upstream of Intake Dam if they are accessible. Additionally, about half of juvenile hatchery-reared study fish released upstream of Intake Dam did not emigrate during the study period, suggesting that habitats upstream of Intake Dam may be capable of supporting Pallid Sturgeon (Jaeger et al. 2005). The prevailing hypothesis suggests that naturally-produced Pallid Sturgeon larvae in the lower Yellowstone River will drift into Lake Sakakawea as long as spawning occurs downstream of Intake Dam (Braaten et al. 2008). This information indicates that available drift distance for larvae is artificially truncated by Intake Dam on the upstream end and water levels in Lake Sakakawea at the downstream end. This lack of drift distance is an ongoing threat limiting recruitment in the upper Missouri River.

Pallid Sturgeon also have been entrained in the irrigation canal associated with Intake Dam (Jaeger et al. 2004). In 2012, a new irrigation water-control structure was completed that incorporates fish screens intended to eliminate entrainment losses. However, to date, upstream fish passage concerns at Intake Dam remain unresolved. Providing fish passage at Intake Dam

can facilitate Pallid Sturgeon recovery by improving access to historically occupied habitats and providing the potential for increased larval drift distances.

Yellowtail Dam on the Bighorn River and Tongue River Dam on the Tongue River (Figure 4), both major tributaries to the Yellowstone River, have altered sediment transport and flows into the lower Yellowstone River. Other anthropogenic modifications on the Yellowstone River include bank stabilization projects to protect private property and transportation infrastructure, as well as municipal, industrial, and agricultural water withdrawal projects.

Niobrara River

Wild Pallid Sturgeon were documented in the lower Niobrara River (Figure 2) around the mid-1900s (Mestl in litt., 2011). Since that time, the lower reach of the Niobrara River has been affected by rapid aggradation due to the siltation at the head of Lewis and Clark Lake on the Missouri River. Approximately 2.2 to 2.8 m (7.5 to 9.5 ft) of aggradation, observed since the 1950s, has changed the lower Niobrara River from a "relatively deep, stable channel with large, bank-attached braid bars to a relatively shallow aggrading channel with braid bars" (Skelly et al. 2003). It is not known to what degree channel aggradation has affected habitats for Pallid Sturgeon.

Pallid Sturgeon habitat in the lower Niobrara River also may be affected by water withdrawals. The Nebraska Department of Natural Resources declared a portion of the lower Niobrara River as fully appropriated (Nebraska 2007), but the Nebraska Supreme Court reversed the fully appropriated designation in 2011 (Nebraska in litt., 2011). Although habitat suitability has changed substantially over the last five decades, the Niobrara River still retains braided channels with shifting sand bars representative of pre-channelization conditions of rivers throughout the Pallid Sturgeon's historical range (Peters and Parham 2008). Recently, three hatchery-reared Pallid Sturgeon originally released in the Missouri River were documented in the Niobrara River downstream of Spencer Dam (located at approximately Rkm 63 (Rmi 39) (Figure 3)); two were approximately 1.6-1.9 Rkm (1.0-1.2 Rmi) upstream of the confluence with the Missouri River while the other was approximately 9.6 Rkm (6 Rmi) upstream of the confluence (Wanner et al. 2010). Additional data are necessary to determine what role this tributary serves for the recovery of Pallid Sturgeon.

James River

The James River (Figure 4) is a north to south flowing prairie river that joins the Missouri River near Yankton, South Dakota. While historical data documenting occupation by Pallid Sturgeon are absent, a telemetry tagged adult pallid sturgeon moved 5.3 Rkm (3.3 Rmi) up the James River during its upstream spawning migration in 2011. It was subsequently recaptured downstream after spawning, though it is uncertain whether it spawned in the James River or in the Missouri River downstream of the confluence (DeLonay in litt., 2013). Additional data are necessary to determine what role this tributary serves for the recovery of Pallid Sturgeon.

Big Sioux River

The Big Sioux River (Figure 4) is a north to south flowing prairie river that originates in South Dakota and drains into the Missouri River downstream of Gavins Point Dam, the lowermost dam on the Missouri River. Historical observations of Pallid Sturgeon in this system are absent.

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However, there is one contemporary report of an angler caught Pallid Sturgeon approximately 112 Rkm (70 Rmi) upstream of the confluence with the Missouri River (Stukel in litt., 2009) as well as documentation of one tagged Pallid Sturgeon that moved upstream 21.1 Rkm (13.1 Rmi) into this river from the Missouri River (DeLonay et al. 2009). Additional data are necessary to determine what role this tributary serves for the recovery of Pallid Sturgeon.

Platte River

The Platte River (Figure 4) is a Missouri River tributary downstream of Gavins Point Dam. With increased sampling efforts, a corresponding increase in the numbers of both hatchery-reared and presumed-wild Pallid Sturgeon have been observed in the lower Platte River (i.e., the Loup River Power Canal outlet near Columbus, Nebraska downstream to the confluence with the Missouri River) since the species was listed. Pallid Sturgeon have been well documented within the lower-most reaches of this river (i.e., up to the Elkhorn River confluence) (Snook et al. 2002; Swingle 2003; National Research Council 2005; Peters and Parham 2008). More recently there have been increased observations of Pallid Sturgeon upstream of the confluence of the Platte and Elkhorn rivers; effectively extending the contemporary range up to near Columbus, Nebraska (Hamel in litt, 2010; Hamel and Pegg 2013). Additionally, Pallid Sturgeon have been documented in the Platte River during the spring, summer and fall periods (Hamel in litt., 2009; Hamel and Pegg 2013). Finally, limited data indicate that the lower Platte River is likely used for spawning (Swigle 2003; Chojnacki in litt., 2012). These data indicate the lower Platte River provides suitable habitat, supports multiple life stages of the species, and should be viewed as important for species recovery.

Although not developed as a navigation corridor, the Platte River has been influenced by anthropogenic alterations that likely affect Pallid Sturgeon habitat. Water demands for industrial, municipal, and agricultural purposes led to construction of low-head diversion dams on the upper Platte River as well as large impoundments on the Platte River and its tributaries. Eschner et al. (1983) state that the Platte River and its tributaries "…have undergone major changes in hydrologic regime and morphology since 1860." These authors describe a process where islands eventually attached to the floodplain, became vegetated, and eventually fixed in place resulting in decreased channel widths. These authors attribute many of these changes in channel morphology to water development and diversions. Similarly, Rodekohr and Englebrecht (1988) noted the Platte River is more constricted than it was in 1949. Despite some of these changes, there appears to be sufficient beneficial qualities within the lower Platte River, such that Pallid Sturgeon occupy and utilize this reach (Swigle 2003; National Research Council 2005: Peters and Parham 2008; Hamel and Pegg 2013). However, the availability and quality of habitat within the lower Platte River can be affected by water withdrawal in conjunction with periods of drought (National Research Council 2005). Sampling within the Missouri River near the confluence of the Platte River also results in substantially more Pallid Sturgeon captures when compared against other Missouri River sampling sites downstream to the Kansas River confluence (Steffensen and Hamel 2007, 2008). This suggests that the Platte River not only provides suitable habitat, but it also provides some positive benefits to Pallid Sturgeon habitat in the Missouri River.

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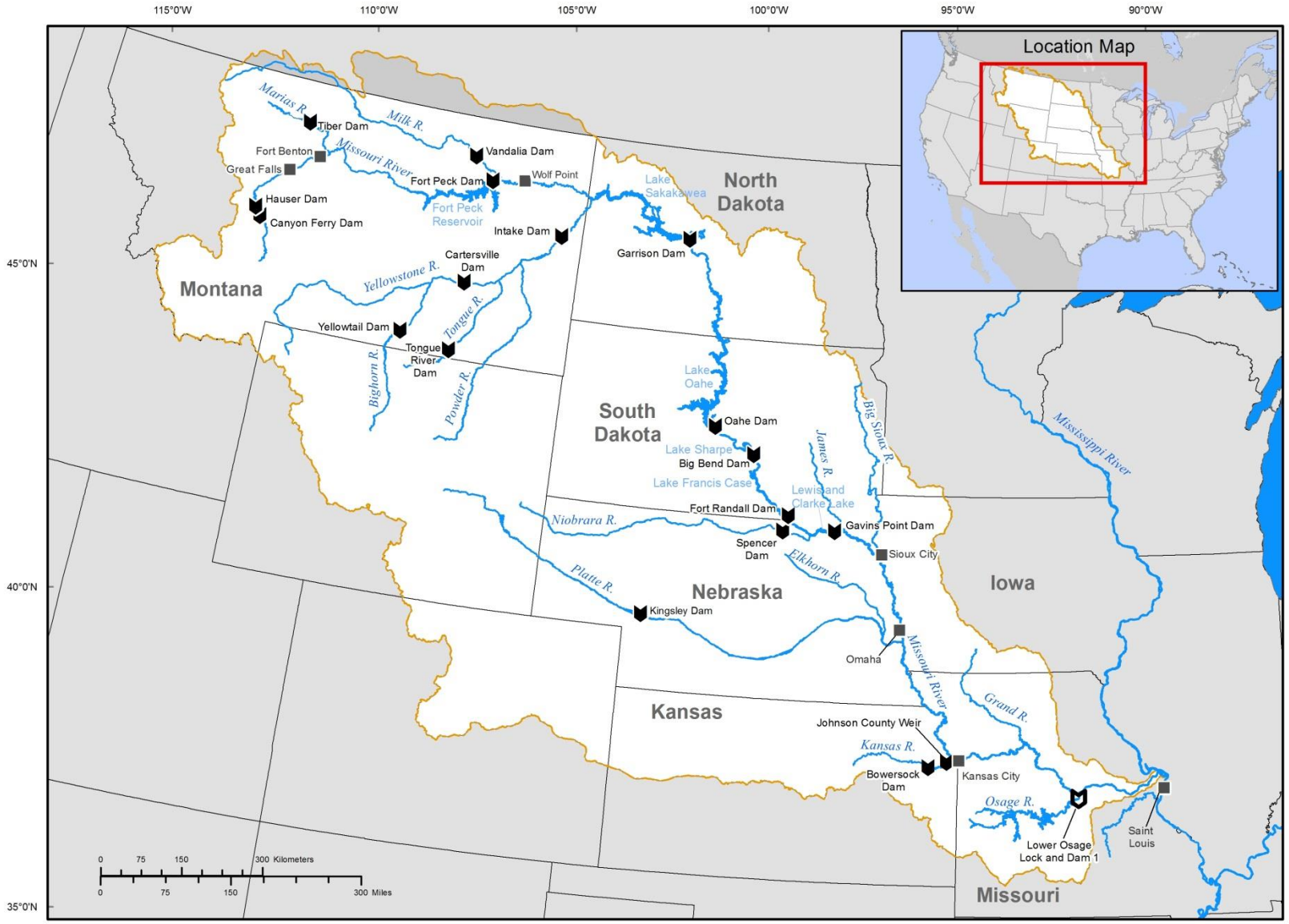

Figure 4 Map of prominent structures within the Missouri River Basin.

Elkhorn River
The Elkorn River is a north-west to south-east flowing tributary to the lower Platte River (Figure 4). When Pallid Sturgeon were listed, this river served merely as a reference point demarking its confluence with the Platte River as the upstream extent of Pallid Sturgeon in the Platte River. However, this river possesses many characteristics of streams currently used by Pallid Sturgeon and there are documented occurrences of Pallid Sturgeon in the Elkhorn River. Nebraska Game and Parks Commission records report angler catches of two Pallid Sturgeon; one each in 1999 and 2002 (National Research Council 2005). The 2002 record is reported to have occurred three miles upstream of Snyder, Nebraska, effectively extending the contemporary range of Pallid Sturgeon in this river (Figure 3). Additional data are necessary to determine what role this tributary serves for the recovery of Pallid Sturgeon.

Kansas River
The Kansas River (Figure 4) has anthropogenic alterations that likely affect some aspects of Pallid Sturgeon life history. Bowersock Dam (Rkm 82, Rmi 51) near Lawrence, Kansas was constructed in the 1870s (Figure 4). In 1952 six juvenile specimens (294-415 mm, 11.6-16.3 in) were collected below this dam during a period of record flooding (Bailey and Cross 1954). Because this barrier was installed prior to Pallid Sturgeon being identified as a species, there is little historical occupancy data for reaches upstream. The Johnson County Weir is another potential barrier to Pallid Sturgeon movement in the lower Kansas River (Rkm 23.7, Rmi 14.7). This structure was built in 1967 to maintain sufficient water delivery for municipal purposes. To date, 15 Pallid Sturgeon, most confirmed to be of hatchery origin (Niswonger, in litt., 2011), have been collected from the lower Kansas River. All known hatchery fish were originally stocked in the Missouri River.

Osage River
The Osage River is one of the larger Missouri River tributaries in Missouri (Figure 4). Pallid Sturgeon have been documented near the confluence of the Osage and Missouri rivers, including three hatchery-reared Pallid Sturgeon in the lower Osage River between Lock and Dam #1 (Rkm 19.4; Rmi 12.1) and the confluence with the Missouri River in 2010 (USFWS 2010, 2012).

Grand River
The Grand River (Figure 4) is a turbid tributary that was highly channelized during the same period that Pallid Sturgeon were likely declining. However, this system continues to support a predominantly native fish assemblage with species such as Lake Sturgeon occasionally being captured. While historical data documenting occupation by Pallid Sturgeon are absent, hatchery-reared Pallid Sturgeon have been captured in the lower 3 Rkm (1.8 Rmi) (Chillicothe News in litt., 2009; DeLonay et al. 2009).

MISSISSIPPI RIVER
The Mississippi River (Figure 5) is often divided into upper, middle and lower reaches. Like the Missouri River, the Mississippi River has been anthropogenically altered, beginning in the early portions of the 18th century as the French began to settle along the Mississippi River (Cowdrey 1977). These early efforts were generally localized and limited in scope. It was not until the 19th century that large-scale efforts to improve navigation and flood control began to have more substantial impacts. Snagging (removing dead trees from the river) was one of the first efforts to

facilitate using the river as a transportation corridor. In the early 1800s and funded with Federal appropriations, snag boats removed large woody debris from the middle and lower Mississippi River between St. Louis, Missouri and New Orleans, Louisiana (Simons et al. 1974; Cowdrey 1977).

The next major efforts to improve navigation involved maintaining navigable channels. In the mid-1800s, construction of jetties and dredging provided the first successful large-scale reduction of sediment deposition and the subsequent forming of sandbars that blocked shipping routes (Cowdrey 1977). Flood control became an increasingly important focus of the United States Congress as more people settled in the Mississippi River valley and the human costs of flood damage increased. Small and localized levee systems were in existence in the 1700s; however, it was not until the 19th and 20th centuries that levee networks increased in size and scope. As the levee system was completed, flood stages increased resulting in the need to shunt flood waters from the river (Cowdrey 1977). Following the flood of 1927, the Flood Control Act of 1928 included provisions for strengthening and raising existing levees and included floodways and spillways (Cowdrey 1977); examples of the latter being the Birds Point-New Madrid floodway, the Old River Control Complex, the Morganza floodway, and the Bonnet Carré spillway (Figure 5).

In addition to the dams on the upper Missouri River, flows into the middle and lower Mississippi River also are influenced by a series of locks and dams in the upper Mississippi and Ohio rivers. The earliest lock and dam structures were constructed in 1867 near Keokuk, Iowa. By 1940, the locks and dams from Minneapolis, Minnesota down to Alton, Illinois, were in place and operational. Finally, revetments and various structures have been used to reduce erosion and restrict flows in many areas. Willow mattresses and cypress pilings, later replaced by articulated concrete mats and rock riprap, were used to prevent loss of riparian land and control flow patterns (Cowdrey 1977). This reduction in river bank erosion has reduced the amount of sediments and large woody debris entering the system. Subsequent loss of connectivity and channel sinuosity occurred as habitats were channelized and off-channel habitats became isolated from normal riverine flow. Modifications to the Mississippi River occurred largely from construction of the locks and dams, levees, tributary alterations, channel cut-offs, and channel maintenance structures.

Upper Mississippi River

The upper Mississippi River, as it relates to Pallid Sturgeon, is defined as being upstream of the confluence of the Missouri and Mississippi rivers to Lock and Dam 19 near Keokuk, Iowa (Figure 5). This reach is approximately 260 Rkm (162 Rmi) in length. The lower most lock and dam (Lock and Dam 26 near Alton, Illinois) is located approximately 8 Rkm (5 Rmi) upstream of the Missouri-Mississippi river confluence (Figure 5). Although fish passage through the six lock and dam structures is impeded for many species, it can occur through the lock chamber or the dam gates during flood events. A single historical Pallid Sturgeon observation in the upper Mississippi River near Keokuk, Iowa (Coker 1929) was considered as "dubious" and likely to represent "stragglers" (Bailey and Cross 1954). Recent sampling, however, has documented the movement of several Pallid Sturgeon through the lowermost locks and dams from the middle Mississippi River into the pools of the upper Mississippi River (Herzog in litt., 2009; Herzog

2010). The extent of use within this impounded reach of the upper Mississippi River is poorly understood and further research is needed to assess its role in species recovery.

Middle Mississippi River

The middle Mississippi River is defined as the Missouri-Mississippi river confluence near St. Louis, Missouri to the Mississippi-Ohio river confluence near Cairo, Illinois (Figure 5). This reach is approximately 313 Rkm (195 Rmi) in length.

In 1881, Congress approved plans to regulate the middle Mississippi River, and by 1973 this reach of the Mississippi River had experienced levee construction, more than 160 km (100 mi) of revetments, and installation of more than 800 dikes to maintain a minimum navigation channel depth of 2.7 meters (9 feet) (Simons et al. 1974). Lock and Dam 27, (Chain of Rocks dam and canal) is located at Rkm 298.5 (Rmi 185.5) near Granite City, Illinois. The canal structure was completed to facilitate navigation around the shallow bedrock that occurred in this reach. Large quantities of rock were dumped over the existing bedrock to create a low-head dam necessary to make the lock canal navigable. Although no Pallid Sturgeon have been documented in the canal, both Pallid and Shovelnose sturgeon concentrate below the Chain of Rocks dam during fall and winter low-flow events (Killgore et al. 2007a).

The cumulative effects of these alterations include an average reduction in river width, river bed degradation, a slight increase in the maximum river stage, a reduction in minimum river stage, and a constricted flood plain (Simons et al. 1974).

Lower Mississippi River

The lower Mississippi River (LMR) is defined as the Mississippi River from the Mississippi-Ohio rivers confluence to the Gulf of Mexico (Figure 5). This reach of the contemporary river is approximately 1,541 Rkm (958 Rmi) in length.

Between 1929 and 1942, bendway cutoffs shortened the LMR by 245 Rkm (152 Rmi) over a 809 km (503 mi) reach (Winkley 1977). The LMR was reduced an additional 88.5 Rkm (55 Rmi) between 1939 and 1955 by constructing artificial channels that bypassed natural river meanders (Winkley 1977). This channel length reduction resulted in the river entrenching in steeper gradient reaches and eroding large amounts of material from the channel banks and bed. Deposition of this material in the lower gradient reaches resulted in a semi-braided channel, and by the 1970s, the river began to reestablish a meandering condition (Winkley 1977). Dikes and bank armoring have been employed in the LMR to stabilize the channel and direct flows to reduce the need for dredging.

Levee construction began in the New Orleans area in the 1700s. Today, excluding a few tributary mouths, levees line the west side of the river and fill in low areas between natural bluffs on the east side (Cowdrey 1977; Baker et al. 1991). These levees are estimated to have reduced the floodplain area by as much as 90% depending on flood magnitude (Baker et al. 1991). Although the LMR channel has been enclosed by levees, numerous and extensive sandbars, vegetated and seasonal islands, and secondary channels remain, equating to a 1.6 million acre floodplain that retains floodplain backwaters and sloughs that are seasonally connected to the river (Schramm et al. 1999). Despite extensive alteration, the lower Mississippi River retains

significant amounts of in-channel complexity and floodplain connectivity thought to be important to Pallid Sturgeon.

MISSISSIPPI RIVER TRIBUTARIES

As previously stated, data post-listing indicate that main-stem tributaries and tributary confluences may be used more frequently than previously recognized. Several captures of Pallid Sturgeon have occurred within tributaries, near the mouth of tributaries, and within close proximity to tributary confluences with the Mississippi River. These habitats may be important to the Pallid Sturgeon during certain times of the year or perhaps during certain life stages.

Meramec River

This tributary to the middle Mississippi River, located near Rkm 254 (Rmi 158) (Figure 5), is a large river within Missouri that contains transitional habitats within its lower reaches. There are no historical accounts of Pallid Sturgeon in this river; however, Pallid Sturgeon have been documented in the Mississippi River near the Meramec River confluence (Koch et al. 2006a). It is not known whether Pallid Sturgeon historically migrated within this system, and additional data are necessary to determine what role this tributary serves for the recovery of Pallid Sturgeon.

Kaskaskia River

The Kaskaskia River is located near Rkm 188 (Rmi 117) near Chester, Illinois (Figure 5). This is Illinois' second largest river system at 515 Rkm (320 Rmi) long draining about 10% of the State. Several Pallid Sturgeon have been documented at the confluence with the Mississippi River (Koch et al. 2006a). While movement into the Kaskaskia River by Pallid Sturgeon has not been documented, movement into this river may be impeded by a lock and dam near the mouth. In addition, the watershed of the Kaskaskia River has been modified over the last 100 years by urbanization, channelization, and levee and dam construction. It is unknown whether Pallid Sturgeon historically migrated within this system, and additional data are needed to determine if this tributary serves any role for the recovery of Pallid Sturgeon.

Ohio River

The Ohio River (Figure 5) is the largest tributary to the Mississippi River system within the range of Pallid Sturgeon. While Pallid Sturgeon have been collected from the Mississippi River near the Ohio River confluence, there are no recent reports of Pallid Sturgeon and no confirmed records of presence in this system. It is possible Pallid Sturgeon could occur in this river up to the Olmstead Lock and Dam (Figure 5), but additional data are needed to determine if this tributary serves any role for the recovery of Pallid Sturgeon.

Obion River

A single Pallid Sturgeon has been documented in the Obion River (Figure 5). This fish was originally tagged in the Mississippi River near Osceola, Arkansas and was subsequently recaptured in the Obion River near Bogota, Tennessee (Killgore et al. 2007b). It is unknown whether Pallid Sturgeon historically migrated within this system and additional data are needed to determine if this tributary serves any role for the recovery of Pallid Sturgeon.

Saint Francis River
The Saint Francis River (Figure 5) flows through south-east Missouri into Arkansas where it confluences with the Mississippi River. In 1994 hatchery-reared Pallid Sturgeon were documented in the lower Saint Francis River (Graham in litt., 1994) downstream from the W. G. Huxtable Pumping Plant (Figure 5). Subsequently, a tagged female Pallid Sturgeon was found to have entered the Saint Francis River in 2013. This fish remained in the river April 14-17. (Lewis in litt., 2013). Additional data are necessary to better understand use of this river by Pallid Sturgeon and what role this river serves in Pallid Sturgeon recovery efforts.

Arkansas River
The Arkansas River (Figure 5) confluences with the Mississippi River near Rkm 933 (Rmi 580). Pallid Sturgeon currently can access the lower 64 Rkm (40 Rmi) from the confluence with the Mississippi River upstream to the Wilbur D. Mills Dam. To date, three Pallid Sturgeon have been documented entering this lower reach during the late-winter through spring (February – April) (Kuntz in litt., 2012). Additional efforts are ongoing to better understand usage of this tributary by Pallid Sturgeon and what role this tributary serves for the recovery of Pallid Sturgeon.

Red River
The Red River (Figure 5) was a tributary to the Mississippi River during the 19th and early 20th centuries. However, anthropogenic alterations in the 1960s connected the Red River with the Atchafalaya River when the Old River Control Complex was completed. While historical Pallid Sturgeon presence data are lacking, contemporary observations have documented a limited number of Pallid Sturgeon in the lower Red River; specifically the reaches downstream from Lock and Dam 3 (Slack et al. 2012). Additional data are necessary to better understand use of this river by Pallid Sturgeon and what role this river serves in Pallid Sturgeon recovery efforts.

Atchafalaya River
The Atchafalaya River (Figure 5) is a distributary of the lower Mississippi River that begins just south of Cochie, Louisiana and extends downstream to Morgan City, Louisiana (Rkm 180/Rmi 112), where it flows into the lower Atchafalaya River and ultimately to the Gulf of Mexico. At approximately Atchafalaya River Rkm 156 (Rmi 97), the Wax Lake Outlet was constructed in 1942, providing a shorter route for flood waters to leave the Atchafalaya River. Prior to 1859, the Atchafalaya River received Mississippi River water from overbank flooding. Snagging and channel excavation to support of navigation during the late 19th and early 20th centuries resulted in channel enlargement and increased flows into the Atchafalaya River from the Mississippi and Red rivers. By the 1950s the Atchafalaya River threatened to capture most of the lower Mississippi River flow and in 1963 the U.S. Army Corps of Engineers constructed the Old River Control Complex to prevent this capture by regulating flows into the Atchafalaya River.

The Old River Control Complex (i.e., Low Sill, Overbank, and Auxiliary) at approximately Mississippi Rkm 505 (RM 314) can carry a combined maximum discharge of 700,000 cfs. With the completion of the Sidney A. Murray, Jr. Hydroelectric Station in 1990, just upstream of the Old River Control Complex, the flows are now split between the hydroelectric station and the Old River Control Complex structures with flows released to maximize hydro-power production.

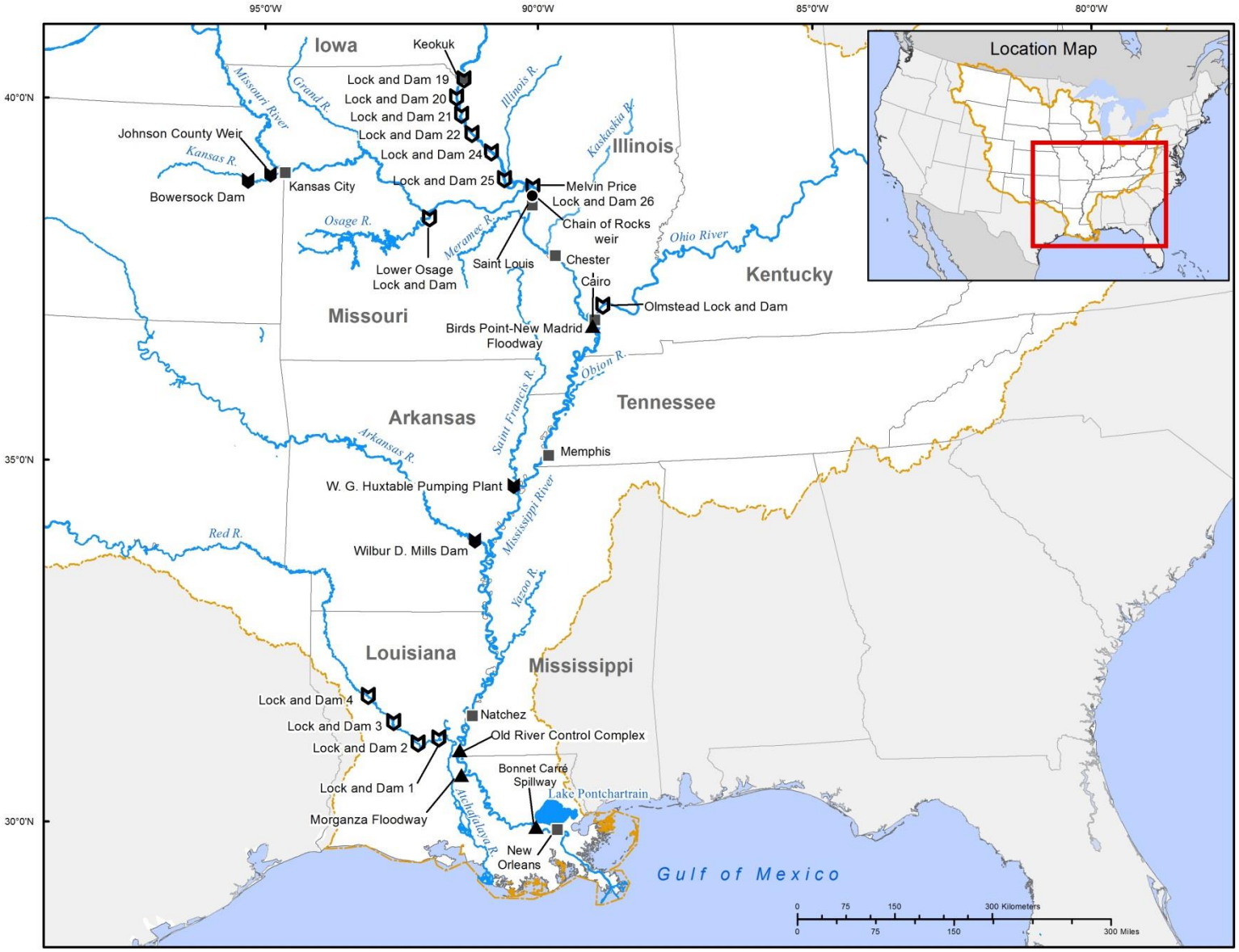

Figure 5 Map of prominent structures in the Mississippi River Basin.

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The Old River Control Complex, in coordination with the hydro-power plant, carries 30% of the combined discharge from the Mississippi and Red rivers, maintaining Mississippi River discharge into the Atchafalaya River at levels comparable to the 1950s. The Atchafalaya River has been leveed to prevent flooding of communities and agricultural lands from Rkm/Rmi 0 to Rkm 85 (Rmi 53). Downstream of Rkm 85, the river levees only contain flows less than the average annual discharge; all greater discharges flow overbank. Most Pallid Sturgeon reported from this river have been captured immediately below the Old River Control structures where almost all sampling occurs (Reed and Ewing 1993). However, Pallid Sturgeon use of the middle and lower Atchafalaya River has been documented (Constant et al. 1997; Schramm and Dunn 2007, Herrala and Schramm 2011).

There is no evidence that Pallid Sturgeon occupied the Atchafalaya River distributary prior to the mid-20th century capture of Mississippi River flows. To date, hatchery fish released in the Mississippi River below Natchez, Mississippi (2 specimens), and above Memphis, Tennessee (1 specimen) have been captured in the Atchafalaya River; confirming that Pallid Sturgeon can be entrained from the Mississippi River into the Atchafalaya River. It is possible that many of the Pallid Sturgeon observations in the Atchafalaya River are the result of entrainment from the Mississippi River; the magnitude of which has not been quantified.

Summary of Impacts from River Channelization, Bank Stabilization, Impoundment, and Altered Flow Regimes

The species was essentially extirpated from approximately 28% of the historical range due to impoundment, and the remaining unimpounded range has been modified by channelization and bank stabilization, or is affected by upstream impoundments that alter flow regimes, turbidity, and water temperatures (Hesse et al. 1989; Keenlyne 1989; USFWS 2000a). River channelization, bank stabilization, impoundment, altered flow regimes, and their effects are documented throughout the range of the Pallid Sturgeon and each can negatively affect Pallid Sturgeon life history requirements. The most obvious effects to habitat are associated with the six main-stem Missouri River dams. These dams and their operations have: 1) truncated drift distance of larval Pallid Sturgeon (Kynard et al. 2007; Braaten et al. 2008), 2) created physical barriers that block normal migration patterns, 3) degraded and altered physical habitat characteristics, 4) greatly altered the natural hydrograph (Hesse et al. 1989), and 5) produced subtle changes in river function that influence both the size and diversity of aquatic habitats, connectivity (Bowen et al. 2003), and benthos abundance and distribution (Morris et al. 1968). Moreover, these large impoundments have replaced large segments of riverine habitat with lake conditions. River channelization, and bank stabilization within the Missouri River basin has altered river features such as channel morphology, current velocity, seasonal flows, turbidity, temperature, nutrient supply, and paths within the food chain (Russell 1986; Unkenholz 1986; Hesse 1987). In addition to the main-stem Missouri River dams, important tributaries like the Yellowstone, Platte, and Kansas rivers have experienced similar affects due to dams and water resource development, as well as bank stabilization efforts within their respective watersheds. Other issues that have influenced habitat formation and maintenance are associated with maintaining navigation channels on portions of the Missouri River and efforts to control flooding. The Mississippi River has received a substantial amount of anthropogenic modification through time, and some changes resulting from those modifications have likely

been detrimental to Pallid Sturgeon. These anthropogenic habitat alterations likely adversely affect Pallid Sturgeon by altering the natural form and functions of the Mississippi River (Simons et al. 1974; Baker et al. 1991; Theiling 1999; Wlosinski 1999). Anthropogenic alterations to tributaries may have contributed to habitat degradation in the Mississippi River as well. Impoundment of major tributaries reduced sediment delivery to the main channel (Fremling et al. 1989) resulting in channel degradation and reduction in shallow water habitats (Simons et al. 1974; Bowen et al. 2003). Thus, the effects from dams, bank stabilization, and channelization activities, individually and cumulatively when implemented within the range of Pallid Sturgeon, should be considered threats to the species.

WATER QUALITY

Much of the available information regarding the likely effects to Pallid Sturgeon from contaminants comes from information obtained for Shovelnose Sturgeon, which can be used as a surrogate species to evaluate environmental contaminant exposure. Shovelnose Sturgeon are considered a suitable surrogate species for Pallid Sturgeon in that they live for 20 years or longer, inhabit the same river basins, spawn at similar intervals and locations, and accumulate similar inorganic and organic contaminants (Ruelle and Keenlyne 1994; Buckler 2011). However, while inferences can be drawn from data related to Shovelnose Sturgeon, limitations of using this species as a surrogate for Pallid Sturgeon are based on life history differences between the two species. Pallid Sturgeon have a longer life-span, attain a larger size, are more piscivorous, and contain a higher percentage of body fat (Ruelle and Keenlyne 1994). These differences may contribute to different contaminant effects or pathways; Pallid Sturgeon may be at greater risk than Shovelnose Sturgeon to contaminants that bioaccumulate and cause reproductive impairment because they have a more piscivorous diet, greater maximum life-span, and a longer reproductive cycle than Shovelnose Sturgeon.

Contaminants /Pollution: Contaminants detected in Shovelnose Sturgeon throughout the Missouri, Mississippi, Platte, and Atchafalaya rivers include: organochlorines, metals, aliphatic hydrocarbons, polycyclic aromatic hydrocarbons, polychlorinated biphenyls (PCBs), and elemental contaminants (Allen and Wilson 1991; Welsh 1992; Welsh and Olson 1992; Ruelle and Henry 1994; Palawski and Olsen 1996; Conzelmann et al.1997; Coffey et al. 2003; Schwarz et al. 2006).

A few field studies have included Shovelnose Sturgeon health assessments in an effort to evaluate environmental contaminant exposure and effects to Pallid Sturgeon (Coffey et al. 2003; Schwarz et al. 2006). Organochlorine pesticides and PCBs were detected at concentrations of concern in Mississippi River Shovelnose Sturgeon tissue samples. Adverse health problems observed included abnormal reproductive biomarkers and enlarged livers (Coffey et al. 2003). A similar evaluation in the lower Platte River identified PCBs, selenium, and atrazine as contaminants that may adversely affect sturgeon reproduction (Schwarz et al. 2006).

Shovelnose Sturgeon collected from the Platte, lower Missouri and Mississippi rivers have exhibited intersexual characteristics (having both male and female gonad tissue) (Harshbarger et al. 2000; Wildhaber et al. 2005; Koch et al. 2006b; Schwarz et al. 2006). Intersexual Shovelnose Sturgeon from the middle Mississippi River were found to have higher concentrations of

organochlorine compounds when compared to normal male Shovelnose Sturgeon (Koch et al. 2006b). One Pallid Sturgeon exhibited both male and female reproductive organs (DeLonay et al. 2009). Although the effects of intersex on sturgeon reproduction are unknown, intersex in other fish species has been linked to decreased gamete production, lowered sperm motility, and decreased egg fertilization (Jobling et al. 2002). Koch et al. (2006b) observed reduced numbers of spermatozoa in highly contaminated and intersexual Shovelnose Sturgeon that may suggest limited reproductive success.

Laboratory studies also have evaluated environmental contaminant exposure and effects to Shovelnose Sturgeon. Papoulias et al. (2003) injected unhatched Shovelnose Sturgeon larvae with PCB 126 and Tetrachlorodibenzo-p-dioxin. They found yolk sac and pericardial swelling, hemorrhaging of the eyes and head, shortened maxillaries, and delayed development. While the experimental exposure concentrations of PCB 126 was at levels beyond what might be found in the wild, the negative effects from Tetrachlorodibenzo-p-dioxin exposure concentrations were at levels that are conceivable in the Mississippi River (Papoulias et al. 2003)

To date, few studies have measured environmental contaminant concentrations in Pallid Sturgeon. Tissue samples from three Missouri River Pallid Sturgeon and 13 other Pallid Sturgeon, mostly collected from the Mississippi River had metals (e.g., mercury, cadmium, and selenium), PCBs, and organochlorine pesticides (e.g., chlordane, dichloro-diphenyl-trichloroethane, and dieldrin) at concentrations of concern (Ruelle and Keenlyne 1993; Ruelle and Henry 1994). In addition to the previously mentioned reports on contaminants in Pallid Sturgeon, raw contaminants data for Pallid Sturgeon from North Dakota, Illinois, and Louisiana are currently being compiled.

Point-source discharges may adversely affect Pallid Sturgeon and their habitat. Wastewater treatment plant effluent can contain hormonally active agents. Endocrine disruption in fish exposed to estrogenic substances discharged by wastewater treatment plants is well documented (Purdom et al. 1994; Routledge et al. 1998; Cheek et al. 2001; Schultz et al. 2003). In addition to wastewater treatment plants, drinking water treatment plants also are a concern. In April 2004, several radio-tagged Pallid Sturgeon were repelled from the mouth of the Platte River immediately following a milky discharge from a drinking water treatment facility upstream (Parham et al. 2005). Further investigation found that the facility was not in compliance with its discharge permit which expired in 1993, and that the discharge likely contained several toxic irritants including ferric sulfate, calcium oxide, hydrofluosilicic acid, chlorine, and ammonia.

Several fish consumption advisories within the range of Pallid Sturgeon are attributable to contaminants (Buckler 2011). The State of Tennessee closed commercial fishing on portions of the Mississippi River because of concerns over chlordane and other contaminants (Tennessee 2008 a and b). The Missouri Department of Health and Senior Services has issued a “do not eat” advisory for Shovelnose Sturgeon eggs and recommends consuming no more than one Shovelnose Sturgeon per month because of concerns over PCB, mercury, and chlordane levels (Missouri 2010). Illinois issued a sturgeon consumption advisory due to PCBs and chlordane levels on the Mississippi River between Lock and Dam 22 to Cairo, Illinois (Illinois 2010). The Kansas Department of Health and Environment (2010) has issued a consumption advisory for bottom-feeding fish, including sturgeon, due to PCB levels in the Kansas River downstream of

Bowersock Dam to Eudora. Fish consumption advisories have been issued for the Missouri River from Omaha to Rulo, Nebraska (Nebraska 2010). Although fish consumption advisories are for the protection of human health, river segments with such designations also have been associated with adverse health effects in the Shovelnose Sturgeon themselves, including enlarged livers, abnormal ratios of estrogen to testosterone, and intersexual characteristics (Coffey et al. 2003; Schwarz et al. 2006).

Because more information is needed to evaluate the exposure and effects of environmental contaminants to Pallid Sturgeon, a basin-wide contaminants review for Pallid Sturgeon was initiated in 2008. To date, this investigation has identified pesticides, metals, organochlorines, hormonally active agents, and nutrients as contaminants of concern throughout the species' range. Further assessments should be targeted in these areas to evaluate the exposure and effects of the impairing contaminants on Pallid Sturgeon and their reproductive physiology.

Additionally, injuries resulting from chance encounters with discarded human-made objects like gaskets and rubber bands have been documented in the Mississippi River; approximately 5% of Shovelnose Sturgeon and 9% of Pallid Sturgeon exhibit scars or deformities from such injuries (Murphy et al. 2007b). Mortalities have not been reported or estimated.

Dissolved Oxygen: Little is known about Pallid Sturgeon tolerances of low dissolved oxygen concentrations and limits have not been quantified for all life stages. However, data from other sturgeon species are insightful. In general, sturgeon are not as tolerant of hypoxic conditions (very low dissolved oxygen levels) as are other fishes (Secor and Gunderson 1998; Niklitschek and Secor 2005). Temperature and dissolved oxygen levels can affect sturgeon survival, growth and respiration with early life stages being more sensitive than adults (Secor and Gunderson 1998).

Like many sturgeon species, Pallid Sturgeon are primarily benthic organisms within 10-12 days post hatch (Kallemeyn 1983; Kynard et al. 2007). This benthic life history strategy can result in sturgeon encountering hypoxic. Like most organisms that encounter unsuitable habitats, juvenile and adult sturgeon have some ability to avoid unfavorable environmental conditions via migration (Auer 1996). In reservoirs, White Sturgeon will avoid those areas where riverine features become more lake like (transition zone) and oxygen levels approach 6 mg/l (Sullivan et al. 2003). Under hypoxic conditions, juvenile Atlantic Sturgeon will move upward in the water column to access more oxygen-rich water (Secor and Gunderson 1998).

Anthropogenic changes within the range of Pallid Sturgeon that affect dissolved oxygen concentrations could be affecting survival and recruitment. Measurements on the lower Missouri River from 2006-2009 showed that large rises in the river during spring and summer may result in dissolved oxygen levels falling to < 2 mg/l and remaining below 5 mg/l for several days (Blevins 2011). Dissolved oxygen levels of 3 mg/l and water temperatures of 22-26 ^{o}C (71.6-78.8 ^{o}F) appeared lethal for juvenile Atlantic Sturgeon and Shortnose Sturgeon (Secor and Gunderson 1998; Campbell and Goodman 2004). Reduced growth was observed in Atlantic Sturgeon at lower non-lethal levels (Secor and Gunderson 1998). In the upper Missouri River basin, larval Pallid Sturgeon are likely transported into or through reservoir transition areas. Because they are weak swimmers at this early life stage (Kynard et al. 2007), they are less able

to migrate away from any encountered hypoxic conditions. Study efforts have been initiated to better evaluate the effects of riverine to reservoir transition areas on Pallid Sturgeon survival.

Temperature: The Pallid Sturgeon is ectothermic, that is its body temperature is dependent on water temperatures. As a result, water temperatures influence nearly every aspect of the Pallid Sturgeon's life history requirements. As described previously, water temperatures affect rates of sexual maturity, spawning migrations, gonad development, rates of embryonic development, larval drift distances, and habitat quality (Keenlyne 1995; Kynard et al. 2002; U.S. Geological Survey 2007; Braaten et al. 2008; DeLonay et al. 2009; Webb in litt., 2011).

Anthropogenic changes within the range of Pallid Sturgeon that have substantially affected historical water temperatures are bottom release dams. The water in deep reservoirs thermally stratifies resulting in a colder and denser water layer at depth. When this cold water is released, it substantially cools the riverine environments downstream. As an example, average and maximum water temperatures immediately downstream of Fort Peck Dam can be reduced by as much as 6° C (10.8° F) and 10.4° C (18°F), respectively (Fuller and Braaten 2012). While the magnitude of these effects decrease with increased distance from the dam, these cooling effects still influence 290 Rkm (180 Rmi) of the Missouri River downstream. Even at this distance, the average and maximum temperatures are still 1° C (1.8° F) cooler than Missouri River reaches above Fort Peck Reservoir (Fuller and Braaten 2012).

Thus, the altered temperature profiles of riverine habitats downstream from large bottom-release dams influence nearly every aspect of the life-history requirements and habitats of Pallid Sturgeon. While the magnitude of effects from altered temperature profiles vary by dam, they may be the most problematic in the inter-reservoir reservoir reaches of the impounded Missouri River.

Summary of Impacts related to Water Quality

Overall water quality can have both immediate and long-term effects on the species. New information, post-listing suggests that water quality can impact Pallid Sturgeon during many life phases and localized and/or regionally poor or degraded water quality should be viewed as a threat to the species. However, additional data are needed to quantify and qualify the magnitude of these threats in some river reaches.

ENTRAINMENT

Another issue that can cumulatively have negative consequences for Pallid Sturgeon range-wide is entrainment loss. The loss of Pallid Sturgeon associated with cooling intake structures for power facilities, towboat propellers, dredge operations, irrigation diversions, and flood control points of diversion has not been fully quantified, but entrainment has been documented for both Pallid and Shovelnose sturgeon.

Adult Shovelnose Sturgeon (and likely adult Pallid Sturgeon) exhibit relatively high prolonged swimming speeds (Adams et al. 1997; Parsons et al. 2003) and would be at lower entrainment risk than young fish. Juvenile Pallid and Shovelnose sturgeon exhibit comparable swimming abilities (Adams et al. 2003). They are not strong swimmers relative to other species and are at

greater risk of entrainment (Adams et al. 1999a), but they also exhibit a variety of complex swimming behaviors which may increase their ability to resist flow (Hoover et al. 2005). *Scaphirhynchus* larvae are weak swimmers and experience high rates of mortality under simulated propeller entrainment and high rates of stranding under simulated vessel-induced drawdown (Adams et al. 1999b; Killgore et al. 2001).

Water Cooling Intake Structures: Preliminary data on the Missouri River indicate that these structures may be a threat that warrants more investigation. Initial results from work conducted by Mid-America at their Neal Smith power facilities located downstream of Sioux City, Iowa, found hatchery-reared Pallid Sturgeon were being entrained (Burns & McDonnell Engineering Company, Inc. 2007a and 2007b). Over a 5-month period, four known hatchery-reared Pallid Sturgeon were entrained, of which two were released alive and two were found dead.

Towboat propellers: Empirically derived propeller entrainment data for Pallid Sturgeon are lacking. However, available propeller entrainment data for Shovelnose Sturgeon collected in the Mississippi River upstream of Lock and Dam 26 (Figure 5), indicates it occurs and can be lethal (Killgore et al. 2011; Miranda and Killgore 2013) with mortality estimates being as high as 0.53 Shovelnose Sturgeon per 1 Rkm (0.6 Rmi) of towboat travel (Gutreuter et al. 2003). Because barge operation occurs in waters occupied by Pallid Sturgeon and propeller entrainment induced mortality has been documented for Shovelnose Sturgeon, it is reasonable to conclude that towboat propellers can entrain and harm Pallid Sturgeon. However, comparable studies have not been conducted in waters commonly occupied by Pallid Sturgeon, thus, the magnitude of this threat is difficult to assess and additional research is needed.

Dredge Operations: The U.S. Army Corps of Engineers has initiated work to assess dredge entrainment of fish species and the potential effects that these operations may have on larval and juvenile *Scaphirhynchus.* Available data collected in the middle Mississippi River near the Chain of Rocks weir (Figure 5) indicate that Shovelnose Sturgeon can be entrained and this entrainment is relatively lethal (Ecological Specialists, Inc. 2010). However, the risk of dredge entrainment is likely to vary by dredge design (i.e., mechanical or hydraulic) and swimming capabilities (Hoover et al. 2011). Dredging in locations where Pallid Sturgeon congregate could result in entrainment and mortality. Small Pallid Sturgeon likely are at risk of being entrained in dredges and additional data for escape speed, position-holding ability, orientation to the current and response to noise, and dredge flow fields are being used to develop a risk assessment model for entrainment of sturgeon by dredges (Hoover et al. 2005).

Irrigation Diversions: Entrainment of hatchery-reared Pallid Sturgeon has been documented in the irrigation canal associated with the Lower Yellowstone Irrigation Project's Intake Diversion Dam on the Yellowstone River (Figure 4) where some of these fish are believed to have perished (Jaeger et al. 2004).

Flood control points of diversions: Two hatchery-reared juvenile Pallid Sturgeon released in the Mississippi River and one adult hatchery-reared Pallid Sturgeon released in either the lower Missouri or middle Mississippi river were entrained by the Old River Control Complex as they were subsequently collected in the Atchafalaya River. During May and June 2008, 14 Pallid Sturgeon were collected behind the Bonnet Carré spillway (Reed in litt., 2008; USFWS 2009a).

Subsequently, in 2011, the Bonnet Carré spillway was opened again to alleviate flooding. Following closure, 20 Pallid Sturgeon were collected behind the spillway (U.S. Army Corps of Engineers 2012) indicating that entrainment occurs at this facility during the rare occasions when flood waters need to be shunted from the Mississippi River to Lake Pontchartrain. One interesting observation in 2011 was the collection of a tagged Pallid Sturgeon from behind the Bonnet Carré spillway that was previously collected behind the spillway and released into the Mississippi River in 2008 (U.S. Army Corps of Engineers 2012). Additionally, the Birds Point–New Madrid and the Morganza Floodways (Figure 5) were also opened in 2011. While subsequent sampling did not document Pallid Sturgeon within either floodway, 26 Shovelnose Sturgeon were reported as entrained in the Birds Point–New Madrid Floodway and no sturgeon were reported in the Morganza Floodway (U.S. Army Corps of Engineers 2012). Additional smaller structures exist or are planned for diverting water and sediments from the Mississippi River for marsh enhancement and hurricane protection in coastal Louisiana. Pallid Sturgeon entrainment potential and significance is unknown.

Summary of Impacts of Entrainment

Entrainment of juvenile and adult Pallid Sturgeon has been documented to occur in the few instances it has been studied. Thus, it is a greater threat than anticipated in the original version of this plan. The level of larval sturgeon entrainment is unknown. The overall effects from entrainment are variable and depend on population demographics, exposure time, quantity of un-screened diversion points, and duration of diversion point usage (i.e., year-round versus seasonal or sporadic operation). Further evaluation of entrainment associated with towboat propellers, dredging operations, water diversion points, and commercial navigation is necessary across the Pallid Sturgeon's range to adequately evaluate and quantify this threat.

CLIMATE CHANGE

Although not a threat specifically identified in the Pallid Sturgeon listing package (55 FR 36641-36647), our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change. "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (Intergovernmental Panel on Climate Change 2007). The term "climate change" refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (Intergovernmental Panel on Climate Change 2007). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of climate interactions with other variables (e.g., habitat fragmentation) (Intergovernmental Panel on Climate Change 2007). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change. Both the Intergovernmental Panel on Climate Change and U.S. Global Change Research Program identify that the trend in global climate patterns is one of warming; average temperatures in the United

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States are at least 1.1°C (2°F) higher than they were 50 years ago (Intergovernmental Panel on Climate Change 2007; U.S. Global Change Research Program 2009).

Within the range of Pallid Sturgeon, predicted affects appear to be shifts in runoff patterns: discharge peaks are anticipated to occur earlier and potentially be larger, late season river flows may be reduced, and water temperatures may rise (Intergovernmental Panel on Climate Change 2007). These changes to the water cycle are anticipated to affect water use (U.S. Global Change Research Program 2009), which may alter existing reservoir operations. Broadly, these potential effects to Pallid Sturgeon could be altered spawning behavior (i.e., movement and timing), reduced survival of early life stages and young-of-year, and reduced late-season habitat suitability due to reduced flows and presumably warmer temperatures. Another predicted outcome is increased or prolonged periods of drought (Intergovernmental Panel on Climate Change 2007; U.S. Global Change Research Program 2009). Increased water demand coupled with reduced late-season flows could significantly affect in-channel habitats which in turn may affect other species that are food items for Pallid Sturgeon.

These effects would likely occur first, or be most pronounced, in the more northern portion of the Pallid Sturgeon range; the Intergovernmental Panel on Climate Change (2007) study suggests that in general, temperature increases correlate with latitude. Thus, higher northern latitudes appear to have relatively higher predicted warming trends. However, reduced annual runoff predicted in the Missouri River basin may be offset by the anticipated increased runoff in the upper Mississippi River basin (U.S. Global Change Research Program 2009) resulting in minimal effects within the middle and lower Mississippi River basins.

Summary of Impacts of Climate Change

At this time, it is difficult to evaluate long-term effects from climate change as there have been many anthropogenic influences across the species' range. Assessing this potential threat and teasing out relationships associated with climate change will be difficult without careful consideration of other already confounding factors.

Factor A Summary

The present or threatened destruction, modification or curtailment of its habitat or range, remains a threat. However, the magnitude of this threat varies across the species' range, due in part to on-going efforts to mitigate anthropogenic effects and the proportion of perturbations relative to the volume of habitat available. For example, the effects from dams (i.e., altered hydrographs and temperature profiles, altered ecologic processes, habitat fragmentation, and conversion of riverine reaches to reservoir) may be the single greatest factor affecting the species in the upper Missouri River basin. While in the middle and lower Missouri River, as well as the middle Mississippi River, water quality, entrainment, and maintenance of the channel for navigation purposes and the associated impacts are significant threats. Additionally, the effects from other threats described below, may be more limiting to the species in these areas. The same applies to the lower Mississippi River. Currently main-stem riverine habitat is not fragmented by dams and many natural ecological processes can still create a diversity of physical habitats believed important for the species. However, data are limited related to overall water quality.

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization for commercial, recreational, scientific, or educational purposes is one of the threats to Pallid Sturgeon identified in the listing determination (55 FR 36641-36647). Given the endangered status of Pallid Sturgeon, use for scientific or educational purposes is regulated under section 6 cooperative agreements or under section 10 of the Act. All recreational and commercial harvest of Pallid Sturgeon is prohibited by Section 9 of the Endangered Species Act as well as State regulations throughout its range.

While these regulations effectively protect Pallid Sturgeon from recreational harvest and overutilization for scientific and educational purposes, they do not prevent lethal take of Pallid Sturgeon as a result of species misidentification associated with commercial Shovelnose Sturgeon fishing. To address this threat, beginning in 2010, Shovelnose Sturgeon are treated as threatened where the two sturgeon species coexist, under the similarity of appearance provisions of the Endangered Species Act (75 FR 53598-53606). This rule extends take prohibitions to Shovelnose Sturgeon, Shovelnose-Pallid Sturgeon hybrids, and their roe when associated with a commercial fishing activity in areas where Pallid Sturgeon and Shovelnose Sturgeon commonly coexist. Continued monitoring will provide data on the effectiveness of this regulation.

Factor B Summary

Current State regulations and protections afforded under the Endangered Species Act, including the similarity of appearance rule, coupled with adequate enforcement, appear sufficient to manage, to the maximum extent practicable, the threat from overutilization for commercial, recreational, scientific, or educational purposes. However, absent protections under the Endangered Species Act, adequate State harvest regulations and enforcement will be necessary to protect the species from overharvest.

Factor C: Disease or Predation

DISEASE

Fish pathogens have the potential to produce severe disease outbreaks, but they may also simply exist in a carrier state. Fish pathogens include viral, bacterial, and parasitic agents. In some instances, disease outbreaks can severely deplete local populations, but these extreme events have not yet been documented in wild Pallid Sturgeon populations. Some pathogens of notable importance for Pallid Sturgeon recovery include Viral Hemorrhagic Septicemia Virus and the Missouri River sturgeon iridovirus.

Viral Hemorrhagic Septicemia Virus is a fish disease that has caused large-scale mortalities in numerous species (Kim and Faisal 2010) and has been described as an “extremely serious pathogen of fresh and saltwater fish” (APHIS 2006). While it has not been documented to affect Pallid Sturgeon, it also has not been found within the range of the species. However, Viral Hemorrhagic Septicemia Virus has been documented in the Great Lakes (APHIS 2006). Various shipping canals have created a connection between the Great Lakes and the Mississippi River so it is possible that through time, this virus could reach areas occupied by Pallid Sturgeon.

Because this pathogen can cause large-scale mortalities in fish populations, and it has a wide range of potential carriers, we believe it is important to monitor for Viral Hemorrhagic Septicemia Virus within the range of Pallid Sturgeon.

Missouri River sturgeon iridovirus is a concern in the context of Pallid Sturgeon recovery because it causes mortality in hatchery-reared Pallid Sturgeon (Kurobe et al. 2011) and its effect on free-ranging sturgeon populations is unknown. The Missouri River sturgeon iridovirus was originally documented during artificial propagation efforts of Shovelnose Sturgeon at the Gavins Point National Fish Hatchery in 1999. However, this iridovirus also can infect Pallid Sturgeon (Kurobe et al. 2011). This disease is known to cause substantial mortality in hatchery-rearing environments (Kurobe et al. 2011). Study fish surviving initial viral outbreaks still harbor the virus even though they may appear healthy (Hedrick et al. 2009; Kurobe et al. 2011). While initially identified in a hatchery environment, additional testing has documented that this virus is found in the wild; of 179 *Scaphirhynchus* tested from the Atchafalaya River between November 2003 and May 2004, 8 (4%) were confirmed as positive for the virus and 5 (2.8%) were suspected of carrying the virus. Subsequent testing with more sensitive methods also confirmed the presence of the virus in the wild (Hedrick et al. 2009), suggesting that it may be endemic in the Missouri River. The effect of the virus on wild populations is not known.

PREDATION

Little information is available implicating piscivory as a threat affecting the Pallid Sturgeon. Predation on larval and juvenile fishes of all species occurs naturally. However, habitat modifications that increase water clarity and artificially high densities of both nonnative and native predatory fishes could result in increased rates of predation. Pallid Sturgeon larvae and fry passively drift post-hatch (Kynard et al. 2007; Braaten et al. 2008). This behavior exposes naturally-spawned Pallid Sturgeon to predation which was moderated historically by high fecundity and turbid waters. However, anthropogenic changes that affect habitats could result in increased vulnerability to predation. In the impounded areas of the upper Missouri River, larvae may be transported into the clear headwaters of reservoirs like Fort Peck and Lake Sakakawea. These reservoirs are or have been artificially supplemented with predatory species like Walleye (*Sander vitreus*).

Maintaining artificially elevated populations of certain species in these reservoirs has been hypothesized as a contributing factor in poor survival of larval and juvenile Pallid Sturgeon. Walleye and Sauger (*S. canadensis*) are capable of eating wild paddlefish up to 167 mm (6.6 inch (in.) body length, 305 mm (12 in.) total length) and, thus, likely could consume naturally-produced Pallid Sturgeon larvae, fry, and fingerlings (Parken and Scarnecchia 2002). When looking at data for sample locations closest to reservoir headwaters, it appears that no age-0 paddlefish were found in Walleye, but were present in Sauger, a native species closely related to walleye. Though Braaten and Fuller (2002, 2003) examined 759 stomachs from 7 piscivore (fish eating) fishes in Montana, they found no evidence of predation on sturgeon. Other studies have, however, documented *Scaphirhynchus* sturgeon as food items. Hogberg and Pegg (2013) found sturgeon in the stomachs of Flathead Catfish (*Pylodictis olivaris*) studied in the lower Missouri River. Predation vulnerability of Pallid Sturgeon (> 40 mm) by Channel Catfish (*Ictalurus punctatus*), Smallmouth Bass (*Micropterus dolomieu*), and Walleye appears to be low, provided other prey species are available (French 2010; French et al. 2010). More data

are needed to adequately assess predation effects on eggs, and larval Pallid Sturgeon in order to evaluate implications on recruitment success (see also Invasive Species/Aquatic Nuisance Species under Factor E Other Natural or Manmade Factors Affecting its Continued Existence).

Factor C Summary

When listed, neither disease nor predation were discussed as threats, primarily due to limited information. New data have highlighted both disease and predation as issues of potential concern and they should be considered as likely threats. At this writing, data are inadequate to quantify the magnitude of the threat either may pose.

Factor D: Inadequacy of Existing Regulatory Mechanisms

Regulatory mechanisms are required for Pallid Sturgeon recovery and to ensure long-term conservation of the species. These mechanisms affect many aspects of legal protection, such as habitat and flow protection, regulation and/or control of nonnative fishes, regulation of hazardous-materials spills, and harvest. In determining whether the inadequacy of existing regulatory mechanisms constitutes a threat to Pallid Sturgeon, our analysis focused on existing State and Federal laws and regulations that could potentially address the main threats to the species described under Factors A and B, and potential new threats described under Factor E.

State Regulations

Water Quality
All States whose waters are occupied by Pallid Sturgeon have enacted legislation intended to preserve water quality. Generally these State regulations (see Appendix A) parallel comparable Federal legislation; in some cases, State statutes may impose requirements that are more stringent than the Federal law. In all cases, Clean Water Act requirements must be adhered to and are enforced in conjunction with State statutes and regulations implemented by the State administrative agencies.

Water Quantity
Many States have enacted legislation and processes specifically to allocate water resources (see Appendix A). Generally, water use permits are obtained from the appropriate State or local administrative agencies. Most States have instream-flow laws intended to maintain "beneficial use" of water left in streams for wildlife. However, these laws typically only protect minimum flows believed necessary to maintain the fishery and, in some states, may afford little protection. For example, water development/usage in Montana is governed by western water law. Under this system, in-stream water rights held by Montana Fish Wildlife and Parks are newer (junior) to many water users with an older (senior) water right. As a result, during extreme drought situations, senior water right owners have priority rights to water, in other words, their rights will be met prior to those of Montana Fish Wildlife and Parks. Once senior rights are satisfied, the remainder can be left in the river and used for fish and wildlife. This could lead to a water depletion situation in areas occupied by Pallid Sturgeon. Additionally lacking in many states, are completion of adjudication processes and full inventories of all water allocations. Without these

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data it is difficult to determine if important rivers and tributaries for Pallid Sturgeon have been or could become over-allocated resulting in future adverse effects.

Harvest

In addition to Federal protection under the Endangered Species Act, Pallid Sturgeon are protected by State designations such as "endangered," "threatened," or "sensitive." These designations typically prohibit intentional take and harvest of any Pallid Sturgeon. Depending on local demographic conditions, these designations may need to remain in place within some States after the species is delisted. When delisted, States within the Pallid Sturgeon's range have the authority to continue State protections or to manage and establish commercial and recreational harvest limits for the species within their borders. Long-range migratory species are often considered 'interjurisdictional' and may be co-managed with neighbor States or through organizations like the Mississippi Interstate Cooperative Resources Association; an organization of 28 State agencies that formed a partnership to improve management of aquatic resources in the Mississippi River Basin. State regulations currently provide protections against take of Pallid Sturgeon associated with commercial, recreational, scientific, and educational purposes. For the most part, these regulations are adequate to protect Pallid Sturgeon from direct intentional taking. However incidental harvest of Pallid Sturgeon during commercial Shovelnose Sturgeon harvest has been documented in several States where Pallid and Shovelnose sturgeon are sympatric. This resulted in a Federal rule treating Shovelnose Sturgeon as threatened under the Endangered Species Act due to similarity of appearance to Pallid Sturgeon (75 FR 53598-53606). To be delisted, State regulatory mechanisms and/or designations will need to ensure continued long-term management and protection for the species.

Summary of State Regulations

While States have implemented many regulations to protect and conserve resources through a mechanism of project proposal review and permitting, these efforts likely are limited by a lack of biological and/or ecological data on Pallid Sturgeon and their ecological thresholds. For example, levels of contaminants that generate negative effects in Pallid Sturgeon have not been fully quantified, limiting the ability to establish protective State standards. Another limitation of State permitting processes is cumulative effects evaluations. Considering cumulative environmental effects in the permitting process requires an understanding of ecological thresholds, baseline conditions, and life history requirements for many species, as well as their response to multiple environmental stressors. Unfortunately, with respect to the Pallid Sturgeon, much of this remains unknown. Finally, when the species is delisted, State regulations will be necessary to manage and protect the species.

Federal Regulations

In addition to State regulations, activities that affect either Pallid Sturgeon or its habitat are regulated under Federal laws. Notable Federal regulations that address Pallid Sturgeon and their habitat are; the Clean Water Act, River and Harbors Act of 1899, Federal Power Act, National Environmental Policy Act, and the Fish and Wildlife Coordination Act .

The Clean Water Act (33 U.S.C. §§1251 et seq.) regulates pollutant discharges into the nation's waters. This is accomplished through defining, monitoring, and regulating water quality

standards for all surface waters, establishing industry wastewater standards, and protecting aquatic life and habitats through permitting. Pertinent regulations can be found at 40 C.F.R., CH 1, subchapter D-water programs (§§ 110, 112, 116, 117, 122-125, 129-133), 40 C.F.R., CH 1, subchapter N-effluent guidelines and standards (§§ 401-471), and 40 C.F.R., CH 1, subchapter O-Sewage sludge (§§ 501, and 503). The Clean Water Act affords substantial protections to the Pallid Sturgeon, its habitat, and life history requirements through establishing water quality standards and reducing the effects from the discharge of harmful pollutants, contaminants and discharge of dredge or fill material. However, residual effects from historical practices and a lack of species specific information on the sensitivity of the Pallid Sturgeon to common industrial and municipal pollutants may be limiting the full conservation potential of the Clean Water Act as it relates to pollutant discharge and water quality standards.

In addition to regulating pollutant discharges, the Clean Water Act also allows the U.S. Environmental Protection Agency to establish regulations for cooling water intake structures (§ 316b). Losses of Pallid Sturgeon through impingement or entrainment from these structures have been documented (see Factor A: Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range, above). Section 316(b) of the Clean Water Act requires the U.S. Environmental Protection Agency to provide reasonable assurances that aquatic organisms are protected from impingement or entrainment. In 2004, the agency issued regulations (69 FR 41575-41624) to minimize entrainment and impingement mortality associated with cooling water intakes at power production facilities. However, these regulations were suspended in 2007 (72 FR 37107-37109). In 2011, the public comment period was reopened for proposed Section 316(b) requirements for all existing power generating facilities and existing manufacturing and industrial facilities (76 FR 43230-43231). While data are limited or lacking, providing reach-specific information on Pallid Sturgeon population size, habitat use, and behavior would be necessary to expect reasonable assurances that the species is protected under subsequent 316(b) provisions of the Clean Water Act. For example, local effects to Pallid Sturgeon associated with entrainment loss may be proportional to species abundance and/or habitat use, as well as intake design and/or location. Additionally, at low population levels or in areas heavily used by the species, the threat from entrainment may be highest. Conversely, entrainment losses may have little or no impact when population levels are robust or in areas seldom frequented by the species.

The Rivers and Harbors Act (33 U.S.C. §§401,403,407 et seq.) prohibits the construction of any bridge, dam, dike or causeway over or in navigable waterways of the U.S. without Congressional approval. Structures authorized by State legislatures may be built if the affected navigable waters are totally within one State, provided that the plan is approved by the Chief of Engineers and the Secretary of Army (33 U.S.C. 401).

The Federal Power Act (16 U.S.C. §§791-828) provides for cooperation between the Federal Energy Regulatory Commission and other Federal agencies, including resource agencies, in licensing and relicensing power projects. The Federal Energy Regulatory Commission is authorized to issue licenses to construct, operate and maintain dams, water conduits, reservoirs, and transmission lines to improve navigation and to develop power from any streams or other bodies of water over which it has jurisdiction which includes many of the rivers inhabited by Pallid Sturgeon. An amendment in1986, the Electric Consumers Protection Act, required several

provisions to benefit fish and wildlife. Specifically, each license is to contain conditions to protect, enhance, and mitigate fish and wildlife affected by the project (16 U.S.C. §§803 et seq.). These conditions are to be based on recommendations received from the USFWS, the National Marine Fisheries Service, and State fish and wildlife agencies pursuant to the Fish and Wildlife Coordination Act. Additionally, there are requirements under 16 U.S.C. §81, related to operation of navigation facilities, they specify " The Commission shall require the construction, maintenance, and operation by a licensee at its own expense …such fishways as may be prescribed by the Secretary of the Interior or the Secretary of Commerce, as appropriate." The Federal Power Act has facilitated conservation of Pallid Sturgeon and their habitats through improved coordination with fish and wildlife management agencies and has the ability, where applicable, to restore connectivity for Pallid Sturgeon through mandated fish passage requirements.

The National Environmental Policy Act (42 U.S.C. §§4321-4347 as amended) requires all Federal agencies in the executive branch to consider the effects of their actions on the environment. This act allows cooperating agencies and interested parties to assess proposed Federal projects and their potential significant impacts to the human environment. In general, participants review proposed actions and provide recommendations to the action agency to minimize or avoid environmental impacts. Affects to endangered species are commonly included in these environmental assessments or environmental impact statements; however, endangered status is not required for such considerations. As such, the processes necessary to comply with this act would include considerations of Pallid Sturgeon and their habitats in project planning. However, while this act provides for disclosure of environmental impacts, it does not require minimization. Thus, the degree to which this act offers protection to the Pallid Sturgeon is variable and based upon voluntary adoption of conservation measures. Compliance with this act would be improved and provide increased benefit with better information on habitat use and needs of Pallid Sturgeon within the Missouri and Mississippi river basins.

The Fish and Wildlife Coordination Act (16 U.S.C. §§661-667e as amended) requires that Federal agencies funding, sponsoring, or permitting activities give consideration and coordination of wildlife conservation with respect to water resources development programs. Under the Fish and Wildlife Coordination Act, Federal agencies must consult with the USFWS and the State fish and wildlife agencies where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted . . . or otherwise controlled or modified" under a Federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources." Through the Fish and Wildlife Coordination Act, Pallid Sturgeon and their habitats are given due consideration in water development activities. However, while the Fish and Wildlife Coordination Act may result in implementation of conservation measures (i.e., screening of water diversion structures) on new water projects, this act does not afford protections for projects implemented or permitted prior to its enactment.

Summary of Federal Regulations

Federal environmental regulations have substantially increased environmental protections throughout the Pallid Sturgeons' range. However, there are instances where these regulations

may not have been adequately followed (Government Accountability Office 2011), possibly resulting in negative effects for the species. In other instances, the implementation of these laws does not offer adequate protection to the Pallid Sturgeon in that it does not address the specific threats that the species faces. In some cases, lack of empirically derived data, specific to Pallid Sturgeon or lack of access to available data may be limiting the efficacy of existing Federal regulations.

Factor D Summary

Federal, State, and local regulatory protections have been developed to minimize and mitigate known and potential threats to fish and other aquatic species, as well as their habitats, from anthropogenic activities. While some of these regulatory mechanisms have been helpful and benefited the species, recovery progress made to date is the result of the Endangered Species Act and its enforceable provisions to ensure conservation of listed species. Absent protections under the Endangered Species Act, current existing State and Federal regulations may be inadequate to ensure long-term protection for the species. However, some of this perceived inadequacy of existing regulatory mechanisms to conserve Pallid Sturgeon primarily relates to a lack of specific information on population size, habitat use, and sensitivity or vulnerability to contaminants, entrainment, and other threats or a lack of easy access to these data where available. As examples:

- State and Federal environmental regulations enacted to reduce or eliminate environmental contaminants and preserve water quality provide regulatory authority to develop and establish standards and implement pollution control programs. The standards established pursuant to these regulations and through State and Federal permitting processes have benefitted the Pallid Sturgeon by protecting and improving water quality. However, data suggest that residual contaminants or their derivatives are still negatively affecting the species (see Factor A: Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range, above). Developing specific information on the sensitivity of the Pallid Sturgeon to common industrial and municipal pollutants and their derivatives will allow for reviewing and if necessary modifying water quality standards specifically to benefit the species.

- Hybridization was identified as a threat to the species when it was listed (55 FR36641-36647) and is discussed further under Factor E below. At the time, the prevailing hypothesis relates hybridization with habitat alterations that resulted in a breakdown of natural reproductive isolating mechanisms. However, more recent information suggests that additional data are needed to fully understand the extent and magnitude of hybridization as a threat (USFWS 2007). If hybridization is related to habitat alterations, conserving and restoring habitats may be the only method to reverse this trend. Use of available regulatory mechanisms to address the threat of hybridization is currently limited by lack of information on the natural reproductive isolating mechanisms between Shovelnose and Pallid sturgeon.

- A number of invasive aquatic species have been introduced into the range of Pallid Sturgeon (see Factor E: Other Natural or Manmade Factors Affecting its Continued Existence, below);

however, the threats they may pose to its conservation are poorly known. Numerous State and Federal regulations, including but not limited to, the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (as amended), Injurious Wildlife provisions of the Lacey Act (18 U.S.C. 42; 50 CFR 16), Asian Carp Prevention and Control Act, and Clean Boating Act of 2008, have been developed to: 1) prevent introduction of new invasive species into the wild; 2) halt the spread of invasive species to unoccupied areas; and 3) to control them in areas where they were introduced. Information on the spread and abundance of invasive species, as well as their effects on reach specific Pallid Sturgeon populations is necessary to determine whether these regulatory mechanisms are adequate to protect the species.

As our knowledge of the species increases, existing regulatory mechanisms can be more effectively evaluated, improved, and implemented.

Factor E: Other Natural or Manmade Factors Affecting its Continued Existence

Potential new threats identified subsequent to the 5-year review (USFWS 2007) or new information has resulted in additional evaluation of: 1) energy development, 2), hybridization, and 3) invasive species/aquatic nuisance species.

ENERGY DEVELOPMENT

Gas and Oil Exploration: Exploration of natural gas and oil deposits occurs in portions of the Pallid Sturgeon's range. Preliminary assessment of the impacts of seismic air guns, a tool used for exploration, suggests that they may have negative effects on larval Pallid Sturgeon (Krentz in litt. 2010). Additional research is necessary to fully evaluate the extent and magnitude of these effects.

Gas and Oil Pipelines: The federal authority for pipeline safety is the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration. This agency reports that there were 2.3 million miles of pipelines in the United States carrying natural gas and hazardous liquids (primarily petroleum, refined petroleum products, and other chemicals). Many pipelines cross rivers within the range of Pallid Sturgeon; some of which are buried under the river bed.

While not directly within the historical range of Pallid Sturgeon, the 2011 rupture of the Silvertip Pipeline crossing under the Yellowstone River serves as a reminder that accidental releases of hazardous materials can occur. Depending on the timing, magnitude, and the material leaked, a ruptured pipeline could pose a threat to Pallid Sturgeon.

Summary of Impacts from Energy Development

Increased demand for energy resources has led to an increased interest in new technology for development and exploration. Oil and gas exploration techniques have the potential to take Pallid Sturgeon yet the ability to evaluate these takings will be nearly non-existent given the nature of the river systems these fish live in.

The conveyance of oil and gas through pipelines could result in localized negative effects should a rupture occur resulting in the substances being transported spilling into waters occupied by Pallid Sturgeon. The U.S. Department of Transportation's Office of Pipeline Safety is responsible for regulating the safety of design, construction, testing, operation, maintenance, and emergency response of domestic oil and natural gas pipeline facilities. Additionally, there are state offices responsible for managing, permitting, and inspecting pipelines.

Strict adherence to existing environmental laws will be necessary to minimize effects and more data will be needed to adequately evaluate and monitor impacts related to energy development.

HYBRIDIZATION

The original version of this recovery plan (USFWS 1993) identified hybridization as a threat to Pallid Sturgeon. This was, in part, based on limited observations of sturgeon (N=12) collected from the middle Mississippi River that appeared morphologically-intermediate to Shovelnose and Pallid sturgeon (Carlson and Pflieger 1981; Carlson et al. 1985) and the belief that hybridization was contemporary (i.e., post 1960 and influenced by anthropogenic changes to habitat). Subsequent genetic and morphological studies have been conducted to explore hybridization between Pallid and Shovelnose sturgeon (Phelps and Allendorf 1983; Carlson et al 1985; Campton et al. 2000; Tranah et al. 2001 and 2004; Kuhajda et al. 2007; Ray et al. 2007; Murphy et al. 2007a). Below is a brief review of the current literature regarding the treatment of intermediate-character sturgeon and putative pallid/shovelnose hybridization in the Mississippi River basin.

Carlson et al. (1985) used principal components analysis based on morphometric measures described in Bailey and Cross (1954) and found that morphologically-intermediate specimens fell in between the Pallid and Shovelnose sturgeon groups leading to their hybridization origin hypothesis. Efforts to confirm hybridization used a suite of allozyme markers (Phelps and Allendorf 1983). These results neither supported nor refuted the hybridization origin hypothesis and only suggested that Pallid and Shovelnose sturgeon share close taxonomic affinities. Tranah et al. (2004) assessed the genetic origins of 10 morphologically intermediate sturgeon collected from the Atchafalaya River. These results were consistent with the hypothesis that hybridization occurs between Pallid and Shovelnose sturgeon. However, this study simply demonstrated that morphologically-intermediate fish had intermediate genotypes. Schrey (2007) analyzed 529 *Scaphirhynchus* samples from the upper Missouri, lower Missouri, middle Mississippi, and Atchafalaya rivers using sixteen microsatellite loci. Like Tranah et al. (2004), the author also found that genetically-intermediate fish tended to also be morphologically-intermediate.

While there are competing hypotheses that may explain morphologically intermediate fish (Murphy et al. 2007a; Ray et al. 2007), there appears to be a positive correlation between genotype and phenotype (Tranah et al. 2004; Schrey 2007). The latest genetic analysis confirms introgressive hybridization between Pallid and Shovelnose sturgeon occurs and likely has been occurring for several generations, perhaps as many as 60 years (Schrey et al. 2011). However, the significance of hybridization as a factor in the status of Pallid Sturgeon is poorly understood. Hybridization between two species could result in the eventual loss of one or both parental forms (Arnold 1992; Allendorf et al. 2001; Rosenfield et al. 2004). Conversely, a few have postulated that hybridization played a role in past sturgeon speciation (Birstein et al. 1997; Vasil'ev 1999; Robles et al. 2005), indicating that hybridization may have always been a process occurring in

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the evolution of sturgeon species and it can lead to the creation of new species (Arnold 1992). However, regardless of whether similar events might have led to new sturgeon species in the past, the Endangered Species Act instructs us to address threats to the integrity of listed species. While the mode and rate of *Scaphirhynchus* hybridization is difficult to assess, understanding the evolutionary relationship between Shovelnose and Pallid sturgeon is important to better be able to assess potential threats that hybridization may impose on Pallid Sturgeon recovery.
Summary of Impacts Related to Hybridization

While we know that experimental mating of Pallid Sturgeon with Shovelnose Sturgeon can produce living offspring (Kuhajda et al. 2007), accurate assessment of hybridization in the evolution of *Scaphirhynchus* and its relative threat to Pallid Sturgeon recovery will require statistically testing the hypothesis of hybridization against alternatives. Since hybridization is occurring in *Scaphirhynchus* and likely has been occurring for many decades (Schrey et al. 2011), it is important to determine the cause (i.e., historical/natural or contemporary), extent, and frequency or rate of occurrence of hybridization. Once these processes are elucidated, simulation/modeling exercises can address the actual risks associated with *Scaphirhynchus* hybridization. If it is determined that alteration of habitats has influenced temporal or spatial reproductive isolating mechanisms resulting in increased rates of hybridization, addressing this threat will likely rely on both site-specific and ecosystem improvement efforts; many of which are identified in the Recovery Outline/Narrative section below.

INVASIVE SPECIES/AQUATIC NUISANCE SPECIES

Although not a threat specifically identified in the Pallid Sturgeon listing package (55 FR 36641-36647), the potential impact of invasive and aquatic nuisance species can be applied to Listing Factor A- The present or threatened destruction, modification, or curtailment of its habitat or range and Listing Factor C- Disease or Predation. Several species with the potential for impacting Pallid Sturgeon have become established in parts of the species' range. These include the Asian carps (Common Carp (*Cyprinus carpio*), Grass Carp (*Ctenopharyngodon idella*), Silver Carp (*Hypophthalmichthys molitrix*), Bighead Carp (*Hypophthalmichthys nobilis*) and Black Carp (*Mylopharyngodon piceus*)) as well as the zebra mussel (*Dreissena polymorpha*). Populations of Asian carp appear to be expanding exponentially in parts of the Mississippi River basin; similarly the range of the zebra mussel continues to expand (Kolar et al. 2005).

According to the American Fisheries Society (Policy 15), potential negative impacts by nonnative species have been categorized into five broad categories: habitat alteration, trophic alteration, spatial alteration, gene pool deterioration and disease transmission. Documenting these impacts in large river ecosystems is especially difficult. Few studies have documented the impacts from these species in the Mississippi Basin. However, data are available from other watersheds that shed insight into potential effects from invasive species.

If food resources were limited from the presence of large populations of planktivores (e.g., Asian carps), early life-stage Pallid Sturgeon could face increased competition with native planktivorous fishes such as Gizzard Shad (*Dorosoma cepedianum*), Bigmouth Buffalo (*Ictiobus cyprinellus*) and Paddlefish (Kolar et al. 2005). Several authors have expressed concern that, because nearly all fish feed on zooplankton as larvae and juveniles, Asian carps have high

potential to impact native fishes in the Mississippi River basin (Laird and Page 1996; Chick and Pegg 2001; Chick 2002). The diets of Bighead and Silver Carp have significant overlap with those of Gizzard Shad and Bigmouth Buffalo (Sampson et al. 2009). In addition to directly competing for food resources, Asian carps also could affect recruitment by predation on Pallid Sturgeon eggs or drifting larvae. Miller and Beckman (1996) have documented white sturgeon eggs in the stomachs of Common Carp. Additionally, disease or parasites can be spread by Asian carp. Goodwin (1999) noted that Channel Catfish became infested with anchorworm when cultured with Bighead Carp. Heckmann et al. (1986 and 1995) reported that this tapeworm was spread to two endangered species when baitfishes were released into Lake Mead, Arizona and Nevada. Currently, the Asian tapeworm is known to infest native fishes in five States; however, none are in the Mississippi River drainage (Kolar et al. 2005).

Zebra mussel colonization has occurred in areas occupied by Pallid Sturgeon but data are limited on direct effects. In juvenile Lake Sturgeon, data show that zebra mussel occupancy changes the nature of the bottom substrates and a reduced foraging effectiveness with mussel presence resulting in avoidance of those areas by study fish more than 90% of the time (McCabe et al. 2006).

Summary of Impacts From Invasive and Aquatic Nuisance Species

Potential threats from invasive or aquatic nuisance species include increased predation on eggs, larval, or juvenile life stages, competition for food in the case of the carps, exclusion of native species from preferred habitats, spread of diseases or parasites, and alteration of habitat quality. Further study is needed to fully qualify and quantify the magnitude of this probable threat to Pallid Sturgeon.

Factor E Summary

Energy development and invasive species are two threats that may have substantial deleterious effects on Pallid Sturgeon populations. Strict adherence to existing environmental laws will be necessary to minimize effects from these threats and more data will be needed to adequately evaluate the extent and magnitude of these effects.

Conservation Measures

Numerous planning and conservation measures have been implemented range-wide to reduce localized effects from identified threats. The following is not intended to provide a comprehensive list of all conservation activities range-wide, but rather highlight projects and efforts that have been or will be implemented to address some of the threats to Pallid Sturgeon described previously.

MISSOURI RIVER

Within the Missouri River basin, where channelization and dams have fragmented habitats and altered natural riverine processes and no evidence for Pallid Sturgeon recruitment exists, many efforts are being explored or implemented to restore ecological function, as well as utilizing the PSCAP to prevent local extirpation. Restoration efforts include, but are not limited to: creating

side channel habitats, restoring connectivity to backwater areas, notching dikes, providing fish passage, and manipulating flows through the dams. In addition to habitat restoration efforts and the PSCAP, a basin-wide Pallid Sturgeon population monitoring program has been established to track changes in species abundance and status.

FORT BENTON TO FORT PECK RESERVOIR, MONTANA

Reservoir operations on tributaries within this reach have been modified from past practices. Releases from Tiber Dam (Figure 4) were modified to occasionally accommodate a high flow discharge period. During 1995, 1997, and 2002, the Bureau of Reclamation provided a June peak release of 4,080, 4,500, and 5,300 cfs, respectively, to benefit downstream fisheries. A response by Pallid Sturgeon was not detected; however, present numbers of Pallid Sturgeon in this reach may be too low to detect or elicit a response. An indirect response to these increased discharges may be the recent establishment of Sturgeon Chub (*Macrhybopsis gelida*) in the lower Marias River. Sturgeon chub are an important prey species of Pallid Sturgeon (Gerrity et al. 2006) and were documented only recently in the Marias River in 2002.

Augmentation and monitoring efforts continue to support and evaluate the Pallid Sturgeon population within this reach.

FORT PECK DAM, MONTANA TO LAKE SAKAKAWEA, NORTH DAKOTA

In addition to artificial supplementation with hatchery-reared Pallid Sturgeon, discussions and exploratory designs have been ongoing in an effort to increase water temperatures in the Missouri River immediately downstream of Fort Peck Dam. Several options have been considered ranging from releasing surface water over the spill-way to modifying the intake structures or installing a large "curtain" around the intakes such that they draw down and release warmer surface waters. To date, warm water releases have not been implemented due in part to insufficient water levels.

The Yellowstone River is the largest tributary to the Missouri River in this reach. A multi-agency effort has been ongoing since the early 2000s to develop and implement fish passage and entrainment protection at Intake Dam. In 2007, the Water Resources Development Act provided the U.S. Army Corps of Engineers the authority to assist the Bureau of Reclamation with design and implementation of fish passage and entrainment protection at Intake Dam. A new water diversion structure, complete with fish screens, was initiated in 2010 and operational in 2012. Final passage options, intended to maximize Pallid Sturgeon passage probabilities to areas upstream of Intake Dam, are still being developed.

FORT RANDALL DAM TO GAVINS POINT DAM, SOUTH DAKOTA AND NEBRASKA

Augmentation efforts are being implemented to help reestablish a population in this reach. The Niobrara River is the largest tributary in this reach. Spencer Dam is a fish passage barrier on the Niobrara River. To date, preliminary discussions among interested parties have begun to explore passage options at this structure, but there are no substantial efforts yet to address this issue.

GAVINS POINT DAM SOUTH DAKOTA/NEBRASKA TO THE MISSISSIPPI RIVER CONFLUENCE

At over 1,296 Rkm (800 Rmi), this is the longest unimpounded reach of the Missouri River. Release of hatchery-reared Pallid Sturgeon produced as part of the PSCAP was initiated in 1994 and has occurred annually since 2002 in this reach. Available data indicate the PSCAP has

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lessened the likelihood of local extirpation, but long-term population viability currently remains uncertain (Steffensen 2012). Additionally, by 2011 an estimated 1,393 hectares (ha) (3,443 acres (ac)) of shallow water habitat has been created by constructing site-specific projects like chutes and revetment chutes, dredging to connect back-water areas, as well as side-channel construction (U.S. Army Corp of Engineers and US Fish and Wildlife Service 2012). Based on current and anticipated commitments, habitat restoration in this reach will continue, effectively increasing the quantity and quality of potential sturgeon habitats.

The Platte River is an important tributary to the Missouri River in this reach. The largest anthropogenic factor affecting habitat in the lower Platte River is upstream water withdrawals. The National Research Council (2005) identified that periods of drought could negatively affect habitats in the lower Platte River. During July 2012, a fish kill incident was reported in the lower Platter River following a period of prolonged drought. One dead hatchery-reared Pallid Sturgeon was confirmed (Nebraska in litt., 2012). A Cooperative Agreement between Nebraska, Colorado, Wyoming, and the U.S. Department of Interior was developed forming the Platte River Recovery Implementation Program to improve and maintain habitat for species, including Pallid Sturgeon. Evaluation of the success of this program is needed to determine if program efforts are indeed meeting the needs of the species.

MISSISSIPPI RIVER

Limited conservation stocking efforts have sporadically occurred in the Mississippi River; however, all stocking was discontinued due to increasing numbers of wild Pallid Sturgeon being collected and evidence for some level of natural recruitment (i.e., Columbo et al. 2007; Killgore et al. 2007a, b). Conservation efforts in the Mississippi River include land procurement; habitat conservation and restoration; sturgeon surveys; population quantification, modeling and monitoring; and habitat use studies. Additionally, commercial Shovelnose Sturgeon fishing has been closed by State and Federal regulations to prevent incidental harvest of Pallid Sturgeon in areas previously open to sturgeon caviar harvest.

UPPER MISSISSIPPI RIVER

While few Pallid Sturgeon have been documented in the Upper Mississippi River, the U.S. Army Corps of Engineers has continued to evaluate fish passage through the locks and dams. In addition, the fish community and habitat diversity is being address through U.S. Army Corps of Engineers elements of the Upper Mississippi River Restoration-Environmental Management Program. These elements include the Habitat Rehabilitation and Enhancement Projects and Long Term Resource Monitoring (U.S. Army Corp of Engineers in litt., 2013). Habitat enhancement projects include dike modifications, construction of chevron dikes, side channel enhancement, island construction, and reconnection of the river to the floodplain. Furthermore, since 1943 the Upper Mississippi River Conservation Committee (see http://www.umrcc.org/) has partnered with agencies and others to further cooperative conservation efforts for fish and habitat within the Upper Mississippi River.

MIDDLE MISSISSIPPI RIVER

The U.S. Army Corps of Engineers has initiated a program to restore side channel connectivity and improve habitat diversity in this reach. Projects include dike modifications, construction of

chevron dikes, side channel enhancement, placement of woody debris piles, and incorporation of woody debris into dikes. More than 1,700 ha (4,200 ac) of flood-prone land have been purchased from willing sellers (USFWS 2009b). This land has been placed into conservation status by inclusion into the National Wildlife Refuge System. The Middle Mississippi National Wildlife Refuge has resulted in improved floodplain connectivity along 96 km (60 mi) of the Mississippi River downstream from St. Louis, Missouri. Pallid Sturgeon population quantification and monitoring efforts have been conducted in the Middle Mississippi River over the past decade, adding greatly to knowledge of habitat use and species abundance in this river reach.

LOWER MISSISSIPPI RIVER

During the 1980s, the U.S. Army Corps of Engineers established the Lower Mississippi River Environmental Program to develop methods to minimize effects of channel maintenance activities on fisheries and other natural resources in the lower Mississippi River. This program evaluated and modified revetment design, as well as dike design and placement to increase fishery habitat complexity. In 2001, the U.S. Army Corps of Engineers Mississippi Valley Division, initiated informal consultation with the USFWS under section 7(a)(1) of the Endangered Species Act to use Lower Mississippi River Environmental Program designs and additional measures to conserve and manage listed species associated with the lower Mississippi River navigation channel. Annual meetings with the U.S. Army Corps of Engineers, the USFWS, and State agencies are held to evaluate planned construction and maintenance activities, and to identify habitat restoration and improvement opportunities.

In addition, the Mississippi Valley Division and the Districts work with the Lower Mississippi River Conservation Committee (a Federal and State agency partnership) to identify and initiate secondary channel restoration opportunities within the leveed floodplain. Under its Mississippi River Conservation Initiative, this group has identified approximately 220 priority restoration opportunities in the Lower Mississippi River. Over the past decade, more than 64 km (40 mi) of secondary channel habitats have been rehabilitated helping to restore hundreds of acres of seasonally flooded habitats and over 200 dike notches have been constructed to maintain and/or increase in-channel habitat complexity (DuBowy 2010). Other construction modifications implemented to protect and enhance habitats include the construction of hardpoints in lieu of revetment and chevrons to encourage small island formation.

The U.S. Army Corps of Engineers' Engineer Research and Development Center has been conducting distribution and abundance studies on Pallid Sturgeon for more than 10 years. This center has evaluated susceptibility of sturgeon to entrainment through dredging and diversion structures, identified engineering modifications to minimize entrainment potential, assessing the benefits of dike notching, sturgeon utilization of in-river engineered structures, seasonal and spatial distribution of young-of-year sturgeon, and young-of-year sturgeon diets. Other research and monitoring efforts include a multi-agency, multi-year telemetry study to identify Pallid Sturgeon habitat associations and movements in the Atchafalaya River and in a short reach of the Mississippi River. Additionally, the USFWS is funding and coordinating research efforts to improve identification of river sturgeon species, and to quantify hybridization levels and trends in sturgeon of the Lower Mississippi River.

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Part II: Recovery

Recovery Strategy

The primary strategy for recovery of Pallid Sturgeon is to: 1) conserve the range of genetic and morphological diversity of the species across its historical range; 2) fully quantify population demographics and status within each management unit; 3) improve population size and viability within each management unit; 4) reduce threats having the greatest impact on the species within each management unit; and, 5) use artificial propagation to prevent local extirpation within management units where recruitment failure is occurring. Pallid Sturgeon recovery will require an increased understanding of the status of the species throughout its range; developing information on life history, ecology, mortality, and habitat requirements; improving our understanding of some poorly understood threat factors potentially impacting the species; and using that information to implement management actions in areas where recovery can be achieved (see *Recovery Outline/Narrative*).

Management Units

Suitable habitat for Pallid Sturgeon is typically found within the flowing reaches of the Missouri, middle and lower Mississippi, and Atchafalaya rivers, and in portions of major tributaries like the Yellowstone and Platte rivers. However, some recovery tasks include actions at main stem dams/reservoirs and in other major tributaries when those actions would benefit Pallid Sturgeon in downstream reaches.

Originally, the U.S. Fish and Wildlife Service established six recovery priority management areas to focus recovery efforts at locales believed to have the highest recovery potential in 1993 (USFWS 1993). Since that time, our understanding of the species has improved and warrants redefining those management areas into four management units. These management unit boundaries are based on: 1) genetic data (Campton et al. 2000; Tranah et al. 2001; Schrey and Heist 2007); 2) morphological differences (Kuhajda et al. 2007; Murphy et al. 2007a); 3) biogeography of other fish species and speciation associated with physiographic provinces (Metcalf 1966; Wiley and Mayden 1985; Burr and Page 1986; Cross et al. 1986); 4) common threats; and 5) the potential need and ability to implement differing management actions to address varying threats within a management unit. As genetic and stock structure data are further refined, these management units may be correspondingly adjusted.

Like the original recovery priority management areas, these management units possess riverine reaches that are currently occupied habitats and typically represent the least degraded areas that retain the highest configuration of sandbars, side channels, and varied depths (Pallid Sturgeon Recovery Team 2006 and 2007). However, differing threats may affect each management unit independently (e.g., main-stem impoundments are a threat in the upper portion of the species' range but are not implicated as a threat in the most downstream reaches of the species' range). All river reaches within the species' historical range not specifically identified in the following management unit descriptions should not immediately be excluded from recovery activities if new information indicates these areas are deemed necessary to either prevent local extirpation or to facilitate recovery.

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The management units (Figure 6) identified in the recovery strategy described above are defined as:

> The Great Plains Management Unit (GPMU) (Figures 6 and 7) is defined as the Great Falls of the Missouri River, Montana to Fort Randall Dam, South Dakota. This unit includes important tributaries like the Yellowstone River, as well as the Marias and Milk rivers. The upper boundary is at the Great Falls of the Missouri River as this is a natural barrier above which Pallid Sturgeon could not migrate historically. The lower boundary was defined as Fort Randall Dam to ensure consistent management practices on an inter-reservoir reach of the Missouri River.
>
> The Central Lowlands Management Unit (CLMU) (Figures 6 and 8) is defined as the Missouri River from Fort Randall Dam, South Dakota to the Grand River confluence with the Missouri River in Missouri and includes important tributaries like the lower Platte and lower Kansas rivers.
>
> The Interior Highlands Management Unit (IHMU) (Figures 6 and 9) is defined as the Missouri River from the confluence of the Grand River to the confluence of the Mississippi River, as well as the Mississippi River from Keokuk, Iowa to the confluence of the Ohio and Mississippi rivers.
>
> The Coastal Plain Management Unit (CPMU) (Figures 6 and 10) is defined as the Mississippi River from the confluence of the Ohio River downstream to the Gulf of Mexico including the Atchafalaya River distributary system.

Recovery Criteria

Section 3 of the Endangered Species Act, defines an endangered species as one that is in danger of extinction throughout all or a significant portion of its range, and a threatened species as one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Accordingly, a recovered species is one that no longer meets these definitions. Determining whether a species should be reclassified from endangered to threatened or delisted requires assessment of the same five categories of threats which were considered when the species was listed.

Recovery criteria define those conditions that are believed necessary to indicate that a species should be reclassified from endangered to threatened or delisted. Thus, when satisfied, recovery criteria are mileposts that measure progress toward recovery. Recovery criteria are provided below. Because the appropriateness of downlisting or delisting is assessed by evaluating the five threat factors identified in the Endangered Species Act, the recovery criteria below pertain to and are organized by these factors. These recovery criteria are our best assessment, at this time, of what needs to be completed so that the species may be downlisted to threatened status or removed from the list entirely. Because we cannot envision the exact course that recovery may take and because our understanding of the vulnerability of a species to threats is very likely to change as more is learned about the species and its threats, it is possible that a status review may indicate that downlisting or delisting is warranted although not all recovery criteria are met. Conversely, it is possible that the recovery criteria could be met and a status review may indicate

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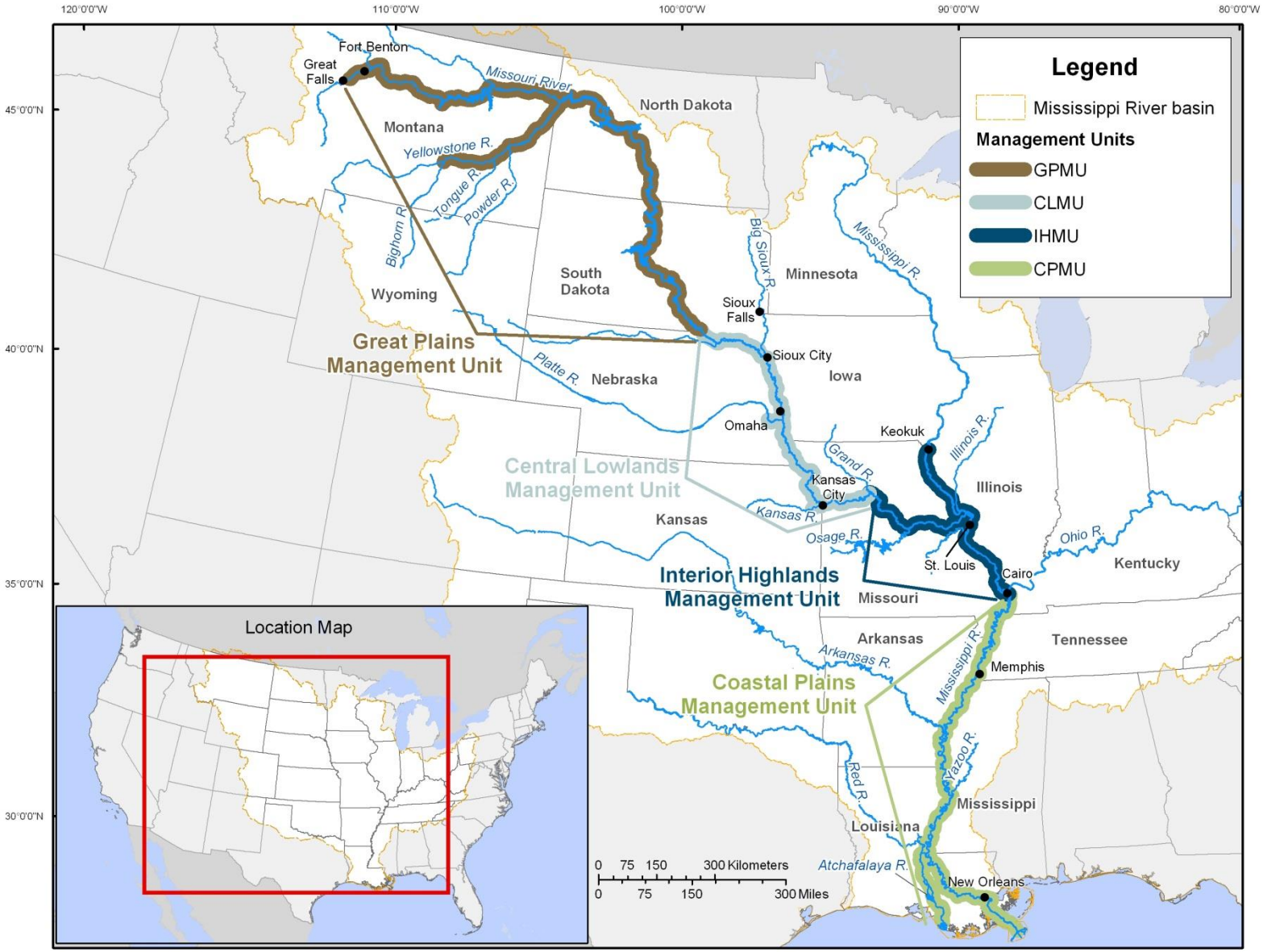

Figure 6 Map depicting Pallid Sturgeon management units.

Figure 7 Map depicting the Great Plains Management Unit.

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Figure 8 Map depicting the Central Lowlands Management Unit.

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Figure 9 Map depicting the Interior Highlands Management Unit.

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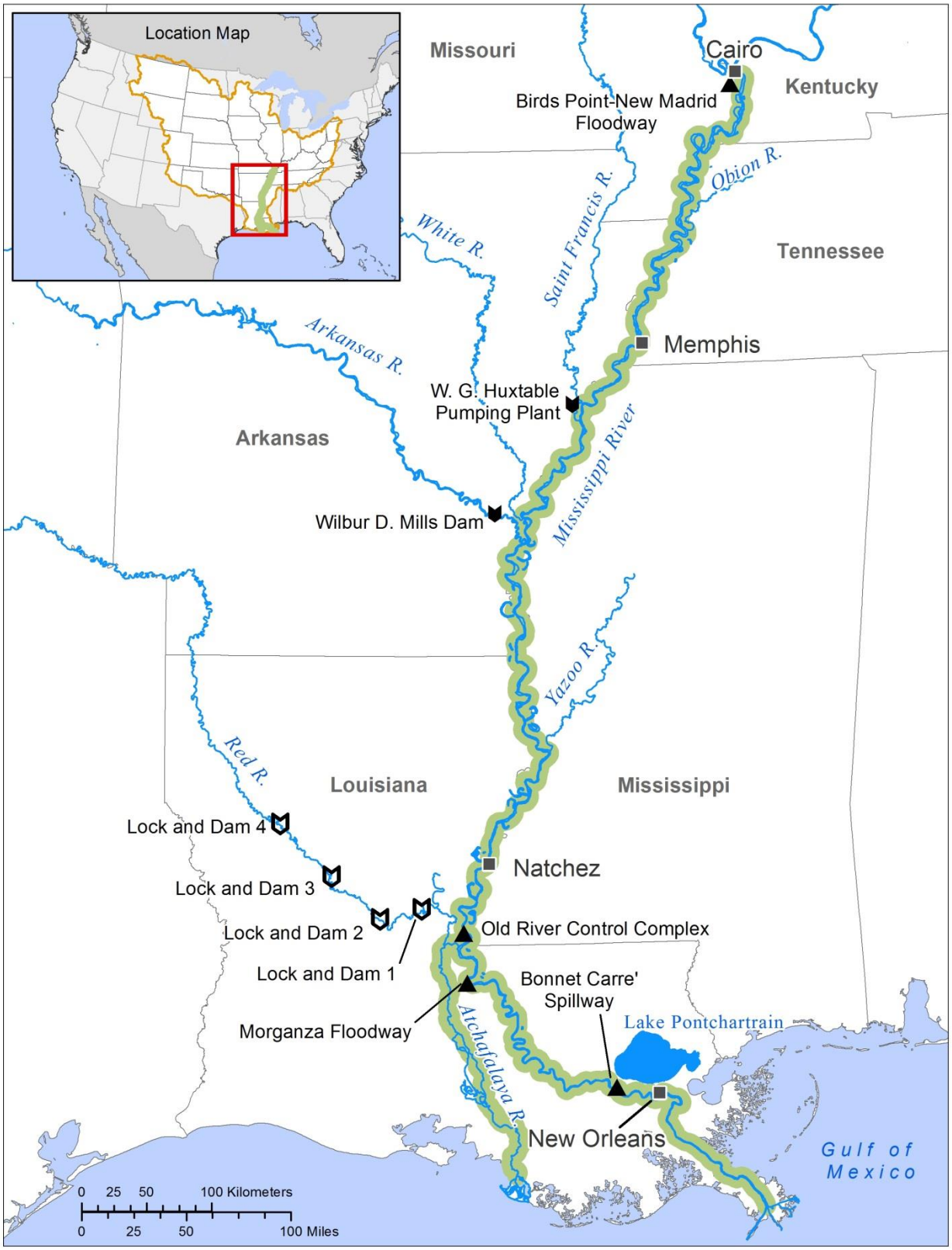

Figure 10 Map depicting the Coastal Plains Management Unit.

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that downlisting or delisting is not warranted; for example, a new threat may emerge that is not addressed by the recovery criteria below that causes the species to remain threatened or endangered.

Criteria for Reclassification to Threatened Status

Pallid Sturgeon will be considered for reclassification from endangered to threatened when the listing/recovery factor criteria are sufficiently addressed such that a self-sustaining genetically diverse population of 5,000 adult Pallid Sturgeon is realized and maintained within each management unit for 2 generations (20-30 years). In this context, a self-sustaining population is described as a spawning population that results in sufficient recruitment of naturally-produced Pallid Sturgeon into the adult population at levels necessary to maintain a genetically diverse wild adult population in the absence of artificial population augmentation. Metrics suggested to define a minimally sufficient population would include incremental relative stock density of stock-to-quality-sized naturally produced fish (Shuman et al. 2006) being 50-85 over each 5-year sampling period, catch-per-unit-effort data indicative of a stable or increasing population, and survival rates of naturally produced juvenile Pallid Sturgeon (age 2+) equal to or exceeding those of the adults (see Justification for Population Criteria below for details). Additionally, in this context a genetically diverse population is defined as one in which the effective population size (N_e) is sufficient to maintain adaptive genetic variability into the foreseeable future ($N_e \geq 500$), conserve localized adaptions, and preserve rare alleles.

Criteria for Delisting Species

Pallid Sturgeon will be considered for delisting when the criteria for reclassification to threatened status have been met and sufficient regulatory mechanisms are established to provide reasonable assurances of long-term persistence of the species within each management unit in the absence of the Act's protections.

Listing/Recovery Factor Criteria

The following listing factors (A through E) are applicable to the reclassification and delisting criteria described above, although differences may apply in the methods used to achieve them. Addressing these criteria to sufficient levels can be facilitated by implementing the recovery tasks described under the RECOVERY OUTLINE/NARRATIVE section.

Listing Factor A: **Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range.**

This factor will be considered addressed when:

(1) Habitat conservation and restoration efforts establish and maintain riverine habitats capable of meeting and sustaining all life history requirements of the species (i.e., sufficient habitat is available to support a self-sustaining population within each management unit as described under "Criteria for Reclassification to Threatened Status");

(2) Regulations and enforcement provide reasonable assurances that water quality parameters and contaminants of concern meet or exceed the latest national recommended water quality criteria (e.g., U.S. Environmental Protection Agency 2009);

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(3) Entrainment losses from all sources (i.e., water cooling intake structures, dredge operations, irrigation diversions, etc.) are minimized such that attributable mortality does not impair maintenance of self-sustaining populations;
(4) The potential effects associated with changes in climate are assessed and mitigated or minimized.

Listing Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes.
This factor shall be considered addressed when take of Pallid Sturgeon associated with commercial, recreational, scientific or educational uses is fully controlled by State regulation, and has little to no effect upon the sustainability of the species within each management unit.

Listing Factor C: Disease or Predation
Disease and Predation were not implicated in the reduction of the species. Existing State and Federal regulations have been established to minimize pathogen introduction from outside the Pallid Sturgeon's range. The threat from predation will be considered addressed when sufficient data to assess the effects of intraspecific competition from nonnative/invasive species are available, and, if needed, regulations and management measures are established to minimize competition and predation threats to the species.

Listing Factor D: Inadequacy of Existing Regulatory Mechanisms
This factor shall be considered addressed when adequate mechanisms are in place and enforcement provide reasonable assurance that excessive non-natural mortality is reduced to sustainable levels and adequate regulations protect habitat and habitat forming processes sufficient to maintain self-sustaining populations within each management unit or when the underlying threat has been addressed such that regulatory mechanisms are no longer needed. For example, overutilization must be addressed for either downlisting or delisting to occur. Under the current protections afforded by the Endangered Species Act and similarity of appearance regulations, existing protections may be sufficient to support downlisting. However, delisting will require State harvest regulations that will provide adequate protection from overutilization in the absence of the Act's protections.

Listing Factor E: Other Natural or Manmade Factors Affecting its Continued Existence
This factor shall be considered addressed when:
(1) Energy development and new technologies are evaluated and assessed and, if necessary, measures are implemented to minimize any adverse effects from these activities;
(2) Once simulation studies can assess if alterations of habitats have influenced temporal or spatial reproductive isolating mechanisms resulting in increased rates of hybridization, this threat will likely be addressed by both site-specific and ecosystem improvement efforts such that actual risks associated with pallid/shovelnose hybridization are mitigated.
(3) Invasive species or aquatic nuisance species are regulated and reduced such that deleterious effects (i.e., predation and competition) are minimized.

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Justification for Population Criteria

The following targets, when met, should provide sufficient assurances that the population criteria for recovery have been met.

ADULT POPULATION TARGETS:

The requirements of a minimum adult population capable of maintaining adaptive genetic variability long-term will need an effective population size (N_e) of at least 500 (Franklin and Frankham 1998) to perhaps as high as 5000 (Lande 1995). To estimate the census size (N) necessary to meet these criteria, one needs to understand how N_e relates to N. The relationship between N_e and N can be affected by a variety of factors, however, values for N_e /N averaged 0.10-0.11 based on published estimates from 102 species (Frankham 1995). Using Frankham's average values (1995) and the following formula, a theoretical minimum estimate of breeding adults can be obtained.

$$\frac{Ne}{N} = 0.1 \text{ or } \quad N = \frac{N\,e}{0.1}$$

If the desired N_e is 500 to 1,000 as suggested by Franklin and Frankham (1998) or 5000 as described in Lande (1995), a theoretical range of 5,000-50,000 adults would constitute a desired adult Pallid Sturgeon population. Reed et al. (2003) used population viability analysis to estimate minimum viable population sizes of many vertebrate taxa (n=102). They found, on average, that 7,000 breeding adults, along with sufficient habitat to support them, was a minimum requirement for long-term maintenance of a species.

Based on the above data, the minimum desired adult Pallid Sturgeon population within each management unit will be 5,000.

Because empirically derived data have not been analyzed for Pallid Sturgeon, this minimum target should be considered interim until Pallid Sturgeon specific data are evaluated and incorporated into an appropriate population viability analysis to derive management unit or, if designated, DPS specific minimum viable adult population estimates. In this fashion, the delisting and downlisting targets will be modified in an adaptive fashion based on available data and analyses.

Measuring Natural Recruitment

Recruitment failure has been documented in the Great Plains Management Unit, and only limited evidence of recruitment exists within the other management units (USFWS 2007). Concerns over limited recruitment (i.e., potential for local extirpation) resulted in the establishment of the PSCAP. While artificial propagation and stocking measures are helping to maintain the species, successful natural spawning and recruitment is necessary for recovery. To evaluate when this has been achieved, reliable population trend estimates will be needed.

Annual survival rates of hatchery-reared Pallid Sturgeon are relatively high ($\geq$ 0.8) for age 2+ fish (Hadley and Rotella 2009; Steffensen et al. 2010). These rates likely are comparable to those of age 2+ wild fish given that most age 2+ hatchery-reared fish were at large for at least 1 year and subject to comparable selection pressures as wild fish; the presence of wild juvenile

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Pallid Sturgeon (age 2+) can provide inferences into potential adult recruitment levels. Thus, documenting presence or absence of wild juvenile Pallid Sturgeon in annual survey efforts is one approach to help assess if short-term natural recruitment is occurring within a management unit.

Because length frequency data are commonly collected in fishery surveys, these data remain useful and provide a cost-effective index to monitor a fish population and are more suitable long-term than the short-term presence/absence method described above. The general applicability and limitations of using stock density indices as a tool for assessment of length frequency data are described by Willis et al. (1993). The applicability of stock density indices to Pallid Sturgeon data are discussed in Shuman et al. (2006 and 2011). Additionally, stock density indices also have been applied to monitor trends in Shovelnose Sturgeon (Quist et al. 2002). In the context of long-term fish population monitoring, incremental relative stock densities (RSD) are appropriate to use (Willis et al. 1993); thus, incremental-RSD values of stock-sized fish as described by Shuman et al. (2006) likely will provide a useful measure to monitor recruitment. In addition to length frequency data, catch-per-unit effort data and survival rates also will be important data (Willis et al. 1993) to identify when natural recruitment is sufficient to sustain the species long-term.

Interim long-term targets for Pallid Sturgeon recruitment will be based on indices indicative of adequate recruitment; (i.e., incremental-RSD of stock to quality-sized naturally produced fish (Shuman et al. 2006) being 50-85 over each 5-year sampling period, catch-per-unit-effort data indicative of a stable or increasing population, and survival rates of naturally produced juvenile Pallid Sturgeon fish (age 2+) equal to or exceeding those of the adults).

Distinct Population Segment Overview

We may consider splitting this species-level listing into multiple DPSs in the future. Section 3 of the Endangered Species Act defines "species" to include "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." Pursuant to the Act, the USFWS considers if information is sufficient to indicate that listing, reclassifying, or delisting any species, subspecies, or, for vertebrates, any DPSs of these taxa may be warranted. In 1996, the USFWS and National Marine Fisheries Service published a joint policy guiding the recognition of DPSs of vertebrate species (61 FR 4722-4725). Under this policy, we consider two factors to determine whether the population segment is a valid DPS—1) discreteness of the population segment in relation to the remainder of the taxon, and 2) the significance of the population segment to the taxon to which it belongs. If a population meets both tests, it is a DPS, and then the population segment's conservation status is evaluated according to the standards in section 4 of the Endangered Species Act for listing, delisting, or reclassification (i.e., is the DPS endangered or threatened).

Analysis for Discreteness

A population segment of a vertebrate taxon may be considered discrete if it satisfies either one of the following conditions—(1) is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors (quantitative measures of genetic or morphological discontinuity may provide evidence of this separation); or (2) is delimited by international governmental boundaries within which differences in control of

exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

Analysis for Significance
If we determine a population segment is discrete, we next consider available scientific evidence of its significance to the taxon to which it belongs. The DPS policy states that this consideration may include, but is not limited to, the following factors: 1) persistence of the discrete population segment in an ecological setting unusual or unique for the taxon; 2) evidence that loss of the discrete population segment would result in a significant gap in the range of the taxon; 3) evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range; and/or 4) evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

If DPS are designated in the future, the criteria for reclassification and delisting would then be applicable to each designated DPS rather than to all management units as now indicated. Any determination to divide the currently listed entity into DPSs would go through the rulemaking process, which means that we would request public comments and peer review on our proposed course of action before we would make a final determination.

Recovery Outline/Narrative

The following recovery tasks were developed in concert with the Upper, Middle, and Lower Basin Pallid Sturgeon Workgroups and depict those items believed necessary to recover Pallid Sturgeon within each management unit. The following section is written to cover both broad scale approaches and, where possible, provide management unit specific details.

1. CONSERVE AND RESTORE PALLID STURGEON HABITATS, INDIVIDUALS AND POPULATIONS

1.1 RESTORE HABITATS AND FUNCTIONS OF THE MISSOURI AND MISSISSIPPI RIVER ECOSYSTEMS AT SUFFICIENT LEVELS AND QUALITY TO MEET THE LIFE HISTORY REQUIREMENTS OF THE SPECIES.

Anthropogenic alterations to the Missouri and Mississippi Rivers and their tributaries have affected natural riverine processes that Pallid Sturgeon evolved with. These anthropogenic habitat alterations adversely affect Pallid Sturgeon by altering the natural form and functions of these rivers (Simons et al. 1974; Fremling et al. 1989; Baker et al. 1991; Theiling 1999; Wlosinski 1999; Bowen et al. 2003). Restoration activities that return lost ecological process are necessary for the species to satisfy its life history requirements. However, the extent needed to accomplish this is currently not quantifiable. Thus, it will be necessary to improve our understanding of critical life history needs and tailor restoration efforts that will improve ecological conditions to address them.

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1.1.1 DETERMINE EFFECTS OF DAMS ON LIMITING RECRUITMENT AND SURVIVAL OF PALLID STURGEON

Dams greatly reduced the river's ability to satisfy the life history requirements of Pallid Sturgeon by: 1) blocking movements to spawning and feeding areas; 2) affecting historical genetic exchange among reaches, (i.e., affecting emigration and immigration); 3) decreasing turbidity levels by trapping sediment in reservoirs; 4) reducing distances available for larvae to drift; 5) altering water temperatures; 6) altering conditions and flows in spawning areas; 7) altering flows and temperatures associated with spawning movements; and 8) possibly reducing food sources by lowering productivity (Hesse et al. 1989; Keenlyne 1989; USFWS 2000a; Bowen et al. 2003).

Modifying current dam operations to restore a more natural hydrograph can facilitate meeting the species' life history requirements to promote species recovery. Modifying dam releases (increasing or decreasing), at the appropriate time, may improve spawning cues over baseline conditions and lowered discharges in the summer may reduce larval drift rates in truncated reaches. Additionally, lower pool elevations in some key reservoirs, (i.e., Fort Peck Reservoir and Lake Sakakawea) could increase the amount of available habitat for drifting larvae and provide additional rearing habitat for juvenile Pallid Sturgeon (Bramblett 1996; Gerrity 2005). Because drift rates of larval Pallid Sturgeon are related to water velocity and temperature (i.e., larval Pallid Sturgeon drift distance increases with increased velocity) (Kynard et al. 2007; Braaten et al. 2008), reducing dam releases during the larval drift period to levels that mimic the natural hydrograph may benefit Pallid Sturgeon by reducing channel velocities with a corresponding decrease in total larval drift distance. Additional features that may reduce drift distances are slower velocity seasonal secondary channels or other off channel low velocity areas. A reduction in drift rate and distance could help retain larvae in suitable riverine habitats rather than them being transported into downstream reservoirs.

Additional studies are needed to fully understand the effects main-stem Missouri River and tributary dams have on disrupting various life history requirements of the species and to implement actions to mitigate these effects. Spillway releases and altered flow scenarios should be evaluated to assess their ability to improve habitats (i.e., flow conditions, increase sediment transport, floodplain access, and normalize temperature profiles) in downstream reaches. Areas specifically identified for study are:

GPMU

(1) Determine reservoir pool elevations at Fort Peck Reservoir and Lake Sakakawea necessary to provide adequate larval drift distance.
    (a) If pool level elevation modifications will increase larval survival, adjust reservoir operations to maintain pool elevations necessary to provide adequate larval drift distances and to maximize juvenile rearing habitat.

(2) Evaluate spillway releases from Fort Peck Dam to improve flow, turbidity, and temperature conditions downstream.
    (a) If necessary, implement spillway releases to improve flow, turbidity, and temperature conditions downstream.

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(3) Evaluate flow scenarios from Fort Peck Dam to increase retention times and/or reduce larval development times (i.e., reduce drift rates and/or increase water temperatures) for larval Pallid Sturgeon.
   (a) If necessary, modify releases from Fort Peck Dam to increase retention times and/or reduce larval development times (i.e., reduce drift rates and/or increase water temperatures) for larval Pallid Sturgeon.

(4) Evaluate temperature control options on Fort Peck Dam to improve temperature conditions downstream.
   (a) If necessary, implement temperature control options to improve temperature conditions downstream.

(5) Evaluate flow scenarios from dams (Canyon Ferry, Tiber and others) upstream of Fort Peck Reservoir to improve habitat conditions and drift rates for larval Pallid Sturgeon.
   (a) If necessary, modify flows from dams (Canyon Ferry, Tiber and others) upstream of Fort Peck Reservoir to improve habitat conditions and drift rates for larval Pallid Sturgeon.

(6) Evaluate flow-release scenarios from Yellowstone River tributary dams (Yellowtail Dam and Tongue River Reservoir) to improve habitat conditions and drift rates for larval Pallid Sturgeon.
   (a) If necessary, modify flows from Yellowstone River tributary dams to improve habitat conditions and drift rates for larval Pallid Sturgeon in the Yellowstone River.

CLMU

(1) Evaluate spillway releases and/or flow-release scenarios from Missouri River dams (Fort Randall and Gavins Point dams) to improve habitat conditions in downstream reaches.
   (a) If necessary, implement spillway releases and/or alter flows to improve turbidity and temperature conditions in downstream reaches.

(2) Evaluate temperature control options on Fort Randall Dam to improve temperature conditions downstream.
   (a) If necessary, implement temperature control options on Fort Randall Dam to improve temperature conditions downstream.

(3) Evaluate the feasibility of increasing sediment transport downstream from Gavins Point Dam (i.e., assess the feasibility of: relocating the dam to a point upstream of the Niobrara River confluence, re-routing the Niobrara River to confluence with the Missouri River downstream of Gavins Point Dam, modifying flows from the dam, or removing Gavins Point Dam).
   (a) If feasible and necessary, implement method of increasing sediment transport downstream from Gavins Point Dam.

(4) Modify flows from Gavins Point Dam to facilitate successful migration, spawning, and survival of pallid sturgeon upstream of the Platte River confluence.
   (a) If feasible and necessary, implement flow modifications re-create elements of the hydrograph necessary for the appropriate and successful migration and spawning of pallid sturgeon above the Platte River.

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1.1.2 RESTORE HABITAT CONNECTIVITY WHERE BARRIERS TO FISH MOVEMENT OCCUR

Evaluating the degree to which a structure may impede movements is necessary to determine if passage is needed at a particular structure. Additionally, existing structures that are barriers to fish movement likely prevent spread of aquatic nuisance species so careful analysis is need to consider the tradeoffs associated with removing barriers. Passage assessments must consider this as well as the importance for recovery. Following is a list of barriers by management unit that either have been assessed for passage needs or need to be further evaluated.

GPMU

(1) Restore fish passage at Intake Diversion Dam, Yellowstone River.
   (a) Evaluate success of fish passage at Intake Dam once completed.

(2) Evaluate need for passage of Pallid Sturgeon at Cartersville Diversion Dam, Yellowstone River.
   (a) Restore passage at Cartersville Dam if deemed necessary for Pallid Sturgeon recovery.

(3) Evaluate need for passage of Pallid Sturgeon at Vandalia Diversion Dam, Milk River.
   (a) Restore passage at Vandalia Diversion if deemed necessary for Pallid Sturgeon recovery.

CLMU

(1) Evaluate need for passage of Pallid Sturgeon at Spencer Dam, Niobrara River.
   (a) Restore passage at Spencer Dam if deemed necessary for Pallid Sturgeon recovery.

(2) Evaluate need for passage of Pallid Sturgeon at the, Johnson County Weir, Kansas River.
   (a) Restore passage at Johnson County weir if deemed necessary for Pallid Sturgeon recovery.

(3) Evaluate need for passage of Pallid Sturgeon at the Bowersock Dam, Kansas River.
   (a) Restore passage at Bowersock Dam if deemed necessary for Pallid Sturgeon recovery.

IHMU

(1) Evaluate need for passage of Pallid Sturgeon at Chain of Rocks Weir, Mississippi River.
   (a) Restore passage at Chain of Rocks Weir if deemed necessary for Pallid Sturgeon recovery.

(2) Evaluate need for passage of Pallid Sturgeon at Melvin Price Locks and Dam, Mississippi River.
   (a) Restore passage at Melvin Price Locks and Dam if deemed necessary for Pallid Sturgeon recovery.

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(3) Evaluate need for passage of Pallid Sturgeon at Lower Osage Lock and Dam #1, Osage River.
    (a) Restore passage at Lower Osage Lock and Dam #1if deemed necessary for Pallid Sturgeon recovery.

CPMU
(1) Evaluate need for passage of Pallid Sturgeon at the Wilbur D. Mills Dam on the Arkansas River.
    (a) Restore passage at the Wilbur D. Mills Dam if deemed necessary for Pallid Sturgeon recovery.
(2) Evaluate need for passage of Pallid Sturgeon at the W. G. Huxtable Pumping Plant on the St. Francis River.
    (a) Provide passage at the W. G. Huxtable Pumping Plant if deemed necessary for Pallid Sturgeon recovery.
(3) Evaluate the potential need for passage at the Old River Control Complex, Atchafalaya River.
    (a) Restore passage at the Old River Control Complex if deemed necessary for Pallid Sturgeon recovery.

1.1.3 CREATE PHYSICAL HABITAT AND RESTORE RIVERINE FUNCTION

The loss of physical habitat needed by Pallid Sturgeon has been documented. However, not all efforts to restore habitat will generate equal benefits. As an example, the practice of modifying dikes has been implemented at various locations within the Missouri and Mississippi rivers as means to create habitat and restore riverine function. However, evaluation of these practices suggests that the intended benefits may not be fully manifesting themselves (Ridenour et al. 2009: Schloesser et al. 2012). Thus, it is essential to evaluate existing efforts to create habitat as compared to using natural processes associated with flow and sediment manipulation from dams to form instream habitats. Additionally, when habitat restoration sites are cleared and grubbed, it may be beneficial to leave clearing and grubbing material in the project site as a source of woody debris. Important activities by management unit are identified below. Finally, operation of dams upstream of spawning areas can influence total drift distance needed for larval fish (Kynard et al. 2007). Reduction in flows at Fort Peck Dam also may assist with reducing total drift distance of larval fish.

GPMU, CLMU, IHMU
(1) Assess relationship of discharge to physical habitat creation and larval fish drift (shallow water habitat, sand bars) in river reaches important for recovery.
    (a) Monitor the outcomes of flow manipulations from dams, and use resulting information to improve techniques, using adaptive management principles.
    (b) Decrease releases from Fort Peck Dam during the larval drift period (based on monitoring and research, this drift likely occurs in late June to early July) to reduce larval drift rates.

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(2) Maintain lower reservoir pool levels downstream from important spawning areas to increase larval drift distance and provide both juvenile and adult habitats (see also Recovery Task 1.1.1).

GPMU, CLMU, IHMU, CPMU

(1) Protect, enhance, and restore habitat diversity and connectivity.
    (a) Pursue options to incorporate levee setbacks to increase flood plain connectivity.
    (b) Reconnect perched or disconnected side channels.
    (c) Develop programs that increase woody debris in these systems.
(2) Develop and maintain standardized monitoring programs to evaluate effects of habitat manipulation and annual variations to determine degrees of response in Pallid Sturgeon.
    (a) Monitor the outcomes of habitat manipulations, and use resulting information to improve habitat restoration and construction techniques, using adaptive management principles.

1.1.4 PROVIDE AND PROTECT INSTREAM FLOWS

Instream flows can be affected by water withdrawal. Over allocation of water resources can affect instream habitats by reducing the hydrograph or extreme flow depletions can render river reaches as uninhabitable for portions of the year. Understanding existing water allocations and projected withdrawal patterns is essential to evaluating the magnitude of effects associated with depletions and implementing flow protection strategies necessary to meet the life history needs of Pallid Sturgeon. Additionally, instream flows also can be affected daily and seasonally through reservoir operations. The following tasks are intended to increase the understanding of the effects of water depletion and reservoir operations on Pallid Sturgeon and their habitats and may be useful in better understanding the effects of climate change.

GPMU, CLMU, IHMU

(1) Develop an instream flow plan for riverine reaches important to Pallid Sturgeon recovery.
    (a) Assess tributary water allocations to determine depletion effects on habitat formation and maintenance.
    (b) Determine what flows are necessary to meet Pallid Sturgeon life history requirements.
        (i) Consider precipitation pattern models and climate change forecasts when developing flow requirements.
    (c) Implement flow protection strategies based on instream flow plan.
(2) Evaluate dam discharges during spring, summer, and fall (both main-stem and tributaries) to protect instream flows.
    (a) Manipulate reservoir releases if needed to protect or restore flows for recovery of Pallid Sturgeon.

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1.1.5 QUANTIFY AND MINIMIZE EFFECTS OF ENTRAINMENT

Studies at water diversion points have documented entrainment of Pallid Sturgeon. However, not all sites have been assessed to determine and quantify entrainment effects. Thus, it will be necessary to assess and quantify entrainment losses of Pallid Sturgeon at industrial, municipal, and agricultural water intakes, pumping facilities, and other diversion structures. The U.S. Environmental Protection Agency administers the Clean Water Act and should develop and implement section 316 (b) standards that will minimize entrainment of adult and juvenile Pallid Sturgeon. The Bureau of Reclamation and Natural Resources Conservation Service develop and operate many irrigation projects within the range of Pallid Sturgeon. Where necessary these projects should be fitted with screens that will minimize or prevent entrainment.

GPMU, CLMU, IHMU, CPMU

(1) Assess potential for entrainment losses at industrial, municipal, and agricultural water intakes, pumping facilities, and other diversion structures.
    (a) Implement strategies to prevent/minimize entrainment.

CLMU, IHMU, CPMU

(1) Assess potential for entrainment losses associated with commercial navigation/towboat entrainment.
    (a) Implement strategies to prevent/minimize entrainment.
(2) Inventory and assess potential for entrainment losses associated with dredging and gravel mining operations.
    (a) Implement strategies to prevent/minimize entrainment.

1.1.6 PROVIDE PROTECTION FOR IMPORTANT HABITAT FORMING PROCESSESS

Natural erosion and deposition processes create dynamic and diverse riverine habitats. Protecting these ecological processes will facilitate naturally creating habitats important for Pallid Sturgeon. There are tools being developed that can help guide these actions. Examples include the land Capability Potential Index (Jacobsen et al. 2007) and the Channel Migration Zone delineation developed as part of the cumulative effects study on the Yellowstone River (Thatcher et al. 2009) This measure will involve developing new programs and expanding existing ones to develop partnerships necessary to conserve these important areas.

GPMU, CLMU, IHMU, CPMU

(1) Develop and implement non-regulatory mechanisms to retain natural riverine ecological processes.
    (a) Develop programs that provide conservation incentives to willing participants.
        (i) Establish easements to reduce bank armoring in reaches important for Pallid Sturgeon.

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(ii) Enroll adjacent riparian lands from willing participants in long-term conservation easements.
(iii) Purchase land from willing sellers and place in public trust (i.e., refuges, State parks).
(iv) Establish water conservation programs to offset anticipated lower late-season flows associated with climate change.

(b) Develop additional landscape-level tools to improve assessment and prioritization of non-regulatory conservation efforts.

1.2 MINIMIZE THREATS FROM EXISTING AND PROPOSED HUMAN-CAUSED ACTIVIES

Current State and Federal regulations generally benefit Pallid Sturgeon by providing oversight on anthropogenic activities. However, not all State and Federal regulations have established standards that are applicable to Pallid Sturgeon. In many instances, necessary data are lacking to establish thresholds or for comprehensive review. However where empirically derived Pallid Sturgeon data exist, improving data exchange, (i.e., a centralized easily accessible repository for Pallid Sturgeon data accessible by agency regulatory personnel) will allow for improved evaluation of effects within the permitting processes.

1.2.1 ENSURE COMPLIANCE WITH EXISTING STATE AND FEDERAL ENVIRONMENTAL REGULATIONS

The U.S. Environmental Protection Agency and State environmental divisions have rules and regulations designed to maintain water quality standards. These standards may need to be modified to protect Pallid Sturgeon based on Task 2.1.4.

The U.S. Army Corps of Engineers is responsible for administering Section 404 of the Clean Water Act. Efforts conducted to fulfill components of Tasks 1.1.1-1.1.3 will need to be considered in future 404 permits to limit inputs into those areas where habitats have been restored or protected to benefit Pallid Sturgeon.

The Federal Energy Regulatory Commission regulates interstate transmission of electricity as well as licensing hydropower projects. As part of the licensing process, Federal Energy Regulatory Commission should evaluate projects and their potential effects on Pallid Sturgeon life history requirements.

Any future introductions of nonnative fish species (i.e., aquaculture) may introduce diseases, increase competition, or result in predation on Pallid Sturgeon. Stocking new nonindigineous species anywhere in the Missouri and Mississippi river watersheds must not occur until after a risk assessment is completed that considers potential adverse effects to Pallid Sturgeon.

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GPMU, CLMU, IHMU, CPMU

(1) Develop a viable data sharing platform that will enable both regulatory and action-agencies access to the best available science for improved species consideration in consultations, permit issuance, and restoration efforts.

(2) Work with States to develop a policy that will establish risk assessment evaluations prior to introduction of new nonindigenous and exotic species in the Missouri and Mississippi river basins. Only introductions proved not to be deleterious to Pallid Sturgeon should be allowed.

(3) Continue to enforce State and Federal water quality standards.

1.2.2 EVALUATE INVASIVE SPECIES/AQUATIC NUISANCE SPECIES

Potential threats from invasive or aquatic nuisance species include increased predation on eggs, larval, or juvenile life stages, competition for food in the case of the carps, exclusion of native species from preferred habitats, spread of diseases or parasites, and alteration of habitat quality. Further study is needed to fully qualify and quantify the magnitude of this probable threat to Pallid Sturgeon. The results of these investigations should be used to implement eradication or control efforts consistent with Pallid Sturgeon recovery.

GPMU, CLMU, IHMU, CPMU

(1) Where applicable, assess the effects of invasive or aquatic nuisance species to increase the understanding of these organisms and the magnitude of their status as a threat to Pallid Sturgeon.

    (a) If necessary, implement control measures to minimize adverse effects resulting from of invasive or aquatic nuisance species.

2. CONDUCT RESEARCH NECESSARY FOR SURVIVAL AND RECOVERY OF PALLID STURGEON

2.1 RESOLVE SPECIES IDENTIFICATION ISSUES IN THE LOWER MISSOURI AND MIDDLE MISSISSIPPI RIVERS.

The lower Missouri and Mississippi rivers contain sturgeon specimens that appear phenotypically and genotypically intermediate between Pallid and Shovelnose sturgeon. Development of accurate species classification indices and genetic tests are essential to ensure correct species assignment for population status evaluations.

2.1.1 DEVELOP METHODS FOR ACCURATE SPECIES ASSIGNMENT

IHMU, CPMU

(1) Use genetic and morphological data to test for significant agreement among these methods.

(2) If no association exists, reevaluate morphological characters in light of the genetic data.

    (a) Develop improved morphological based identification methods.

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2.2 OBTAIN INFORMATION ON LIFE HISTORY AND HABITAT REQUIREMENTS OF ALL LIFE STAGES OF PALLID STURGEON

While much has been learned about the species since it was listed, data gaps still exist that prevent us from understanding how to recover the Pallid Sturgeon. Filling these gaps will facilitate management actions and improve efforts to address the five listing factors. Where spawning has been found to occur, spawning habitats must be characterized. If spawning habitats are limited or found to be excessive due to system alterations in certain reaches, this information should be considered when habitat restoration projects are developed (see Task 1.1.3). After spawning success has been documented, spawning success/failure should be quantified in each management unit based on collections of eggs, larvae and young-of-year. These data will help guide adaptive programs to improve efficiency in habitat conservation and restoration efforts.

2.2.1 EVALUATE SEXUAL MATURITY AND SPAWNING LIFE HISTORY PARAMETERS

GPMU, CLMU, IHMU, CPMU

(1) Evaluate if spawning occurs, identify spawning areas, and characterize spawning habitat within each management unit.
(2) Estimate sex ratios, spawning periodicity, and reproductive structure of adult population.
(3) Identify and evaluate spawning site fidelity.

2.2.2 FILL INFORMATION GAPS FOR AGE-0 TO AGE-1 PALLID STURGEON

GPMU, CLMU, IHMU, CPMU

(1) Improve methods to better distinguish larvae and juvenile Pallid Sturgeon from larvae and juvenile Shovelnose Sturgeon.
(2) Quantify spawning success/failure in the Missouri and Mississippi rivers and tributaries based on collections of larvae and/or young-of-year.
(3) Quantify drift-transport distance/retention of larvae in the Missouri and Mississippi rivers and tributaries.
(4) Test the hypothesis that larvae and juveniles cannot survive in reservoirs.
(5) Investigate imprinting during the early life history stages as a mechanism to stimulate homing/spawning site fidelity.
(6) Quantify growth and survival rates from hatch through the transition to exogenous feeding, and from the onset of exogenous feeding through the termination of the growing season as related to environmental conditions (e.g., temperature, dissolved oxygen, food type, and ration size).
(7) Identify and describe habitat requirements for larvae and age-0 juveniles.
    (a) Use this information to determine if habitat is limiting this life stage.

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2.2.3 FILL INFORMATION GAPS FOR AGE-1 TO SEXUAL MATURITY PALLID STURGEON

GPMU, CLMU, IHMU, CPMU

(1) Identify and describe habitat requirements for juvenile Pallid Sturgeon.
    (a) Use this information to determine if habitat is limiting this life stage.
(2) Diet information;
    (a) Obtain appropriate diet information
    (b) Quantify diets and describe trophic linkages.
    (c) Assess if food/feeding is limiting this life stage.

2.2.4 INVESTIGATE EFFECTS OF ENVIRONMENTAL CONTAMINANTS ON ALL PALLID STURGEON LIFE HISTORY STAGES

Current data are lacking to adequately quantify this threat under existing environmental laws. Research suggests a link between environmental contaminants and potential reproductive problems in several sturgeon species (Feist et al. 2005; Koch et al. 2006b). Research on the effects of contaminants on Pallid Sturgeon reproductive mechanisms should continue as part of Pallid Sturgeon recovery efforts. Once contaminants affecting Pallid Sturgeon are identified and their effects are understood, plans may need to be developed to eliminate point and non-point sources into the Missouri and Mississippi river watersheds. These actions will need to be coordinated with the U.S. Environmental Protection Agency, State agencies with jurisdiction over water quality, and the USFWS' contaminants program. These data will be necessary to evaluate current water quality parameters and contaminants of concern relative to Pallid Sturgeon. If necessary, these data will help establish water quality standards sufficient to meet the life history requirements of the species.

GPMU, CLMU, IHMU, CPMU

(1) Monitor contaminant levels in wild populations to identify problem contaminants.
(2) Determine effects of problem contaminants on growth, survival, and reproduction of Pallid Sturgeon.
    (a) Evaluate contaminant effects on adult fish, gamete development, and reproductive success.
    (b) Evaluate contaminant effects on embryo/larval and juvenile development and survival.
(3) Identify and remedy sources of problem contaminants.

3. OBTAIN INFORMATION ON POPULATION GENETICS, STATUS, AND TRENDS

Having adequate information on this species' demographic structure and trends through time is fundamental to evaluate when recovery criteria requirements have been met. Consistent range-wide monitoring efforts are essential to evaluating the species responses to recovery tasks as well as threats as they are addressed.

3.1 DEVELOP AND IMPLEMENT STANDARD MONITORING PROCEDURES FOR PALLID STURGEON THROUGHOUT THE RANGE

Monitoring is essential to understanding the species' status, evaluating responses to management actions, and tracking recovery progress (Campbell et al. 2002). Currently, there is no funded systematic monitoring program. Existing monitoring efforts on the Missouri River are primarily conducted through the Pallid Sturgeon Population Assessment Program and are focused on detecting changes in Pallid Sturgeon and other species' population trends in response to habitat restoration practices. Data from these efforts have been useful in evaluating success of some recovery tasks like stocking, survival, distribution, and population growth; however, geographic expansion of this program could provide much or all of the data necessary to facilitate evaluating delisting and downlisting criteria. While assessment efforts on the Missouri River are a good foundation for monitoring, large river reaches fall outside of existing funded monitoring efforts, including; the middle and lower Mississippi River, the Atchafalaya River, the Missouri River upstream of Fort Peck Dam, and the Yellowstone River. Thus, large portions of the range have limited or no standardized monitoring.

GPMU, CLMU, IHMU, CPMU

(1) Develop and implement a range-wide Pallid Sturgeon monitoring program that will provide adequate data to evaluate progress toward downlisting and delisting criteria.
(2) Implement range-wide standardized reporting requirements for population monitoring projects.
(3) Continue to update, as needed, and implement the "Biological procedures and protocols for researchers and managers handling Pallid Sturgeon" range-wide.
(4) Develop a range-wide standardized database to integrate monitoring, propagation, stocking, and genetic data to meet reporting requirements that measure progress toward recovery.

3.2 MONITOR GENETIC MAKEUP OF PALLID STURGEON

Additional research is necessary to evaluate genetic differences across the species' range. Currently, there is a data gap in the lower Mississippi River and portions of the lower Missouri River. These data are essential for defining genetically meaningful management units and for understanding evolutionary trends, reproductive exchange among areas, and hybridization.

GPMU, CLMU, IHMU, CPMU

(1) Develop and implement a range-wide monitoring program that will provide adequate genetic data to guide stocking practices.
(2) Implement range-wide standardization among genetic labs work with Pallid Sturgeon.
(3) Implement range-wide standardized analysis and reporting requirements for all genetic data.

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(4) Integrate archival catalogs of genetic samples and genetic results with standardized monitoring and stocking databases.
(5) Continue to assess relationship and justification of management units.
(6) Continue to maintain a range-wide tissue sample archiving as described in the "Biological procedures and protocols for researchers and managers handling Pallid Sturgeon".

3.3 ASSSESS STRUCTURE OF PALLID STURGEON POPULATION RANGE-WIDE FOR CONSIDERATION OF DISTINCT POPULATION SEGMENTS.

When Pallid Sturgeon were listed in 1990 (55 FR 36641-36647), data were not available regarding range-wide population structure, and a policy on DPSs did not exist. Subsequently, the Departments of Interior and Commerce jointly developed a DPS policy in 1996 (61 FR 4722-4725). This policy describes elements necessary to identify a DPS: 1) population discreteness and 2) population significance.

Data indicate that the population of Pallid Sturgeon in the upper Missouri River may meet the DPS policy criteria of discreteness (61 FR 4722-4725). They are genetically distinct from Pallid Sturgeon in the middle and lowermost portions of the range (Campton et al. 2000; Tranah et al. 2001; Schrey 2007; Schrey and Heist 2007), and they are physically separated by multiple dams. However, these studies lack adequate samples from portions of the Mississippi River, making it difficult to discern if additional discrete populations exist.

GPMU
(1) Evaluate population significance as defined in the DPS policy
(2) Evaluate conservation status as defined in the DPS policy.
(3) If conservation status assessment indicates a change is appropriate which will meaningfully advance conservation or significantly limit unnecessary regulation, identify and list appropriate DPS(s), if appropriate.

CLMU, IHMU, CPMU
(1) Continue collection and evaluation of genetic, ecological, behavioral, and physiological data to identify if additional populations meet the discreteness criteria as defined in the DPS policy.
(2) If additional discrete populations exist, evaluate their significance as defined in the DPS policy.
(3) If additional discrete and significant populations exist, evaluate their conservation status as defined in the DPS policy.
(4) If conservation status assessment indicates a change is appropriate which will meaningfully advance conservation or significantly limit unnecessary regulation, identify and list appropriate DPS(s), if appropriate.

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3.4 CONDUCT A POPULATION VIABILITY ANALYSIS

A population viability analysis (PVA) should be conducted to further quantify population levels for recovery goals.

Criteria addressing minimum viable population size and demography will be useful in assessing if populations can persist through natural reproduction and, thus, will be an important component to evaluate the criteria for downlisting or delisting Pallid Sturgeon. A PVA also can be a useful tool for developing minimum viable population size estimates (Reed et al. 2003). All monitoring activities (see task 3.1) should consider the data requirements necessary to conduct PVA and should be designed to provide these data (Morris et al. 2002).

GPMU, CLMU, IHMU, CPMU

(1) Identify and collect data necessary to develop management unit or DPS (if designated) specific PVAs.

(2) Estimate management unit or DPS (if designated) specific minimum viable population size.

(2) Update PVA models as new data are available to facilitate downlisting and delisting criteria evaluations.

4. IMPLEMENT AND EVALUATION A CONSERVATION PROPAGATION AND STOCKING PROGRAM

4.1 IMPLEMENT CONSERVATION PROPAGATION AND STOCKING PROGRAM

Current stocking efforts are conducted in accordance with a range-wide stocking plan (USFWS 2008). This plan should be amended if necessary using adaptive management principles as new data become available from Tasks 3.1-3.3 and 4.2.

GPMU, CLMU, IHMU, CPMU

(1) Annually review, update if necessary, and implement range-wide stocking and propagation plans using the most recent information.

(2) Annually review and update the tagging plans with the most recent information.
- (a) Improve tagging mechanisms to minimize tag loss/failure in hatchery produced fish.
  - (i) Ensure that genetic samples are collected from all fish used in propagation efforts.
  - (ii) Continue to evaluate tag placement location for improved PIT tag retention.
  - (iii) Ensure that all monitoring crews have appropriate tag reading equipment.
- (b) Ensure that all field crews throughout the Missouri and Mississippi River drainages have appropriate equipment to read tags.
- (c) Implement tagging plan.

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4.2 EVALUATE SUCCESS OF PROPAGATION AND STOCKING PROGRAM

GPMU, CLMU, IHMU, CPMU

(1) Evaluate Pallid Sturgeon supplementation using various age classes of progeny.
    (a) Use data to derive Pallid Sturgeon specific survival rates where stocking occurs.
    (b) Use data to refine stocking strategies:
        (i) Determine optimal stocking numbers,
        (ii) Determine optimal stocking size,
        (iii) Determine optimal stocking time and location.
    (c) Evaluate dispersal of hatchery progeny.
    (d) Evaluate effectiveness of hatchery products within each management unit.
    (e) Determine when stocking is no longer needed.
(2) Ensure that hatchery stocking and propagation records are incorporated into integrated a range-wide species recovery database.

4.3 RESEARCH METHODS TO IMPROVE SPAWNING, CULTURING, REARING, AND STOCKING OF PALLID STURGEON

GPMU, CLMU, IHMU

(1) Continue to refine efficient, effective spawning techniques in the hatcheries and in the field.
(2) Conduct trials to determine spawning requirements of broodstock (e.g., optimal spawning temperature) and methods for maximizing survival and growth of progeny collected from broodstock.
(3) Continue to refine techniques to improve hatchery product quality and survivability.
(4) Continue to refine and improve cryopreservation techniques.
    (a) Insure cryopreservation program is adequately funded to maintain preserved sperm as long as necessary.

5. COORDINATE AND IMPLEMENT CONSERVATION AND RECOVERY OF PALLID STURGEON

5.1 WORK WITH STAKEHOLDERS/PARTNERS TO MAINTAIN AND / OR INCREASE PALLID STURGEON NUMBERS RANGE-WIDE (IN ALL MANAGEMENT UNITS).

GPMU, CLMU, IHMU, CPMU

(1) Collaborate with governmental agencies at all levels; local universities, land managers, private land owners, industry, and the general public to recover the Pallid Sturgeon.
    (a) Enlist State agencies / State managers in regional and range-wide recovery efforts for the Pallid Sturgeon.
    (b) Determine ways to improve communication and find innovative methods to work closely with Federal and State regulatory partners to improve upon recovery efforts for this fish.

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(c) Engage local communities, businesses, aquariums, non-governmental organizations, and others to support Pallid Sturgeon.

5.2 COMMUNICATE WITH STURGEON RESEARCHERS, MANAGERS, AND THE PUBLIC

GPMU, CLMU, IHMU, CPMU

(1) Develop a method to integrate and incorporate information from all researchers and biologists working with Pallid Sturgeon.
   (a) Ensure that Federal endangered species permits are reviewed in a timely manner and coordinated such that annual reporting requirements are met and that Pallid Sturgeon collection and morphologic data and genetic tissue samples are provided to the appropriate repositories.
   (b) Identify disparate data sources necessary to evaluate progress toward downlisting and delisting criteria.
      (i) Develop a range-wide data management and archiving strategy/plan to relationally link data necessary to evaluate progress toward downlisting and delisting criteria.
      (ii) Implement data management and archiving strategy/plan.
      (iii) Review and update data management and archiving strategy/plan as data needs and as technology changes.
   (c) Annually update central database using permit reporting data.
   (d) Improve and maintain central clearinghouse of Pallid Sturgeon bio-data and encounter history.

(2) Develop a web-based application related to Pallid Sturgeon life history that has direct links to scientific literature and current research.

(3) Improve dissemination of up-to-date information on Pallid Sturgeon (including research, new program updates, etc.).
   (a) Hold a range-wide "*Scaphirhynchus*" conference at least every 5 years.
   (b) Produce and share basin specific reports on Pallid Sturgeon through a user friendly outlet.
   (c) Encourage and support publication of research, management, and other recovery-related information.

(4) Collaborate with partners and develop an outreach program that highlights the Pallid Sturgeon and its ecosystem and the importance of protecting this fish
   (a) Develop and distribute information and education materials on Pallid Sturgeon and its ecosystem.
   (b) Increase public awareness of the laws and needs for protecting Pallid Sturgeon and their habitats.
   (c) Provide cultured Pallid Sturgeon to aquaria and comparable facilities where they can be viewed by the public.
   (d) Develop activities and materials for grade, middle, and high school teachers.

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(e) Establish signs at all public boat ramps accessing the Missouri and Mississippi rivers describing Pallid Sturgeon.

6.0 POST DOWNLISTING OR DELISTING PLANNING

(1) Work with partners (including State and Federal agencies and others) to develop a post delisting management and monitoring strategy as progress is gained toward full recovery of this species.
(a) Develop and implement a post downlisting or delisting range-wide monitoring plan.

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Part III: Implementation Schedule

Recovery plans are intended to assist the USFWS and potential Federal, State, and private partners in implementing actions to recover and/or protect endangered species. The following Implementation Schedule outlines recovery tasks, task priorities, task descriptions task duration, and estimated task costs for this recovery plan (2014-2047).

Parties with authority, responsibility, or expressed interest to implement specific recovery tasks are identified in the Implementation Schedule. The identification of agencies within the Schedule does not imply a requirement or that prior approval has been granted by that party to participate nor does it constitute and additional legal responsibilities beyond existing authorities, i.e., Endangered Species Act, Clean Water Act, Federal Land Policy and Management Act, etc. Recovery plans do not obligate other parties to implement specific tasks and may not represent the views, official positions, or approval of any individuals or agencies involved with developing the plan, other than the USFWS.

Recovery tasks are assigned numerical priorities to highlight the relative contribution they may make to species recovery. Priority numbers in column 1 of the schedule are defined as follows:

Priority 1	All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
Priority 2	All actions that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
Priority 3	All other action necessary to provide for reclassification or full recovery of the species.

The cost estimates provided in the Schedule identify foreseeable expenditures that could be made to implement the specific recovery tasks. Accurate cost estimates were not practicable to derive for some recovery tasks due to the complex nature of the action (i.e., availability of willing sellers of private property rights, changes in existing laws, etc.). Additionally, some of the costs of identified tasks may be wholly or partially funded under existing State or Federal programs intended to fulfill the requirements of existing laws or regulations outside of the Endangered Species Act, but ultimately may provide benefits to Pallid Sturgeon. As such, these costs are difficult to estimate and not included in the calculation of the costs estimates for downlisting and delisting.

Actual expenditures by identified agencies/partners will be contingent upon appropriations and other budgetary constraints.

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Key to acronyms used in Implementation Schedule

BOR	U.S. Bureau of Reclamation
COE	U.S. Army Corps of Engineers
ES	Ecological Services Division (USFWS)
EPA	U. S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FR	Fisheries Division (USFWS)
NRCS	Natural Resources Conservation Service, U.S. Department of Agriculture
LE	Law Enforcement (USFWS)
RF	Refuge Division (USFWS)
STATES	State agencies located within the range of the species
USGS	U. S. Geological Survey
WAPA	Western Area Power Administration

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Implementation Schedule

Pallid Sturgeon Recovery Plan Implementation Schedule												
Priority	Task #	Task Description*	Task Duration	RESPONSIBLE PARTY			COST ESTIMATES (thousands of dollars)					COMMENTS/NOTES
				USFWS		OTHER	2014 -2018	2019 -2024	2025 -2030	2031 -2040	2040 -2047	
				REGION	DIVISION							
1	1.1.1	Determine effects of dams on limiting recruitment and survival of Pallid Sturgeon	3	6	FR, ES	BOR, COE, STATES	300	600				Costs estimate based on focused research projects for evaluation of identified structures.
1	1.1.2	Restore habitat connectivity where barriers to fish movement occur	5+	6	FR, ES, RF	BOR, COE, STATES	43,000	40,000	27,000			Cost estimates impossible to derive as each barrier will likely require a unique solution.
1	1.1.3	Create physical habitat and restore riverine function	5+	3,4,6	FR, ES	COE, BOR,	6,000	6,000	3,000			
1	1.1.4	Provide and protect instream flows	5+	3,4,6	FR, ES	COE, BOR, NRCS,USFWS, STATES						Cost estimates impossible to derive.
1	1.1.5	Quantify and minimize effects of entrainment	5+	3,4,6	FR, ES	COE, BOR, EPA, NRCS, FERC, STATES	27,000	18,000	17,000			
1	1.1.6	Provide protection for important habitat forming processes	5+	3,4,6	FR, ES, RF	COE, BOR, EPA, NRCS,STATES	5,000	5,000	5,000	5,000	5,000	
1	1.2.1	Ensure compliance with existing State and Federal environmental regulations	ongoing	3,4,6	ES	COE, BOR, EPA, FERC, STATES						Cost may be absorbed under existing programs.
2	1.2.2	Evaluate invasive species/ Aquatic Nuisance Species	3+	3, 4, 6	FR, ES	USFWS, STATES						Cost may be absorbed under existing programs.
1	2.1.1	Develop methods for accurate species assignment	3	3,4,6	FR, ES	USFWS, COE	150	150				
1	2.2.1	Evaluate sexual maturity and spawning life history parameters	3	3,4,6	FR, ES	USGS, COE, BOR, STATES	750	750				
1	2.2.2	Fill information gaps for - Age-0 to Age-1 Pallid Sturgeon	3	3,4,6	FR, ES	USGS, COE, BOR, STATES	750	750				
1	2.2.3	Fill information gaps for - Age-1 to sexually mature Pallid Sturgeon	3	3,4,6	FR, ES	USGS, COE, BOR, STATES	750	750				

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Implementation Schedule (continued)

Pallid Sturgeon Recovery Plan Implementation Schedule												
Priority	Task #	Task Description*	Task Duration	RESPONSIBLE PARTY			COST ESTIMATES (thousands of dollars)					COMMENTS/NOTES
				USFWS		OTHER	2014 - 2018	2019 - 2024	2025 - 2030	2031 - 2040	2040 - 2047	
				REGION	DIVISION							
1	3.1	Monitor Pallid Sturgeon population	5+	3,4,6	FR	COE, BOR, USGS, STATES	3,000	3,000	3,000	3,000	3,000	
1	3.2	Monitor genetic makeup of Pallid Sturgeon	5+	3,4,6	FR, ES	COE, USFWS, STATES	200	200	200	200	200	
3	3.3	Assess population for consideration of DPSs	5+	3,4,6	FR,ES	USFWS		20				Some cost may be absorbed under existing programs.
2	3.4	Conduct a population Viability Analysis	4	3,4,6	FR, ES	USGS, COE, BOR		100	100			Data analysis. Data collection costs absorbed under existing programs
1	4.1	Conservation propagation and stocking program	5+	3,6	FR	COE, BOR, STATES	925	1025	550			
1	4.2	Evaluate success of propagation and stocking program	5+	3,4,6	FR	COE, BOR, STATES	75	75	50	50		Data analysis. Data collection costs absorbed under existing programs
2	4.3	Research to improve spawning, culturing, rearing and stocking	3	3,4,6	FR, ES	USGS, COE, BOR, STATES	150	150				Cost may be absorbed under existing programs
1	5.1	Work with stakeholders/partners to maintain and/or increase Pallid Sturgeon numbers range-wide.	ongoing	3,4,6	FR, ES, RF	USGS, COE, BOR, STATES	200	200	200	200	200	Cost may be absorbed under existing programs
3	5.2	Communicate with sturgeon researchers, managers, and the public.	5+	3,4,6	FR, ES	USGS, COE, BOR, STATES	200	200	200	200	200	Cost may be absorbed under existing programs
3	6.1	Post downlisting or delisting planning.	3	3,4,6	FR, ES	USGS, COE, BOR, USFWS, STATES, WAPA, NRCS			100	100		

*detailed description available in Recovery Outline/Narrative section.

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APPENDIX A: *State Regulatory Requirements*

The table that follows lists the major state laws that establish requirements, permits, approvals, or consultations that may apply to projects in or near waterways that may affect water quality or quantity.

The citations in this table are those of the general statutory authority that governs the indicated category of activities to be undertaken.
Under such statutory authority, the lead state agencies may have promulgated implementing regulations that set forth the detailed procedures for permitting and compliance.

Definitions of abbreviations used in the table are provided here.

ACA Arkansas Code, Annotated
IAC Iowa Code
ILCS Illinois Compiled Statutes
KAR Kentucky Administrative Regulations
KSA Kansas Statues Annotated
LAC Louisiana Administrative Code
MCA Montana Code Annotated
MSC Mississippi Code
MRS Missouri Revised Statutes
NDCC North Dakota Century Code
NRS Nebraska Revised Statute
SDAR South Dakota Administrative Rules
TCA Tennessee Code Annotated

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Table B State Statues Related to Water Quality and Usage.

	AUTHORITY	CITATION
Arkansas	Arkansas Water and Air Pollution Control Act (ACA §§ 8-4-101 et seq.) Arkansas Water Resources Development Act of 1981 (ACA §§ 15-22-601 to 15-22-622) Arkansas Natural and Scenic Rivers System Act (ACA §§ 15-23-301 to 15-23-315) Flood Control (ACA §§ 15-24-101 et seq,)	
Illinois	Environmental Protection Act (ILCS §§ 415-5-1 et seq.) Water Pollutant Discharge Act (ILCS §§ 415-25-.01 et seq.) Watershed Improvement Act (ILCS §§ 505-140-.01 et seq.) Water Use Act of 1983 (ILCS §§ 525-45-1 et seq.)	
Iowa	Surface Water Protection and Flood Mitigation Act (IAC §§ 466B.1 to 466B.9) Initiative on Improving Our Watershed Attributes (I on IOWA) (IAC §§ 466-1 to 466-9) Protected Water Area Systems (IAC §§ 462-B.1 to 462-B.16) Public Lands and Waters (IAC §§ 461-A.1 to 462-A.80) Soil Conservation Districts Law (IAC §§ 161-A.1 to 161-A.80)	
Kansas	State Water Resource Planning (KSA §§ 82a-901 to 82a-954) Bank Stabilization Projects (KSA §§ 82a-1101 to 82a-1103)	
Kentucky	Designation of uses of surface waters (401 KAR 5:206) Anti-degradation policy (401 KAR 5:030) Surface Water Standards (401 KAR 5:031)	
Louisiana	Louisiana Environmental Quality Act (LAC §§30-II-2001 to 2566) Surface Water Quality Standards (LAC §§ 33-IX-1101 et seq.)	
Mississippi	Mississippi Air and Water Pollution Control Law (MSC §§ 49-17-1 to 49-17-43)	
Missouri	Missouri Clean Water Law (MRS §§ 640.010 et seq. and §§ 644.006 et seq.)	
Montana	Aquatic Ecosystem Protections (MCA §§ 75-7-101 et seq.) Flood Plain and Floodway Management (MCA §§ 76-5-101 et seq.) Surface Water and Groundwater (MCA §§ 85-2-101 et seq.) Public Water Supplies, Distribution and Treatment (MCA §§ 75-6-101 et seq.) Water Quality (MCA §§ 75-5-101 et seq.) Montana Water Use Act (MCA § 85-2-101 et seq.).	
Nebraska	Environmental Protection Act (NRS §§ 81-1501 et seq.)	
North Dakota	Control, prevention, and abatement of pollution of surface waters (NDCC §§ 61-28-01 et seq.)	
South Dakota	Surface Water Quality Standards (SDAR §§ 74-51-01 et seq.)	
Tennessee	Tennessee Water Quality Control Act of 1977 (TCA §. 69-3-101 et seq.) General Water Quality Criteria (§§1200-4-3-01 et seq.) Use Classification for Surface Waters (§§1200-4-4-01 et seq.)	

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APPENDIX B: *Summary of Public Comments*

On March 15, 2013, we published a notice in the Federal Register soliciting public comments on our release of a draft revised recovery plan for the endangered Pallid Sturgeon (51 FR 16526).

The new revised recovery plan constitutes the first revision of the recovery plan since 1993. The revised recovery plan documents the current understanding of the species' life history requirements, identifies probable threats that were not originally recognized, includes revised recovery criteria, and based on improved understanding of the species, describes those actions believed necessary to eventually delist the species.

In our announcement, we request assistance in the recovery plan revision effort by providing the public with the opportunity to review the revised plan and solicited any additional information related to Pallid Sturgeon that was not already included in the draft revision. Specifically, we requested any new information, analyses, or reports that summarize and interpret: population status and threats, demographic or population trends; genetics and competition; dispersal and habitat use; habitat condition or amount; and adequacy of existing regulatory mechanisms, management, and conservation planning.

Concurrent with the public comment period, we solicited independent peer review of the document from four individuals prominent in the field of sturgeon biology, ecology, and/or large river ecosystems.

The 60-day public comment period closed on May 14, 2013 and we are grateful for the contributions from those who provided information during this review and comment period. This input ultimately improved the information contained within this revision to our 1993 Pallid Sturgeon Recovery Plan.

Peer-review and public comments ranged from minor editorial suggestions to providing new information. As appropriate, we have incorporated all applicable comments into the text of this revised recovery plan. All comment letters are on file at the Montana Fish and Wildlife Conservation Office, 2900 4th Ave. North, Suite 301, Billings, Montana 59101.

List of Commenters:

PEER REVIEWERS:

Dr. Craig Paukert
Missouri Cooperative Fish
and Wildlife Research Unit
University of Missouri
302 Anheuser-Busch Nat Res
Bldg.,
Columbia, MO 65211

Dr. Mark Pegg
School of Natural Resources
University of Nebraska
402 Hardin Hall
Lincoln, NE 68583

Dr. Kenneth J. Sulak
U.S. Geological Survey
Southeast Ecological Science
Center
7920 NW 71st St.
Gainesville, FL 32653

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ADDITIONAL COMMENTERS:

Montana Fish Wildlife and Parks

Nebraska Game and Parks Commission

Missouri Department of Conservation

South Dakota Dept. of Game, Fish, and Parks

National Park Service,
Biological Resource Management Division

U.S. Army Corps of Engineers,
Mississippi Valley Division

Following are those substantive comments that were not addressed in the final Pallid Sturgeon Recovery Plan, along with our response to each comment. Comments are arranged into the following categories – general information, downlisting/delisting criteria, and recovery tasks.

GENERAL INFORMATION

Comment 1: One reviewer questioned how we can conclude the Pallid Sturgeon population is stable when very large sections of the range have no population estimates?

Response 1: In this context, a stable population is one that is in a relatively steady-state either artificially or naturally. A stable designation, however, is not meant to imply that the population is viable, self-sustaining, or recovered. Our conclusion that the Pallid Sturgeon population is stable is based on a variety of factors including, but not limited to:

1) The success of the Pallid Sturgeon Conservation Augmentation Program (PSCAP). As a result of the PSCAP, multiple year-classes have been established and current survival estimates suggest that long-term persistence of the species is anticipated to occur in those reaches where localized extirpation appeared imminent prior to implementation of the PSCAP.

2) Long-term sampling data in many portions of the range with relatively consistent catch-per-unit-effort data;

3) Population abundance estimates, where available; and

4) Implementation of the Similarity of Appearance Rule to reduce or eliminate harvest of Pallid Sturgeon in association with commercial shovelnose sturgeon harvest.

Comment 2: One commenter suggested the section describing the diets of Pallid Sturgeon should mention the importance of native large-river minnow species.

Response 2: We acknowledge that limited data suggest that native turbid-adapted cyprinid species have been documented as a food item for Pallid Sturgeon and several species of these minnows have declined coincident with Pallid Sturgeon. However, while it has been documented that Pallid Sturgeon consume native large-river minnow species, where they are relatively abundant, their overall importance to Pallid Sturgeon is difficult to ascertain. Future research will attempt to examine species relationships and dependencies.

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Comment 3: One reviewer questioned whether the Kansas River was ever historically occupied by Pallid Sturgeon and one commenter indicated support for increased emphasis on the potential importance of tributaries to the recovery of Pallid Sturgeon.

Response 3: Information gained following the original version of this plan warrants further investigation into the potential roles tributary rivers play in overall Pallid Sturgeon recovery. One explanation of the low observations of Pallid Sturgeon in tributaries, post-listing, could be attributable to low sampling efforts, low population sizes, or both. Currently, increased sampling and monitoring efforts across the species' range have resulted in more tributary observations including those in the Kansas River. Additionally, in portions of the range, hatchery-reared Pallid Sturgeon account for many of the observations in tributaries. Thus, more information is needed to fully assess the role of certain tributaries in Pallid Sturgeon recovery.

Comment 4: One reviewer noted that fundamental empirical knowledge of how many Pallid Sturgeon exist for major portions of the species' range are lacking (i.e., between Gavins Point Dam and St. Louis, Missouri and the Mississippi River downstream of the Ohio River confluence). Additionally, it was noted that no population segment currently exceeds either the 500 or 5000 minimum adequate population size explained within the plan. Finally, it was suggested that Pallid Sturgeon in the northern most reaches of its range should be considered as critically endangered, since abundance estimates do not approach the lower threshold of 500 individuals in the effective breeding population.

Response 4: We summarized the available information related to abundance estimates in the Present Distribution and Abundance section within the draft version of this plan. Based on additional information received during the comment period on the draft version of this plan, this section was updated in the final version.

The recommendation for considering population segments as critically endangered as compared to endangered may be the result of terminology used by different groups. While the International Union for Conservation of Nature distinguishes between critically endangered and endangered species by defining a critically endangered species as one being at an extremely high risk of extinction in the wild and an endangered species as one being at a very high risk of extinction in the wild, the Endangered Species Act does not. Under the Endangered Species Act, an endangered species is one defined as "…any species which is in danger of extinction throughout all or a significant portion of its range...", thus, in accordance with Federal law we use the latter definition for Pallid Sturgeon.

Comment 5: Several commenters discussed proposed hydrokinetic installations in the Mississippi River. The comments ranged from concerns over what effects these structures may have on Pallid Sturgeon and how they would be monitored to providing references for research efforts that may offer insight into the probable effects from these structures.

Response 5: Between the completion of the first draft and final draft revision to this plan, the large numbers of preliminary permits issued for exploration of hydrokinetic power in the Mississippi River were withdrawn by the permit holders. Thus, the section on hydrokinetic power was removed from the energy development discussion in the final version of this plan. However, if future permit applications suggest this potential threat may re-emerge, it will be reconsidered in the context of species recovery planning.

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Comment 6: One reviewer indicated that not enough attention has been given to looming problems due to global warming and climate change.

Response 6: We agree that there are many uncertainties associated with the possible effects from climate change. Given these uncertainties, it is difficult to predict what future conditions might be and how those conditions may affect currently recommended practices. However, recovery plans can and should be updated, as needed, to ensure that both new and changing threats are acknowledged, described, and suitable recovery tasks are identified.

Comment 7: One commenter suggested adding additional language to the Water Quantity section under Factor D: Inadequacy of Existing Regulatory Mechanisms to clarify various nuances related to water rights held by Montana Fish Wildlife and Parks, and water reservations held by County Conservation Districts and municipalities.

Response 7: The intent of this section within the plan is not to provide a thorough account of the nuances associated with instream flow reservations, nor to discuss the nuances of water rights and reservations, but rather to provide a very simple illustrations to the reader such that they may better understand the relationship between junior and senior water rights under western water law. Our recommendations to resolve the concerns identified above are discussed in the Recovery Outline/Narrative under section 1.1.4.

Comment 8: One reviewer indicated that important placenames or landmarks used in the text and important in delineating the extent of listed reaches are not shown in some figures (e.g., Figure 2 and 3).

Response 8: Due to the scale of the maps used in various figures (e.g., Figure 2 and 3) some prominent landmarks were not labeled in order to prevent overcrowding of feature labels. We chose instead to highlight the contemporary range of the species within the map (bold and red line) to visually illustrate the reaches being described within the text.

Comment 9: One commenter expressed concern over the Platte River Recovery Implementation Program's ability to improve and maintain habitat for species, including Pallid Sturgeon and described a fish kill on the Lower Platte River during the late summer of 2012 which included two confirmed Pallid Sturgeon. The commenter attributed this fish kill to water withdrawal and low flows during a prolonged drought and concluded that flows are not always sufficient to maintain Pallid Sturgeon in the Platte River. Additional information provided included modeling efforts at the University of Nebraska suggesting river discharge and the daily variability in discharge were the biggest factors leading to the occurrence of Pallid Sturgeon in the lower Platte River and that maintenance of adequate flows and a natural hydrograph are vital to the management of the Platte River to aid Pallid Sturgeon recovery.

Response 9: The Platte River Recovery Implementation Program was developed to offset the adverse effects to federally listed species resulting from federal water-related activities in the Platte River basin above the Loup River confluence (i.e., central Platte River). One of the goals of the Platte River Recovery Implementation Program is to test the assumption that, by managing flows for federally listed species in the central Platte River, benefits would accrue to Pallid Sturgeon habitat located downstream in the lower Platte River. Members of the Platte River Recovery Implementation Program have committed to provide 130,000-150,000 acre feet of managed flows for central Platte River species by the end of calendar year 2019. As a partner in the Platte River Recovery Implementation Program, we are

committed to ensuring defined benefits for all federally listed species in the Platte River basin including the Pallid Sturgeon in the lower Platte River.

We acknowledge the commenter was correct when they stated that a fish kill on the lower Platte River during the summer of 2012 resulted in the confirmed death of at least two Pallid Sturgeon and many Shovelnose Sturgeon. This fish kill was likely the result of high temperatures and low flows, which led to unfavorable conditions for fish. We will work with Platte River Recovery Implementation Program partners and water users in the lower Platte River basin to minimize the death of additional Pallid Sturgeon by avoiding low flow conditions.

Comment 10: One reviewer noted the terms "sub-adult" and "juvenile"were used in the draft plan, but never defined and recommended it might be useful to define the terms "juvenile" and "sub-adult" to distinguish these from one another, and from adults.

Response10: In the draft version of this plan, we used sub-adult and juvenile synonymously. In the final version of this plan we use the term juvenile in reference to all fish that are not considered embryos or larvae, and those that have not reached sexual maturity.

DOWNLISTING/DELISTING CRITERIA

Comment 11: One commenter recognized the current difficulties with identifying small Pallid Sturgeon and expressed concerns that identifying natural recruitment based on young-of-year or juvenile Pallid Sturgeon as a recovery criteria may not be realistic.

Response 11: As described in this plan under the General Description heading, Pallid Sturgeon are similar in appearance to Shovelnose Sturgeon and taxonomic (i.e., morphomerisitic) characters and ratios can vary with age of the fish (allometric growth), making identification of juvenile fish difficult. This lack of uniform applicability of morphometric indices also may be attributable to greater morphological differences documented between the upper Missouri River Pallid Sturgeon and Pallid Sturgeon inhabiting the middle and lower Mississippi and Atchafalaya rivers. Another confounding factor is genetic introgression between Shovelnose and Pallid sturgeon. Genetic analysis confirms introgressive hybridization between Pallid and Shovelnose sturgeon occurs and likely has been occurring for several generations, perhaps as many as 60 years, however; it is poorly understood how this may affect identification accuracy based on taxonomic (i.e., morphomerisitic) characters. To better resolve these issues, we have funded a comprehensive study within the lower Mississippi River to independently compare genomic species identification with identification based on taxonomic (i.e., morphomerisitic) characters to better evaluate concordance among these two methods. Until these results are completed, we consider that a combination of genetic and taxonomic (i.e., morphomerisitic) characters is more reliable than taxonomic character identification alone.

Comment 12: Several reviewers and commenters discussed the current goal of 5,000 adults per management. In general the nature of these comments were:

1) One reviewer sought clarity on if this was achievable or measurable and if we would use confidence intervals in determining whether the goal was met.

2) One reviewer indicated that the goal was reasonable.

3) One commenter sought clarity on how the adult population size would be determined and defined three possible analytical approaches.

4) One commenter expressed concern about this goal and the carrying capacity of currently available habitat.

Response 12: As part of the recovery planning process, we are required to provide objective and measurable recovery criteria. In this plan (see Adult Population Targets section), we defined a minimum target of 5,000 adult fish in each management. This target was determined by using the minimum effective breeding population size to derive an initial minimum target for each management unit. However, we also recognize that this target should be considered interim until empirically-derived Pallid Sturgeon specific data are developed, evaluated, and incorporated into an appropriate population viability analysis to derive management unit or, if designated, DPS specific minimum viable adult population estimates. Thus, the delisting and downlisting targets defined in this plan can and should be updated and modified in subsequent plan revisions, as appropriate, in an adaptive fashion based on available data and analyses.

Finally, at present, there is not a universal standard approach to deriving reliable population estimates for Pallid Sturgeon. We are, however, required to review and consider the best commercially and scientifically available data when making listing-related decisions. As such, we will consider the validity of the methods used based on the data available, the variability in the data (i.e., confidence intervals surrounding a population point estimate), assumptions made, and appropriateness of methodology employed as population estimates are developed.

Through the above process, we anticipate that future management unit specific, or, if designated, DPS specific minimum viable adult population targets, would account for and consider carrying capacity of available suitable habitats during the estimation development.

Comment 13: Two reviewers and several commenters raised questions or concerns about the use of stock density indices as a measure of recruitment. In general, the nature of these comments or questions were to seek clarity on:

1) How does an incremental-RSD equate to a specific number of adult pallid sturgeon?

2) The application of Shuman et al. (2006) to calculate stock density estimates range-wide and the applicability of these to all management units due to latitudinal gradients in growth and morphology.

3) Stock density indices and Catch-per-unit-effort are useful tools to assess population structure and recruitment, but how do they fit into the recovery criteria?

Response 13: We specified incremental-RSD values for stock to quality sized fish (as described by Shuman et al. (2006)) being 50-85 over each 5-year sampling period as a means to monitor and assess if adequate recruitment was occurring within each management unit. Thus, the incremental-RSD values specified are not intended to be directly related to a specific number of adults. However, with the application of appropriate survival rate information, inferences in predicted future adult trends maybe possible to derive.

We have concluded that the application of Shuman et al. (2006) to calculate stock density estimates are appropriate because relative stock density indices are a valid method to quantify length frequency data. The length categories utilized in stock density development are derived from and based upon percentages of the world-record length of the species in question (Willis et al. 1993). The values described in Shuman et al. (2006) were derived as a percentage of the largest fish on record. Therefore, the stock density length categories are expected to be appropriate across the range of the species. Additionally, in developing this interim target, we considered reach-specific variability across the Pallid Sturgeon's range and identified the interim target incremental-RSD of stock to quality-sized naturally produced fish as a range from 50-85, rather than a set value, to account for range-wide variability.

Finally, we also recognize that the utility of the incremental-RSD index relies on the ability to accurately discern small Pallid Sturgeon from Shovelnose Sturgeon which seems to become increasingly harder to do in the lower reaches of the species' range and can require genetic testing. Thus, we included other variables that are not solely dependent on identification of the smaller-sized Pallid Sturgeon (i.e., catch-per-unit-effort data indicative of a stable or increasing population and survival rates of naturally produced fish (age 2+) equal to or exceeding those of the adults). These indices, used in conjunction with incremental-RSD of stock to quality-sized naturally produced fish being 50-85, should provide sufficient confidence when evaluating if the downlisting or delisting criteria have been met.

Comment 14: One commenter suggested the stated Pallid Sturgeon generation time (20-30 years) is too short.

Response 14: The definition we used for generation length is defined as the average age of parents of individuals in a cohort of offspring. Generation length (IUCN 2010) offers insights into the turnover rate of breeding individuals in a population, and is considered greater than the age at first breeding and less than the age of the oldest breeding individual. Additionally, based on the IUCN guidelines (2010) we agree with their assertion that in the context of this plan that it is appropriate to extrapolate generation length from closely related well-known taxa (Shovelnose Sturgeon in the case of this plan) and to apply it to lesser-known and potentially threatened taxa.

Given the limited data on management-unit-specific age structure for this species, we estimated the generation length for each species as age at first reproduction + 1/natural mortality rate as defined by the IUCN (2010). We assumed a stable age structure with an earliest age of maturity, averaged over both sexes, of 10 for Pallid Sturgeon (Keelyne & Jenkins 1993) and 5 for shovelnose sturgeon (Keenlyne 1997). The annual mortality rate for both species was assumed to be 5% for adults after reaching sexual maturity (Bratten et al. 2009, Keenlyne 1997). The estimate for Pallid Sturgeon and Shovelnose Sturgeon, using primarily upper basin information, generated a generation length time of 22 and 12, respectively. The range provided is given to reflect variance across the species' range (i.e., anticipated shorter generation lengths and possible earlier maturity in the lower portions of the species' range).

Comment 15: One commenter agreed that the potential application of the DPS policy could provide a mechanism to reconsider reach-specific listing status for the Pallid Sturgeon while keeping full Endangered Species Act protection for identified DPSs that have not yet experienced recovery. However, they expressed concerns that the criteria used to designate a DPS (i.e., discreteness and significance) may be biased towards listing rather than downlisting.

Response 15: We appreciate the expression of support for our inclusion of the Distinct Population Segment Overview section in this plan. We recognize that the DPS policy provides flexibility under the Endangered Species Act and that there may be current data gaps that will need to be filled in order to make an adequate determination under the DPS policy.

RECOVERY TASKS

Comment 16: Several reviewers commented on the lack of recovery task prioritization.

Response 16: Identified recovery tasks are assigned numerical priorities to highlight the relative contribution they may make towards species' recovery. The following ranking schema is utilized in Part III: Implementation Schedule in this plan.

The priority numbers found in column 1 of the implementation schedule are defined as follows:

Priority 1	All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
Priority 2	All actions that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
Priority 3	All other action necessary to provide for reclassification or full recovery of the species.

Through this process we have identified a general prioritization of recovery actions.

Comment 17: One reviewer questioned the availability of data to support the plan's recommendation to provide fish passage, while another commenter agreed that fish passage was an important concept for assisting with Pallid Sturgeon Recovery.

Response 17: Numerous lines of evidence indicate that increasing habitat connectivity can provide benefits and facilitate recovery. Newly hatched Pallid Sturgeon larvae are predominantly pelagic, drifting in the currents for 11 to 13 days and dispersing 245 to 530 km (152 to 329 mi), depending on water column velocity and temperature. Within portions of the species' range, requisite drift distances are lacking due to fragmentation (e.g., Intake Dam on the Yellowstone and Fort Peck Dam on the Missouri). Thus, providing access to spawning areas upstream of some barriers can increase the available drift distances. Additionally, historical and current data indicate suitable habitats exist upstream of several known barriers. These are some examples of the data leading us to conclude, that for some barriers providing fish passage is a reasonable recovery tasks which, if implemented, will help to address the threats of habitat loss, alteration, and degradation within the historical range of the species. Where possible, we tried to identify and highlight areas where fish passage efforts may assist overall recovery by increasing access to tributary habitats.

Comment 18: One commenter questioned the need to provide fish passage at the Wilbur D. Mills Dam constructed to block the old Arkansas River channel and indicated that restoring fish passage at this site would be challenging.

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Response 18: At this time, we have not concluded whether Pallid Sturgeon passage at the Wilbur D. Mills Dam is necessary or essential for recovery of Pallid Sturgeon. In both the draft and final version of this plan, we recognized this barrier on a large tributary to the Mississippi River as a possible recovery option. However, we have not recommended doing anything at this structure at the present time. We believe this issue (the need to provide passage of Pallid Sturgeon at the Wilbur D. Mills Dam) should be further evaluated. If data were to indicate that providing passage would further conservation of the species and is deemed necessary for recovery, then we would recommend that passage be restored at this site.

Comment 19: One commenter indicated they were unaware of any published studies documenting Pallid Sturgeon utilizing woody debris, or that woody debris is essential to their forage base.

Response 19: While direct data defining linkages between Pallid Sturgeon and/or their common forage base directly using woody debris may be unavailable, it should not be simply discounted. Natural riverine processes, prior to anthropogenic alteration, included bank erosion that recruited large woody debris into the riverine environment. The important ecological role of woody debris in river environments is well documented in numerous publications (e.g., Fishcenich and Morrow 1999; Boyer et al. 2003; Archer 2009) some of which include: contributing organic matter, providing substrate for invertebrates, generating hiding cover and velocity breaks for fishes, as well as affecting river channel morphology, sediment deposition, hydraulic characteristics, and increased habitat diversity.

Given that historical snag removal efforts were effective at removing woody debris from extensive portions of Missouri and Mississippi rivers and bank stabilization activities have limited natural erosion process that would allow woody debris recruitment, we have identified the need to develop programs or efforts that can help restore woody debris to these rivers as a means of restoring riverine function or creating habitats. This recommendation then focuses more on ecosystem restoration to benefit the species; a fundamental purpose defined within the Endangered Species Act. The three studies cited in the above paragraph include:

Archer, M. W. 2009. Retention, movement, and the biotic response to large woody debris in the channelized Missouri River. Master's thesis. University of Nebraska, Lincoln.

Boyer, K. L., D. R. Berg, and S. V. Gregory. 2003. Riparian management for wood in rivers. Pages 407-420 in S. V. Gregory, K. L. Boyer, and A. M. Gurnell, editors. The ecology and management of wood in world rivers. American Fisheries Society, Symposium 37, Bethesda, Maryland.

Fischenich, C., and J. Morrow, Jr. 1999. "Streambank Habitat Enhancement with Large Woody Debris," EMRRP Technical Notes Collection (ERDC TN-EMRRP-SR- 13), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Comment 20: One reviewer and two commenters expressed concerns related to the Pallid Sturgeon Conservation Augmentation Program. The concerns ranged from stocking taking up resources that could be used to implement other recovery tasks, the need to begin shifting emphasis from the propagation program to monitoring of introduced, hatchery-reared pallid sturgeon (i.e., dispersal of hatchery progeny into the Mississippi River, effects on genetic diversity and fitness, and general behavior as they mature), and risks of introducing or amplifying pathogens into the river systems through hatchery-reared fish.

Response 20: From a recovery planning perspective, priority is given to those actions that must be taken to prevent extinction, local extirpation, or populations declining to an irreversible level. In the context of this plan, the use of artificial propagation is identified as a method to prevent localized extirpation. Where appropriate, we prioritized efforts in developing and implementing the Pallid Sturgeon Conservation Augmentation Program. The focus of this program is to preserve the remaining wild genetic diversity before it is lost due to recruitment failure and localized extirpation, as well as to bolster population numbers within reaches where conservation augmentation is deemed necessary. These efforts have been successful at preventing local extirpation and capturing genetic diversity; essentially providing additional time to implement other necessary aspects of the recovery program.

Additionally, in this plan we discuss the use of artificial propagation, where deemed necessary, in the Recovery Outline/Narrative. Specifically, we identified the need to annually review, update if necessary, and implement range-wide stocking and propagation plans using the most recent information, as well as using the best available information to evaluate effectiveness of hatchery products within each management unit, and to determine when stocking is no longer warranted. We will continue to work closely with our partners and seek input and guidance from the Pallid Sturgeon recovery team and basin working groups to help ensure the range-wide stocking and augmentation plan is governing stocking efforts appropriately.

Comment 21: One reviewer commented on the development of a population viability analysis (Task 3.4) cautioning that there must be fundamental empirical pallid Sturgeon population data in place from a multi-year mark-recapture research effort. Additionally, this reviewer identified other data deficiencies for developing a population viability analysis, including; population size, population structure (modes and valleys), and mortality rate.

Response 21: We generally agree that there are prerequisite data that must be acquired before a population viability analysis should be attempted. As such, we ranked the recovery tasks to reflect this. For example, in the implementation schedule, the items under Task 3.1 Monitor Pallid Sturgeon Population, e.g., developing and implement a range-wide Pallid Sturgeon monitoring program that will provide adequate data to evaluate progress toward downlisting and delisting criteria, are identified as priority 1. Whereas task 3.4 Conduct a Population Viability Analysis is ranked as a priority 2 item.

Comment 22: One reviewer and two commenters highlighted what they see as apparent deficiencies in fundamental knowledge and suggested an outline of priority needs as follows:

> 1) Develop the fundamental knowledge of population abundance and structure for each major reach occupied by the species over its range (i.e., a range-wide population assessment),
>
> 2) Finding bottlenecks to recruitment,
>
> 3) Identify spawning grounds, and
>
> 4) Identify important habitats used by key life history stages.

Response 22: We agree and believe our prioritization list provided in the Implementation Schedule aligns with and addresses the general concern identified. It should also be noted that many of the specific items

mentioned are included in ongoing research activities (i.e., developing population estimates, survival rate estimation, studying spawning movements and locations, etc.).

Comment 23: One commenter questioned why some recovery tasks under Section 1.1.1 use the word "evaluate" and inferred from this that potential implementation of restoration efforts is not a focus of near-term conservation efforts. The commenter ultimately recommended increased emphasis on implementation over evaluation to address issues related to dams that are well understood and documented.

Response 23: As part of the recovery planning process, we identify limiting biology or life history requirements, the recognized and probable threats to the species relative to the identified listing factors, and delineate reasonable measures believed necessary to assure sustainable recovery. Through this process, we have identified that dams are one of the primary anthropogenic landscape-level alterations associated with Listing Factor A: Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range. To help address the threat from dams, we have outlined a series of reasonable potential actions to facilitate achieving a self-sustaining population of Pallid Sturgeon within each management unit such that downlisting and eventual delisting can be realized.

For example, looking at the recommendation under the Recovery Outline/Narrative under section 1.1.1 (2), we recommend evaluating spillway releases from Fort Peck Dam to improve flow, turbidity, and temperature conditions downstream, specifically to benefit Pallid Sturgeon in terms of promoting species recovery, and further identify actively implementing this activity if it proves feasible and useful in facilitating recovery of the species. However, the exact magnitude, duration, and timing of spillway releases necessary to improve flow, turbidity, and temperature conditions specifically necessary for Pallid Sturgeon recovery are unknown. Thus, we conclude that this action should be evaluated such that necessary prescribed flows can be developed and subsequently implement if feasible.

Comment 24: One commenter recommended inclusion of language in the plan that emphasizes the importance of Pallid Sturgeon recovery in all historically occupied river reaches that currently are considered suitable Pallid Sturgeon habitat, or can be restored to such levels through habitat restoration and that the success criterion for the fish passage project at Intake Dam on the Yellowstone River be based on Pallid sturgeon measures (e.g., passage, spawning, and recruitment).

Response 24: When this plan was developed, there was a strong emphasis from the Upper Basin Pallid Sturgeon Workgroup to seek and implement fish passage and entrainment protection measures at Intake Dam and sufficient data are available to warrant this management action. Thus, this plan identifies the need to restore fish passage at Intake Dam as mentioned above. However, this plan does not define the exact mechanism through which fish passage and entrainment protection would be achieved. Those specifics are being developed in coordination and cooperation with recovery partners and are subject to various processes (i.e., National Environmental Policy Act).

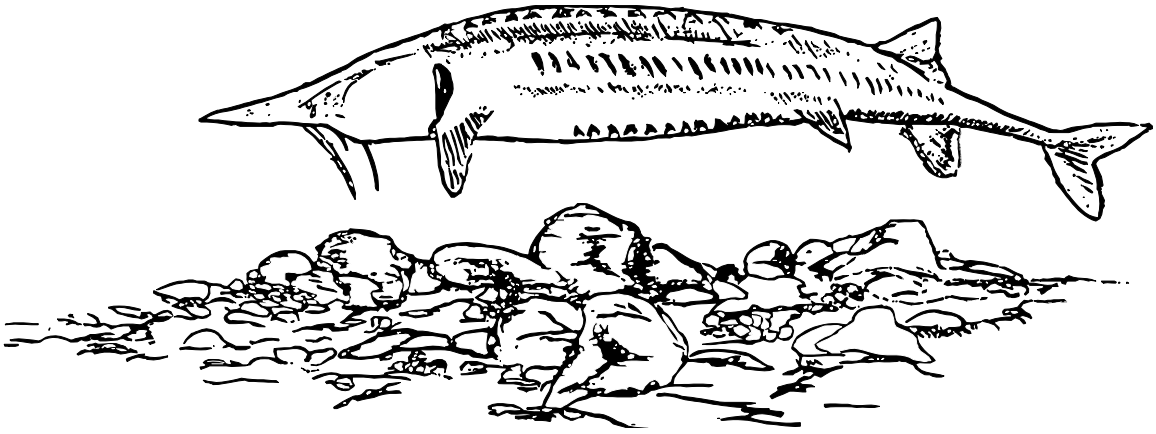
We are committed to working with partners to help ensure defined benefits for this federally listed species in the Missouri and Mississippi River basins are met, but want to reiterate that the goal of this species recovery program is to sufficiently address the threats to Pallid Sturgeon such that the species no longer fits the definition of threatened or endangered.

Comment 25: One commenter questioned if levee setbacks have been implemented within the range of the Pallid Sturgeon and acknowledge that the concept of increasing floodplain connectivity can improve aquatic habitat conditions. However, this commenter indicated that this type of restoration would have limited applicability because of cost and that benefits would be very reach specific. This commenter concluded that there is no published evidence to support the contention that Pallid Sturgeon require floodplain connectivity because they are main-channel inhabitants and the majority of the food items observed in the digestive tract of Pallid Sturgeon, at least in the Lower Mississippi River, originate in main-channel environments.

Response 25: We agree that increasing floddplain connectivity can improve aquatic habitat conditions and, ultimately, improving the ecosystem upon which Pallid Sturgeon depend. We also recognize that restoring this connectivity will have varying degrees of benefit which may be largely dependent upon levee proximity to the existing channel, the degree of localized channelization, and existing riparian habitat features. The Recovery Task category this is listed under is Create Physical Habitat and Restore Riverine Function which specifically relates to protecting, enhancing, and restoring habitat diversity and connectivity. It is anticipated that site specific planning and evaluation will be required to implement the various components associated with this task. Finally, while data documenting Pallid Sturgeon usage of the inundated floodplain is currently unpublished, Nebraska Game and Parks Commission has documented Pallid Sturgeon usage of floodplain habitats associated with the Missouri River flooding in 2011 (Justin Haas in litt., 2013; Kirk Steffensen, personal communication).

Pallid Sturgeon
(Scaphirhynchus albus)

5-Year Review
Summary and Evaluation



U.S. Fish and Wildlife Service
Pallid Sturgeon Recovery Coordinator
Billings, Montana

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5-YEAR REVIEW
Pallid sturgeon (*Scaphirhynchus albus*)

1.0 GENERAL INFORMATION

1.1 Reviewers

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1.2 Methodology Used to Complete the Review

On July 7, 2005, the U.S. Fish and Wildlife Service (USFWS) announced a 5-year review of Black-footed ferret (*Mustela nigripes*) and Pallid sturgeon (*Scaphirhynchus albus*) (70 FR 39326-39327). Through this notice, a public comment period also was initiated with a conclusion data of September 6, 2005. During this comment period, the lead office received one written comment from the Lower Brule Sioux Tribe, South Dakota, indicating that no pallid sturgeon have been reported being caught on or near the reservation during the past 5 years.

All data compilation and the drafting of this document was a group effort consisting of the Pallid Sturgeon Recovery Team, the Team's Genetic Advisory Group, and Regions 3, 4, and 6 of the USFWS. Initial data compilation for this status review was the result of a request from the Pallid Sturgeon Recovery Team Coordinator sent to biologists most familiar with pallid sturgeon demographics within all the Recovery Priority Management Areas (RPMAs) as defined in the Pallid Sturgeon Recovery Plan (USFWS 1993). This request was to summarize all demographic data from each RPMA. These demographic data as well as the most recent genetics data were summarized and presented to the Pallid Sturgeon Recovery Team and the Pallid Sturgeon Recovery Team's Genetic Advisory Group on September 28-29, 2005. The Pallid Sturgeon Recovery Team, Genetics Advisory Group, and USFWS lead and cooperating field offices compiled all available data and completed sections 2.3, 2.4, and 5.0.

The USFWS oversaw production and considered all available information to assemble this review and made all recommendations regarding appropriate status, application of the Distinct Population Segment Policy (1996), application of other relevant policies (see below), adequacy of recovery criteria, species status and classification determinations, and priority number designation. Peer review of this document was completed in accordance with the peer review plan (see Appendix A). Peer reviewer comments and responses to peer reviewers also are presented in Appendix A.

Sections 3(3), 10(a)(1)(A) and 10(j) of the Endangered Species Act (ESA) of 1973, as amended authorize the use of artificial propagation and experimental populations to further the conservation and recovery of threatened and endangered species. To clarify these roles and responsibilities, the USFWS and National Marine Fisheries Service (NMFS) jointly published a *Policy Regarding Controlled Propagation of Species Listed under the Endangered Species Act* (65 FR 56916-56912, September 20, 2000).

The NMFS has subsequently published a *Policy on the Consideration of Hatchery-Origin fish in Endangered Species Act Listing Determinations for Pacific Salmon and Steelhead* (70 FR 37204-37216, June 28, 2005). This latter policy was developed in response to the *Alsea Valley Alliance* v. *Evans* Federal court decision (aka "Hogan decision") which explicitly stated that hatchery-origin fish must be included with the listing of an endangered or threatened species under the ESA if those hatchery-origin fish are considered biological members of the listed entity (species, subspecies, distinct population segment, or evolutionary significant unit). This latter policy of NMFS also states, "Hatchery fish will be included in assessing an ESU's (evolutionarily significant unit) status in the context of their contributions to conserving natural self-sustaining populations."

Pallid sturgeon are currently listed as endangered under the ESA. Artificial propagation of pallid sturgeon is one component of the existing Recovery Plan and is currently ongoing. As a result, tens to hundreds of thousands of juvenile pallid sturgeon are produced and released annually via artificial propagation and captive spawning of wild-caught adults in accordance with the pallid sturgeon stocking and augmentation plan (USFWS 2006a).

The following statement is for the purpose of defining how hatchery-reared pallid sturgeon were viewed in this review, and implementing the ESA for pallid sturgeon in a manner consistent with the joint USFWS-NMFS *Policy Regarding Controlled Propagation of Species Listed under the ESA* and the *Alsea Valley Alliance* v. *Evans* Federal court decision. The following statement also is intended to be consistent with the NMFS' policy on the consideration of hatchery-origin fish in ESA listing determinations for Pacific salmon and steelhead.

The USFWS considers hatchery-reared pallid sturgeon, resulting from artificial propagation or captive breeding, to be members of the listed species and are, thus, protected under the provisions of the ESA, except as described in Section 10. All assessments of the status of pallid sturgeon under the ESA will consider the contributions of hatchery-origin fish to conserving natural self-sustaining populations. For the purpose of assessing the status of pallid sturgeon, the USFWS must consider the data available regarding the role of hatchery-reared pallid sturgeon in support of the conservation of naturally-spawning pallid sturgeon and the ecosystems upon which they depend, consistent with section 2(b) of the ESA (16 U.S.C. 1531(b)).

Current data indicate that hatchery-reared pallid sturgeon are essential to preventing local extirpation in portions of the range (RPMA 1 and 2) and have been used to reestablish pallid sturgeon in a small portion of the species' range (RPMA 3). However, it is too early to determine if these artificially propagated pallid sturgeon will spawn and naturally reproduce, and thus it is unclear if these hatchery-reared fish are contributing to conserving natural self-sustaining populations.

1.3 Background

1.3.1 Federal Register Notice Citation Announcing Initiation of this Review

70 FR 39326-39327, July 7, 2005

1.3.2 Listing History

Federal Register Notice: 55 FR 36641-36647
Date listed: September 6, 1990
Entity listed: Species
Classification: Endangered

1.3.3 Associated Rulemakings

NA

1.3.4 Review History

- A previous USFWS 5-year review for pallid sturgeon was noticed on November 6, 1991 (56 FR 56882). In this review, all currently listed species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors, threats, etc., as they pertained to the different species' recovery. The notices summarily listed these species and stated that no

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changes in the designation of these species were warranted at that time. In particular, no changes were proposed for the status of the pallid sturgeon in the review.

- Although not technically a 5-year review per our regulatory requirements, on November 7, 1993, we announced the availability of the Pallid Sturgeon Recovery Plan. This document summarized the status of the species and biological requirements of the species as best known at the time.

1.3.5 Species' Recovery Priority Number at Start of Review
2C

1.3.6 Recovery Plan or Outline
Name of plan: Pallid sturgeon (*Scaphirhynchus albus)* Recovery Plan
Date issued: November 7, 1993
Dates of previous revisions: NA

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment Policy

2.1.1 Is the species under review a vertebrate?
_X_ Yes
___ No

2.1.2 Is the species under review listed as a DPS?
___ Yes
_X_ No

2.1.3 Was the DPS listed prior to 1996?
NA

2.1.4 Is there relevant new information for this species regarding the application of the DPS policy?
___ Yes
_X_ No

Currently there are data that suggest some form of genetic structuring range-wide and even suggest discernable genetic groups (Heist and Schrey 2006a and b; Tranah et al. 2001). However, these data are incomplete or lacking for portions of the species' range.

Therefore, current data appear insufficient to warrant application of the DPS policy at this time. However, as new data are developed and analyzed those data will be considered and the applicability of DPS policy will be reevaluated.

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2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria?

___Yes
_X_ No

The 1993 recovery plan noted the short-term recovery objective for the pallid sturgeon is to prevent species extinction. Delisting criteria were deemed "undeterminable" in 1993. And while this recovery plan outlined "interim" downlisting criteria (see section 2.2.3 below), the criteria were vague due to our limited understanding of the species and immediate focus on preventing extinction.

2.2.2 Adequacy of Recovery Criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

No

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

No

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors* are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here.

Interim Downlisting Criteria: 1) a population structure with at least 10% sexually mature females occurring within each recovery-priority management area has been achieved; and 2) when sufficient population numbers are present in the wild to maintain stability.

Evaluation Of Interim Recovery Criteria: In the 14 years since the recovery plan (USFWS 1993) was approved, we have learned much about the species, its threats, and its needs. We now believe that the best scientific and commercial information available suggests these downlisting criteria are no longer relevant to a potential future downlisting as written. Each recovery priority management area

*1)Present or threatened destruction, modification or curtailment of its habitat or range;
2) Overutilization for commercial, recreational, scientific, or educational purposes;
3) Disease or predation;
4) Inadqequacy of existing regulatory mechanisms;
5) Other natural or manmade factors affecting its continued existence.

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(RPMA) is faced with problems beyond just total population numbers and male-to-female ratios. A self-sustaining population can not be maintained without adequately addressing identified threats. A revision of the recovery plan is suggested (see section 4.0 for a complete list of recommended future actions).

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

The pallid sturgeon is a member of the genus *Scaphirhynchus*. This species is a bottom-oriented, large rivers obligate inhabiting the Missouri and Mississippi Rivers from Montana to Louisiana (Kallemeyn 1983) and the Atchafalaya River (Reed and Ewing 1993). Within this range, pallid sturgeon tend to select main channel habitats (Sheehan et al., 1998) in the Mississippi River and main channel areas with islands or sand bars in the upper Missouri River (Bramblett 1996). Food habits of this species range from aquatic insects to fish depending on life stage (Gerrity 2005, Gerrity et al. 2006, Wanner 2006). The species can be long lived with females reaching sexual maturity later than males (Kallemeyn 1983). Spawning appears to occur between June and August, and females may not spawn each year (Kallemeyn 1983). Larval fish produced from the spawning event drift downstream from the hatching site (Kynard et al. 2002), and begin to settle from the lower portion of the water column 11 to 17 days post hatch (Braaten et al. in review).

2.3.1.1 Abundance, Population Trends, Demographic Features, or Demographic Trends

At the time the pallid sturgeon (*Scaphirhynchus albus*) was listed under the ESA on September 6, 1990 (55 FR 36641-36647), the species was known from two small populations of large, old-aged sturgeon isolated by dams surviving in the upper Missouri River, and from various rare collection records from the lower Missouri River and the Mississippi River near Grafton, Illinois, at the mouth of the Illinois River (Forbes and Richardson 1905). In their discussion, Forbes and Richardson (1905) indicate that "…about one in five hundred of the shovelnose sturgeons taken in central Mississippi [River] belongs to this new species …" and note that catches of the new species comprised about one-fifth of total sturgeon collected near West Alton, Missouri, suggesting that pallid sturgeon were believed more abundant in the Missouri River at that time. Bailey and Cross (1954) defined the range of pallid sturgeon in the Mississippi River as extending from the mouth of the Missouri River to New Orleans, Louisiana; however, they apparently located no collection records of the species between these two points. Records of pallid sturgeon from the upper Mississippi River at Keokuk, Iowa, were discounted by Bailey and Cross (1954) as "…stragglers from downriver." However, in 2000 the Illinois Department of Natural Resources (Atwood in litt. 2006) reported catching one pallid sturgeon in the tail waters of Melvin Price Locks and Dam. This structure is in the upper Mississippi River approximately 7 mi (11.3 km) upstream from the mouth of the Missouri River.

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In 1991, the species was documented from the Atchafalaya River in central Louisiana (Reed and Ewing 1993).

Because the pallid sturgeon was not recognized as a species until 1905, few data are available concerning the species' early abundance and distribution (Pflieger 1975). Even as late as the mid-1900s, it was common for pallid sturgeon to be tallied in the commercial catch as either shovelnose, *Scaphirhynchus platorynchus*, or lake sturgeon, *Acipenser fulvescens*, (Keenlyne 1995). Correspondence and notes of researchers suggest that pallid sturgeon were still fairly common in many parts of the Mississippi and Missouri River systems as late as 1967 (Keenlyne 1989). Bailey and Cross (1954) also noted the presence of pallid sturgeon in the Missouri River from around Fort Peck Reservoir, Montana, and perhaps from Fort Benton, Montana, down to its mouth, as well as from within the Kansas River, Kansas.

The Pallid Sturgeon Recovery Plan (USFWS 1993) identified six RPMAs for implementation of recovery tasks based on most recent pallid sturgeon records of occurrence, and the potential of these areas for recovery of the species. The pallid sturgeon RPMAs (Figure 1) are defined in the Pallid Sturgeon Recovery Plan (USFWS 1993).

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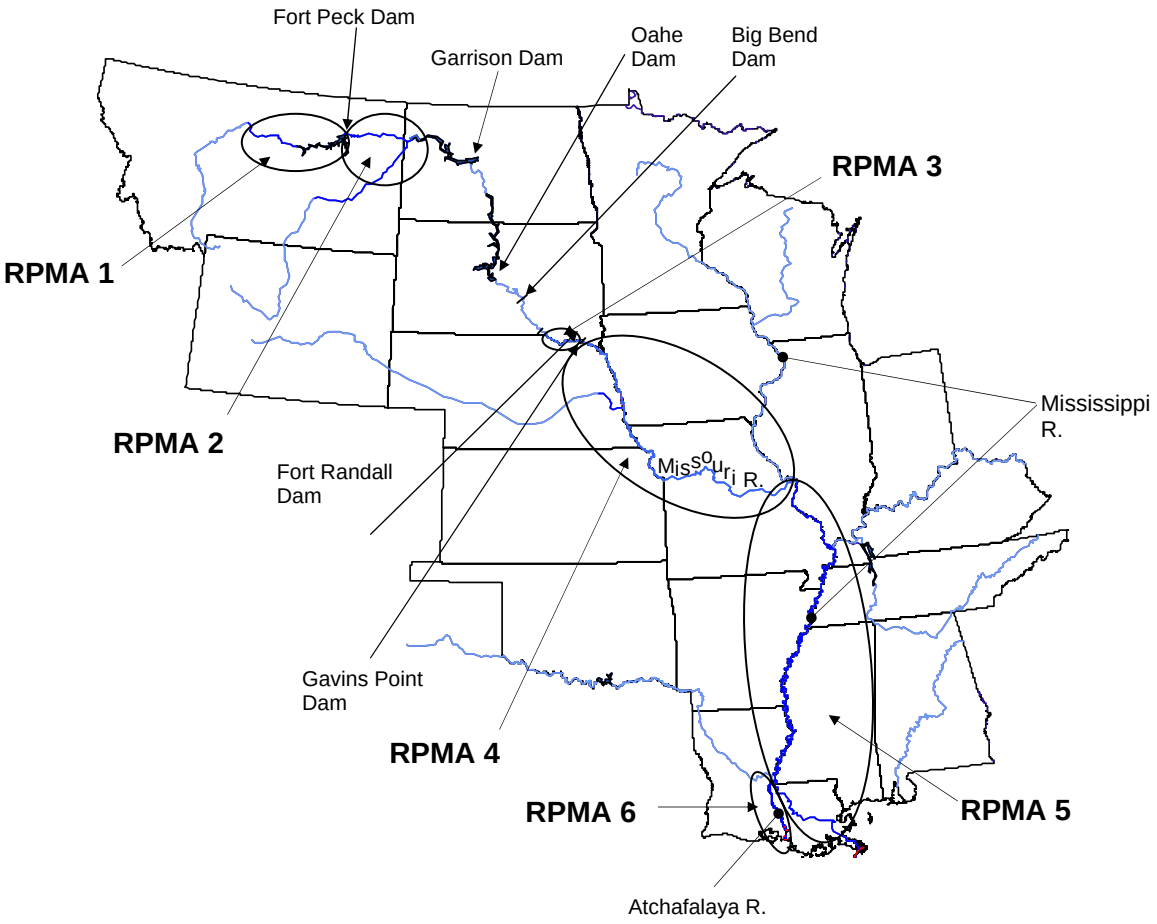

Figure 1. Map depicting Missouri and Mississippi Rivers with major dams identified. Outlined areas (ovals) correspond with approximate location of RPMAs as defined in the Pallid Sturgeon Recovery Plan (USFWS 1993). Map not to scale.

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Demographic Data by Recovery Priority Management Area

Following is a summary of demographic data by RPMA. In addition to abundance information (including both wild and hatchery raised data), the following illustrates significant size differences within the species among different portions of the range (see also figures 14 and 15). This issue is discussed in further detail in section 2.3.1.6 below.

RPMA 1

RPMA 1 is defined as the Missouri River from the headwaters of Fort Peck Reservoir upstream to the confluence of the Marias River, Montana (USFWS 1993) (Figure 1). The status of wild pallid sturgeon in RPMA 1 has remained relatively unchanged since listing and continues to decline. According to data obtained from the National Pallid Sturgeon Database (USFWS 2006b), a total of 52 wild pallid sturgeon (individual fish) has been collected in RPMA 1 during 15 years of sampling (1990-2005) (Figure 2). The length frequency data suggests these are all adult fish. Current population estimates suggests that as few as 45 wild pallid sturgeon still remain in RPMA 1 (Bill Gardner, Montana Fish Wildlife and Parks (MFWP), pers. comm., 2005). There is an obvious absence of smaller sized wild pallid sturgeon despite utilization of sampling gear (gill nets, trammel nets, seines, and or trot-lines) capable of collecting smaller sized hatchery-reared pallid sturgeon (Figure 2). The size and age of surviving fish suggest that spawning, recruitment, or both, are severely limited or absent within this reach. However, the population is being supplemented with hatchery produced fish (USFWS 2006a) in efforts to prevent local extirpation. Supplementation of RPMA 1 with hatchery produced pallid sturgeon has occurred sporadically since 1997, and is required to maintain the species within this RPMA. Based on recapture data from the National Pallid Sturgeon Database (USFWS 2006b), pallid sturgeon from all stocking events have produced recaptures and are contributing to the current population structure (Figures 2 and 3).

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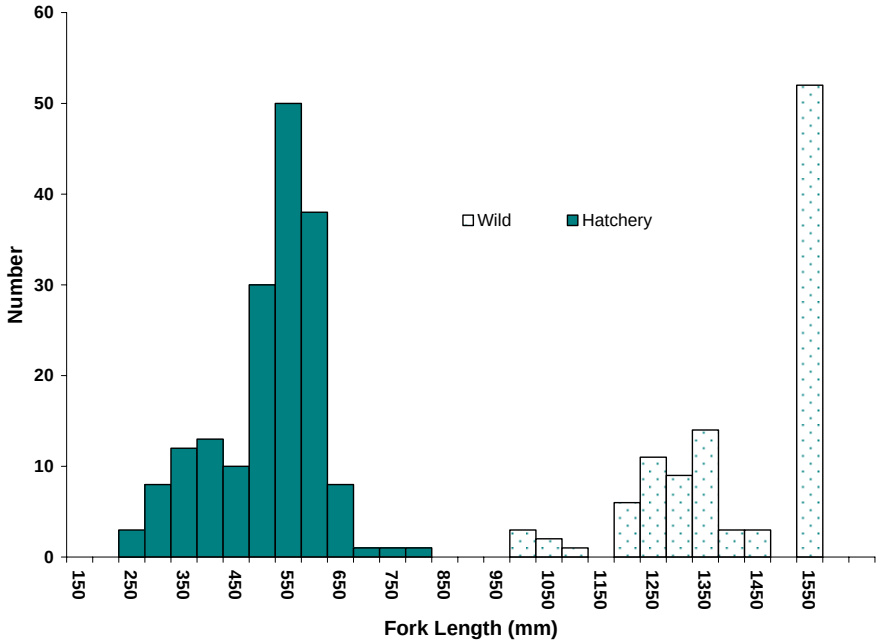

Figure 2. Upper Missouri River (RPMA 1) length frequency histogram representing each total individual wild and hatchery pallid sturgeon collected 1990-2005 for which there were length data (Wild n=52, Hatchery n=175). Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

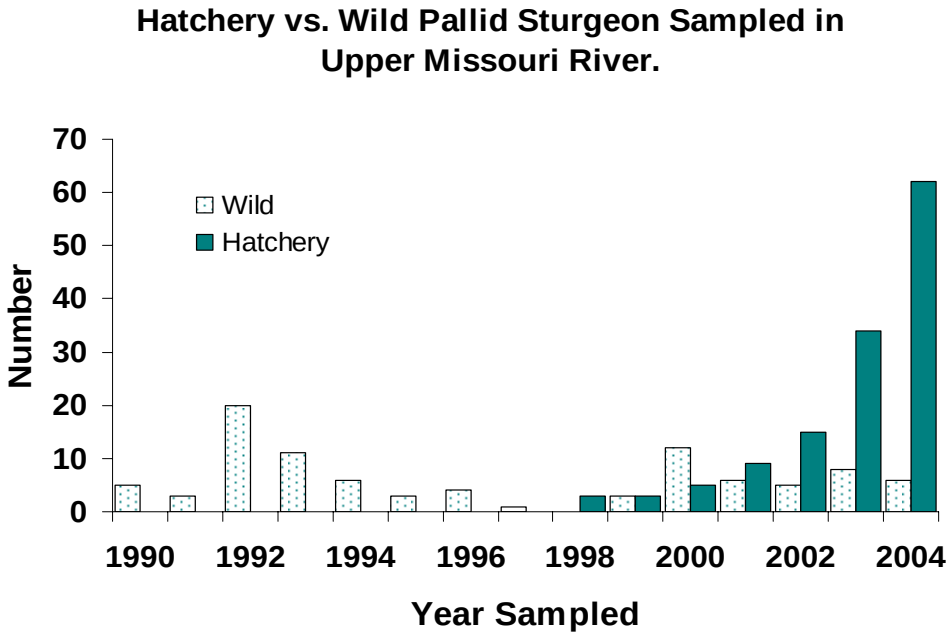

Figure 3. Upper Missouri River (RPMA 1) wild pallid sturgeon and hatchery produced pallid sturgeon collected with all gear types 1990-2004. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

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RPMA 2

The Missouri River below Fort Peck Dam to the headwaters of Lake Sakakawea and the lower Yellowstone River up to the confluence of the Tongue River, Montana, is defined as RPMA 2 (Figure 1). The wild pallid sturgeon population in RPMA 2 continues to decline. According to data compiled from the National Pallid Sturgeon Database (USFWS 2006b), 527 wild pallid sturgeon captures occurred during 16 years of sampling (1990-2006). However, many of the adults were collected multiple times during those years. Removing recaptured pallid sturgeon from the query, indicates a total of 245 unique individual pallid sturgeon were collected during this timeframe. Available length frequency data indicate that these were essentially all adult fish (Figure 4). There is an obvious absence of smaller-sized wild pallid sturgeon despite utilization of sampling gear (gill nets, trammel nets, seines, and trot-lines) capable of collecting smaller sized hatchery-reared pallid sturgeon (Figure 4). The size and associated age of surviving fish suggest that spawning, recruitment, or both are severely limited within this reach. However, the population is being supplemented with hatchery-reared fish to prevent local extirpation (USFWS 2006a). Recent population estimates suggests that approximately 136 wild adult pallid sturgeon still remain in RPMA 2 (Klungle 2004). The length frequency data indicate that, up until the time supplementation began, all collected pallid sturgeon were adults except for one small fish collected in 1993 (Figures 3 and 4). This suggests that, like RPMA 1, spawning, recruitment, or both are limiting viability within this reach. Supplementation of RPMA 2 with hatchery produced pallid sturgeon has occurred sporadically since 1998 with various numbers being stocked depending on hatchery success for any given year (USFWS 2006a). To date, pallid sturgeon from all stocking events have produced recaptures and are contributing to the current population structure (Figures 4 and 5).

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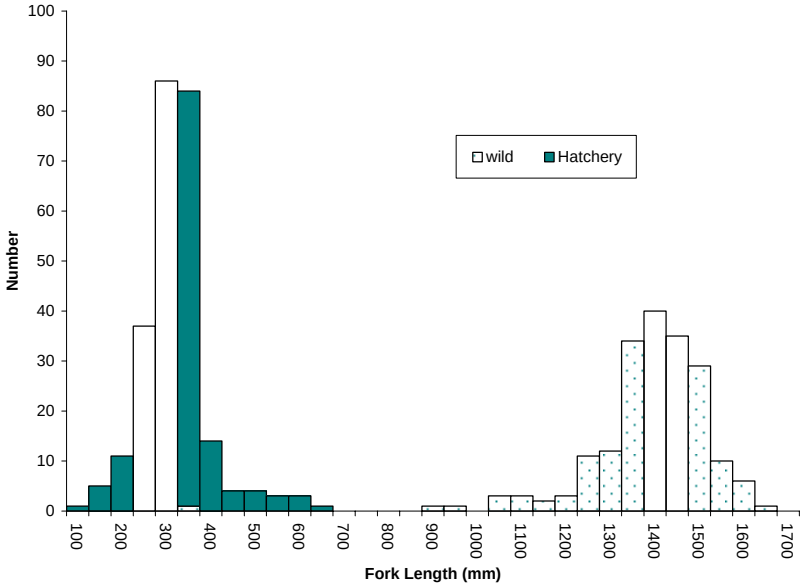

Figure 4. Upper Missouri River (RPMA 2) length frequency histogram representing each total individual wild and hatchery pallid sturgeon collected 1990-2006 for which there were length data (Wild n=192, Hatchery n=252). The 350-millimeter (mm) wild individual pallid sturgeon was collected in 1993. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

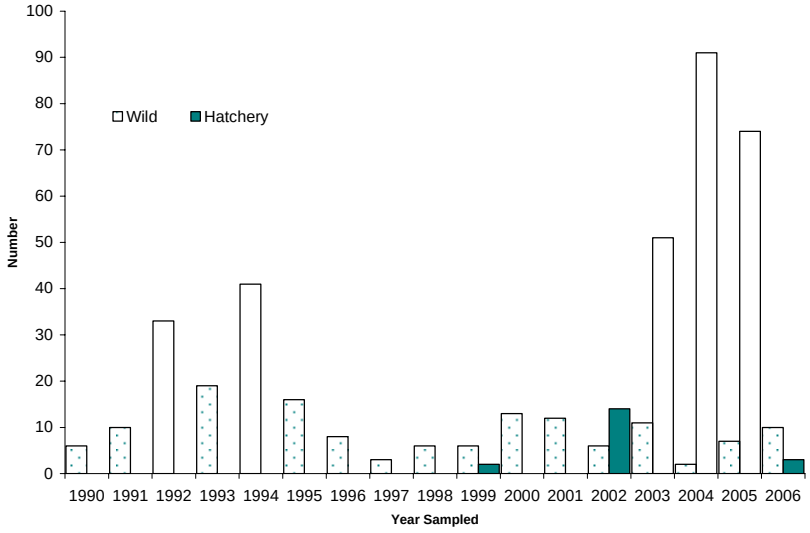

Figure 5. Upper Missouri River (RPMA 2) wild pallid sturgeon and hatchery produced pallid sturgeon collected 1990-2006. All 2006 data entries were not completed at the time this graph was made. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

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RPMA 3

RPMA 3 is the Missouri River from 20 miles (mi) (32 kilometers (km)) upstream of the mouth of the Niobrara River to Lewis and Clark Lake (Figure 1). There is no native wild population of pallid sturgeon known to survive in RPMA 3 and the current population consists entirely of hatchery stocked fish. According to the National Pallid Database (USFWS 2006b), the last record of a wild species from this area, that was not translocated, was the collection of a single pallid sturgeon circa 1991. Prior to this (1952-1991), there was a small number of wild pallid sturgeon collected from this area. Figure 6 represents all wild pallid sturgeon collected in RPMA 3 including the collection of a translocated wild pallid sturgeon in 2003. Research within RPMA 3 during 1998 and 1999 (prior to stocking hatchery-reared pallid sturgeon in this reach) did not document a single pallid sturgeon, but numerous shovelnose sturgeon[**] were collected. A total of 102 pallid sturgeon has been collected in RPMA 3 during 2 years of sampling (2003-2005) (Figure 7). All of these were hatchery-reared with the exception of a few translocated wild pallid sturgeon. These data suggest that prior to supplementation, pallid sturgeon were extremely rare or extirpated in RPMA 3. Supplementation of RPMA 3 with hatchery-reared pallid sturgeon has occurred sporadically with various numbers being stocked depending on hatchery success for any given year. Recent work by Shuman et al. (2005) indicates that these stocked pallid sturgeon are surviving and growing (mean growth of age-6 and older fish was <0.06 mm/day (mm/d), mean growth for ages 2-4 was 0.238 mm/d, and the youngest year class (2004) grew 1.249 mm/d) in this reach with all stocked year classes (1997-1999 and 2001 and 2002) being collected in their samples (see also Figures 6 and 7).

[**]The shovelnose sturgeon, smallest of the ancient sturgeon species in North America, is similar in appearance to the pallid sturgeon. Like pallid sturgeon, the shovelnose has bony plates instead of scales, a ventral sucker-type mouth and large barbels or whisker-like sensors in front of its mouth. While shovelnose sturgeon have a flattened and shovel-shaped snout, the head shape of a pallid sturgeon may appear longer and skinnier. The shovelnose is generally darker in color (tan to gray or yellowish green dorsally, light ventrally) than the pallid sturgeon (greyish-white) and attains smaller maximum size. The shovelnose sturgeon rarely exceeds 15 lbs in weight, while the pallid can exceed 6 ft (2m) in length and weigh over 80 lbs (36 kg). Also, the belly of the adult shovelnose sturgeon is covered with bony plates while pallid sturgeon bellies tend to feel smooth to the touch. The barbels are positioned differently when the two species are compared. Generally, in the shovelnose all four barbels insert in a roughly even line perpendicular to the species midline, and are evenly spaced in front of the mouth. In the pallid, the outer barbels insert posterior to the inner barbels. The shovelnose sturgeon is strictly a freshwater species that was historically found throughout most of the Mississippi and Missouri River basins, from Montana south to Louisiana, and from Pennsylvania west to New Mexico. While the shovelnose has not experienced the range reduction of some of the larger Mississippi River Valley sturgeons (i.e., lake and pallid sturgeons), it is no longer found in Pennsylvania, New Mexico, and large parts of Kansas, Kentucky, Tennessee, and other States where it was once abundant. For more information see http://www.fws.gov/Midwest/Fisheries/library/broch-shovelnose.pdf.

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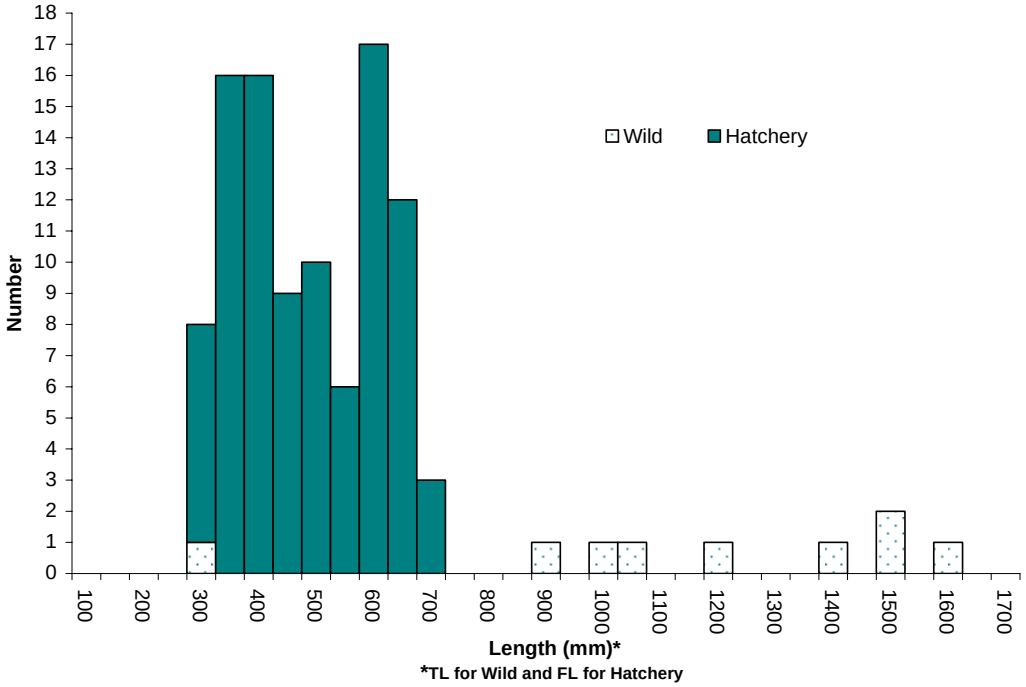

Figure 6. Upper Missouri River (RPMA 3) length frequency histogram representing each total individual wild pallid sturgeon collected 1952-2003 and hatchery pallid sturgeon collected 2001-2005 for which there were length data (Wild n=9, Hatchery n=96). The length reported is total length, not fork length for wild pallid sturgeon. The change is related to how data were reported prior to listing in 1991. The translocated 2003 fish is based on fork length (1,430 mm). The 300-mm wild pallid sturgeon was collected in 1952. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

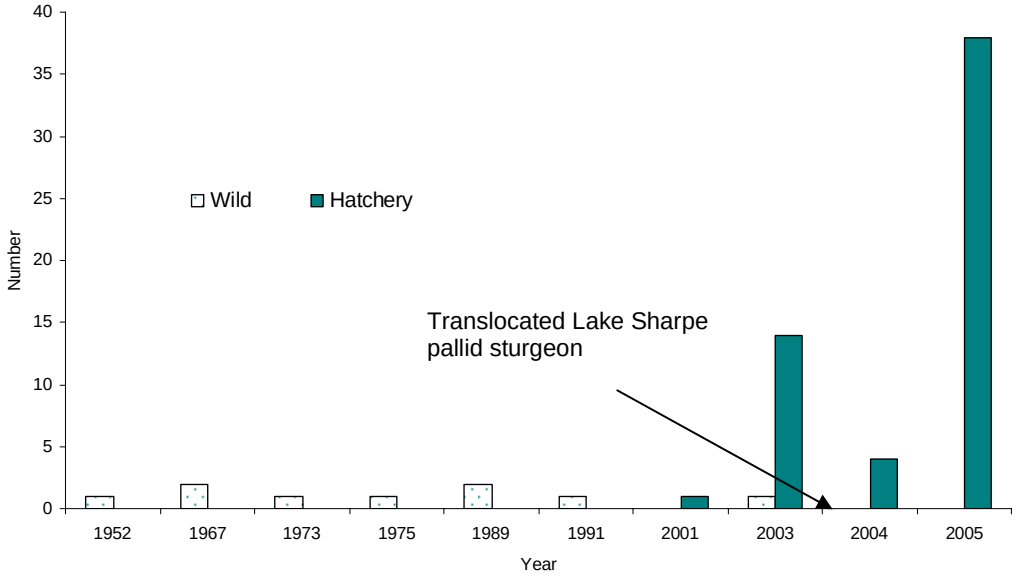

Figure 7. Upper Missouri River (RPMA 3) wild pallid sturgeon and hatchery produced pallid sturgeon collected 1952-2005. The fish collected in 2003 was a translocated pallid sturgeon form Lake Sharpe, South Dakota. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

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RPMA 4

The Missouri River downstream of Gavins Point Dam, South Dakota to the Missouri River/Mississippi River confluence, including major tributaries such as the Platte River, defines RPMA 4 (Figure 1). Although pallid sturgeon captures in RPMA 4 continue to increase with fishing effort, population levels and trends, habitat use, and movement patterns remain unknown. In the late 1990s, the USFWS Columbia Fishery Resources Office collected larval sturgeon in the Lisbon Chute on the Missouri River. Three were confirmed as larval pallid sturgeon and seven others were identified as probable pallid sturgeon (Krentz 2000) (identification by Darrel Snyder, Colorado State University Larval Fish Laboratory). Larval sturgeon (species not confirmed) also have been documented in the Missouri River below Gavins Point Dam by Nebraska Game and Parks Commission (NGPC) (Gerald Mestl, NGPC, pers. comm., 2005) and the Missouri Department of Conservation (MDC) (Herzog et al. 2005) and in the lower Platte River (Hofpar 1997, Reade 2000). Some of these smaller fish may have been pallid sturgeon, but accurately identifying these larval fish to species is difficult (Kuhajda et al. In Press). Recent studies also identify low numbers of unmarked pallid sturgeon (larger than fry) being collected from the lower Missouri River (Kennedy et al. 2006; Utrup et al. 2006). Augmentation with hatchery-reared pallid sturgeon has occurred sporadically since 1994 (USFWS 2006a), and the collection of individuals from all stocked cohorts indicates that hatchery supplementation is contributing to the population (Barada and Steffensen 2006; Kennedy et al. 2006; Steffensen and Barada 2006; Utrup et al. 2006). Of a total 156 pallid sturgeon captured between 1999 and 2005, 51 are believed to be wild, 82 were of hatchery origin, and 24 were of unknown origin. These fish were identified as wild if they did not possess a physical mark (i.e., coded wire tag or elastomere tag) indicating they were from a hatchery and were of a size class greater than what was associated with known hatchery-released fish. Fish labeled as hatchery origin had a distinguishing physical mark. Unknown individuals were consistent in length with known hatchery fish, but had no notable marks. These are considered unknown because certain marking techniques, like PIT tags, have been documented to fail. However, data within the National Pallid Sturgeon Database (USFWS 2006b), for the period 1990-2005, notes 117 unique wild pallid sturgeon for RPMA 4. Available length frequency data for these fish indicates the majority to be adults. A few have been reported that are of sub-adult sizes (<600 mm), yet these sub-adult pallid sturgeon were all collected after supplementation commenced in 1994. Retrospective testing of the unmarked fish has revealed that 23 of the 24 unmarked pallid sturgeon were of hatchery origin, and the remaining unknown origin fish remained in that category because parental genetic samples were not available for all families released downstream of Gavins Point Dam and they could have originated from one of the unsampled families (DeHaan et al. submitted). The apparent lack of naturally produced or unknown origin pallid sturgeon in smaller size classes, coupled with higher relative abundances of hatchery origin pallid sturgeon (Figures 8 and 9) and frequent captures of smaller size class shovelnose sturgeon, suggests that the sampling gear and effort being used are effective and that natural recruitment of pallid sturgeon is sporadic or limited in RPMA 4 (Barada and Steffensen 2006, Kennedy et al. 2006, Steffensen and Barada 2006, Utrup et al. 2006). These data also indicate that hatchery stocked fish are being collected and contributing to the population (Figures 8 and 9).

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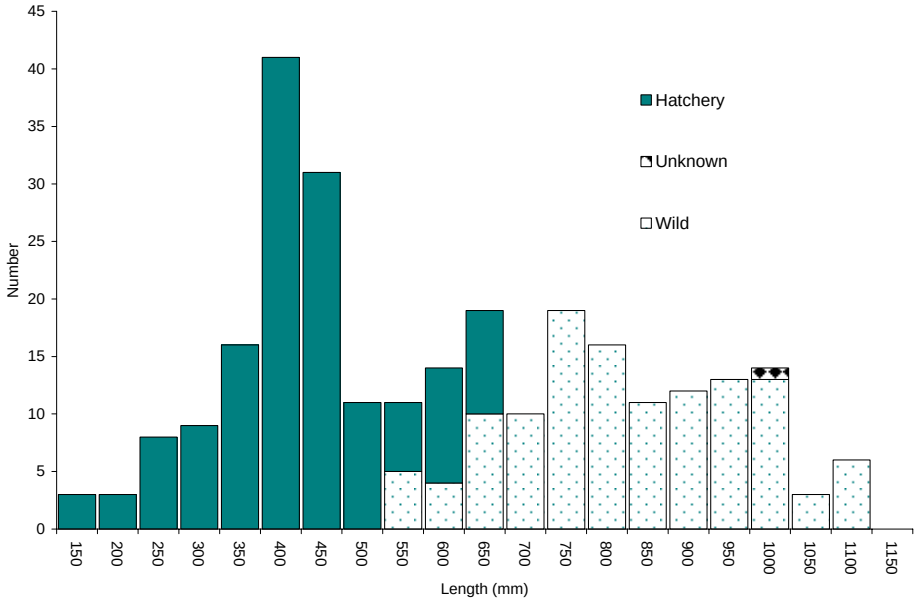

Figure 8. Middle and lower Missouri River (RPMA 4) length frequency histogram representing each total individual wild pallid sturgeon collected 1990-2005 for which there were length data. Unknown fish represented in this graph are pallid sturgeon whose origin is unknown. Their lengths are consistent with hatchery-reared pallid sturgeon yet they had no physical marks and did not match to known parents when genetically analyzed. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

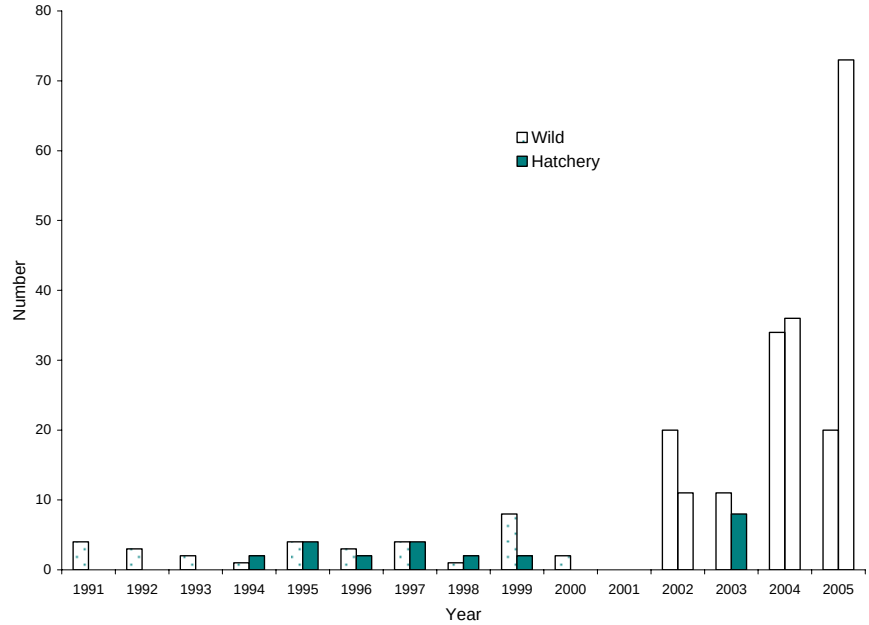

Figure 9. Middle and lower Missouri River (RPMA 4) wild pallid sturgeon and hatchery produced pallid sturgeon collected with all gear types 1991-2005. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

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RPMA 5

The Mississippi River from its confluence with the Missouri River to the Gulf of Mexico defines RPMA 5 (Figure 1). While not identified in the Recovery Plan, the Mississippi River is often subdivided into two segments: 1) the lower Mississippi River, extending 953 River miles (Rmi) (1,533.7 River kilometers (Rkm)) from the Gulf of Mexico to Cairo, Illinois; and 2) the middle Mississippi River, extending 200 Rmi (321.9 Rkm) from near Cairo, Illinois, to just above the mouth of the Missouri River confluence near St. Louis, Missouri. The availability of demographic data in RPMA 5 (Figure 10) for pallid sturgeon has increased since the species was listed. Although pallid sturgeon captures in RPMA 5 continue to increase with fishing effort, population levels and trends, habitat use, and movement patterns remain unknown. Only 28 records of pallid sturgeon were recognized from the Mississippi River when the species was listed in 1990 and the recovery plan was published in 1993 (USFWS 1993). During the past 6 years, over 300 pallid sturgeon (both sub-adult and adult size classes) have been collected from the Mississippi River (Figures 10 and 11). However, caution must be applied when looking at total catch because some of the collected pallid sturgeon reported by D. Herzog, (MDC) may also have been reported by Jack Killgore (U.S. Army Corps of Engineers (USACE) during their collaborative efforts. According to the National Pallid Sturgeon Database (USFWS 2006b), 279 unique pallid sturgeon have been collected in RPMA 5 between 1990 and 2004. It is unclear what percentage of these may be hatchery origin pallid sturgeon with failed physical marks. Jack Killgore, USACE, (pers. comm., 2005) indicated that, between the winter of 2004 and the spring of 2005, 39% (7 of 18) of the pallid sturgeon sampled were hatchery stocked recaptures with a coded wire tag (CWT). Prior to 2004, pallid sturgeon were not checked for coded wire tags, a physical mark that was utilized on hatchery-reared pallid sturgeon stocked from Missouri's Blind Pony fish hatchery.

Middle Mississippi River

From 2002 through 2005, the USACE, MDC, and Southern Illinois University conducted a joint pallid sturgeon research project in the middle Mississippi River using trawling, gillnets, and trotlines as the primary sampling gears. As part of this project a little over 64,000 hours of effort (combined for all gear types) was expended to catch a total of 148 pallid sturgeon. Of the 148 pallid sturgeon collected, 12 individuals (8%) were hatchery origin fish determined by the presence of coded wire tags. This 8% is likely underrepresenting the total number of hatchery origin fish in this sampling effort because scanning for coded wire tags was not a standard practice until 2004 (Jim Garvey, Southern Illinois University, pers. comm. 2006).

Herzog et al. (2005) documented successful reproduction by the collection of larval pallid sturgeon in the middle Mississippi River, though the origin of these larval pallid sturgeon from within the middle Mississippi River is not known. Wild pallid sturgeon collected from this reach ranged between 500 and 1,000 mm fork length (FL; the length measured from the anterior most portion of the fish to the median caudal fin rays) (Figure 10). Pallid sturgeon above 600 mm FL are believed to be of reproductive size, and the capture of small adult and sub-adult pallid sturgeon around and below this size may indicate that some level of recruitment is likely occurring in the middle Mississippi River or lower Missouri River, or could be a product of

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undetected marks in hatchery origin pallid sturgeon. Limited supplementation with hatchery-reared pallid sturgeon has occurred in the middle Mississippi River (USFWS 2006a).

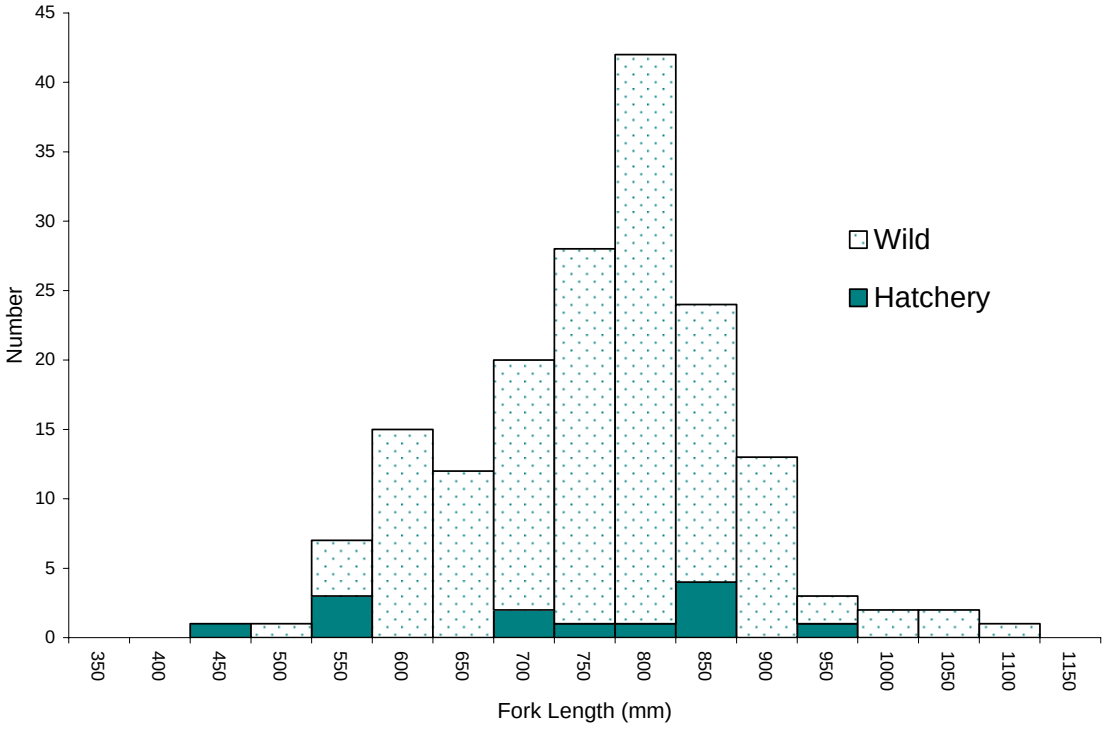

Figure 10. Middle Mississippi River (RPMA 5) length frequency histogram representing each total individual wild and known hatchery-reared pallid sturgeon collected 1991-2005 for which there were length data. The middle Mississippi River is the reach of the Mississippi River from the confluence of the Ohio River near Cairo, Illinois, to the confluence of the Missouri River, near Saint Louis, Missouri. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

Lower Mississippi River

The USACE sampled the lower Mississippi River (below the Ohio River to the mouth) from 2000 to 2006. During this time, 162 pallid sturgeon were collected from over 130 locations (i.e., specific Rmi/Rkm) between Rmi 145 to 954 (Rkm 233 to 1535) (J. Killgore, USACE, pers. comm., 2005), with 3 recaptures. Sizes of pallid sturgeon collected range between 400 and 1,000 mm FL (Figure 11). This data set includes at least 30 "sub-adult" pallid sturgeon (i.e., <600 mm FL), showing some level of recruitment in the lower Mississippi River population. It is possible that recruitment of pallid sturgeon in RPMA 5 is higher than that reflected in sampling data. Although morphologically distinct pallid sturgeon as small as 450 mm FL are occasionally captured (Figure 11), some young-of-year and sub-adult pallid sturgeon may be misidentified as shovelnose or hybrids.

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One recent study found that character indices do not correctly identify small upper Missouri River hatchery-reared juvenile pallid sturgeon (<250 mm standard length; the length from the tip of the upper jaw to the posterior end of the vertebral column that is most commonly used in taxonomic studies) from shovelnose or hybrid sturgeon, or reliably separate larger pallid sturgeon (up to 600 mm standard length) from hybrid sturgeon (Kuhajda and Mayden 2001). Measurements taken from 48, 10-month old hatchery-reared juvenile pallid sturgeon (309 to 413 mm FL) spawned from Atchafalaya River stock and reared at the Natchitoches NFH, incorrectly identified all but two of these hatchery-reared pallid sturgeon as hybrids, and the two exceptions were incorrectly identified as shovelnose sturgeon (Jan Dean, USFWS, pers. comm., 2005). These juvenile fish were reared from morphologically distinct pallid sturgeon confirmed by genetic analysis.

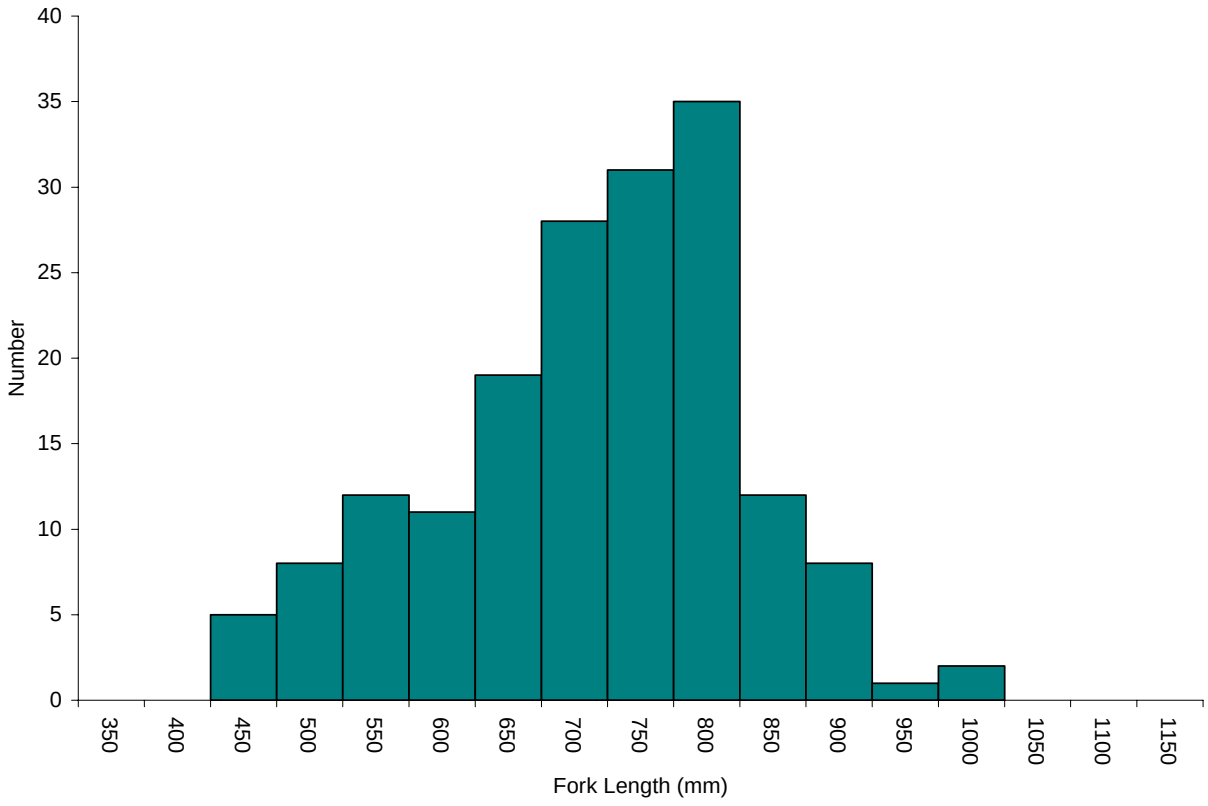

Figure 11. Lower Mississippi River (RPMA 5) length frequency histogram representing wild pallid sturgeon collected during 1991-2005 for which there were length data (n=172). The lower Mississippi River is the reach of the Mississippi River from the confluence of the Ohio River near Cairo, Illinois, to the Gulf of Mexico. Data compiled from National Pallid Sturgeon Database (USFWS 2006b).

Murphy et al. (in press) also have found greater morphological variation in specimens of pallid and shovelnose sturgeon from the Mississippi River than what is accounted for in current identification indices. These studies suggest that at least some young-of-year, sub-adult, or small

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adult pallid sturgeon can be misidentified in the field as hybrid or shovelnose sturgeon. Captures of pallid sturgeon in the Mississippi River have been associated with islands, sand bars, gravel bars, and dikes, in both the main channel and in secondary channels.

RPMA 6

RPMA 6 is the Atchafalaya distributary system to the Gulf of Mexico (Figure 1). Collection data from this RPMA reflects an improvement in our understanding of the pallid sturgeon population trend. Prior to listing in 1990, pallid sturgeon had not been documented from the Atchafalaya River. In 1991, seven pallid sturgeon were collected from the Atchafalaya River near the Old River Control Complex, in Concordia Parish, Louisiana (Reed and Ewing 1993). A few years later (1993-95) an additional 106 pallid sturgeon captures were reported (Constant et al. 1997). A conservative total of 499 individual pallid sturgeon have been collected from the Atchafalaya River since 1991 (Figure 12). A conservative approach to species identification was used, based upon morphometric measurements, to identify pallid versus intermediate or "hybrid" sturgeon, and thus actual number of pallid sturgeon captured from the Old River Control Complex (ORCC) is likely underrepresented in these data. There have been at least 37 wild adult pallid sturgeon recaptures in the ORCC area since 1991, of which 32 have been during 2004-2006 (J. Dean, USFWS, pers. comm., 2006).

The length distribution of pallid sturgeon captures has remained relatively consistent over the past 7 years, although the population appears to be comprised of predominantly adult pallid sturgeon >650 mm FL (Figure 12). However, gears used to sample this area are larger mesh and may not reliably sample sturgeon smaller than 400 mm. It is currently unknown if this consistent length frequency distribution through time combined with the occasional collection of smaller pallid sturgeon, results from local reproduction and recruitment, the passage of sub-adult and/or adult pallid sturgeon from the Mississippi River through the ORCC into the Atchafalaya River, or is simply a product of gear selectivity/bias.

Gill net collections at the Old River Control Complex regularly capture shovelnose sturgeon between 400 and 750 mm FL. The pallid sturgeon are larger, measuring (with occasional exceptions) above 650 mm FL (e.g., Figure 12). It has been noted in the discussion under RPMA 5, above, that there are difficulties in separating juvenile *Scaphirhynchus* to species. This also is true in RPMA 6. For example, trawl sampling for 2 days below Old River Control Complex during June 2005, resulted in the capture of six young-of-year *Scaphirhynchus* (196 to 410 mm total length (the length measured from the anterior most portion of the fish to the tip of the caudal fin rays). Three of these fish were marked indicating they were hatchery-reared juvenile pallid sturgeon released during fall and winter of 2004, and the other three had no physical mark and were considered wild young-of-year sturgeon. A character index was used on all six fish and misidentified the three hatchery-reared pallid sturgeon as hybrids, and identified two of the unknown wild sturgeon as shovelnose and the other as a hybrid (Jan Dean, USFWS, pers. comm., 2005). Further investigation is required to determine if allometric growth is resulting in the misidentification of some juvenile or sub-adult pallid sturgeon as shovelnose or "hybrids/intermediates" (e.g., Figure 13), and to document local reproduction and recruitment in RPMA 6.

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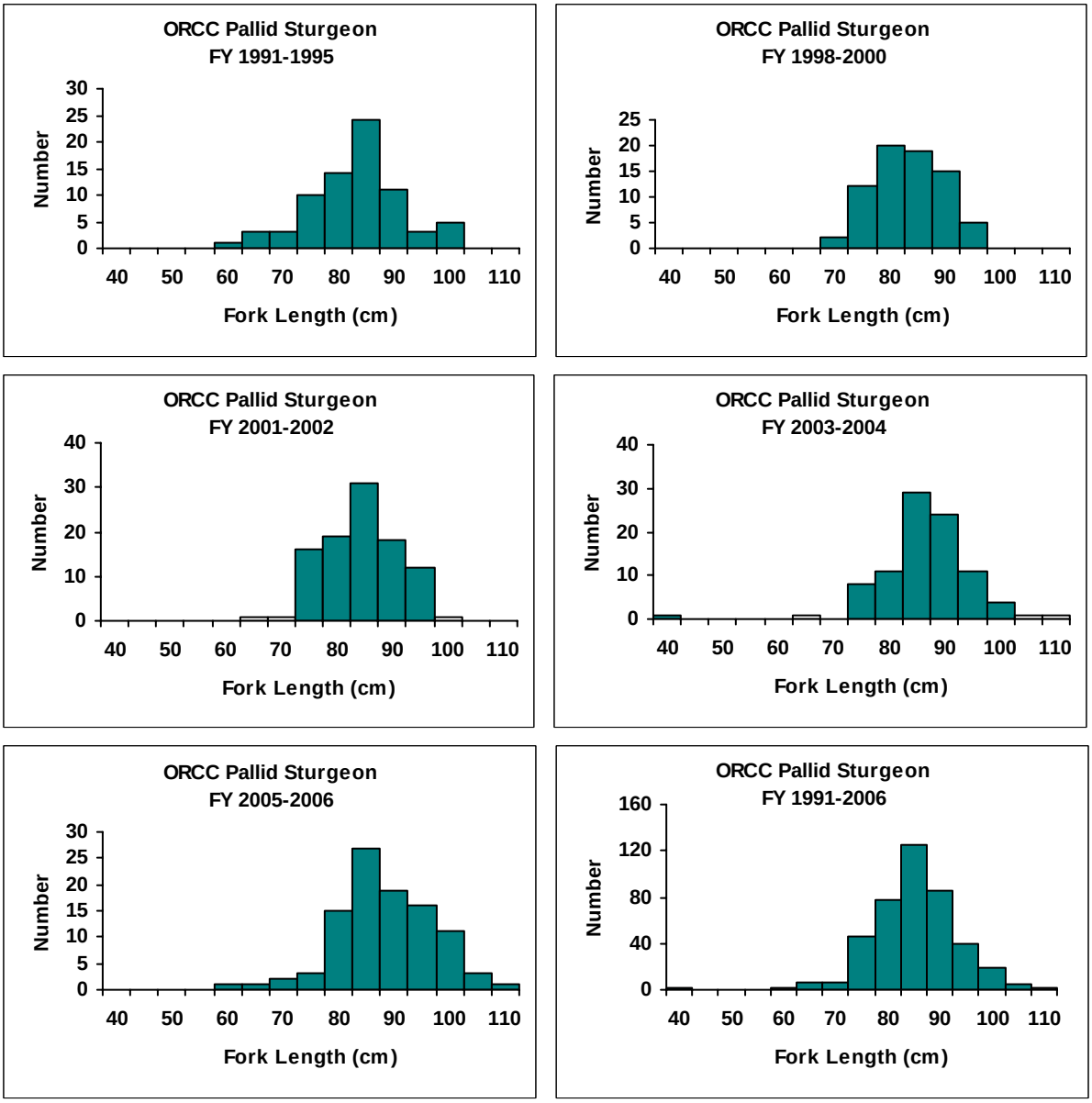

Figure 12. Conservative representation of pallid sturgeon length frequency data collected from the Atchafalaya River, 1991-2006. The actual number of pallid sturgeon captured from the Old River Control Complex area during that time likely exceeds 500 individuals. A conservative approach, based upon morphometric measurements, was used here to separate pallid sturgeon from intermediate character sturgeon. Data provided by J. Dean, USFWS and reported by Federal Fiscal Year (October-September) not calendar year (January-December).

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Figure 13. Length frequency histogram representing total pallid sturgeon (n=46), intermediate characteristic sturgeon (n=43) and shovelnose sturgeon (n=83) collected from the Atchafalaya River during 2005. Data provided by Jan Dean, USFWS.

2.3.1.2 Genetics, Genetic Variation, or Trends in Genetic Variation

While morphological differences among pallid and shovelnose sturgeon have been described (Bailey and Cross 1954, Keenlyne et al. 1994), genetic differentiation has been more difficult. Initial genetic studies were unable to distinguish pallid from shovelnose sturgeon by examining 37 allozyme loci (Phelps and Allendorf 1983), restriction fragment length polymorphism (RFLP) analysis of five protein coding genes (Morizot 1994), or comparing sequence variation at two mitochondrial loci (1137 bases of cytochrome b and 829 bases of the control region (D-loop) (Simons et al. 2001). These results have been variously interpreted as a lack of reproductive isolation between the species (Phelps and Allendorf 1983), a low evolutionary rate within the genus *Scaphirhynchus* (Simons et al. 2001), or that pallid and shovelnose sturgeon have recently diverged, undergone rapid morphological differentiation, and the type of genetic markers examined had not yet diverged enough to distinguish the species (e.g., Campton et al. 2000).

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Campton et al. (2000) and Tranah et al. (2001) were able to find genetic markers that distinguish pallid from shovelnose sturgeon. Campton et al. (2000) found significant haplotype frequency differences, based on approximately 500 base pairs, between the 2 species at the mitochondrial DNA control region. This initial finding of genetic distinction between pallid and shovelnose sturgeon was supported by Tranah et al. (2001) who examined the same samples using five nuclear DNA microsatellite loci. The concordant conclusions from these studies using different genetic markers were the first to support the genetic distinction between pallid and shovelnose sturgeon.

Intercrosses (hybridization) Between Pallid and Shovelnose Sturgeon

The pallid sturgeon was listed as endangered over its entire range (USFWS 1990). Recent concerns have been raised regarding the genetic structuring of the species across its range. Following listing, genetic data have been evaluated to help better understand the range-wide population structure of pallid sturgeon.

The presence of sturgeon that appear to be morphologically intermediate between pallid and shovelnose sturgeon, were presumed to represent pallid-shovelnose sturgeon hybrids (Keenlyne et al. 1994, Carlson et al. 1985) and spurred an effort to determine the genetic origins of these fish. Tranah et al. (2004) combined the data from Campton et al. (2000) and Tranah et al. (2001) and added 4 additional microsatellite loci to the data set to determine the genetic origins of 10 morphologically intermediate sturgeon collected from RPMA 6. All fish were classified as pallid, shovelnose or hybrid sturgeon via the hybrid index method of Campton (1987).

Results of Tranah et al. (2004) support earlier morphometric-based conclusion on the presence of hybrids (Keenlyne et al. 1994) suggesting that intercrossing or gene flow between the two species (pallid and shovelnose sturgeon) is more pronounced in the middle Mississippi and Atchafalaya Rivers than elsewhere (e.g., upper Missouri River). Tranah et al. (2004) also suggested that while shovelnose and pallid sturgeon are distinct morphologically, they are undergoing hybridization in the lower Mississippi and Atchafalaya Rivers. Morphometric data also may indicate hybridization in the lower Missouri River (Grady et al. 2001a; Grady et al. 2001b; Doyle and Starostka 2003) based on the presence of morphologically intermediate sturgeon. The extent to which these hybrids are going beyond the first generation (introgressive hybridization) is currently unknown. Tranah et al. (2004) suggest that female pallid sturgeon are mating with shovelnose sturgeon males and the hybrids are subsequently backcrossing with the more numerous shovelnose sturgeon. This finding should be treated as preliminary because a small number of fish classified morphologically as hybrids were examined.

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Allendorf et al. (2001) theorized that pallid and shovelnose sturgeon in the lower Mississippi River have not evolved reproductive isolation to the same degree as pallid and shovelnose sturgeon in the upper Missouri River and suggested there may be no pure pallid sturgeon in the lower Mississippi River because all sturgeon located in that reach comprise a hybrid swarm. Although microsatellite studies have provided evidence of hybridization between pallid and shovelnose sturgeon in the Missouri, Mississippi, and Atchafalaya Rivers (Tranah et al. 2001; Heist and Schrey 2006a and b), these and other studies (Ray et al. in press) have also demonstrated that shovelnose and pallid sturgeon remain genetically distinct from each other in the Missouri, Mississippi, and Atchafalaya Rivers, and a third group, hybrids/intermediates, are present.

These genetic comparisons of hybrids need to be considered in the context of studies with hatchery-reared pallid, shovelnose, and hybrids that show small pallids may be regularly misidentified as hybrids based on morphological characters (Kuhajda and Mayden 2001; Kuhajda et al. in press; Murphy et al. in press). More information is needed on the evolutionary dynamics of intermediate forms between pallid sturgeon and shovelnose sturgeon to understand if they are natural or if anthropogenic modification has forced an overlap of breeding areas and thus a realized threat.

Population Structure of Pallid Sturgeon

Campton et al. (2000) used approximately 500 base pairs of the mitochondrial DNA control region to examine genetic variation within and among 3 pallid sturgeon populations, 2 of which were located in the upper Missouri River (RPMA 1 and 2) and 1 from RPMA 6 river system. The pallid sturgeon from these geographically divergent areas did not share any haplotypes ($P < 0.001$), and the genetic distance between these two groups (0.14%) was nearly as great as the genetic distance between pallid and shovelnose sturgeon in the upper Missouri River (0.15%). The authors note that this may represent reproductive isolation and genetic divergence between these two populations of pallid sturgeon that is nearly as old as the isolation between pallid and shovelnose sturgeon. Another explanation offered in Campton et al. (2000) is that northern and southern pallid sturgeon arose independently from different ancestors and are not a monophyletic lineage, thereby representing two separate species.

Tranah et al. (2001) examined genetic variation within and among the same three pallid sturgeon samples. The allele frequencies at five microsatellite loci indicated the two upper Missouri River groups, separated by Ft. Peck Dam, did not differ significantly from each other. Conversely, pallid sturgeon genetic samples from the upper Missouri population did differ from samples collected from the Atchafalaya River ($F_{st} = 0.13$ and 0.25; both $P < 0.01$). They concluded pallid sturgeon collected from RPMA 1 and 2 (the northern

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fringe of their range) are reproductively isolated from those sampled from RPMA 6 (southern extreme of their range) and should be treated as genetically distinct populations.

Heist and Schrey (2006a) found significant F_{st} differences between the upper Missouri River pallid sturgeon samples when compared with samples from the middle Mississippi River. Heist and Schrey (2006b) subsequently examined samples collected from the upper portion of RPMA 4. These samples were collected below Gavins Point Dam, South Dakota, downstream to Kansas City, Missouri. Heist and Schrey (2006b) note that pallid sturgeon in this part of the range appear to be genetically intermediate between the upper and lower Missouri River pallid sturgeon samples.

In 2006, Dr. Ed Heist and Aaron Schrey provided an overview of their research to the Pallid Sturgeon Recovery Team (Team) and the Team's Genetics Advisory Group during a conference call (see Appendix B). The results were based on output from the software package STRUCTURE. This program does not require *a priori* species identification and identifies natural groupings among samples to minimize Hardy-Weinberg deviations and linkage disequilibrium. When only putative pallid sturgeon samples were analyzed, three genetic groups of pallid sturgeon appear across the species range. The three groupings are a well differentiated upper Missouri River group and two less differentiated groups in the lower Missouri/middle Mississippi and Atchafalaya River samples.

These data (Campton et al. 2000, Tranah et al. 2001, Heist and Schrey 2006a) suggest that the genetic structuring within the pallid sturgeon's range represents two distinct groups at the extremes of the species range with a middle intermediate group representing the lower Missouri and middle Mississippi Rivers. This pattern is suggestive of a pattern of isolation by distance, with gene flow more likely to occur between adjacent groups than among geographically distant groups, and thus, genetic differences increase with geographical distance.

2.3.1.3 Taxonomic Classification or Changes in Nomenclature

NA

2.3.1.4 Spatial Distribution, Trends in Spatial Distribution, or Historic Range

The historical range of pallid sturgeon is the Missouri and Mississippi River systems from near Fort Benton, Montana, to Head of Passes, Louisiana. Historically, larger tributaries like the Yellowstone, Platte, Lower St. Francis, and Big Sunflower Rivers also were utilized as well as the Atchafalaya River distributary (see also 2.3.1.1 above). Currently, pallid sturgeon habitat in the upper Missouri River is highly fragmented and reduced. RPMA 1 contains approximately 174 Rmi (280 Rkm) of flowing river conditions, RPMA 2

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extends for 186 Rmi (300 Rkm), while RPMA 3 provides approximately 52 Rmi (85 Rkm) of riverine conditions between Ft. Randall Dam and Lewis and Clark Lake. Riverine conditions extend virtually uninterrupted for about 2,000 Rmi (3,200 Rkm) between Gavins Point Dam in the middle Missouri River and the Gulf of Mexico (RPMAs 4 and 5). RPMA 6 contains approximately 140 Rmi (224 Rkm) of the Atchafalaya River. The Old River Control Complex forms a potential uni-directional barrier to fish movement between the Mississippi and Atchafalaya Rivers. The structures associated with the Old River Control Complex likely could allow movement of fish from the Mississippi River into the Atchafalaya River, but could constitute a velocity type barrier to movement from the Atchafalaya River into the Mississippi River. Collection of lake sturgeon (*Acipenser fulvescens*) and one pallid sturgeon, known to have been released in the middle Mississippi River, below the Old River Control Complex, indicates passage from the Mississippi River into the Atchafalaya River does occur (B. Reed, Louisiana Department of Wildlife and Fisheries, pers. comm., 2006; Hartfield in litt, 2006). However, passage or lack of passage in the opposite direction has not been determined.

2.3.1.5 Habitat or Ecosystem Conditions

Missouri River

Anthropogenic modifications to the Missouri River restrict the life cycle requirements of pallid sturgeon by blocking movements to spawning and feeding areas, destroying spawning areas, altering conditions and flows of potential remaining spawning areas, and reducing food sources by lowering productivity (Keenlyne 1989; USFWS 2000a). The most obvious habitat changes were creation of a series of impoundments on the main stem of the upper Missouri River and channelization of the lower Missouri River for navigation. Upper Missouri River dams and their operations have--1) created physical barriers that block normal migration patterns, 2) degraded and altered physical habitat characteristics, and 3) greatly altered the natural hydrograph (Hesse et al. 1989). Moreover, these large impoundments have replaced large segments of riverine habitat with lentic conditions. Damming of the upper Missouri River has altered lotic features such as channel morphology, current velocity, seasonal flows, turbidity, temperature, nutrient supply, and paths within the food chain (Russell 1986; Unkenholz 1986; Hesse 1987).

Fort Peck Reservoir forms the lower boundary of RPMA 1 (Figure 1) and some theorize that this reservoir is a major impediment to larval pallid sturgeon survival. Currently, shovelnose sturgeon within RPMA 1 are self-sustaining (B. Gardner, MFWP, pers. comm., 2005) while pallid sturgeon are not. Recent work by Gerrity (2005) indicates that immature hatchery-reared pallid sturgeon are more likely to utilize the lower reaches of RPMA 1 than are shovelnose sturgeon. The reaches frequented by Gerrity's

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study fish are attributable to the low pool levels in Fort Peck Reservoir. These lower reaches can be inundated at higher reservoir pool levels, and loose their lotic attributes. Thus it may be considered that behavioral differences occurring between the two sturgeon species results in divergent life history traits. Differences in larval drift (Kynard et al. 2002, 2005) or habitat selection in more upstream reaches (Gerrity 2005) may result in better survivorship of immature shovelnose sturgeon compared to pallid sturgeon. Similar to the observations of Gerrity (2005), Bramblett (1996) found that pallid sturgeon used 25 km of riverine habitat that would be inundated by Lake Sakakawea at full pool in RPMA 2. Canyon Ferry, Hauser, and Holter Dams are upstream of Great Falls, Montana, and likely do not impose any migratory barriers because passage at the natural falls likely did not exist historically. However, these structures, like most dams, reduce sediment and nutrient transport, maintain an artificial hydrograph, and delay thermal cues. A reduction in sediment input and transport has been shown to reduce naturally occurring habitat features like sandbars. Kellerhals and Church (1989) identify that discharge and sediment load, together with physiographic setting are primary factors controlling the morphology of large alluvial rivers. One other dam of importance in the system is Tiber Dam located on the Marias River. The Marias River may have been a historically important tributary for pallid sturgeon (B. Gardner, MFWP, pers. comm., 2005).

Fort Peck Dam was constructed in 1937 and Garrison Dam was completed in 1954. Fort Peck Dam forms the upper boundary of RPMA 2 and Lake Sakakawea forms the lower boundary (Figure 1). Fort Peck Reservoir and Lake Sakakawea may be impediments to larval pallid sturgeon survival. Support for this theory is provided in recent studies. Kynard et al. (2002) studied drift in *Scaphirhynchus* "free embryos." They determined that post-hatch larvae begin to migrate on day 0 and that pallid sturgeon larvae may migrate at a slower rate than shovelnose sturgeon, but they migrate for a longer time. Subsequent work was conducted with larval pallid sturgeon released within RPMA 2 as part of a larval drift study. These data suggest that pallid sturgeon larvae can drift 152 to 329 mi (245 to 530 km) depending on water column velocity (Braaten et al. in review). This drift distance would likely transport naturally spawned pallid sturgeon larvae into the headwaters of Fort Peck Reservoir and Lake Sakakawea. Braaten et al. (in review) speculate that differences in larval drift rates found between shovelnose and pallid sturgeon might explain why the two species experience different recruitment levels in the upper Missouri River. As part of this 2004 study various ages (in days) of fry were stocked, and in 2005 four non-physically marked pallid sturgeon were genetically traced back to the 11- to 17-day-old fry released as part of this drift study (William Ardren, USFWS, pers. comm., 2005). This indicates that fry released at ages 11 to 17 days are able to

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survive to age-1 in RPMA 2 and provides some evidence that the limitation on natural recruitment could be somewhere between the actual spawning event and the first couple of weeks after hatch.

Another limiting factor is an altered hydrograph and temperature profile attributable to water releases and reduced sediment transport from Fort Peck Dam. A reduction in sediment transport can reduce naturally occurring habitat features like sandbars (Kelllerhals and Church 1989). The Yellowstone River, a major tributary to the Missouri River, was likely a historically important tributary for spawning. Bramblett (1996) documented that pallid sturgeon prefer the Yellowstone River over the Missouri River below Fort Peck, many fish move into the lower Yellowstone River during spawning season, ripe fish occur in the Yellowstone River, and aggregations of fish during spawning season strongly suggest that pallid sturgeon spawning occurs in the lower 10 to 15 Rkm of the Yellowstone River. However, in the early 1900s, the Bureau of Reclamation (BOR) completed work on the Lower Yellowstone Irrigation Project with the completion of a full channel low-head dam (Intake Dam, circa 1910) across the Yellowstone River approximately 71 Rmi (114 Rkm) upstream from the Missouri and Yellowstone River confluence. This dam has effectively reduced the migratory potential of pallid sturgeon within the Yellowstone River system (Bramblett and White 2001, Jaeger et al. 2005). Telemetry work conducted in the Yellowstone River with juvenile pallid sturgeon (Jaeger et al. 2005) identified that about half of the study fish stocked upstream of Intake Dam remained there. Telemetered pallid sturgeon also have been entrained in the irrigation ditch served by Intake Dam (Jaeger et al. 2004). Larval drift work by Braaten et al. (in review) suggests that larval drift of fish naturally produced in the Yellowstone River will likely result in the fry drifting into Lake Sakakawea, and the ongoing threat to spawning success in the Yellowstone River is likely to be downstream drift of larvae into Lake Sakakawea (Bob Bramblett, Montana State University, in litt. 2006 (see Appendix A)). Other anthropogenic modifications include bank stabilization projects and water withdrawal projects.

The primary threat to pallid sturgeon existence within RPMA 3 is historical hydrograph alterations and habitat fragmentation. Fort Randall Dam was completed in 1956 and Gavins Point Dam was completed about a year later. Fort Randall Dam forms the upper boundary of RPMA 3 and Gavins Point Dam forms the lower boundary (Figure 1). The habitat threats associated within RPMA 3 are an altered hydrograph and temperature profile, a reduction in sediment transport, and fragmentation that could preclude adequate drift distance for larval pallid sturgeon. However, other native riverine species successfully spawn within this reach.

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RPMA 4 has over 800 Rmi (1,296 Rkm) available for pallid sturgeon, is not impounded, and is biologically and hydrologically connected with RPMA 5, but is not immune from anthropogenic modifications. Channelization of the Missouri River within RPMA 4 has reduced water surface area by half, doubled current velocity, decreased habitat diversity, and decreased sediment transport (Funk and Robinson 1974, USFWS 2000a). RPMA 4 can be characterized into three distinct reaches: the unchannelized, upper channelized, and lower channelized reaches. The unchannelized Missouri River reach in RPMA 4 extends approximately from Gavins Point Dam (Rmi 811/Rkm 1305) downstream to the mouth of the Big Sioux River (Rmi 736/Rkm 1184). The upper channelized portion of RPMA 4 extends from the Big Sioux River (Rmi 736/Rkm 1184) to the Kansas River (Rmi 367.5/Rkm 591), and the lower channelized reach extends from the Kansas River confluence downstream to St. Louis, Missouri (Rmi 0). The reason for the distinction of the channelized reaches is that, though they are channelized, they may provide varying degrees of habitat suitability. The upper channelized river is in its current location by construction, has no natural hydrological event, is of uniform size and construction activities, and has lost most of its sandbars, islands, and shallow water habitat. The lower reach was channelized in its natural location, has frequent high water events during the spring and summer months, and contains a wide range of dike types and sizes (USFWS 2006a).

The lower Platte River is a major Missouri River tributary in RPMA 4 and likely is/was important habitat for pallid sturgeon. The lower Platte River is defined in Snook et al. (2002) as the Platte River from the confluence with the Missouri River upstream to the Loup River. Snook (2001) documented that hatchery-reared pallid sturgeon (1992 year class produced at Blind Pony State Fish Hatchery, Missouri) released (1994) in the lower Platte River tended to remain in this reach, and speculate that habitat features like sand bars were important features for the species. In 2003, Swingle (2003) collected two presumed wild pallid sturgeon in the lower Platte River and subsequently followed their movement via telemetry. One of these was a gravid female collected early May 2001 that subsequently moved into the Missouri River on June 9, 2001, suggesting the lower Platte River may be an important tributary for spawning.

Mississippi River

RPMA 5 is unimpounded for 1,153 Rmi (1,922 Rkm) from the confluence with the Missouri River to the Gulf of Mexico (Figure 1). The Mississippi River has received a substantial amount of anthropogenic modification through time, and some changes resulting from those modifications have likely been detrimental to pallid sturgeon. These anthropogenic habitat alterations likely adversely affect pallid sturgeon by altering the natural form and functions of the Mississippi River (Simons et al. 1974; Baker et al. 1991;

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Theiling 1999; Wlosinski 1999). Anthropogenic alterations to tributaries may have contributed to habitat degradation in the Mississippi River as well. Impoundment of major tributaries reduced sediment delivery to the main channel (Fremling et al. 1989) resulting in channel degradation and reduction in shallow water habitats (Simons et al. 1974; USFWS 2000b).

Middle Mississippi River

The middle Mississippi River historically had a meandering pattern and shifted its course many times over the years, leaving oxbow lakes and backwaters (Theiling 1999). The undeveloped river was shallow and characterized by a series of runs, pools and channel crossings that provided a diversity of depth along the main channel (Theiling 1999). Currently the middle Mississippi River channel is fixed as a result of channel training structures and no longer meanders across the floodplain. This has reduced channel width and surface area, and thereby reduced habitat diversity. Side channels have been cutoff from the main river channel by closing structures. Many of these have been lost over time due to sedimentation. In the middle Mississippi River, the river is no longer free to migrate and produce new side channels due to channel training structures (e.g., wingdams, revetments, closing structures). Additionally, bendway weirs inhibit the establishment of point bars on inside bends of the river channel.

Channel training structures also have altered the natural hydrograph of the middle Mississippi River by contributing to higher water surface elevations at lower discharges than in the past and to a downward trend in annual minimum stages (Simons et al. 1974; Wlosinski 1999). The downward shift of annual minimum stages can be partially attributed to the degradation of the low-water channel by wingdams (Simons et al. 1974). River stages fluctuate as much as 45 feet (ft) (15 meters (m)) annually, effectively dewatering some secondary channels during low stages (Fremling et al. 1989).

Approximately 80% of the floodplain in the middle Mississippi River has been isolated from the main channel due to levee construction. This has allowed the conversion of floodplain habitats to agriculture and other land uses. Isolated backwaters, side channels, and wetlands have been degraded or lost. Destruction and isolation of these floodplain features has reduced riverine productivity (Theiling 1999) by decreasing energy inputs (organic matter and carbon) into the main channel.

Lower Mississippi River

Anthropogenic alterations have been documented in the lower Mississippi River with identified decreases in aquatic habitats (Baker et al. 1991). Construction of bendway cutoffs to facilitate navigation in the lower Mississippi River locally increased bed gradient and current velocities. As the

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river responded to the cutoffs, it first became entrenched, and then developed a semi-braided condition and a wider channel (Winkley 1977). Dikes constructed to offset this geomorphic response contributed to bed degradation. Historically, bed degradation resulted in dewatering of some side channels during periods of low discharges (Fremling et al. 1989). Levee construction effectively increased river stage and velocities at higher discharges by preventing water spillover onto the adjacent floodplains effectively isolating the floodplain (Baker et al. 1991). Wasklewicz et al. (2004) found that the upper and lower reaches of the lower Mississippi River have experienced increases in peak, mean, and minimum monthly stages, while the middle portion of the lower Mississippi River has experienced decreases in peak, mean, and minimum river stages. Separately, tributary impoundments, bendway cutoffs, and dike and levee construction changed localized patterns of channel erosion and deposition in the Mississippi River; collectively they resulted in a degradation trend throughout the system. Baker et al. (1991) documented a net loss in channel length, steep bank, sandbar, slough, oxbow lake, seasonal inundated floodplain, and floodplain pond habitat types when compared against features believed present in the lower Mississippi River prior to modification efforts. They documented an increase in low river stage pool habitat that was attributed to the extensive dike system, but noted that these artificial pools may not serve the same ecological function as lost natural slackwater habitats associated with the floodplain. Even so, 92 secondary channels remain in the lower Mississippi River between Rmi 132 and 946 (Rkm 212 and 1522), and although there has been a net loss in secondary channel habitats above +5 Low Water Reference Plane[***] over the past 40 years, elevations around 0 Low Water Reference Plane have remained relatively consistent and there has been a net increase in acreage of -5 Low Water Reference Plane shallow water habitats (Tom Keevin, USACE, pers. comm., 2006). Effects of these changes on pallid sturgeon are unknown, because there are no historical data for comparison.

Atchafalaya River

RPMA 6, the Atchafalaya River, has been significantly affected by reductions in sediment delivery. The Old River Control Complex was designed and constructed to stabilize the distribution of water and sediments between the Mississippi and Atchafalaya Rivers at the same proportions that occurred in 1950, and to prevent the Mississippi River from changing course. However, impoundment of its two major tributaries, the Red and Black Rivers, significantly reduced the sediment load from those sources. This reduction in sediment along with the construction of a hydropower plant just above Old River Control Complex has precipitated channel and bank erosion throughout the Atchafalaya River.

[***] Note that the Low Water Reference Plane is defined in Baker et al. (1991) as "...the river level corresponding to a discharge that is exceeded 97% of the time based on the 20-year period of record from 1954 to 1973. This elevation is assigned a value of 0 ft and river stages are referenced to this standard."

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Because historical data regarding populations of pallid sturgeon is lacking or incomplete, and information on spawning sites, spawning behavior, and juvenile and adult habitat needs and uses are lacking, the significance and effects of changes in riverine habitats on pallid sturgeon are not entirely clear. However, lower capture rates in the upper and lower Missouri and middle Mississippi Rivers suggest that pallid sturgeon are more seriously affected where habitat modification has been greatest (USFWS 2000a).

2.3.1.6 Other

The larvae of *Scaphirhynchus* are pelagic, exhibiting swim-up and drift behavior immediately after hatching. Downstream drift of larval pallid sturgeon begins day-0 at hatching and continues up to day-13, with a decline after day-8 (Kynard et al. 2002, 2005). Field studies of drift dynamics and behavior of larvae pallid sturgeon, conducted in a Missouri River side channel, suggested that they may drift 152 to 329 mi (245 to 530 km), depending on water velocity, during the first 11 days, and tend to become more benthic between days 11-17 (Braaten et al. in review), suggesting that river distance and suitable habitat available below spawning areas may be important to survival of *Scaphirhynchus* larvae, and a key factor in recruitment success of river sturgeon.

Pallid sturgeon are thought to spawn in the spring or early summer like other sturgeon species. However, the capture of *Scaphirhynchus* larvae and post-larvae in the Mississippi River during fall months, as well as spring, could be interpreted as an extended season or a second spawn in the lower latitudes of distribution (Paul Hartfield, USFWS, pers. comm., 2006).

In addition to range-wide genetic structuring identified in section 2.3.1.2., there are morphological differences documented between the upper Missouri River pallid sturgeon and pallid populations in the lower Mississippi and Atchafalaya Rivers (Kuhajda and Mayden 2001). The upper Missouri River pallid sturgeon are characterized by large sizes in excess of 60 lb, and large pointed snouts, while pallid sturgeon from the lower Missouri, Mississippi, and Atchafalaya Rivers typically have shorter and rounder snouts and fish size rarely exceeds 15 lb (Figures 14 and 15). However, pallid sturgeon exhibiting morphological traits similar to the northern sample (Figures 14 and 15) from the lower Missouri and middle Mississippi Rivers (Appendix B) have been collected. This suggests that there may be a fair amount of phenotypic plasticity in the species.

Sheared principal components analysis of 19 head measurements (e.g., snout shape, placement of barbels, size and placement of mouth) show that a size-free comparison between upper Missouri River pallid sturgeon,

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shovelnose sturgeon, and known hatchery-reared hybrids are quite different from lower Mississippi and Atchafalaya Rivers pallid, shovelnose, and intermediate sturgeons (Figure 16, see also Appendix B).

These morphological data suggest different populations of pallid sturgeon in the upper Missouri and lower Mississippi/Atchafalaya Rivers. These differing groups of pallid sturgeon also appear to occur in very distinct physiographic regions. The upper Missouri River lies within the Great Plains Region of the Interior Plains Province above the Fall Line, and the lower Mississippi/Atchafalaya Rivers lie within the Mississippi Alluvial Plain of the Coastal Plain Province. There are many examples of freshwater fishes having distinct populations within a species or distinct species within a lineage across different physiographic regions (Wiley and Mayden 1985).

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Figure 14. Adult pallid sturgeon: the northern specimen (largest) from the upper Missouri River (RPMA 2) and smaller southern specimen from the lower Mississippi/Atchafalaya River RPMA 5 or 6) (bottom). Both specimens represent some of the largest specimens from each region. (Photo courtesy of Dr. Bernard Kuhajda, University of Alabama.)

Figure 15. Adult pallid sturgeon: northern specimen from the upper Missouri River (right) and southern specimen from the lower Mississippi/Atchafalaya River (left). Both specimens represent some of the largest examples from each region. (Photo courtesy of Dr. Bernard Kuhajda, University of Alabama.)

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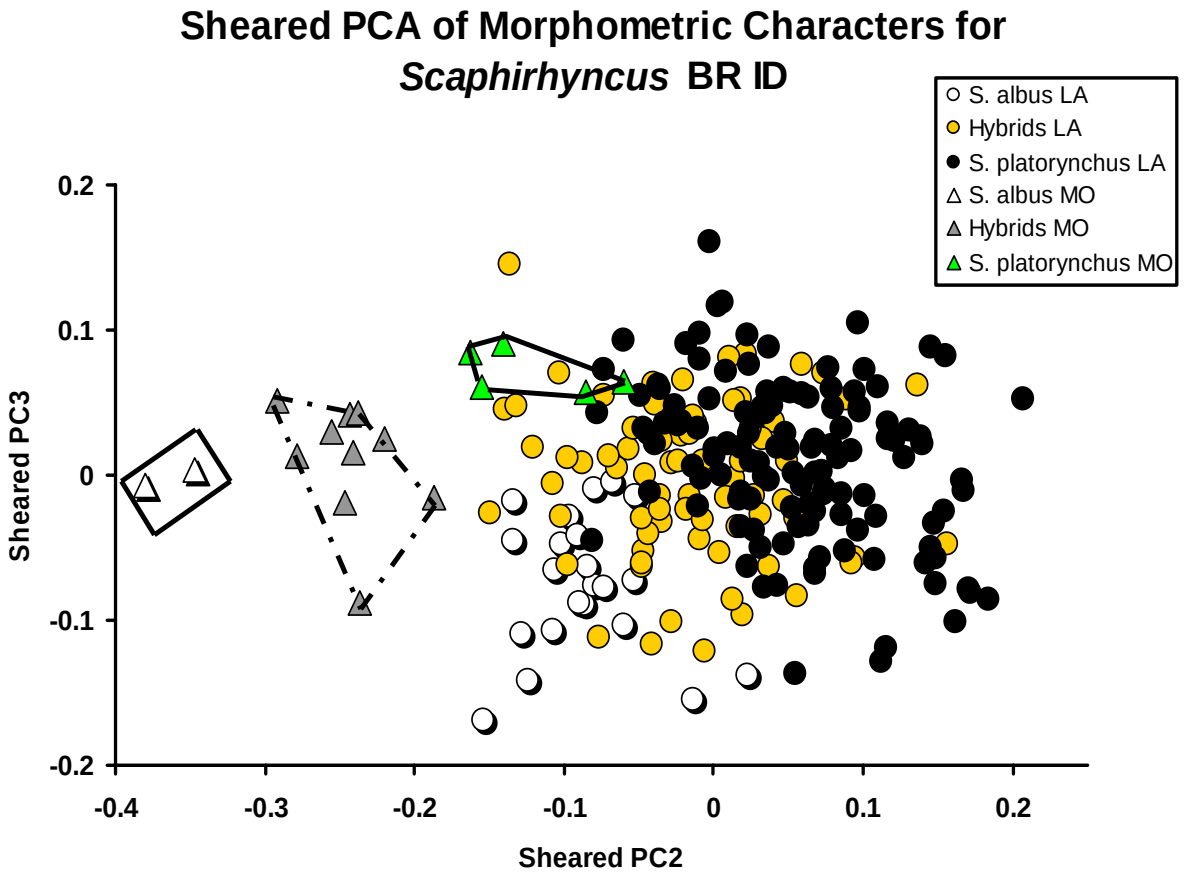

Scaphirhynchus

Figure 16. Sheared principal components analysis of 19 head measurements of upper Missouri River pallid sturgeon, shovelnose sturgeon, and known hatchery-reared hybrids (MO) and lower Mississippi/Atchafalaya River pallid, shovelnose, and intermediate sturgeons (LA). Each point represents measurements from an individual fish. (Courtesy of Dr. Bernard Kuhajda, University of Alabama.)

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2.3.2 Five-Factor Analysis

2.3.2.1 Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range

Habitat

Pallid sturgeon habitat has been dramatically altered during the past 60 years. Approximately 51% of the pallid sturgeon's historical range has been affected to some degree by channelization, 28% has been impounded, and the remaining 21% is affected by upstream impoundments that alter flow regimes, depress both turbidity and water temperatures, and have continuing bank stabilization activities that limit channel meandering (Keenlyne 1989, USFWS 2000a). Following listing in 1990, efforts have been taken to improve or restore habitats in various sections of the Missouri and Mississippi River systems, though most of these efforts have occurred during the last several years and little data are available to evaluate the success of implemented restoration projects. Below is a summary of what has been accomplished or determined since the Pallid Sturgeon Recovery Plan was completed in 1993.

Fort Benton to Fort Peck Reservoir Montana (RPMA 1)

There have been some significant changes in reservoir operations on tributaries within RPMA 1. Operations of Tiber Dam, located on the Marias River a tributary to the Missouri River, have been recently modified to occasionally accommodate a high flow discharge period in June. During 1995, 1997, and 2002 BOR provided a June peak release of 4,080, 4,500, and 5,300 cfs, respectively for downstream fisheries benefits. These releases were 1.8 to 2.3 times the average June peak discharge that has occurred since construction of Tiber Dam (1957-1994) (B. Gardner, MFWP, pers. comm., 2006). A direct response by pallid sturgeon was not observed; however, present numbers of pallid sturgeon could now be too low to detect or elicit a response. An indirect response to flow operational changes may be the recent establishment of sturgeon chub in the lower Marias River. Sturgeon chub are an important prey species of pallid sturgeon (Gerrity et al. 2006) and were documented only recently in the Marias River in 2002. The BOR is conducting a 5-year study to evaluate how operations of their four dams in the upper Missouri River system (including Tiber) affect pallid sturgeon recovery.

Recent research suggests that drought-induced lower water levels in Fort Peck Reservoir may increase available habitat for hatchery-reared juvenile pallid sturgeon as well. Gerrity (2005) noted that low water levels in Fort Peck Reservoir created an additional 34 mi (56 km) of riverine habitat upstream of the reservoir and this suggests that maintaining lower reservoir pools may be beneficial in creating additional riverine habitat for pallid sturgeon. In addition to providing juvenile pallid sturgeon habitat, the additional riverine

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reach produced by low water levels in Fort Peck Reservoir also should provide some additional drift distance for larval sturgeon. However, it is yet to be determined if the additional drift distance is sufficient to promote survival of naturally produced larvae.

Fort Peck Dam, Montana to Lake Sakakawea, North Dakota (RPMA 2)

Little direct manipulation of habitat has occurred in this reach to specifically benefit pallid sturgeon. However, there are several efforts in progress that ultimately will lead to habitat connectivity or flow manipulations that may be beneficial.

The Yellowstone River is the largest tributary to the Missouri River in this reach. However, about 71 Rmi (115 Rkm) from the confluence of the Yellowstone and Missouri Rivers is a low-head dam that effectively blocks the migration of pallid sturgeon (Bramblett and White 2001). To address this barrier, a joint effort involving the Irrigation District, MFWP, USACE, BOR, USFWS, and The Nature Conservancy is underway. The primary goal of this effort is to develop suitable fish passage on the Yellowstone River at the Intake Diversion Dam and screening to prevent entrainment in the canal. Preliminary estimates suggest this project will not be completed for at least 3 to 5 years.

Another potential manipulation of existing conditions to benefit pallid sturgeon is proposed flow releases from the Fort Peck Dam spillway that could utilize warm surface water to improve temperatures and flows. The Missouri River biological opinion (USFWS 2000a) identifies these releases as important to maximizing the amount of warm water habitat available below the dam. Utilizing warm water releases to simulate natural conditions to improve spawning cues for the species have been precluded due to reservoir levels being too low to utilize the spillway. Recommendations in the Biological Opinion are based on snow pack, and identify flows ranging from 20,000 to 30,000 cfs between mid-May and the end of June. Higher flows would be recommended during higher snow pack years. To date, utilizing warm water releases to simulate natural conditions to improve spawning cues for the species have been precluded due to extended drought conditions. Like RPMA 1, the drought conditions have decreased pool levels in Lake Sakakawea resulting in more available riverine habitat. However, it is yet to be determined if this additional riverine habitat is sufficient to promote survival of naturally produced larvae.

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Fort Randall Dam to Gavins Point Dam, South Dakota and Nebraska (RPMA 3)

This is the smallest RPMA identified in the Recovery Plan. Work in this reach indicates that it possesses necessary habitat and is suitable for pallid sturgeon supplementation efforts (Jordan et al. 2006). The largest tributary in this reach is the Niobrara River. Spencer Dam is a fish passage barrier on the Niobrara River and preliminary discussions, among USFWS and the State of Nebraska, to address fish passage have occurred. However, there is no real effort yet to address this concern. Development and associated bank stabilization projects still occur in this reach. These projects individually may not have a substantial impact on habitat, but cumulatively they may be reducing sediment by stopping channel meandering and the creation of new habitat. The loss of sediment inputs affects channel habitat diversity. Siltation in the upper reaches of Lewis and Clark Reservoir appears to be producing more riverine like habitat in this RPMA. However, it is yet to be determined if this additional riverine habitat is sufficient to promote survival of naturally produced larvae.

Gavins Point Dam South Dakota/Nebraska to the Mississippi River Confluence (RPMA 4)

This is the longest Missouri River RPMA identified in the Recovery Plan and has seen the most attention in terms of habitat improvement efforts. This is in part attributed to the 2003 amendment to the Missouri River Biological Opinion (USFWS 2000a). This amendment identified development of shallow water habitats between Sioux City and the Platte River. This was later extended upstream to Ponca State Park, Nebraska, and downstream to the mouth of the Osage River, Missouri. Approximately 1,400 to 1,800 acres (ac) (566 to 728 hectares (ha)) of shallow water habitat was constructed in 2004 by notching dikes and constructing site-specific projects like dredging to connect back-water areas, and pilot channel construction (USACE and USFWS 2004).

In addition to increasing shallow water habitat in this reach, the Biological Opinion (USFWS 2000a) identifies manipulation of flows from Gavins Point Dam, to stimulate a biological response from fishes as well as potentially create habitat, as an important reasonable and prudent alternative. To accomplish this, a spring rise was proposed of +17,500 cubic feet per second (cfs) (total 49,500 cfs) 1 year out of 3 with an annual summer low flow of 21,000 cfs. It is believed that these releases will begin to provide the conditions that simulate the range of historic natural fluctuations of the Missouri River. Increased discharge in the spring followed by low discharge in the summer is hypothesized to provide missing cues suspected as one cause of little to no spawning/recruitment of pallid sturgeon in this reach. A minor spring rise was implemented from Gavins Point Dam in 2006. Peak discharge of this pulse was about 25,000 cfs.

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Recently there have been a variety of efforts to physically improve aquatic habitat diversity and abundance, and restore some measure of connectivity in the Missouri River and tributaries to benefit not only sturgeon but other native river species. Adult pallid sturgeon have been collected in both Upper Hamburg Bend and Plattsmouth Chutes (K. Steffensen, NGPC, pers. comm., 2005). The presence of pallid sturgeon in these created/restored habitats demonstrates their suitability for at least periodic use by multiple life stages of sturgeon. In 1998, larval pallid sturgeon were found in a naturally created chute in Missouri (Krentz 2000), suggesting that restored chutes and shallow water habitat may indeed be beneficial. Currently, efforts are underway to develop a better understanding of important habitat features that may improve restoration project designs and substantially increase our limited database on sturgeon habitat use. Based on current and anticipated commitments for aquatic habitat restoration in this RPMA, the next several years should produce increased quantity and quality of potential sturgeon habitat in RPMA 4. At present the data are incomplete or lacking to determine if these efforts are sufficient to maintain a self-sustaining population in RPMA 4.

The importance of the lower Platte River for pallid sturgeon has been documented (Snook 2002, Swigle 2003). The largest factor affecting habitat in the lower Platte River is upstream water withdrawl. A Cooperative Agreement between Nebraska, Colorado, Wyoming, and the U.S. Department of Interior (USFWS and BOR 2006) has been developed to improve and maintain habitat for species like pallid sturgeon. To date, the Platte River Recovery Implementation Program has been signed by the Department of the Interior Secretary and the Governors from Nebraska, Wyoming and Colorado. Though this program has been signed by all parties, authorizing legislation is needed to implement the thirteen year program. Planned flow improvements in the central Platte River are expected to improve conditions for pallid sturgeon in the lower Platte River. Research and monitoring will occur to assess these potential affects. Without authorizing legislation in place, agreed-upon program activities that provide ESA compliance can only be implemented to a limited extent under existing ESA authorities. For example, acquisition of program habitat lands and water projects can not occur using Federal appropriations until after the proposed legislation has become law.

Mississippi River (RPMA 5)

Middle Mississippi River

A Biological Opinion on the upper Mississippi River includes a jeopardy opinion for pallid sturgeon in the middle Mississippi River (USFWS 2000b) in part due to habitat alterations required to maintain a 9-foot navigation channel. Practices that alter habitats include--channel training structures, locks and dams, dredging and spoil disposal, and flood control projects.

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Following listing of pallid sturgeon as endangered, the USACE St. Louis District issued Design Memorandum No. 24 "Avoid and Minimize Measures" in October 1992. This program was developed to minimize effects associated with maintenance of the 9-foot channel. Under this program, several projects have been completed to restore side channel connectivity and habitat diversity. Also, in recent years, as a result the jeopardy biological opinion for operation and maintenance of the 9-foot navigation channel, the USACE has initiated several "pilot" projects aimed at improving habitat diversity in the middle Mississippi River. These projects include dike modifications, construction of chevron dikes, side channel enhancement, placement of woody debris piles, and incorporation of woody debris into dikes. Specific details can be found in the Biological Opinion (USFWS 2000b).

Efforts to purchase flood prone areas have increased following flooding in 1993. By 2000, approximately 4,300 ac (1,740 ha) of former agriculture lands had been purchased from landowners who decided farming was not economically feasible in flood prone areas. Protection and restoration of these flood prone areas could provide increased flood plain access and connectivity to restore allochnous inputs. Potential restoration of these nutrient inputs are hypothesized to be indirectly beneficial to the pallid sturgeon by increasing overall stream productivity and result in a beneficial trophic effect as well as directly beneficial by preventing further practices (e.g., rip-rap, side channel cut offs) that may be detrimental to pallid sturgeon habitats. Much of the original land purchased was incorporated into the Mark Twain National Wildlife Refuge (NWR). Also, in 2000, Mark Twain NWR was split into five separate refuges with Harlow, Wilkinson, and Meissner becoming the new Middle Mississippi River NWR.

During 2005 to 2006, through donations from the American Land Conservancy, 2,110 ac (853 ha) on Kaskaskia Island, also known as Horse Island, was conveyed to the Middle Mississippi River NWR establishing the Horse Island Division (Cail in litt. 2006). Kaskaskia Island is an approximately 16,000-ac (6,475-ha) oxbow complex created when the Mississippi River changed course during the flood of 1881 (Cail in litt. 2006). The Mississippi River carved a new channel connecting to the southern portion of the Kaskaskia River, establishing Illinois State property on the west side of the big river. Prior to conveyance to the USFWS, the American Land Conservancy enrolled 2,110 ac (853 ha) in the Wetland Reserve Program (Cail in litt. 2006). Wetland restoration and reforestation on more than 400 ac (162 ha) resulted in support from the Natural Resource Conservation Service. The Kaskaskia River is just upstream from land acquired on Horse Island, and is a tributary that joins the Mississippi River in the vicinity of where fishery biologists have reliably captured pallid sturgeon.

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Also during 2005-2006, funds from the Illinois Clean Energy Community Foundation and the North American Wetlands Conservation grant program has resulted in the conveyance of 722 ac (292 ha) to the USFWS and 318 ac (128 ha) to Ducks Unlimited on Rockwood Island (Cail in litt. 2006). Rockwood Island is a 2,500-ac (1,011-ha) island and side channel complex containing both forested and agriculture lands, and an active 2.5-mi (4-km) side channel. The active side channel provides habitat for big river fishes and other wetland obligates (Cail in litt. 2006). These lands are unprotected by levees and offer the opportunity for fish and wildlife restoration activities in the future.

Current acres/hectares for the Middle Mississippi River NWR include Meissner Island 78 ac/31 ha, Harlow Island (1,225 ac/496 ha), Beaver Island (249 ac/101 ha), Horse Island (2,110 ac/853 ha), Rockwood Island (722 ac/292 ha), and Wilkinson Island (2,532 ac/1,025 ha), which total 6,916 ac/2,799 ha (Cail in litt. 2006). In July 2004, the Mark Twain NWR Complex Comprehensive Conservation Plan and Environmental Assessment were approved, resulting in approved acquisition boundaries for the Middle Mississippi River NWR enclosing 14,758 ac/5,972 ha (Cail in litt. 2006).

The Middle Mississippi River NWR lands currently are spread along 60 mi (96 km) of the Mississippi River below St. Louis, Missouri. Protection and restoration of these areas has been attributed with improved floodplain connectivity as well as improved habitat conditions (USFWS 2000b). With the previously identified practices in place, the USFWS' Biological Opinion (USFWS 2000b) still indicates that maintaining the 9-foot navigation channel "is likely to jeopardize the continued existence of pallid sturgeon." As such, four reasonable and prudent alternatives (RPAs) were identified. These are-- 1) conduct a study of pallid sturgeon habitats on the middle Mississippi River, 2) facilitate development of a pallid sturgeon conservation and restoration plan, 3) implement the habitat restoration plan developed in item 2, and 4) implement short-term restoration measures that are believed to benefit pallid sturgeon until RPA 1-3 are completed.

Lower Mississippi River

Between 1929 and 1942, 16 bendway cutoffs were constructed by the USACE that shortened the river 152 mi (245 km) over a 503-mi (809-km) reach (Baker et al. 1991). In response to this 30% reduction in channel length, the river became entrenched in steeper gradient reaches, eroding large amounts of material from the channel banks and bed. Deposition of this material in the lower gradient reaches resulted in a semi-braided channel, and by the 1970s the river was attempting to reestablish a meandering condition (Winkley 1977). Increasing flood flows due to loss of outlets, and construction of levees in major tributaries and the Mississippi River contributed to overall channel instability. Because of these geomorphic adjustments to

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anthropogenic changes, an aggressive program of bank revetment and dike construction was required to fix and maintain the navigation channel, and to protect the levee system. Although successful in its overall intent to facilitate navigation and provide flood control benefits, this program reduced secondary channel formation, floodplain connectivity, and both lentic and lotic sandbar formation in the lower Mississippi River (Baker et al. 1991).

In 1981, the USACE established the Lower Mississippi River Environmental Program, with a goal of protecting fisheries and other natural resources in the lower Mississippi River. Input from the Lower Mississippi River Environmental Program resulted in experimentations with dike placement and notches as measures to protect secondary channels and maintain shallow water and fisheries habitats. In 2001, the USACE Mississippi Valley Division, initiated informal consultation under section 7(a)(1) with the USFWS to develop and implement additional measures to conserve and manage listed species associated with the lower Mississippi River navigation channel. Under this process, the Memphis and Vicksburg Districts hold annual meetings with the USFWS and State conservation agencies to review and modify, if necessary, construction and maintenance plans and activities to minimize potential impacts to listed species, avoid further loss of secondary channel habitats, and to restore and improve secondary channel areas when possible (USACE in litt. 2004, 2005, and 2006). The USACE Mississippi Valley Division and the Districts also are working with the Lower Mississippi River Conservation Committee, State agencies, and the USFWS to identify and initiate secondary channel restoration opportunities. However, results of the Lower Mississippi River Environmental Program and section 7(a)(1) conservation actions have not been quantified and it is currently unknown if habitat degradation trends in the lower Mississippi River have been reduced, stopped, or reversed.

Atchafalaya River (RPMA 6)

The Atchafalaya River is a distributary to the Mississippi River. Water enters the Atchafalaya River from the Mississippi River through the Old River Control Complex and an adjacent hydropower plant. Construction of these structures has altered habitats by reducing sediment transport into the Atchafalaya River (Reed and Ewing 1993) and the structures likely are effective barriers for fishes trying to move from the Atchafalaya system into the Mississippi River.

Impoundment of the Red and Black Rivers, also has significantly contributed to the reduction of sediments moving into the Atchafalaya River, precipitating bank and channel erosion. Other habitat alterations in this RPMA contributing to channel habitat degradation include construction of levees and

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navigation dredging. Effects of these habitat alterations on pallid sturgeon are unknown, since there is little to no information on pallid sturgeon from the Atchafalaya River prior to 1991 (USFWS 1993).

While there have been substantial anthropogenic alterations to riverine habitat throughout the range of pallid sturgeon, there have also been numerous activities design to improve current habitat conditions. Available demographic data do not indicate that these habitat improvement activities have resulted in improved pallid sturgeon populations within the Missouri River and data are insufficient to assess affects of these improvements in the Mississippi River. Thus while the threat of destruction, modification or curtailment of habitat or range may not be increasing, past activities may not have been rectified to such a point that the threat can be considered addressed.

2.3.2.2 Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Commercial or recreational harvest of pallid sturgeon is a threat to the species and is prohibited by section 9 of the ESA and by State regulations throughout the range. Collection of adults for any purpose imposes a potential reproductive loss within any given RPMA. Overutilization of pallid sturgeon for scientific or educational purposes is likely negligible. Following the species listing, possession of pallid sturgeon is governed through the ESA 10(a)1(A) permit program. Take associated with these activities is quantifiable and appears to be very small. Overexploitation for commercial or recreational purposes is harder to quantify and likely poses a bigger threat as greater numbers of reproductively capable adults can be lost in a relatively short time frame. However, incidental and illegal harvest of pallid sturgeon has been documented in the Mississippi River, and may be a significant impediment to survival and recovery of the species in some portions of its range (see 2.3.2.2., below). Other forms of overutilization are not known to currently affect the species.

Overexploitation

Commercial harvest of sturgeon for roe and meat was a traditional fishery in the Missouri and Mississippi River systems. Because pallid sturgeon and shovelnose sturgeon are very similar in appearance, increasing trends in shovelnose harvest increases the likelihood of unintentional harvest of pallid sturgeon.

Williamson (2003) presented data from the MDC that showed an increase in commercial catch of shovelnose sturgeon from 5,850 pounds (lb) (2,653 kilograms (kg)) in 2000 to 12,370 lb (5,610 kg) in 2001. A total of 7,472 lb (3,389 kg) were reported in 1999. To reduce the effects of harvest on pallid sturgeon, Montana, North Dakota, South Dakota, Nebraska, and Iowa

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have closed commercial sturgeon fishing on the Missouri River. Missouri still allows commercial harvest, but has limited harvest by closing commercial sturgeon fishing on the Missouri River upstream of the Kansas River to the Iowa border. Incidental or purposeful illegal harvest of pallid sturgeon associated with commercial fishing likely is having a negative impact on the demographics of this species and should be viewed as a potential threat to pallid sturgeon in RPMA 4 where commercial harvest is still allowed.

There is a paucity of historical information on commercial harvest of sturgeon for roe and meat in the middle and lower Mississippi River. Cook (1958) provides commercial harvest information for the years 1894, 1899, 1903, 1908, 1922, and 1931. This report details total pounds harvested and from which river, but most of these data are reported as "sturgeon" with one reference to shovelnose. There appears to have been a decreasing trend in sturgeon harvest through time with a high of 8,600 lb (3,900 kg) reported in 1899 to a low of 100 lb (45 kg) reported in 1931. Williamson (2003) provided data reported by the Illinois Department of Natural Resources and the Kentucky Department of Fish and Wildlife Resources for commercial catch of shovelnose sturgeon. In Illinois, the Statewide commercial catch of shovelnose sturgeon flesh increased from 8,853 lb (4,015 kg) in 1990 to 65,462 lb (29,693 kg) in 2001. The amount of roe taken increased from 47 lb (21 kg) reported in 1999 to 8,197 lb (3,718 kg) reported in 2001. In Kentucky, the commercial catch of shovelnose sturgeon in the Mississippi River increased from 25 lb (11 kg) (flesh) in 1999 to 8,324 lb (3,775 kg) in 2002. The harvest of roe was reported at 1,021 lb (463 kg) in 2001 and 731 lb (331 kg) in 2002. Overharvest of sturgeon is a major concern in pools 12-26 of the Mississippi River. Harvest of shovelnose sturgeon roe by licensed Illinois fishermen has increased almost 10-fold since the late 1990s (Figure 17).

Several States have initiated restrictions to reduce take of pallid sturgeon. Commercial take of any species of sturgeon was prohibited by Mississippi and Louisiana during the early 1990s to avoid incidental take of endangered or threatened sturgeon species. For similar reasons, Arkansas prohibits sturgeon fishing in the Mississippi River and restricts commercial take of shovelnose sturgeon to tributaries. Tennessee, Missouri, Kentucky, and Illinois continue to allow commercial harvest of shovelnose sturgeon. Iowa currently does not allow commercial shovelnose sturgeon harvest on the Missouri River, but does allow commercial harvest on the Mississippi River.

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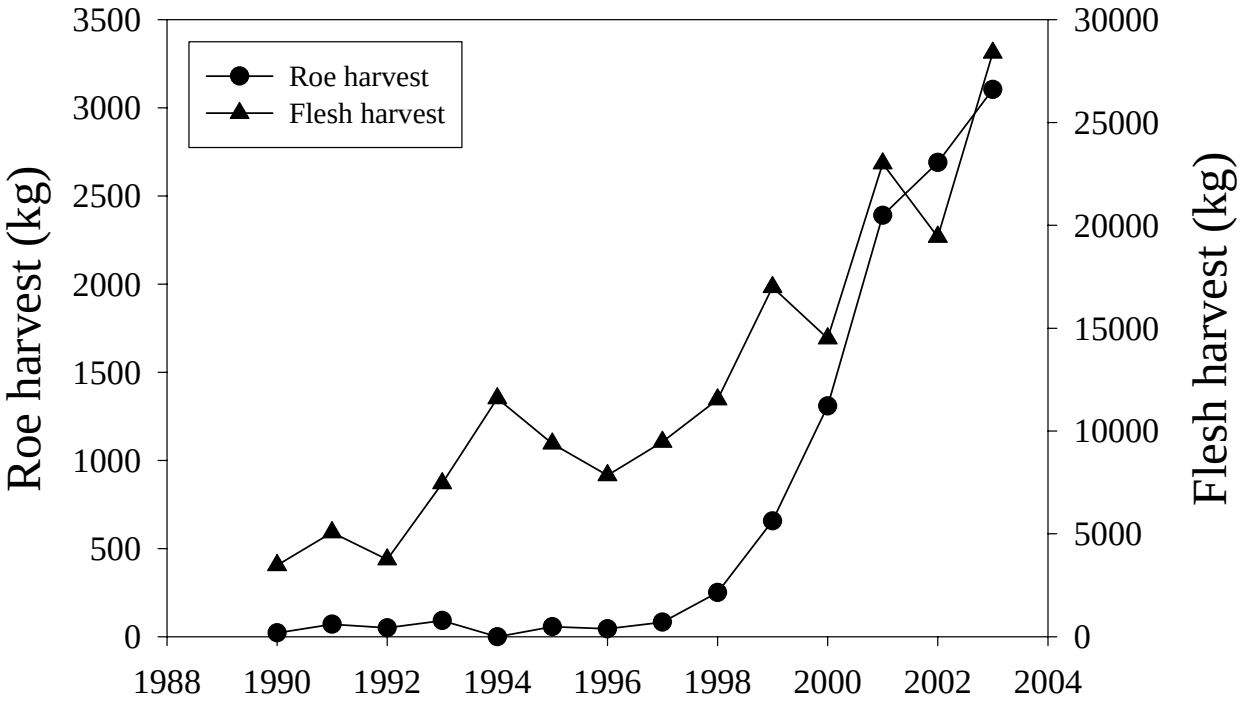

Figure 17. Reported commercial harvest (i.e., by licensed Illinois harvesters) of shovelnose sturgeon roe and flesh from Pools 12-26 of the Mississippi River.

The restrictions imposed through State fishing regulations have helped; however, there is still evidence of incidental take of pallid sturgeon associated with commercial harvest of shovelnose sturgeon. Pallid sturgeon remains have been discovered in fish markets (Sheehan et al. 1997) and pallid sturgeon with egg biopsy scars have been documented by biologists from the USFWS Columbia Fishery Resource Office, Columbia, Missouri (Wyatt Doyle, USFWS, pers. comm., 2006). In the spring of 2006, at least three adult pallid sturgeon were found in the possession of a commercial fisherman illegally fishing Arkansas waters (Keevin in litt. 2006). In that same year, there also were nearly 100 sturgeon carcasses found in a dumpster near the Chain of Rocks area in St. Louis, Missouri. Of the 100 carcasses, there was 1 suspected pallid sturgeon. Region 3 of the USFWS also has reported there are between 6 to 14 document cases of illegal or unintentional harvest of pallid sturgeon that are being investigated or part of ongoing investigations by State or USFWS law enforcement officials (Mike Oetker, USFWS, pers. comm., 2006). Preliminary age studies of pallid sturgeon spine sections in the middle Mississippi River where harvest of shovelnose sturgeon is permitted, have estimated maximum pallid sturgeon age at 15 years, with mortality rates of 37 to 39% (Colombo et al. in press). Estimates for the lower Mississippi River, where shovelnose sturgeon harvest is not permitted, place maximum age at

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21 years, with a mortality rate of 12% (J. Garvey, Southern Illinois University, J. Killgore, USACE, data presented at the pallid sturgeon Recovery Team meeting September 28-29, 2005, held in Lakewood, Colorado). The higher age and lower mortality estimates for pallid sturgeon within the lower Mississippi River, where commercial harvest of shovelnose sturgeon is prohibited, suggests that incidental take of pallid sturgeon by commercial harvest is more prevalent in the middle Mississippi River. This suggests that incidental and illegal take during commercial harvest of shovelnose sturgeon is having a substantial and detrimental effect on the pallid sturgeon in the middle Mississippi River.

Overexploitation is a factor that must be considered in pallid sturgeon conservation. Unintentional and illegal take of pallid sturgeon for commercial purposes will likely increase in the middle Mississippi and lower Missouri Rivers as commercial pressures on domestic sturgeon increase due to the importation ban of beluga sturgeon (*Huso huso*) caviar into the United States and the general trend toward reduced caviar exports from the Caspian Sea sturgeon stocks (CITES 2006). This recent ban has limited supply and likely has attributed to an increase in roe prices.

The threat of overutilization for commercial, recreational, scientific, or educational purposes has diminished since listing, due in part to changes in regulations involving harvest and scientific collections. However, illegal take of pallid sturgeon still occurs and thus this threat, while reduced since listing, has not been eliminated (see also 2.3.2.4 Inadequacy of Existing Regulatory Mechanisms).

2.3.2.3 Disease or Predation

An iridovirus is known to infect pallid and shovelnose sturgeon. This disease originally surfaced during artificial propagation efforts and is known to cause substantial mortality in a hatchery rearing environment (USFWS 2006a). The iridovirus was first identified by histology from a female pallid held at Garrison Dam National Fish Hatchery (USFWS 2006). Subsequent testing has documented that this virus is found in the wild. Of 179 *Scaphirhynchus* tested from the Atchafalaya River between November 2003 and May 2004, 8 (4%) were identified as virus positive and 5 (2.8%) were considered virus suspect. Both pallid and shovelnose sturgeon tested either positive or suspect. When manifested, this disease is known to cause substantial mortality in a hatchery rearing environment, but the effect of the virus on wild populations is poorly understood (USFWS 2006). Documenting the natural background level of the virus in the wild is needed to identify an acceptable baseline percentage of virus-positive individuals in a given sample size.

Little information is available documenting piscivory as a threat limiting the recovery of the pallid sturgeon. Predation on larval fishes of all species

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occurs naturally. However, habitat modifications that increase water clarity and artificially high densities of both non-native and native predatory fishes could limit a species' natural ability to sustain itself.

Pallid sturgeon larvae and fry drift freely immediately post-hatch as "free embryos" (Kynard et al. 2002, Braaten et al. in review). This drift distance would likely expose any naturally spawned pallid sturgeon to predation and transport naturally spawned pallid sturgeon larvae into the headwaters of Fort Peck Reservoir and Lake Sakakawea. In addition to these reservoirs creating a more lentic environment, they are or have been artificially supplemented with predatory species like walleye (*Sander vitreum*). Maintaining elevated populations of certain species in these reservoirs has been hypothesized as a contributing factor in poor survival of larval and juvenile pallid sturgeon. Parken and Scarnecchia (2002) reported that walleye and sauger (*S. canadense*) in Lake Sakakawea (just downstream of RPMA 2) were capable of eating wild paddlefish (*Polyodon spathula*) up to 6.6 inch (in.) (167 mm) body length (12 in./305 mm total length) and thus likely could consume naturally produced pallid sturgeon larvae and smaller hatchery produced pallid sturgeon released as part of supplementation efforts. When looking at these data for their sample location closest to the headwaters area, it appears that no age-0 paddlefish were found in walleye, but were present in sauger, a native species closely related to walleye. Braaten and Fuller (2002, 2003) examined 759 stomachs from 7 piscivores species in Montana and found no evidence of predation on sturgeon. However, in all species sampled, unidentified fish or fish fragments were present. More data are needed to adequately evaluate predation effects on pallid sturgeon recruitment success.

2.3.2.4 Inadequacy of Existing Regulatory Mechanisms

One regulatory challenge that has not been fully addressed since the Recovery Plan was finalized is accidental or intentional take of pallid sturgeon as a result of commercial harvest.

Generally, shovelnose sturgeon can be distinguished from pallid sturgeon by their smaller size as mature adults. However, this can be an inaccurate gauge at the upper size range for shovelnose sturgeon, since both species experience a wide range of size variation depending on their geographic home range (Table 1).

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Table 1. Maximum and average sizes of large adult shovelnose and pallid sturgeon.

RIVER	PALLID STURGEON maximum length	SHOVELNOSE STURGEON	
		maximum length (range)	average large size
Mississippi River	1,350 mm	1,000-1,050 mm	800 mm
Lower Missouri River	1,162 mm	800-804 mm	720 mm
Upper Missouri River	1,638 mm	1,400-1,500 mm	900 mm

Currently, biologists use character indices as tools to distinguish between pallid sturgeon and shovelnose sturgeon. These tools, developed by taxonomists, use as many as 13 morphometric body measurements and meristic ray fin counts to differentiate between the two species. However, in a recent meeting of the Pallid Sturgeon Recovery Team and its Genetics Advisory Group, data were presented showing limited success using character indices when compared to genetic confirmation of species (Kuhajda et al. in press; Murphy et al. in press, see also Appendix B). Geneticists and taxonomists have shown a gradient of morphometric and genetic differences throughout these species' geographic range and suggest that recent evolutionary divergence also may complicate genetic distinction. It can be difficult for trained biologists to differentiate between shovelnose and pallid sturgeon. Pallid sturgeon are at risk in States allowing commercial harvests of shovelnose due to the difficulty in distinguishing between the two species (see also 2.3.2.2. Overutilization for commercial, recreational, scientific, or educational purposes: Overexploitation). Currently, efforts by Iowa and Missouri to restrict commercial harvest of shovelnose sturgeon to certain areas likely have reduced this threat, but may not have eliminated it. Tennessee, Missouri, Kentucky, Iowa, and Illinois continue to allow regulated commercial harvest of shovelnose sturgeon for flesh or roe. Applicable commercial harvest regulations are as follows:

- Tennessee has established a 24- to 32–in. (609- to 813-mm) FL harvestable size limit and fishing season (October 15 to May 15) for roe harvest on the Mississippi River and has closed a portion of the river to commercial harvest due to contaminants concerns (Tennessee Wildlife Resources Agency 2006).
- Missouri has established a 24- to 30–in. (609- to 762-mm) FL harvestable size limit and fishing season (November 1 through May 15) on the Missouri River. Also, there are areas closed to harvest, including Kansas City upstream to the State line and approximately 30 Rmi around the mouth of the Osage River (15 mi above and below the confluence). The restrictions for the Mississippi River are a 24- to 32–in. (609- to 813-mm) FL harvestable size limit and a fishing season (October 15 to May 15).

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Commercial anglers are required to purchase a permit (MDC 2006) and harvested shovelnose sturgeon are to remain whole and intact while on waters of the State and adjacent banks. Nonresidents are not allowed to harvest shovelnose sturgeon on the Missouri River.

- Kentucky has established a 24- to 32-in. (609- to 813-mm) FL harvestable size limit, a season (October 15 through May 15), and monthly catch reporting requirements for commercial fisherman (Kentucky 2006).
- In July 2006, the Iowa Natural Resources Commission adopted changes to their commercial fishing regulations that establish a minimum shovelnose sturgeon fork length of 27 in. (686 mm). A maximum fork length of 34 in. (863 mm) also was established for the Mississippi River bordering Wisconsin. These regulation changes identify a closed season for shovelnose sturgeon harvest (May 16 through October 14) and require that shovelnose sturgeon remain intact until the fish are delivered to a processing facility (Iowa 2006).
- Illinois currently has no size limits on shovelnose sturgeon, but does require monthly reporting of roe harvest. Also, there are areas closed to commercial fishing on the Mississippi River, such as Quincy Bay, including the waterfowl management area and other USFWS NWR Waters (Illinois 2006).

While these self-imposed regulations are intended to assist with protecting *Scaphirhynchus* in the middle Mississippi River, their long-term effects have yet to be demonstrated. Recent work, by Colombo et al. (in press), indicates that the current minimum size length of 24 in. (609 mm) is not sufficient to maintain a sustainable shovelnose sturgeon fishery long term. The size range of pallid sturgeon overlaps harvestable length shovelnose sturgeon in these States and thus unintentional or illegal harvest is likely continuing because the two species can be difficult to discern from each other. This concern also is highlighted in Colombo et al. (in press). Their data suggests that in the middle Mississippi River, pallid sturgeon annual mortality rates are very similar to those calculated for the commercially harvested shovelnose sturgeon and suggest that harvest-induced mortality is negatively affecting pallid sturgeon mortality rates.

As caviar prices rise and commercial pressures on shovelnose sturgeon increase, incidental and illegal take of pallid sturgeon is expected to increase in the middle Mississippi and lower Missouri Rivers, and may become an issue in the lower Mississippi and Atchafalaya Rivers. In light of the existing regulatory, advisory, and enforcement mechanisms, the difficulties in distinguishing between pallid sturgeon and shovelnose sturgeon still exist (see also 2.3.2.2. Overutilization for commercial, recreational, scientific, or educational purposes). Accidental or intentional take of pallid sturgeon can occur and be difficult to enforce. Given the potential difficulty in enforcing regulations where the two species overlap, these regulatory mechanisms may not adequately address the illegal

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harvest of pallid sturgeon. Addressing unintentional or illegal take is essential for recovery and current regulatory and enforcement mechanism may be inadequate to fully address this threat.

2.3.2.5 Other Natural or Manmade Factors Affecting its Continued Existence

Contaminants

Currently there are several fish consumption advisories for shovelnose sturgeon attributable to contaminants. Contaminant levels in pallid sturgeon also have been noted, but data are minimal. Elevated levels of polychlorinated biphenyls (PCBs), cadmium, mercury, and selenium have been detected in tissue samples from three pallid sturgeon collected from the Missouri River in North Dakota and Nebraska (Ruelle and Keenlyne 1992). Ruelle and Keenlyne (1992) also noted detectable concentrations of chlordane, DDE, DDT, and dieldrin. The effects of contaminants on pallid sturgeon reproduction also are poorly understood. However, research involving white sturgeon (*Acipenser transmontanus*) in the Columbia River found lower condition factors, gonadal abnormalities, and hermaphrodism in fishes with elevated levels of metabolites of DDT (DDE and DDD) as well as total PCBs and mercury (Feist et al. 2005). Shovelnose sturgeon collected from the lower Missouri River have a consumption advisory because of concerns relating to overelevated levels of PCB and chlordane (DHSS 2006), and also lower Missouri River shovelnose sturgeon have been noted to exhibit intersexual characteristics (Wildhaber et al. 2005). Intersexual shovelnose sturgeon from the middle Mississippi River were found to have higher concentrations of organochlorine compounds when compared against male shovelnose sturgeon (Koch et al. 2006). Current data are lacking to adequately understand and address this problem under existing environmental laws, but contaminant research suggests a link between environmental contaminants and potential reproductive problems in several sturgeon species (Feist et al. 2005; Koch et al. 2006). Research on the effects of contaminants on pallid sturgeon reproductive mechanisms should continue as part of pallid sturgeon recovery efforts.

The State of Tennessee closed commercial fishing on the Mississippi River from the State line to downstream of Meeman-Shelby State Park (Rmi 745) because of concerns over chlordane and other contaminants (Tennessee 2004). Currently, the Missouri Department of Health and Senior Services (2006) has issued a “do not eat” advisory for shovelnose sturgeon eggs because of concerns over PCB and chlordane levels. Illinois has a sturgeon consumption advisory (PCBs) on the Mississippi River between Lock and Dam 22 to Cairo, Illinois.

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Entrainment

Another issue that is negatively impacting pallid sturgeon throughout its range is entrainment. The loss of pallid sturgeon associated with water intake structures has not been accurately quantified. The U.S. Environmental Protection Agency published final regulations on Cooling Water Intake Structures for Existing Facilities per requirements of Section 316(b) of the Clean Water Act. The rule making was divided into three phases. However, only Phase I and II appear applicable to inland facilities; Phase III applies to coastal and offshore cooling intake structures associated with coastal and offshore oil and gas extraction facilities. The following rule summaries are based on information found at the website <http://www.epa.gov/waterscience/316b/>.

Phase I rules, completed in 2001, require permit holders to develop and implement techniques that will minimize impingement mortality and entrainment. Phase II, completed in 2004, covers existing power generation facilities that are designed to withdraw 50 million gallons per day or more with 25% of that water used for cooling purposes only. This rule, implemented through National Pollutant Discharge Elimination System permits, is intended to minimize negative affects associated with water cooling structures. This rule provides permit holders with five alternatives to ensure compliance:

1) Demonstrate that it will reduce or has reduced its intake flow commensurate with a closed-cycle recirculating system and, therefore, is deemed to have met the impingement mortality and entrainment performance standards, or that it will reduce or has reduced the design intake velocity of its cooling water intake structure to 0.5 ft/s and, therefore, is deemed to have met the impingement mortality performance standards;
2) Demonstrate that its existing design and construction technologies, operational measures, and/or restoration measures meet the performance standards and/or restoration requirements;
3) Demonstrate that it has selected and will install and properly operate and maintain design and construction technologies, operational measures, and/or restoration measures that will, in combination with any existing design and construction technologies, operational measures, and/or restoration measures, meet the specified performance standards and/or restoration requirements;
4) Demonstrate that it meets the applicability criteria for a rule-specified technology or a technology that has been pre-approved by the Director and that it has installed, or will install, and will properly operate and maintain the technology; or,

5) Demonstrate that it is eligible for a site-specific determination of best technology available to minimize adverse environmental impacts and that it has selected, installed, and is properly operating and maintaining, or will install and properly operate and maintain, design and construction technologies, operational measures, and/or restoration measures that the Director has determined to be the best technology available to minimize adverse environmental impact for the facility.

Section 316(b) of the Clean Water Act requires the U.S. Environmental Protection Agency to insure that aquatic organisms are protected from impingement or entrainment. As part of the Phase II ruling, some power plants have begun conducting required entrainment studies.

Preliminary data on the Missouri River suggests that entrainment may be a serious threat that warrants more investigation. Initial results from work conducted by Mid-America at their Neal Smith power facilities found hatchery-reared pallid sturgeon were being entrained (Jordan in litt. 2006, Ledwin in litt. 2006, Williams in litt. 2006). Over a 5-month period, four known hatchery-reared pallid sturgeon have been entrained, of which two were released alive and two were found dead. Ongoing entrainment studies required by the Clean Water Act will provide more data on the effects of entrainment. However, addressing entrainment issues may not occur immediately and continued take of hatchery-reared or wild pallid sturgeon will limit the effectiveness of recovery efforts.

In addition to cooling intake structures for power facilities, concerns have been raised regarding entrainment associated with dredge operations and irrigation diversions. Currently little data are available regarding the effects of dredge operations. However, the USACE, St. Louis District, and the Dredging Operations and Environmental Research Program have initiated work to assess dredge entrainment of fish species and the potential effects that these operations may have on larval and juvenile *Scaphirhynchus*. Data for escape speed, station-holding ability, rheotaxis and response to noise, and dredge flow fields are being used to develop a risk assessment model for entrainment of sturgeon by dredges. If funds become available during the upcoming year (2007), field work will be expanded to include trawling of frequently dredged areas and examining dredge spoil. Entrainment has been documented in the irrigation canal supplied by Intake Dam on the Yellowstone River (Jaeger et al. 2004) (see also 2.3.1.5. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem)). Given that entrainment has been documented to occur in the few instances it has been studied, further evaluation of entrainment at other water withdrawal points is warranted across the pallid sturgeon's range to adequately evaluate this threat.

Hybridization

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The Pallid Sturgeon Recovery Plan (USFWS 1993) identifies hybridization as a threat to pallid sturgeon. This was, in part, based on work by Carlson et al. (1985) who identified sturgeon in the middle Mississippi River that were intermediate in character between shovelnose and pallid sturgeon. In addition, sturgeon with intermediate characteristics were reported in commercial catch records from the lower Missouri and middle and lower Mississippi Rivers.

The presence of morphologically intermediate forms presumed to represent pallid-shovelnose sturgeon hybrids (Keenlyne et al. 1994; Carlson et al. 1985) spurred an effort to determine the genetic origins of these fish. Recent genetic tools have been utilized to explore the concept of hybridization between pallid and shovelnose sturgeon (See also 2.3.1.2. Intercrosses between Pallid and Shovelnose Sturgeon).

Tranah et al. (2004) combined the data from Campton et al. (2000) and Tranah et al. (2001) and added 4 additional microsatellite loci to the data set to determine the genetic origins of 10 morphologically intermediate sturgeon collected from the Atchafalaya River. All fish were classified as pallid, shovelnose or hybrid sturgeon via the hybrid index method of Campton (1987). These results are consistent with the hypothesis of hybridization between pallid and shovelnose sturgeon. However, this study simply demonstrated that morphologically intermediate fish had genetically intermediate genotypes (Don Campton, USFWS, pers. comm., 2005). The data represent a circular argument for "hybridization" because the data set on which the conclusions were based also was the data set used to parameterize the "hybrid index" function. Moreover, Tranah et al. (2004) did the analyses separately for fish in the upper Missouri and Atchafalaya Rivers. As a result, genotypically-intermediate fish in one region would not necessarily have been genotypically intermediate fish in the other region, because the level of divergence between regions within species was as large as the divergence between species within regions (Campton et al. 2000, also suggested in Heist and Schrey 2006b). Based on these data, one cannot distinguish true "hybridization" (i.e., secondary contact following allopatric speciation) from sympatric speciation and assortative mating. Both mechanisms would yield a positive correlation between genotype and phenotype, which is what Tranah et al. (2004) measured. Likely, the correlation would collapse if Tranah et al. (2004) had performed their "hybrid index" analyses for all fish and both regions combined. Because pallid and shovelnose sturgeon are very closely related evolutionarily, particularly compared to other congeneric species of fishes in North America, the available data do not allow us to reject the hypothesis that pallid sturgeon (as a morphological phenotype) may have had a polyphyletic origin relative to shovelnose sturgeon.

Hence, based on the available genetic information, neither the allopatric speciation/hybridization hypothesis nor the sympatric speciation/polyphyly hypothesis can be rejected at this time.

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More information is needed on the evolutionary dynamics of intermediates between pallid sturgeon and shovelnose sturgeon to understand if they are natural or a threat that has resulted from anthropogenic alterations to spawning habitat or cues.

2.4 Synthesis

The primary threats identified for pallid sturgeon in the final rule and in the Recovery Plan (USFWS 1993) were--1) curtailment of range, 2) habitat destruction and modification, 3) low population size, 4) lack of recruitment, 5) commercial harvest, 6) pollution/contaminants, and 7) hybridization. Significant new information gathered since listing is summarized below in relation to the species' status and associated threats.

Range/Habitat

The curtailment of range and habitat destruction/modification were primarily attributed to the construction and operation of dams on the upper Missouri River and modification of riverine habitat by channelization of the lower main stem Missouri and Mississippi Rivers. Dams substantially fragmented pallid sturgeon range in the upper Missouri River. However, free-flowing riverine conditions currently exist throughout the lower 2,000 mi (3,218 km) (60%) of the pallid sturgeon's historical range. Although the lower Missouri River (RPMA 4) continues to be impacted by regulated flows and modified habitats, actions have been developed and are being implemented to address habitat issues. Recent studies and data from the Mississippi River (RPMA 5) suggests that riverine habitats are less degraded than previously believed, and that they continue to support diverse and productive aquatic communities, including pallid sturgeon. Although there are ongoing programs to protect and improve habitat conditions in RPMAs 1, 2, 3, 4, and 5, positive effects from these programs on pallid sturgeon have not been demonstrated or quantified.

Population Size

Data for the Missouri River continue to indicate that wild pallid sturgeon in RPMA 1 and 2 are large, mature, and likely old individuals, and provide little to no evidence supporting a naturally self-sustaining population. There appears to be no natural wild population surviving in RPMA 3. Sampling in RPMA 4 during the past decade continues to confirm a small population of wild pallid sturgeon in the lower Missouri River. Pallid populations in RPMAs 1-3 are being augmented with hatchery produced fish in order to ensure persistence of the species until threats are adequately addressed to promote a self-sustaining population. Data collected after the Recovery Plan was developed indicate that pallid sturgeon numbers are higher in the Mississippi and Atchafalaya Rivers than initially documented in 1993 (see Demographic Data by Recovery Priority Management Area sections discussing RPMA 5 and RPMA 6). However, this increase in collections can be associated with increased sampling efforts and not quantified with catch-per-unit effort data. When listed, there were only 28 recognized records of pallid sturgeon from the Mississippi River, with no recognized records from the Atchafalaya River.

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According to the National Pallid Sturgeon Database (USFWS 2006b), there have been a total of 279 individual pallid sturgeon collected from RPMA 5 and 499 collected from RPMA 6. However, the sampling effort within these RPMAs does not adequately sample all size/age classes. Population estimates are currently unavailable due to limited sampling in RPMA 5 and 6.

Recruitment

While there are documented cases of natural reproduction in RPMAs 2, 4, and 5, data on natural recruitment of pallid sturgeon continues to be limited throughout the species' range. Current wild pallid sturgeon populations in RPMA 1 and 2 are comprised of old-aged individuals, and RPMAs 1, 2, and 3 are dependent on hatchery augmentation programs for recruitment. No wild pallid sturgeon have been collected in the last 10 years within RPMA 3 that were not translocated, and no spawning or recruitment has been detected. Addressing recruitment bottlenecks in the three upper Missouri River RPMAs is critically important for the species to become self sustaining and be recovered in those reaches. A few sub-adult or young adult wild pallid sturgeon have been collected in RPMA 4, along with a few larval pallid sturgeon. Larval pallid also have been collected in the middle Mississippi River, but no data are available to accurately evaluate recruitment levels. The presence of smaller-sized cohorts of pallid (400-600 mm) in both RPMA 5 and 6, coupled with age data indicating that no pallid sturgeon were beyond 15 years old in the middle Mississippi River (Colombo et al. In Press), suggests that some level of recruitment is occurring. Additional efforts are needed to document population demography, reproduction, and recruitment in RPMAs 4, 5, and 6.

Commercial Harvest

Illegal commercial harvest of pallid sturgeon is occurring in portions of RPMAs 4 and 5. Data show lower ages and higher mortality rates of pallid sturgeon in areas where shovelnose sturgeon are commercially harvested (Colombo et al. in press). This threat is likely to increase as caviar sources are reduced world-wide and caviar prices increase.

Pollution and Contaminants

Data continue to be incomplete regarding the effects of contaminants on pallid sturgeon viability or rates of hermaphrodism. Studies of shovelnose sturgeon in the Missouri and Mississippi Rivers documents hermaphrodism (Wildhaber et al. 2005), which may be the result of exposure to certain forms of water pollution (Koch et al. 2006). Limited data also have documented elevated contaminants levels in pallid sturgeon (Ruelle and Keenlyne 1992), but there are no known documented instances of pallid sturgeon being collected exhibiting intersexual characteristics.

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Hybridization

Microsatellite studies (Tranah et al. 2004; Heist and Schrey 2006a) have provided some genetic evidence for intermediates between pallid and shovelnose sturgeon in the Missouri, Mississippi, and Atchafalaya Rivers. However, it is currently unknown if all morphologically intermediate sturgeon are hybrids, if some hybridization is natural, or if hybridization is a result of habitat or other environmental changes.

If these intermediates represent the effect of natural intercrossing between the monophyletic pallid sturgeon and shovelnose sturgeon due to anthropogenic influences, then intercrossing may indeed be perceived as a threat to the species. However, if genetically intermediate sturgeon are the result of sympatric speciation and a polyphyletic evolutionary origin of pallid sturgeon (e.g., as suggested by Campton et al. 2000 as a competing, alternative hypothesis), then these intermediate fish could be considered a natural occurrence and the previously-identified mechanisms suggested for causing hybridization may not exist and intermediate sturgeon are a component of natural evolutionary processes and may not really pose a threat.

In summary, the status of wild pallid sturgeon has not improved since listing in the Missouri River. Successful hatchery and stocking programs appear to be useful in preventing local extirpation in the Missouri River, but the notable lack of natural recruitment suggests an overall declining status. New information on habitat extent and conditions, population size, potential recruitment in the Mississippi River, and new information on population size in the Atchafalaya River has improved our understanding of the species in these areas. The immediate risk of local extirpation in RPMAs 1 and 2 has been reduced by implementation of an artificial propagation program, and the species has been reintroduced in RPMA 3. Stocking also has occurred in RPMAs 4, 5, and 6. However, if supplementation efforts were to cease, the species would be facing local extirpation in RPMAs 1, 2, 3, and possibly 4 (the Missouri River RPMAs). Numbers of wild pallid sturgeon are higher in the Mississippi and Atchafalaya Rivers than initially documented, but data regarding recruitment and spawning success, survivorship from one age class to the next, habitat needs and use, and overall abundance are still very limited. Currently it is not possible to accurately estimate the population abundance in the Mississippi and Atchafalaya Rivers and the pallid sturgeon's population status is unknown.

Genetic and morphological differences have been documented between upper Missouri River pallid sturgeon (RPMAs 1 and 2) and lower Missouri and lower Mississippi/Atchafalaya River populations (RPMAs 4, 5, and 6) (Campton et al. 2000, Tranah et al. 2001, Heist and Schrey 2006 a and b, Kuhajda et al.). Additional information on genetic and morphological differences is needed to clearly identify past relationships of the populations, and the significance of gene flow among them.

Although information on pallid sturgeon throughout its range has increased considerably since listing, threats to the pallid sturgeon remain essentially the same. The continued existence of the species is threatened by habitat loss and inadequate regulatory

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mechanisms in all or portions of its range, and limited data suggests that contaminants may have some affect on reproduction (see 2.3.2.5 Other Natural or Manmade Factors Affecting its Continued Existence). These threats have precipitated the need for population augmentation in portions of it range. In addition to these threats, the lack of adequate information on spawning, recruitment and habitat requirements; and a lack of information on population size, recruitment, and trends in RPMAs 4, 5, and 6 makes it difficult to identify positive species response to many recovery activities. The species continues to meet the definition of endangered and no change in classification is needed. However, should sufficient data become available to support Distinct Population Segments, future reclassification may consider listing Distinct Population Segments.

Significant Portion of the Range

We assessed the pallid sturgeon in each identified RPMA throughout its range. Assessing sturgeon in units smaller than RPMAs is not feasible, due to data collection methods and fishing regulations that apply to streams within the range of the species. As noted above, a lack of adequate information on population size, recruitment, and trends exists in RPMAs 5 and 6. In RPMAs 1, 2, 3, and 4, which represent about half of the range of the pallid sturgeon, data indicate that without artificial supplementation efforts, the species could face local extirpation. Therefore, we conclude that the pallid sturgeon does not meet our criteria for downlisting to threatened status or for delisting in any portion of its range.

3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (Indicate reasons for delisting per 50 CFR 424.11):
____ Extinction
____ Recovery
____ Original data for classification in error
_X_ **No change is needed**

3.2 New Recovery Priority Number NA (Remains 2C)

3.3 If a reclassification is recommended, indicate the Listing and Reclassification Priority Number (USFWS only): NA

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Identify and implement measures to eliminate or significantly reduce illegal and accidental harvest of pallid sturgeon.

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- Update the Recovery Plan to include the most recent information regarding genetics, distribution, life history, abundance and trends, threats, and conservation measures. The revised recovery plan shall include objective and measurable downlisting and delisting criteria that when achieved eliminate or sufficiently minimize threats to the species, per the 5 listing factors, such that it no longer rises to the level of threatened or endangered under the ESA.
- Continue further study of issues where the extant of the threat is not well understood (such as hybridization and pollution/contamination).
- Reevaluate RPMAs as they relate to conservation needs of the drainage populations. Consider identifying management units based on genetic data.
- Develop a science-based, independently reviewed program that evaluates implementation of recovery criteria as well as provides periodic reports of recovery success.
- Develop and implement standardized methodology to test for and quantify iridovirus in wild populations of *Scaphirhynchus*.
- Develop and implement methods to measure and monitor riverine habitats in the Mississippi River, and their response to engineering actions.
- Develop and implement a standardized monitoring program for the Mississippi and Atchafalaya Rivers (e.g., Missouri River Population Assessment Program) to ensure adequate demographic data are collected to assess the population structure of the pallid sturgeon in these reaches.
- Implementation of the Population Assessment Program (Drobish 2006) to monitor supplementation efforts and obtain adequate samples to thoroughly understand the demographic trends of the species.
- Implement rangewide standardized reporting requirements, i.e., catch-per-unit effort, to enable rangewide population status trend comparison.
- Identify spawning cues and habitats utilized by pallid sturgeon throughout its range.
- Conduct telemetry research to identify habitat utilization in un-impounded areas to better understand the true requirements of the species in terms of range and variety of habitats used.

Data Needed for Next 5-year Review

- Population and habitat studies in the Mississippi and Atchafalaya Rivers to establish base-line conditions for monitoring status and conservation success, and for measuring habitat trends.
- Spawning habitats and cues remain unknown; this information is essential to successful management and conservation.
- Information on migration cues, food habits, and food availability throughout the range.

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- Genetic information to determine similarities and evolutionary relationships among populations throughout the range of pallid sturgeon, including their evolutionary relationships to shovelnose sturgeon.
- Experiments to assess relationships of morphology differences and causes of those differences in terms of environmental differences and genetics.
- Assessment of habitat construction projects in the Missouri and Mississippi Rivers and determination of their value for recovering pallid sturgeon and addressing the threats associated with habitat modifications.
- Evaluation of the value of spring pulses for pallid sturgeon and its habitat.
- Survival and growth of stocked juvenile pallid sturgeon and assessment of data to determine the success of supplementation efforts where it is occurring and to develop survival estimates for hatchery-reared pallid sturgeon.
- Genetic information to determine the amount and significance of hybridization between pallid and shovelnose sturgeon.
- Estimates of immigration and emigration of both wild and hatchery-produced pallid sturgeon to generate viable population assessments.
- Data to evaluate population trends, i.e., catch-per-unit effort and quantification of natural recruitment range-wide.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF PALLID STURGEON (*Scaphirhynchus albus*)

Current Classification Endangered

Recommendation resulting from the 5-Year Review

___ **Downlist to Threatened**
___ **Uplist to Endangered**
___ **Delist**
_X_ **No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted by George Jordan, Pallid Sturgeon Recovery Coordinator

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve for Henry Maddux Date 5/4/7

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 5/7/07

Cooperating Assistant Regional Director, Fish and Wildlife Service Region 3

✓ Concur ____ Do Not Concur

Signature _____ Date 5/29/07

for **Cooperating Assistant Regional Director, Fish and Wildlife Service Region 4**

✓ Concur ____ Do Not Concur

Signature Warren E. Walsh Date 4/13/07

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APPENDIX A
Summary Of Peer Review
For The 5-Year Review Of Pallid Sturgeon (*Scaphirhynchus albus*)

A. Peer Review Method

General: On July 7, 2005, the USFWS announced the initiation of a 5-year review for Pallid Sturgeon and requested submission of any new information (70 FR 39326). In accordance with the peer review requirements of the Office of Management and Budget's Final Information Quality Bulletin for Peer Review, in fall 2006 we initiated peer review of the science relevant to the draft Pallid Sturgeon 5-year review and our use of said science.

Solicitations were sent to State agencies, professional societies, and/or universities, to nominate potential peer reviewers. We requested that these groups consider the following criteria for any potential nomination.

- Expertise: The reviewer should have knowledge, experience, and skills in one or more of the following areas: pallid sturgeon *Scaphirhynchus albus* or similar species biology; conservation biology; small and declining population dynamics and extinction risk analysis; land development and use, invasive species, and other environmental pressures within the range of these species; land planning and management; modeling; and/or evaluation of biological plausibility.
- Independence: The reviewer should not be employed by the USFWS or other agencies within the Department of Interior. Academic and consulting scientists should have sufficient independence from the USFWS or Department if the government supports their work.
- Objectivity: The reviewer should be recognized by his or her peers as being objective, open-minded, and thoughtful. In addition, the reviewer should be comfortable sharing his or her knowledge and perspectives and openly identifying his or her knowledge gaps.
- Advocacy: The reviewer should not be known or recognized for an affiliation with an advocacy position regarding the protection pallid sturgeon under the ESA.
- Conflict of Interest: The reviewer should not have any financial or other interest that conflicts or that could impair his or her objectivity or create an unfair competitive advantage.

Nominations were requested by October 6, 2006. While expertise was the primary consideration, the USFWS selected peer reviewers (considering, but not limited to, these nominations) that added to a diversity of scientific perspectives relevant to 5-year review. Under certain circumstances some conflict may be unavoidable in order to obtain the necessary expertise. If such a situation arises, promised to disclose these real or perceived conflicts in the 5-year review and the agency shall inform potential reviewers of this likely disclosure at the time they are recruited. We anticipated sending the document to the peer reviewers no later than October 20, 2006. Responses were requested by December 1, 2006.

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We solicited reviews from six qualified experts. The USFWS provided each peer reviewer with information explaining his or her role and instructions for fulfilling that role, the draft 5-year review, public comments received in response to our *Federal Register* notice initiating the 5-year review (70 FR 39326, July 7, 2005), a full list of citations noting whether the source has been peer reviewed, and all citations (or for some longer documents, the relevant pages of the document) in electronic format on a CD. The purpose of seeking independent peer review was to ensure use of the best scientific and commercial information available and to ensure and to maximize the quality, objectivity, utility, and integrity of the information upon which the draft 5-year review is based, as well as to ensure that reviews by recognized experts were incorporated into the final document.

Peer reviewers provided individual, written responses to the USFWS. Peer reviewers were advised that their reviews, including their names and affiliations, would (1) be included in the official record for this review, and (2) once all reviews are completed, would be available to the public upon request.

About Public Participation

The public was provided an opportunity to comment on this planned peer review process from September 9, 2006 (when the peer review plan was posted online) through October 6, 2006. The public was invited to send comments on this peer review plan to George Jordan, Pallid Sturgeon Recovery Coordinator, 2900 4th Avenue North, Room 301, Billings, Montana 59101. Comments on this plan also may be submitted by electronic mail to >r6espeerreview@fws.gov<. The subject line should read "Pallid Sturgeon (*Scaphirhynchus albus*) 5-Year Review: Summary and Evaluation."

The public had an opportunity to provide input on the 5-year review from July 7, 2005, through September 6, 2005 (70 FR 39326, July 7, 2005). This Notice announced our initiation of a 5-year review of the species and requested submission of any new information.

Contact

For more information, contact George Jordan, Pallid Sturgeon Recovery Coordinator 406-247-7365 or George_Jordan@fws.gov.

B. Peer Review Charge

Peer reviewers were asked not to provide advice on policy. Instead, the charge to the reviewers was to review the science relevant to the 5-year review and our use of said science, focusing their review on identifying and characterizing scientific uncertainties. Additionally, peer reviewers were asked to consider the following questions and to provide any other relevant comments, criticisms, or thoughts:

1. Is our description and analysis of the biology, habitat, population trends, historic and current distribution of the species accurate?

2. Does the 5-year review provide accurate and adequate review and analysis of the factors affecting the species (habitat loss and modification, overutilization, disease, predation, existing regulatory mechanisms)?
3. Are our assumptions and definitions of suitable habitat logical and adequate?
4. Are there any significant oversights, omissions or inconsistencies in the 5-year review?
5. Are our conclusions logical and supported by the evidence we provide?
6. Did we include all necessary and pertinent literature to support our assumptions and conclusions?

C. Peer Review Comments

1. Robert G. Bramblett Review

To Whom It May Concern:

My review is structured with page numbers and quotes from the Pallid Sturgeon *(Scaphirhynchus albus)* 5-Year Review: Summary and Evaluation, U.S. Fish and Wildlife Service, followed by my comments. I added emphasis using italics and bold font in some quotes and comments.

Sincerely,

Pages 3 and 4 - "relevant new information that would lead you to consider listing this species…"

I am not an expert on DPS designation or genetics; however, it is apparent from Heist and Schrey (2006a; 2006b), that pallid sturgeon populations have a genetic structure that indicates isolation by distance. This is indicated even without a full set of data, or with data missing from parts of the species range. Tranah et al. (2001) conclude that "pallid sturgeon in the upper Missouri and Atchafalaya rivers should be managed as genetically distinct populations."

It seems probable that pallids from the upper Missouri are markedly different from those in the lower Mississippi and Atchafalaya Rivers. Although it would be difficult to draw a line or lines that separate pallid sturgeon DPSs, it seems obvious that genetics from geographically distant populations should not be mixed. I recommend having a population geneticist evaluate considering DPS status for pallid sturgeon and if this is inconclusive, that a more complete set of genetic samples be obtained and a complete analysis be performed.

Page 8 - "wild pallid sturgeon population trend is relatively unchanged." This statement is not supported in this report, and may not be accurate. There is just one population estimate given (without confidence intervals) thus a trend cannot be determined. The report also states that recruitment is severely limited; therefore, we have to assume that unless there is zero mortality the trend for wild pallid sturgeon is a decline in numbers.

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"however, the population is being ***successfully*** supplemented with hatchery produced fish." This statement is not supported in the text. There are no data presented on the growth, survival, and abundance of stocked fish. Without these data the success of supplementation cannot be assessed. Figure 3 shows that hatchery produced pallid sturgeon are being captured, but does not indicate if they are growing, surviving, or may reasonably be expected to achieve sexual maturity.

Page 9 - "wild pallid population trend has remained relatively unchanged since listing" this statement is not supported and likely not accurate. It is difficult to obtain inference on population trends and success of stocking programs from Figures 3 and 5 because it is not known whether these data represent standardized sampling or stocking efforts. Catch-per-unit effort would be more demonstrative, if sampling was standardized to season, location, and method.

A total of 245 individuals captured from 1990-2006, coupled with the most recent estimate of 136 (without confidence intervals) would suggest a strong decreasing population trend. As in RPMA 1, long-term success of hatchery augmentation is not demonstrated.

Pages 11-12 - Specific detail from the Shuman *et al.* (2005) report would help the reader assess the level of growth and survival.

"These data suggest that prior to supplementation, pallid sturgeon were extremely rare in RPMA 3." These data suggest that pallid sturgeon were extremely rare or ***extirpated*** from RPMA 3.

Pages 13-14 - "These data also indicate that hatchery stocked fish are being collected and contributing to the population (Figures 8 and 9)."

Important additional information could be gleaned from these data. For example, in Figure 9, in 2004, 36 hatchery pallid sturgeon were captured and in 2005, 72 hatchery pallid sturgeon were captured. How many net-hours did it take to capture these; i.e., what was the catch-per-unit-effort (CPUE)? How many stocked cohorts were in the catch? If multiple sampling efforts were conducted, what was the recapture rate? Recapture data could be used to do multiple mark-recapture estimates that could then be used to assess recruitment to the sampling gear and the survival of stocked cohorts. By estimating some of these parameters, we could start to get at actual estimates of abundance and population trends. If we knew the survival rate of stocked fish, we could predict how many will live to attain sexual maturity thereby projecting the likelihood of success for the stocking program. I recommend that an expert population modeler be contracted to assess these types of population parameters for each RPMA using the National Pallid Sturgeon Database.

Pages 15-18 - This section reports capture of stocked fish, but no description of where, where, or how many fish were stocked.

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Figure 10 - Is it correct that hatchery fish ranged as large as 900-950 mm? This is a significant finding if fish > 600 mm are considered adults. Were these hatchery fish sexually mature? Is this the only documented recruitment to adulthood of stocked pallid sturgeon?

"Although these ratios must be interpreted with caution, they demonstrate an improvement in knowledge of, and ability to collect pallid sturgeon in large river habitats."

These ratios are difficult to interpret. For example, a 1:18 ratio could represent a total of one pallid captured to 18 shovelnose captured or 100 pallids captured to 1,800 shovelnose captured, so we do not know if overall catch went up or down. Also, the increase in pallid to shovelnose ratio is difficult to interpret if sampling was not standardized. The changing ratios could indicate many things, including sampling different habitat types, locations, times, flow conditions, capture efficiencies, increased pallid sturgeon abundance, or decreased shovelnose sturgeon abundance.

Page 19 - As mentioned previously, these recapture data could be used to calculate population estimates with confidence intervals. This would improve assessment of abundance and population trends.

"The BK character index misidentified all three hatchery-reared young-of-year as hybrids, and identified two of the wild young-of-year as shovelnose and other as a hybrid."

Is it feasible to sample genetics on all or a subsample of all putative pallid sturgeon captured range-wide? This also would have the benefit of providing data to clarify the genetic structure of pallid sturgeon in regard to DPS status.

Page 20 - The histograms indicate that these pallid sturgeon average about 400-500 mm smaller than pallid sturgeon captured at RPMAs 1 and 2. Are these fish smaller at the same age, or younger fish? If smaller at the same age, this may have bearing on DPS status.

Page 21-24 - "The three groupings are a well differentiated upper Missouri River Group and two less differentiated groups in the lower Missouri Middle Mississippi, and Atchafalaya river samples." Is this sufficient evidence to ***consider*** DPS designation (as on Pg. 3) for perhaps the upper Missouri group. If DPS listing is not appropriate, perhaps this decision needs to be supported in light of the genetic evidence presented on pages 21-24 and in the citations.

Page 25 - Similar to the observations of Gerrity (2005), Bramblett (1996) found that pallid sturgeon used 25 km of riverine habitat that would be inundated by Lake Sakakawea at full pool. Bramblett, R.G. 1996. Habitats and movements of pallid and shovelnose sturgeon in the Yellowstone and Missouri rivers, Montana and North Dakota. Doctoral dissertation. Montana State University, Bozeman.

Page 26 - "A reduction in sediment transport could reduce naturally occurring habitat features like sandbars."

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Reduction in sediment inputs does reduce naturally occurring habitat features, including sandbars. Discharge and sediment load, together with physiographic setting are proimary factors controlling the morphology of large alluvial rivers (Kelllerhals 1989). Kellerhals, R., and M. Church. 1989. The morphology of large rivers: characterization and management. Proceedings of the international large river symposium. Canadian Special Publication of Fisheries and Aquatic Sciences 106:31–48.

"The Yellowstone River, a major tributary to the Missouri River, was likely a historically important tributary for spawning."

The Yellowstone River undoubtedly was and likely remains an essential spawning location. Bramblett (1996) documented the following: pallid sturgeon prefer the Yellowstone River over the Missouri River below Fort Peck, many fish move into the lower Yellowstone River during spawning season, ripe fish occur in the Yellowstone River and aggregations of fish during spawning season strongly suggest that pallid sturgeon spawning occurs in the in the lower 10 to 15 Rkm of the Yellowstone River. The ongoing threat to this spawning aggregation is downstream drift of larvae into Lake Sakakawea. Although Lake Sakakawea is described as a potential impediment to larval pallid sturgeon survival on page 25-26, it is not specifically addressed in the context of the Yellowstone River pallid sturgeon spawning aggregation.

Pages 30-31 - More evidence to consider a DPS?

Page 32 (and in other RPMAs with dams) - Although previously addressed, is it not appropriate to include the effect of shortened riverine reaches on larval drift as "present destruction or modification of habitat?"

Page 41 - "However, Parken and Scarnecchia (2002) reported that walleye, *Sander vitreum*, and sauger, *S. canadense*, in Lake Sakakawea (just downstream of RPMA 2) were capable of eating wild paddlefish (*Polyodon spathula*) up to 167 mm body length (305 mm total length), but Braaten and Fuller (2002, 2003) examined 759 stomachs and found no evidence of predation on sturgeon by seven piscivore species in Montana."

This is unclear. Parken and Scarnecchia (2002) results suggest a predation threat in Lake Sakakawea, but the results of Braaten and Fuller (2002, 2003) do not lessen the suggestion of a threat because they sampled from the Missouri River, whereas Parken and Scarnecchia (2002) sampled in the reservoir. Presumably, it would more difficult to detect predation on *Scaphirhynchus* the nearer you are to the spawning location because the larvae would be smaller and digested more rapidly, as well as probably drifting through the area for a relatively short time period. Did Parken and Scarnecchia (2002) find any *Scaphirhynchus* in the stomachs they sampled? Did they sample near the headwaters of Lake Sakakawea?

Page 46 - "Studies since listing continue to show small, **declining** old-age wild populations of pallid sturgeon in RPMA 1 and 2," this statement conflicts with previous statements on Pages 8 and 9, e.g., "wild pallid sturgeon population trend is relatively unchanged."

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"Pallid populations in RPMAs 1-3 are being **successfully** augmented with hatchery produced fish."

It is not my intent to criticize the crucial stocking program, but I do not think it is important to acknowledge that augmentation success will only come if these fish survive to adulthood. Further challenges remain in terms of rectifying recruitment bottlenecks, otherwise stocked fish will have to be brought back to the hatchery for gamete collection, repeating the propagation/ stocking cycle. I am concerned that some readers may interpret "successful augmentation" as "problem solved."

Page 47 - "The presence of smaller-sized cohorts of pallid (400-600 mm) in both RPMA 5 and 6 suggest some level of recruitment is occurring." Can this be said without supporting age data given the context of overall smaller size of these southern pallid sturgeon?

2. Gene Zuerlein Review

November 28, 2006

George R. Jordan
Pallid Sturgeon Recovery Coordinator
USFWS, Jameson Federal Building
2900 4th Avenue, Room 301
Billings, MT 59101

Reference: Five-year review for pallid sturgeon per Section 4(c)(2) of the Endangered Species Act of 1973

Dear George,

The compilation of current information on pallid sturgeon by the Recovery Team, Genetics Advisory Team, and U.S. Fish and Wildlife Service has been substantial and insightful. In regard to the *draft* report entitled-Pallid Sturgeon (Scaphirhynchus albus), 5-Year Review: Summary and Evaluation, I have the following comments:

1. Is our description and analysis of the biology, habitat, population trends, historic and current distribution of the species accurate?

Comment - In the demographic data by RPMAs starting on pg 8, the National Pallid Sturgeon Database is often referred to, but no citation is ever used. Is this database owned by the USFWS, and if so, should it not be cited according to scientific protocols? Since it appears to be a living, working document, perhaps it should be cited as a USFWS document? Utilization of the data base to extract the number and length frequency of wild v. hatchery pallids in each RPMA is helpful in discerning approximate age of the pallids under review.

On page 13 under RPMA 4, line 9 refers to larval *Scaphirhynchus* being documented from the Platte River (G. Mestl, NGPC, pers. comm. 2005). There are a number of studies documenting larval *Scaphirhynchus* being sampled from the lower Platte River in Nebraska (Hofpar 1997, Reade 2000). The lower 100 miles of this river contains geomorphologic features conducive to habitat needs of sturgeon and prey species including shifting sand bars, braided channels, side channels, varied depths, and periodic flooding to maintain in channel characteristics conducive to sturgeon and other big river species, including blue sucker. Snook (2001) studied the movements and habitat use of hatchery-reared pallid sturgeon in the lower Platte. Likewise (Swingle 2003) studied movements and habitat use of 17 shovelnose and 2 wild caught pallids from July 2000 through October 2002. Parham et al. (2005) studied the movement of 15 pallid sturgeon in the lower Platte between 2000-2004. Of the 15 pallids caught, 6 carried either elastomere or pit tags and 9 carried no identification and were presumed to be wild fish. Additional reports and publications with Dr. Ed Peters and colleagues on the lower Platte River are currently underway. Further, a Cooperative Agreement between the States of Nebraska, Colorado, Wyoming, and the U.S. Department of the Interior is being consummated to improve and maintain habitat for four threatened and endangered species-the whooping crane, interior least tern, and piping plover in the central reach of the Platte as well as the pallid sturgeon in the lower Platte River. To date the governors of Nebraska and Colorado have signed on as well as Interior Secretary Kempthorne. The Wyoming governor is expected to sign soon. When signed, the Platte River Recovery Implementation Program (USFWS and USBR 2006) will help address pallid sturgeon needs in the lower Platte River.

On page 15 and 16 under RPMA 5, descriptors to the different reaches are delineated by Rmi and Rkm. While this is appropriate, if the Mississippi reaches also were identified with natural features such as from the Gulf of Mexico upstream to the mouth of the Ohio River, from the mouth of the Ohio upstream to the confluence with the Missouri River it might be easier for readers to identify with.

2. Does the 5-year review provide accurate and adequate review and analysis of the factors affecting the species (habitat loss and modification, overutilization, disease, predation, existing regulatory mechanisms)?

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Comment - Habitat loss in each RPMA is descriptive, but you may want to briefly describe what was lost in order to bring home the immense amount of riverine habitat which was eliminated from the functioning river ecosystem. For example, on page 27 in the RPMA 4 reach about 552,000 ac of aquatic and terrestrial habitat was eliminated from the natural channel and meander belt prior to 2003 (USACE 2004). Riverine habitat loss equated in acres adds perspective, although when percentages were used they also were useful. This includes most sandbars, secondary channels, and shoal areas.

Comment - The review on Hybridization (pg 45) and Appendix B (Genetic Analysis data using the software Structure) is informative and interesting. Researchers should be applauded for this innovative genetic analysis, but acknowledgement and the statement that identification of three genetic groups of pallid sturgeon should be regarded as tentative appears to be warranted. Although the six mainstem dams and embankments were closed (Peck 1937, Garrison 1953, Oahe 1958, Big Bend 1963, Ft. Randall 1952, Gavins Point Dam 1955), given the long life span of this species, only one or two generations have potentially passed since the river has been segmented for genetic isolation. On the other hand, one tagged hatchery pallid stocked in RPMA 3 near Verdel (Rmi 851.5) on June 6, 2000, was subsequently recaptured in Omadi Bend (Rmi 721) some 130.5 miles downstream on March 3, 2006. A second tagged hatchery pallid stocked in RPMA 3 was subsequently recaptured below Gavins Point Dam (RPMA 4). Specifically, this pallid also was stocked at Rmi 851 near Verdel which is upstream of Lewis and Clark Lake on March 21, 2002. Over 2 years later it was recaptured on July 20, 2004, at Rmi 447.7 near St. Joseph, Missouri. Both of these pallids must have passed through the Gavins Point Dam power house because a drought was going on in the basin and no gates were open during this time frame. It is a known fact that paddlefish above Gavins Point Dam occasionally pass through and survive electrical generator turbines and of course occasional dam gate openings associated with high water releases. Consequently, downstream movement is possible but not upstream movement because there are no fish passageways built on any of the mainstem dams. In the future, when the USACE addresses passing trapped sediment in the system (USFWS 2003a), especially the delta built up on the upper end of Lewis and Clark Lake behind Gavins Point Dam, there is the potential that passing sediment below Gavins Point Dam also could incorporate a fish passageway within this small dam.

3. Are assumptions and definitions of suitable habitat logical and adequate?

Comment - Given the fact that pallid sturgeon were only listed in 1990 and there is descriptions of riverine habitat types lost in the systems (RPMA 1-6) it is probably the best that can be anticipated until ongoing monitoring and research study data can be analyzed. It may take a number of years to help delineate what habitat parameters within the RPMAs are being used throughout its range to include depth, velocity, etc. What riverine habitat components are used by the different life cycle stages also is important to discern, not to mention adequate food organisms needed by the different life stages of pallid sturgeon. This species cannot thrive in a vacuum, and habitat for prey fish species is important for older pallid sturgeon. Hesse (1994) stated the declining status of selected chubs and minnows in the Missouri River in Nebraska from 1971-1993 most likely contributed to the demise of sauger, catfish, burbot, and sturgeon among other species. Wanner (2006) citing (Held 1969)

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refers to pallid and shovelnose sturgeon as opportunistic suctorial feeders on benthic organisms using barbels, an inferior mouth, and modified fleshy lips. Wanner (2006) also cites (Coker 1930; Cross 1967; and Carlson et al. 1985) in that while adult pallids utilize aquatic insects, there is a greater proportion of fish (mostly cyprinids) in their diet compared to shovelnose sturgeon. Most likely, there are other sources of information on prey species in other RPMAs which can be resourced for the next 5-year review.

4. Are there significant oversights, omissions or inconsistencies in the 5-year review?

Comment - I do not think so. I believe the pg 46 (II.D.) Synthesis is on target and that a change in pallid sturgeon status is not currently warranted for the specified reasons. I recommend that the National Pallid Sturgeon Database be scrutinized further to determine if there are other cases of marked (elastomeres etc.) pallids stocked and subsequently recaptured between RPMA 3 and RPMA 4. Results should then be shared with genetic researchers for their consideration.

5. Are our conclusions logical and supported by the evidence we provide?

Comment - Overall, authors and reviewers used the body of literature and references available to document and substantiate statements and conclusions, especially the hybridization hypotheses discussed on page 45-46.

6. Did we include all necessary and pertinent literature to support our assumptions and conclusions?

Comment - Yes. Overall, the 5-year review document is a substantial piece of work, but like many things in science, there is always new things to learn. Recently, Hay (2006) used a multi-year, multi-location data base of biological sampling to develop statistical models relating biotic responses to variables representing discharge, temperature, and turbidity in the Missouri River from Fort Randall Dam, South Dakota, to Rulo, Nebraska. Results from macroinvetebrate modeling indicated greater drift densities were related to higher flows out of Fort Randall Dam (RPMA 3) and low flows and reduced turbidity below Gavins Point Dam (RPMA 4). For larval fish modeling, water temperature was the most important predictor variable. Greater temperatures or degree days consistently increased the probability of finding larval fish and the resulting drift densities. Greater catch per unit effort of age-0 or age-1 fish were generally related to less variable discharge in the unchannelized reaches and to greater, rising discharge in the channelized reaches below Sioux City. Overall, his results suggest that a more natural discharge, temperature, and turbidity regime would benefit native fish and invertebrate species in the Missouri River.

Thanks for the opportunity to review this worthwhile document.

Gene Zuerlein
Certified Fishery Professional
Fisheries Division
Nebraska Game and Parks Commission

NEW CITATIONS

Coker, R.E. 1930. Studies of common fishes of the Mississippi River at Keokuk. U.S. Bureau of Fisheries Bulletin 45:141-225.

Cross, F.B. 1967. Handbook of fishes in Kansas. University of Kansas, Museum of Natural History Miscellaneous Publication 45, Lawrence.

Hay, C.H. 2006. Fish and Invertebrate Abundance in Relation to Abiotic Factors in the Missouri River. PhD Dissertation. University of Nebraska, Lincoln. 208 p.

Held, J.W. 1969. Some early summer foods of the shovelnose sturgeon in the Missouri River. Transactions American Fisheries Society 98:514-517.

Hesse, L.W. 1994. The Status of Nebraska Fishes in the Missouri River, Selected Chubs and Minnows (*Cyprinidae*): sicklefin chub (*Macrhybopsis meeki*), sturgeon chub (*M. geldida*), silver chub (*M. storerians*), speckled chub (*M. aestivalis*), flathead chub (*Platygobio gracilis*), plains minnow (*Hybognathus placitus*), and western silvery minnow (*H. Argyritis*). Pages 99-108 *in* Transactions of the Nebraska Academy of Sciences, Vol 21., 1994.

Hofpar, R.L. 1997. Biology of Shovelnose Sturgeon, Scaphirhynchus platorynchus, in the lower Platte River, Nebraska. Master's thesis. University of Nebraska, Lincoln. 83p.

Parham, J.E., J.J. Olnes, C. N. Reade, and E.J. Peters. 2005. Ecology and Management of Pallid Sturgeon and Sturgeon Chub in the Lower Platte River, Nebraska. Draft Final Report to The Pallid Sturgeon, Sturgeon Chub Task Force and The Nebraska Game and Parks Commission. April 2005.

Reade, C.N. 2000. Larval Fish Drift in the Lower Platte River, Nebraska. Master's thesis. University of Nebraska, Lincoln. 116 p.

Snook, V.A. 2001. Movements and Habitat Use by Hatchery-Reared Pallid Sturgeon in the lower Platte River, Nebraska. Master's thesis. University of Nebraska, Lincoln. 152 p.

Swingle, B.S. 2003. Movements and Habitat Use by Shovelnose and Pallid Sturgeon in the Lower Platte River. Master's thesis. University of Nebraska, Lincoln.

U.S. Army Corps Engineers. 2004. Missouri River Fish and Wildlife Mitigation Project. Kansas City District, Kansas City, Missouri. http:///www.nwk.usace.army.mil/projects/mitigation/.

U.S. Fish and Wildlife Service and U.S. Bureau Reclamation. 2006. Platte River Recovery Implementation program. Final Environmental Impact Statement. Summary. http://www.platteriver.org.

Wanner, G.A. 2006. Sampling techniques for juvenile pallid sturgeon and the condition and food habitats of sturgeon in the Missouri River below Fort Randall Dam, South Dakota. Master's thesis. South Dakota State University, Brookings. 153p.

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Editorial Comments
Pallid Sturgeon (*Scaphirhynchus albus*), 5-Year Review: Summary and Evaluation
Gene Zuerlein, Nebraska Game and Parks Commission

1. Page 5. Throughout the document there are a number of names with personnel communication behind them without the year listed. See pg 5-B. Atwood, pg 18-J. Killgore, pg 32-B. Gardner, pg 34 K. Steffensen, pg 39-R. Short. Like wise, there are names listed in the text portion of the report which are not listed under Personal Communications on pg 57-58. These include K. Steffensen, NGPC pg 34; R. Short, Wisconsin pg 39; T. Keevin, USACE pg 42.

2. Page 8. figure 1 should be Figure 1. Standardize throughout the report. See pg 11 on figure 1; pg 19 on figure 1.

3. Page 17. I believe Figure 10: Middle Mississippi River (RPMA 4) should be labeled (RPMA 5). On pg 15 the RPMA 5 is defined as the Mississippi River from its confluence with the Missouri River to the Gulf of Mexico. The Middle Mississippi River is the reach between the confluence of the Ohio River near Cario, IL and the confluence of the Missouri, near Saint Louis, MO.

4. Page 18. I believe Figure 11: Lower Mississippi River (RPMA 4) should be labeled (RPMA 5). The Lower Mississippi River is the reach of the Mississippi River from the confluence of the Ohio River near Cario, IL to the Gulf of Mexico.

5. Page 49. Although a number of tributaries have been mentioned through the Missouri River Basin in relationship to the various RPMAs. It might be appropriate under the Data needed for the next 5-year review to state any tributary data generated from pallid sturgeon studies also should be reviewed. I know Dr. Ed Peters is planning on publishing his work on radio-tagged pallids in the Lower Platte River.

6. Page 51. Duffy, W.G. et al . 1996. is cited but I could not find it in the text of the report. I may have missed it, but you should check again. On page 53, Kallemeyn, L.W. 1983 also is cited but I could not find it in the report text.

7. Page 50. Braaten, P.J., and D.B. Fuller. 2004. Pg 29 has this citation as 2005.

8. Page 50-56. A number of citations are used as acronymns. It would clarify these citations if they were spelled out in parentheses after they were used. Example: pg 51, DHSS. 2006 could read MDHSS (Missouri Department Health & Senior Services). 2006. Pg 54, MDC. 2006. could read MDC (Missouri Department Conservation). 2006.

9. Page 4. Ray et al. In Press is cited but it is missing in the Literature Cited section on pg 54.

10. Page 22. Ray et al. 2005. is cited but is missing in the Literature Cited section on pg 54.

11. Page 55. TWRA. 2006 could read TWRA (Tennessee Wildlife Resources Agency). 2006.

12. Page 34. USACE 2004 is cited, but missing in the Literature Cited section.

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13. Page 22. Carleson should be Carlson.

3. Vince Travnichek Review

Dr. Vince Travnichek provided comments directly on hard copy of the draft 5-Year review. His comments were primarily editorial in nature.

Critique of Draft 5-Year Pallid Sturgeon Review Document

December 6, 2006

Jim Garvey, Southern Illinois University

This report summarizes the current state of knowledge about the pallid sturgeon throughout its range in the Mississippi and Missouri River basins. I largely agree with the synthesis and conclusions. Below, I make some comments that might provide some food for thought. Of course, all of these comments are colored by my perception of the population in RPMAs 4-6.

General Thoughts

1. Should the report include a section on the potential problems associated with barge entrainment and channel dredging? Unless I missed these issues in the report, they probably need to garner some mention. Jack Killgore's group is currently involved in a St. Louis District-funded project exploring the impact of tow boats on fish communities. Although I am unsure of the source, there was some talk of sturgeon being entrained by dredging. You might want to check with Jack or Tom Keevin about this issue.
2. All the evidence points to a large population that is separated genetically by distance; however, there are no distinct boundaries among populations, with the exception of the Upper Missouri, of course. In my view, it might be instructive to have the report more forcefully state that conservation stocking must account for these geographic differences by collecting broodstock from the specific RPMAs (and perhaps even at specific locations within each RPMA) and restrict stocking to the location-specific lineages. I know there continues to be controversy about this; however, this is the risk averse approach for now until we understand more about genetics and reproductive site fidelity.
3. You mention in the report that there is marked phenotypic plasticity within the pallid sturgeon. We really need to disentangle the genetic versus environmental effects on growth and morphology. Although I realize that this report is not a SOW, we need someone to conduct some common garden experiments to determine whether the size and other physical differences among populations are due to environmental history or genes.
4. Is the eventual goal to recover pallid sturgeon without the need for hatchery supplementation? Or is stocking always going to be included? This needs to be clearly addressed in the report. It seems that the data clearly show that the dams will always reduce survival during early life. Thus, reproduction always will need to be artificially supplemented in this case.

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Specific Comments

1) It might be useful to specifically show the major barriers on Figure 1 and how they correspond to the RPMAs.

2) If I correctly understand the data in Figures 3, 5, and 9, it is important to note that the presence of hatchery-reared fish does not seem to be concurrent with a continued decline of wild-produce fish. In so many instances, populations become dominated by hatchery products while the wild fish continue to decline. One of my concerns is that hatchery fish may cause some degradation of wild stocks; however, this does not appear to be the case with the limited information at hand.

3) There are an awful lot of references to personal communications and unpublished data (guilty as charged) and I think this is important to point out. We, as the community of researchers working with this important species, need to get the word out in the primary, peer-reviewed literature. Perhaps you can do a brief analysis of the literature to date, telling us how the information is distributed between reports and papers. I also would like to see a graph of cumulative number of publications through time.

4) I am unsure whether this is possible, but the report really needs to emphasize that the demarcations between the RPMAs are physical for the Upper Missouri but largely administrative for the lower Missouri and Mississippi River. I am of course biased, but I do believe (and the genetics seems to be supportive) that the southern populations are largely mixing and need to be managed in this fashion. This is implicit throughout much of the report but needs to come out strongly, in my view. Of course, the habitat issues are indeed different between the lower RPMAs but the populations might be mixing.

5) (p. 35) You note that pallid sturgeon have been reliably caught in the Kaskaskia River tributary. Unfortunately, there is a lock and dam directly in the mouth and we have never documented movement into that river to my knowledge. In fact, we have receivers sitting in the mouths of the major tributaries of the MMR and have never documented passage by pallids into them. We do reliably capture pallids near the Kaskaskia River tributary and the island area.

6) You might want to point out that we are currently at the juncture between 1 and 2 of the reasonable and prudent alternatives of the FWS Biological Opinion for the MMR (p. 36). Not sure if we are done with 1 yet, although Tom Keevin has convened a preliminary group to help draft the MMR Conservation Plan.

7) Colombo et al. (in press) is accepted and revised for publication in the Journal of Applied Ichthyology. It would fit nicely in the discussion starting on p. 38.

8) To be fair to Illinois, they are trying to implement regulations – just not there yet (p. 43). Colombo et al. (in press) evaluate some of the implemented size limits and dates and the current regulations do not appear to be sufficient for shovelnose and certainly not for pallids.

9) We all know (with supporting data) that the Chain of Rocks (Lowhead Dam 27, UMR) is a hot spot for sturgeon of both species. Would it be prudent to suggest closing access to all fishing at this area? We suspect that sturgeon are taken incidentally by recreational fishermen with no knowledge of the status of the species.

10) Another important piece of information for decisions about the potential development of DPSs (P. 48), in addition to the genetics, is the extent of movement of these fish between RPMAs. The report should be pretty stern about facilitating increased cooperation among the groups doing telemetry in the Missouri, the MMR, and now the lower Mississippi River, where telemetry efforts are planned by Hal Schramm et al.

11) For the lower RPMAs, we need estimates of immigration and emigration of both wild and hatchery-produced pallids to generate viable population assessments.(p. 49).

12) After completing our final report for the St. Louis District, it appears that we need to understand what makes successful recruitment occur in the lower RPMAs and make more of those conditions. This might help us to improve reproduction and eventually curb the need for supplemental stocking in this part of the pallid sturgeon's range (p. 49).

4. William T. Slack Review

6 December 2006

Mr. George Jordan
U.S. Fish and Wildlife Service
Pallid Sturgeon Recovery Coordinator
2900 4th Avenue North, Room 301
Billings, MT 59101

Dear Mr. Jordan:

I appreciated the opportunity to serve as a reviewer for the Pallid Sturgeon-5 Year Review and have enclosed my comments regarding the document. I have served as a reviewer for numerous peer-review scientific journals and approached this document in the same critical manner. Overall, I feel the document does well in providing the most up-to-date information on the status of pallid sturgeon as well as indicating potential threats to its recovery. As directed in your cover letter, reviewers were asked to consider the following questions during their evaluation of the document.

1) Is our description and analysis of the biology, habitat, population trends, historic and current distribution of the species accurate?

YES, except for spawning/nursery habitat. See Objective 3.

2) Does the 5-year review provide accurate and adequate review and analysis of the factors affecting the species (habitat loss and modification, over utilization, disease, predation, existing regulatory mechanisms)?

YES, except for spawning/nursery habitat. See Objective 3.

3) Are our assumptions and definitions of suitable habitat logical and adequate? **NO. There is no description of spawning habitat, or at least proposed spawning habitat. Identifying spawning habitat and describing the spatial and temporal use of this habitat within RPMAs by both pallid and shovelnose sturgeon should be a high priority. The Recovery Plan states little is known regarding reproduction or spawning activities of**

pallid sturgeon (in 1993). Nothing is included in the current document to indicate gains in information along that front. Habitat loss and alteration are generally listed as primary causes in the decline of pallid sturgeon throughout its range. However, it is ironic that we provide these as causes without having any substantial data on specific habitats such as spawning and/or nursery habitat. Comments are mentioned within the 5-Year Review document (i.e., page 47) indicating that documentation of recruitment within RPMAs is essential to meeting recovery objectives; however, identifying and/or quantifying habitat specific to aspects of recruitment (i.e., spawning habitat) are not listed. Spawning habitats and cues are noted as a concern within the "Data needed for the next 5-year review" section but not prioritized specifically as a "Future Action." Shovelnose sturgeon provide the best surrogate to model potential spawning and/or nursery habitats. Efforts should be placed on targeting those habitats within RPMAs as potential pallid sturgeon spawning areas.

4) Are there any significant oversights, omissions or inconsistencies in the 5-year review?

See Objective 3.

5) Are our conclusions logical and supported by the evidence we provide? **YES**

6) Did we include all necessary and pertinent literature to support our assumptions and conclusions? **YES**

In addition, minor editorial and formatting suggestions are noted directly on the document. Specific points of concern are presented below:

- Do not need labels at the top of each figure. This information is often redundant with the specific figure heading. In those cases where the label is not redundant, incorporate those data/information directly into the figure heading. Also, include sample sizes (n = ___) for histograms, either on the figure or in the figure heading. Information provided in Figure 12 would make it much easier to follow the associated text in the document if sample sizes were listed for each sample period on the figure. Most figure headings are descriptive enough to stand alone from the text but others need to include additional information to better support the figure (i.e., Figure 13).
- Inconsistent use of terms throughout the document (e.g., hatchery-reared vs. hatchery reared; lower/upper vs. Lower/Upper when used to describe specific zones within an RMPA). Inconsistency with citation format in Literature Cited section, particularly with edited volumes.
- Page 14. Need to clarify text on how wild, hatchery and pallid sturgeon of unknown origin were being defined. Numbers of individuals within each category are listed but I am unsure based on the information presented within the document as to how these were determined.
- Page 19. Concerns with catch data presented for RPMA 6: Sampling effort yields absolute number and those numbers are depicted in Figure 12 and 13. Text for RPMA 6 notes "about" and "estimate" for catch effort during specified sampling periods (FY). The actual numbers that were recorded should be stated within the text. Because of the difficulties in

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distinguishing between intermediates, pallid and shovelnose in RPMA 6, the workers feel that the absolute number of pallid recorded for the Area underestimates the total number that are likely there and thus use the term "conservative" for their total estimate of population size.

- Page 19, 20. Patterns depicted in Figure 12 illustrate a consistent frequency pattern that also may reflect gear selectivity. Text describes that shovelnose are regularly captured (40-75 cm FL) and that there is no obvious problem with recruitment. In addition, pallid sturgeon are consistently captured (60-100 cm FL) from the same area and the population size is considered large. It is my understanding that commercial fishermen are routinely involved in the sampling at ORCC and that similar gears are used from year to year. Isn't it just as conceivable to argue that gear selectivity is as much a reason for the pattern that is depicted (gill net mesh adequately samples sturgeon 400-100 cm FL) as is the argument that younger and older fish are migrating from the area through the ORCC? Data presented by Heise (2003) for Gulf sturgeon in the Pascagoula River notes a similar year-to-year size frequency pattern, and attributes the pattern to gear selectivity for large-sized adult Gulf sturgeon.

  Heise, R.J. 2003. The migratory patterns of Gulf sturgeon, Acipenser oxyrinchus desotoi, within the Pascagoula River drainage and potential influences on its behavior. Ph.D. Dissertation, University of Southern Mississippi. Hattiesburg, MS

- Page 19, 20. This is the only section within the entire document that presents data within a fiscal year. Reader is not made aware of what defines the fiscal year as State and Federal resource agencies often have different fiscal years (October through September versus July through June).

- Page 22. Intercross. Is this the most appropriate term to use for this section? This section is discussing the concept of natural hybridization, backcrossing and genetic introgression between pallid and shovelnose and trying to put a single term on the concept...intercross. Wouldn't interbreed be a more all encompassing term than intercross?

- Page 23. Dugo et al. (2004) article enclosed; Data presented in this work illustrates a similar pattern in Gulf sturgeon of genetic distance associated with geographic distance. Populations from adjacent watersheds with less genetic distance than those populations from watersheds at extremes in the range.

- Page 24. Use of the term "importance". Section II.C.1.a. notes the rarity of the animals throughout its proposed range at the time of the description of the pallid sturgeon. Its occurrence in the Yellowstone, Platte, St. Francis, Big Sunflower and Atchafalaya illustrates that its historic range was likely greater than currently recognized, but you cannot say that those river systems were "important". You do not have the historic data to support this.

- Page 25. Discussion about Fort Peck Reservoir and its influence on survival of larval pallid sturgeon. It is unclear from the text as why immature pallid sturgeon are more likely to utilize lower reaches of RPMA 1 than shovelnose sturgeon AND how this influences survival of larval pallid sturgeon.

- Page 27. How do we know that habitat alterations within RPMA 5 have "reduced rearing habitat" when those habitats have not been adequately described and quantified throughout this reach. Comments noted in Objective 3 follow along this thread.

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- Page 28. Text notes 92 secondary channels remain in lower Mississippi River. Is this based on Baker et al. (1991) data or does it reflect more current information from Keevin (2006)?
- Page 29. There is a scant amount of information for shovelnose in the Red, Black and Ouachita rivers (see Douglas 1974). Can this data be used to speculate on potential habitat and range of pallid sturgeon within those systems (particularly the Red) prior to the construction of ORCC. Shovelnose are still being captured in sufficient numbers at ORCC to suggest that habitat for spawning within those systems is still available.
- Page 29. The occurrence of larval and post-larval river sturgeon in the lower Mississippi River around Vicksburg in the fall (September, October; MS Museum of Natural Science Ichthyology Collection) suggests either fall spawning or long distance drift from upriver spawning areas. Comments in the document text propose drift of pallid sturgeon larvae from the Missouri River as a scenario for long distance drift. Data presented on page 26 and summarized on page 29 states that larval pallid sturgeon may drift 200-310 miles depending riverine current velocities but that drift declines after 8 days post-hatching. Given these parameters, 200-310 Rmi upstream of Vicksburg (USACE Rmi 440) would be between Rosedale, Mississippi (Rmi 640), and Memphis, Tennessee (Rmi 750), thus the source would not necessarily have to be the Missouri River.
- Page 32. Have sturgeon chub become reestablished in the Marias River or is this the first documentation of sturgeon chub within the river. Argument is made that occurrence of sturgeon chub is favorable for recovery of pallid sturgeon as it is an important prey species, but if the sturgeon chub had never occurred in the system it may be a mute point in arguing significance toward pallid sturgeon recovery.
- Page 33. Unsure exactly what is inferred with “bank stabilization” as it relates to development. Does this imply “bulkheading” or “armoring” of shorelines with .rip-rap and/or sheet pilings? This phenomenon has been noted to significantly affect inshore nursery habitats of coastal fisheries in Mississippi (Peterson et al. 2000). I would expect similar impacts in freshwater systems which would likely cause a cascading trophic effect.

  Peterson, M.S. et al. (2000). Habitat use by early life-history stages of fishes and crustaceans along a changing estuarine landscape: differences between natural and altered shoreline sites. Wetlands Ecology and Management 8(2/3):209-219.
- Page 34. It is unclear from reading the text what is being “identified” in the Biological Opinion.
- Page 35. Text needs to be included to illustrate how USACE practices to maintain the navigation channel (training structures, locks and dams, dredging, etc) alter habitat. Fleeting needs to be defined.
- Page 38. Little historic data on commercial harvest in lower Mississippi River. Cook (1958) provides an excellent account of fisheries in Mississippi waters includes data for river sturgeon harvest from Mississippi River and associated tributary systems. Prudent to include those comments rather than note that there is little historic data on commercial harvest in Lower Mississippi River. A copy of the document is included in the packet of review comments.

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- Page 41, section II.C.2.D. Inadequacy of existing regulatory mechanisms. The entire section is very choppy and not written very concisely. Redundant information persists throughout the section (pallid and shovelnose can be difficult to distinguish). Section needs to be reworked for better flow and to present the information in a more concise manner.
- Page 44. Entrainment. More description is needed to determine how Phase I rules differ from those implemented in Phase II. Phase I covers facilities. Phase II covers existing facilities with specifics on water withdrawal and cooling. How do facilities in Phase I differ from those in Phase II?
- Page 45, 46. Comments dealing with hybridization. Very well written and makes the points very well. Hybridization may occur between the two with a resulting intermediate morphological phenotype and intermediate genotype, and that additional research is needed to address whether hybridization in the wild is the result of natural processes or anthropogenic influences.
- Page 46. Use of "significantly". This term is used as an opinion of the writer. Impact by regulated flows has not been quantified and thus any assessment of its impact on pallid sturgeon is qualitative. "Significantly" implies quantified comparisons evaluated with statistical analyses. Similarly, riverine habitat has been fragmented but dams do not continue to significantly fragment the habitat (implies increase in fragmentation). Habitat was fragmented by dams and will continue as such until either dams or removed (less fragmented) or .added (more fragmented).
- Page 49. Recommendations for Future Actions AND Data needed for next 5-year review. Section should include focused and directed research efforts towards addressing the extent of movement by pallid and shovelnose across range. Some telemetry work has been done within the upper portions of the range where physical constraints within the system (locks and dams, defined pools) allow for a more logistic project. RPMA 4 and 5 are large areas and movement within and between these areas as well as projects addressing the extent of movement between RPMA 5 and 6 are desperately needed. Admittedly there are some pilot projects underway but dedicated funding towards projects of this scale is much needed.
- Page 49. Recommendations for Future Actions. Cease augmentation of wild stock with hatchery reared stock in RPMA 4, 5 and 6 UNTIL more information is obtained on movement within and between RPMAs. In addition, recent data obtained from research within RPMA 4, 5 and 6 suggests these populations are much larger than once perceived and stocking within these areas may not be necessary to meet recovery objectives
- Page 49. Recommendations for Future Actions. Identify spawning habitat and describing spatial and temporal use of this habitat within RPMAs by both pallid and shovelnose sturgeon to address potential mechanism for observance of hybrids/intermediates within these areas.

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- Page 49. Recommendations for Future Actions. One direction note for "Future Actions" is to model the Missouri River Populations Assessment Program for RPMA 5 and 6. This is a step in the right direction but implementation of such a program is in need of dedicated funding. Many of the partnering states already have USFWS Section 6 funding in place as well as funding appropriated under the USFWS State Wildlife Grant program. However, in most cases those funds are already dedicated toward research of equal importance. A monitoring project of this scale will require teams of personnel and sufficient equipment to perform the task. What agency/entity will coordinate these efforts?

Thank you again for the opportunity and I hope my critique of the draft document and my enclosed comments will be helpful in preparing the final document for the Pallid Sturgeon 5-Year Review. Please feel free to contact me directly if you have any questions regarding my review.

Sincerely,

William T. Slack, Ph.D.
Nongame Research Biologist
Curator of Fishes

5. David L. Galat Review

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December 11, 2006

George R. Jordan
U. S. Fish & Wildlife Service
Pallid Sturgeon Recovery Coordinator
Jameson Federal Building
2900 4th Avenue North, Room 301
Billings, MT 59101.

Dear George,

Thank you for the opportunity to provide a review of the U. S. Fish & wildlife Service's Pallid Sturgeon 5-Year Review. Clearly, much effort has gone into producing this report, particularly given the exponentially increasing amount of research and monitoring on Scaphirhynchus *sturgeons since the USFWS Biological Opinions (BiOPs). Here are my replies to your questions with the numbers corresponding to the questions posed.*

1. I believe that there are numerous inaccuracies in the draft description and analysis of the biology and population trends of pallid sturgeon and these concerns are detailed below with reference to specific aspects of the draft review.
2. I realize it is difficult to include an exhaustive evaluation of all available information in this review; I've noted below instances of significant omissions of information related to factors that may be affecting the species' status.
3. No comment.
4. Omissions and oversights that I've identified are detailed below.
5. I do not concur that the evidence provided herein and in the documents cited adequately support the conclusion of the pallid sturgeon's status remaining "stable" since it's listing in 1990. My concerns and requests for clarification are detailed below.
6. I've noted some omissions in the literature and urge the report preparers to analyze and incorporate results from all of the most recent pallid sturgeon population assessment and habitat–use project reports as well as pertinent literature for other sturgeon species.
To assist in reviewing my comments, I have assigned line numbers to the entire document (attached) and specific comments relate to these using the following format: ***Pg xx, 100-103*** *where the number following the page number refer to specific lines in text. There also are a few editorial comments made in "Track Changes" directly on the draft.*
I commend the authors for incorporating much of the valuable information that has been acquired since the species was listed in 1990 into this review and using it to evaluate the species' current status. I hope you will find my comments and recommendations useful to your review and to furthering conservation of the species.

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Sincerely,

David L. Galat
Assistant Unit Leader- Fisheries
And Associate Professor

Species status is listed as "stable" on pg. 2 I.C.2.

I am unable to locate sufficient scientific evidence within this document to justify the Report's author's reaching this finding. Five factors contribute to this conclusion: (1) What the ESA/FWS official policy is for the contribution of artificially propagated pallid sturgeon and their stocking is to determination of "status" is unclear. (2) Information reported and apparently used to make the conclusion of the species' status is insufficient or incorrectly applied to make determinations about the species' abundance or population status. (3) For a population to be stable there should be large numbers of small individuals present within a length-frequency distribution, illustrating that recruitment is replacing mortality. This is particularly important for long-lived fishes such as sturgeon where growth of old individuals is minimal. (4) The authors have not included relevant references that report a continued decline of the species. (5) The report's Synthesis section emphasizes the highly imperiled status of this species. Text that follows addresses each of these factors.

(1) A critical issue that I believe should be addressed in this review is to clarify for the reader the policy of ESA and FWS on the role stocking pallid sturgeon plays in the species recovery. Can it be used to "rejuvenate" critically low populations in order to increase numbers sufficiently so that natural recruitment at some point can maintain the population or increase it? Peregrine falcons and California condors are examples of where this approach has been successfully applied. I think it might be useful to the public to illustrate similar examples for endangered riverine fishes to lend additional credibility to the stocking program. An equally important question I hope can be clarified in this status review is what is the ESA/FWS's policy relative to inclusion of stocked fish in determinations of defining the pallid sturgeon's population status. Specifically, can a population maintained by stocking for some period of time be classified as "stable" as appears to be the case with pallid sturgeon based on this review, or is *natural* recruitment required for the population of pallid sturgeon to remain "stable"? This is an important consideration I hope can be clarified since much of the information reported on pallid catches in this review relates to stocked fish and stocked fish relative to "wild" fish.

(2) A fundamental requirement for a wild population to be *stable* is that recruitment (presumably natural vs. artificial propagation, but see previous comment) into the population needs to balance mortality losses. A population that is *increasing* has recruitment exceeding mortality, and a *declining* population has mortality exceeding recruitment. Therefore, statements about a population's status should be supported with evidence concerning recruitment and mortality. Can you more effectively summarize the evidence that recruitment is balancing mortality as evidence for concluding the population's status is stable?

(3) All length-frequency distributions in the review show comparatively few small pallid sturgeons relative to "mature" individuals. Length frequency distributions (where length is a surrogate measure of age) of a healthy population are dominated by small size classes (young

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fish) (Van Den Avyle & Hayward 1999). Rarity of small size classes from most RPMAs could be a consequence of several factors acting independently or collectively: (i) sampling effort is biased towards larger size classes; (ii) sampling gears deployed are inefficient at capturing small size classes or the habitats where they may reside are ineffectively sampled (e.g., main-channel thalweg); (iii) difficulty of taxonomically separating small pallid sturgeon from small shovelnose sturgeon results in under-reporting small size classes of pallid sturgeon; or (iv) natural recruitment of pallid sturgeon to sub-mature sizes is not occurring. I recommend this review address each of these factors so that statements about population trends or condition of the pallid population can be substantiated.

Rather there is circumstantial evidence within the document that appears to support continual decline of the species throughout it range in the Missouri River. Here are some relevant quotes from the draft 5-year review for RPMAs to support this observation:

Pg. 8, 300-302; RPMA 1. "The size and age of surviving fish suggest that spawning, recruitment or both are severely limited within this reach. Supplementation of RPMA 1 with hatchery produced pallid sturgeon has occurred sporadically since 1997, and is required to maintain the population."

Pg. 9, 352-355; RPMA 2. "The length frequency data indicate that up until the time supplementation began, all collected pallid sturgeon were adults except for one small fish collected in 1993. This suggests that, like RPMA 1, spawning, recruitment or both are limiting viability within this reach."

Pg. 11, 378-384; RPMA 3. "There is no native wild population of pallid sturgeon known to survive in RPMA 3 (figure 1), the Missouri River from 20 miles (32.2 km) upstream of the mouth of the Niobrara River to Lewis and Clark Lake, and the current population consists entirely of hatchery stocked fish. According to the National Pallid Database, the latest wild record of the species from this area, that was not translocated, was the collection of a single pallid sturgeon circa 1991. Prior to this (1952-1991), there were a small number of pallid sturgeon collected from this area."

Pg 14, l-443-448; RPMA 4. "The low numbers of naturally produced or unknown origin pallid sturgeon in smaller size classes coupled with higher relative abundances of hatchery origin pallid sturgeon (Figure 9) and frequent captures of smaller size class shovelnose sturgeon suggests that the gears being used are effective and that natural recruitment of pallid sturgeon is sporadic or limited in RPMA 4 (Barada and Steffenson 2006, Kennedy et al. 2006, Steffenson and Barada, 2006, Utrup et al. 2006)."

Pg 19, 585-587; RPMA 6. "The length distribution of pallid sturgeon captures has remained relatively consistent over the past 7 years, although the population appears to be comprised of predominantly adult fish >65 cm FL (Figure 12)."

(4) Doyle and Stroska (2003) conclude for the lower Missouri River, "Pallid sturgeon continue to decline at a rapid rate. Within the 200 river-miles sampled, the ratio of pallid to river sturgeon decreased from 1:311 in a 1996-2000 study to 1:387 in 2002.

(5) The synthesis section summary reports catches of adult pallids remain low, recruitment of pallids is infrequently observed, pallid catches are largely composed of old-aged individuals, illegal commercial harvest appears to be increasing, inter-sex specimens of *Scaphirhynchus* are now being observed, and hybridization is now well documented – yet the overall

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conclusion is: "In summary, the status of pallid sturgeon has improved since listing due to successful hatchery and stocking programs in reaches of the Missouri River; new information on habitat extent and conditions, population size, and potential recruitment in the Mississippi River; and new information on population size in the Atchafalaya River."

For this reviewer, it seems the conclusion of a "stable" pallid population status conflicts with a substantial amount of the evidence provided herein or the references cited. Additionally, some of the information presented in this review appears misinterpreted (see previous and following comments), thus making it impossible to objectively evaluate trends in abundance or population status of pallid sturgeon throughout its range. Low numbers of pallids $\leq$350 mm TL collected, insufficient information on changes in pallid CPUE over time, lack of quantitative population estimates, increased fishing mortality, disease, contaminant levels and hybridization lead me to question the report's conclusion that the species' status remains stable.

Perhaps you can help your readers understand this conclusion in the final draft by clarifying what is meant by "stable", what specific criteria were used to reach this conclusion and what other options for the species' status exist (e.g., uncertain, declining, improving?) and what are the criteria for their designation?

What is a population? A *population* is a group of fish of the same species that are alive in a defined area at a given time (Wooten 1990). In fisheries it is generally determined by mark-recapture studies, the methods of which are described in numerous texts (e.g., Bagenal 1978, Wooten 1990, Van Den Avyle & Hayward 1999). Population is not synonymous with catch, or abundance. This status review appears to use the terms "population" or "population trend" very loosely, and in my opinion largely incorrectly. I strongly recommend including the Przemyslaw and Wildhaber (accepted) paper "Population viability analysis of lower Missouri River shovelnose sturgeon with initial application to the pallid sturgeon" in this review as it illustrates very well the type of information necessary to quantify population trends.

Reporting only catch information as is done in this status review does not contribute substantively to evaluation of a species' abundance or its population's status (see other comments) unless it is adjusted for effort, i.e., catch per unit of sampling effort or CPUE. For example, reporting catches as in II.C.1.a. "Abundance, population trends…" (pgs. 5-20) is misleading as does not provide the reader with accurate data about abundance or population trends. See above comment about the rigorous approach that is necessary to evaluate population trends. Statements about patterns in numbers of pallids collected over time also are misleading, unless catch data are adjusted by effort (e.g., see 2004 and 2005 Population Assessment Reports for segments 9-14 for examples of reporting CPUE). For example, pallid sturgeon sampling has likely increased markedly following RPAs in the 2000 and 2003 Biological Opinions. If effort to capture pallids has doubled from 2000 to 2005, then catches also will need to have doubled for relative abundance (not population size) to be considered "stable." Increases in catch over time without adjustment for effort may lead to erroneous conclusions about relative abundance.

Additionally, annual catch data as presented in Figures 3, 5, 7, and 9 provides inappropriate information from which to evaluate population status (see previous comments about misuse to the term *population* throughout this report).

Conservation Measures (Pgs 32-37). A substantial amount of this review is devoted to detailing the various ongoing Missouri and Mississippi rivers mitigation, rehabilitation, or restoration programs. I think it would benefit this status review to summarize more specifically

if, or how, these programs have shown a demonstrated benefit to pallid sturgeon recovery. If there are measurable benefits, please detail. If measurable benefits are not yet able to be documented, why not? Too early, other reasons? In cases where measurable benefits have not been documented, could you detail *expected* benefits from these programs? This will provide a reference point against which future status reviews can be compared. Unless or until measurable objectives of conservation measures to benefit pallid sturgeon recovery are articulated the ability to evaluate success within an adaptive management framework will be challenging. This status review would be an ideal vehicle to provide this guidance.

Quality of evidence used to evaluate pallid sturgeon status. *There is much contention over the status of pallid sturgeon throughout its range. It is imperative given the questions being raised by basin stakeholders over the quality of science surrounding pallid sturgeon decisions (See Spring Rise Process at http://missouririver.ecr.gov/) that scientific evidence used to assess pallid sturgeon status be of the highest quality and subjected to independent science review. This is most effectively accomplished through publication in peer-reviewed outlets. The use of "personal communication" is discouraged and should be used with great caution as (1) validity of personal communication statements cannot be independently confirmed, and (2) it is not possible for the reader to separate opinion from scientifically supported evidence.*

I recommend considering the principles for independent review for Corps projects in the National Research Council (2002) report to assist in developing guidelines for pallid sturgeon science.

References. *The reference to Kuhajada et al. in press of larvae as "may have been pallid sturgeon" is not provided in the references on CD provided reviewers, nor is the Murphy et al. in press reference, although both are in the Report references. Please add both and any others listed in Literature Cited, but not included on CD in the final product. Status report readers need to be able to access all citations or they should be deleted as preparers of the report should not have exclusive access to any information. Other manuscripts submitted from the Scaphirhynchus Symposium and very relevant to pallid sturgeon status also should be incorporated into this review (e.g., Przemyslaw and Wildhaber accepted) and made available as soon as they are accepted for publication.*

Pg 8, 292-295. "The wild pallid sturgeon population trend has remained relatively unchanged in RPMA 1 since listing, however, the population is being successfully supplemented with hatchery produced fish (U.S. Fish and Wildlife Service 2006)."

I cannot determine what evidence was used to reach this conclusion and similar statements for other RPMAs? Do we know what the population was at listing to provide a baseline against which to compare subsequent population estimates? Reporting length frequency data (e.g. Figure 2) or yearly catch data (see previous comment) tells us nothing about **population** size or its trends. To evaluate the hypothesis that *size frequency of catches is stable over time* (note that size frequency distributions provide no evidence of population trends, but just the distribution of lengths within catches) one needs to see diagrams like Figure 2 for each year or at least for 3 to

5-year intervals (e.g., see Figure 12) and then test if the frequency distributions are statistically similar over time. If too few individuals are captured then there is insufficient data to make a conclusion – not conclude that the population is stable.

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Pg 8, 298-300. "Current population estimates suggests that as few as 45 wild pallid sturgeon still remain in RPMA 1 (Bill Gardner, Montana Fish Wildlife and Parks (MFWP, personal communication, 2005)."

Formal analyses yielding population estimates would be very valuable. Can you include the results of this and methods applied along with estimates of confidence intervals so the reader can evaluate its robustness? The potential value and import to recovery of population estimates is great and thus they should be published (preferably in a peer reviewed outlet) if they are to be used to affect recovery actions. See general comments about using "personal communications"

Pg 13, 420-428. Identifying larval and juvenile pallid sturgeons is exceedingly difficult. All tentative IDs of larval pallid sturgeon must be verified by recognized experts (e.g., Darrel Snyder, Colorado State University Larval Fish Laboratory) before they are reported. I am aware that the USFWS Office 1990s larvae were confirmed by Synder, but please include confirmation of those reported by Mestl, Herzog, and others – or acknowledge their tentative status. The following statement (Pg 17, L528-532), "One recent study found that character indices do not correctly identify small Upper Missouri River hatchery reared juvenile pallid sturgeon (<250 mm SL) from shovelnose or hybrid sturgeon, or reliably separate larger pallid sturgeon (up to 600 mm SL) from hybrid sturgeon (Kuhajda and Mayden 2001).", implies that statements made about recruitment of pallid sturgeon or capture of small unmarked pallids should be viewed with caution when assessing population status. Until genetic techniques are available to provide a probability statement of larvae being a pallid sturgeon (Heist et al. proposal recently approved for funding through the SSP program), conclusions about pallids population status based on larvae or juveniles are suspect.

Pg 18, 552-554. *"Although these ratios must be interpreted with caution, they demonstrate an improvement in knowledge of, and ability to collect pallid sturgeon in large river habitats."*

I agree with this statement, and in particular urge you to note that such ratios, unless adjusted for differential gears used or differential collection effort, are not helpful to evaluate the status of pallid sturgeon populations.

Pg 24, 800-802*. "A single low head dam in the middle Mississippi River near the mouth of the Missouri River between RPMA 4 and 5 is not believed to impede movement of fish." Please include the name of this dam. If the sentence refers to Chain-of-Rocks, then I agree with the statement. However, if the sentence is referring to Melvin Price (Lock and Dam 26), then there is substantial evidence that Mississippi River locks and dams impede up-river movement of migrating fishes in general (see Wilcox et al. 2004). This is why the Upper Mississippi River Navigation and Ecosystem Sustainability Program is proposing multi-million dollar fish passage facilities on navigation dams.*

Pg 25, 835-837. "*Recent work by Gerrity (2005) suggests that immature pallid sturgeon are more likely to utilize the lower reaches of RPMA 1 than are shovelnose sturgeon." This statement is incorrect as Gerrity examined* hatchery reared *juvenile pallid sturgeon (HRJPS). Please revise.*

Pg 29, 1035-1042. *"It has been considered that pallid sturgeon spawn in the spring or early summer as do other sturgeon species. However, the capture of* Scaphirhynchus *larvae and post-larvae in the Mississippi River during fall months as well as the spring, could be interpreted as an extended season or a second spawn in the lower latitudes of distribution (P. Hartfield,*

USFWS, personal communication, 2006). An alternative hypothesis to explain this could be later Missouri River spawning dates occurring in more northern latitudes and later downstream drift of those post-larvae pallid sturgeon being collected in the Mississippi River.*"*

The italicized alternative hypothesis cannot explain presence of larvae *in the Mississippi River during the late summer and fall months for two reasons. First, the hypothesis that larval* Scaphirhynchus *drift downstream to the Mississippi River from more northern latitudes – but do not grow, as would be necessary for them to remain as larvae while drifting downriver - untenable given the high energetic demands of larval fishes and the high mortality if they do not feed once the yolk is absorbed (Fuiman and Werner 2002). Second, U.S. Fish and Wildlife Service Columbia Missouri Fishery Resources Office's data shows that age-0* Scaphirhynchus $\leq$ *60 mm TL were collected from the lower Missouri River from April to October 2004 (see Figure 1 attached) supporting for the Missouri River Hartfield's hypothesis of a protracted spawning season for the Middle Mississippi. Additionally, Wildhaber et al (2006) using histological analysis of shovelnose sturgeon ovaries reported "spawning condition" females (oocyte reproductive stage V: follicles are black) in the lower Missouri River from January through August, although the greatest percentage of stage IV (pre-spawning: follicles enlarge, begin to turn black) and stage V females were collected in April and May. The evidence for a protracted spawning season for* Scaphirhynchus *sturgeons is quite substantial.*

Pg 33, 1174-1176. *"Work in this reach indicates that it possesses necessary habitat and is suitable for pallid sturgeon recovery efforts (Jordan* et al. In press*)."*

This paper deals with activity patterns and habitat use of 3-year old stocked pallid sturgeon in RPMA 3. It is my understanding that recovery requires successful natural reproduction which was not evaluated in the cited paper. The study showed that resource conditions within RPMA 3 were suitable for growth of sub-adult pallids – this is not the same as "suitable for recovery". Revise report text to more accurately reflect the studies conclusions.

Pg 34, 1206-1208. *"Increased discharge in the spring followed by low discharge in the summer may provide missing cues suspected as one cause of little to no spawning/recruitment of pallid sturgeon in this reach."*

How does this statement relate reports of a protracted spawning for Scaphirhynchus *and the observation of larval* Scaphirhynchus *in the lower Yellowstone and upper Missouri Rivers in years with high, low, or no spring rise (Pat Braaten, PowerPoint presentation to Spring Rise Process, 2005)? My point here is that evidence for the necessity of a spring rise as a spawning cue for* Scaphirhynchus *is equivocal, making the statement above a hypothesis. I suggest revising text to say, "…in the summer* is hypothesized *to provide missing…"*

Pg 34, 1223-1226. *Suggest revising the sentence by adding italicized word "potential": "Based on current and anticipated commitments for aquatic habitat restoration in this RPMA, the next several years should produce increased quantity and quality of* potential *sturgeon habitat in RPMA 4…"*

Finding a few pallids using a rehabilitated habitat is certainly a positive observation, but statements about their value should be made with caution until more definitive evidence is available. For example, larval and adult pallids also have been captured in the channelized lower Missouri River; does this mean we should channelized currently unchannelized reaches to further restoration efforts?

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Pgs 35-36. Mississippi River (RPMA 5). *The text here summarizes a variety of acquisitions of flood-prone floodplain areas. These will certainly benefit rehabilitation of the Mississippi River floodplain ecosystem, but what evidence is there that these areas will specifically benefit pallid sturgeon that as a fluvial specialist species (Galat et al. 2005) is highly unlikely use floodplain habitats? It believe it is misleading to imply that mitigation projects for Missouri or Mississippi River navigation and bank stabilization programs that restore floodplain lands have a* direct *benefit on pallid sturgeon recovery. I'm aware of no evidence in this document or other literature that supports this hypothesis. These acquisitions are admirable as part of a broad ecosystem restoration program, but it currently is somewhat of a stretch to argue they specifically benefit pallid sturgeon recovery.*

Pg 40. 1479-1480*. "Little peer-reviewed information is available documenting piscivory as a threat limiting the recovery of the pallid sturgeon."*

I find it disconcerting that here the review remarks there is little peer reviewed information supporting piscivory on pallid sturgeon, yet the majority of evidence on other aspects of pallid sturgeon biology and ecology provided in this review up until this point (genetics excluded) also has been derived from non-peer reviewed agency reports or equally non-peer reviewed personal communications. Such selective statements suggest the authors are biased against certain hypotheses of what factors are contributing to pallid sturgeon declines. Note that Quist et al. (2004) report predation as a general research hypothesis related to pallid sturgeon recovery (10.4, Pg 27). Additionally piscivory is considered a potentially important source of predation to hatchery stocked white sturgeon as Gadomski, D. M. and M. J. Parsley (2005) conclude "Our study demonstrated that predation is a likely cause of mortality of age-0 white sturgeon and may be contributing to the year-class failures that have been observed. In addition, the results from this study could be used to reduce the predation risk of artificially propagated white sturgeon released to augment declining populations since fish could be reared to sizes where their vulnerability is low." Finally, Pflieger and Grace (1987) considered increased predation by non-native fishes coupled with increased water clarity as a result of impoundment to be a potentially significant factor affecting populations of native Missouri River fishes.

The Braaten and Fuller progress reports (also not non-peer reviewed) are cited as evidence that piscivory is not an important factor in sturgeon mortality. Their study examined food habits for only two months per year and did not evaluate post-stocking diets of potential piscivores downstream for pallid sturgeon stocking sites.

Clearly evidence for the importance of piscivory as a factor contributing to pallid sturgeon mortality is equivocal and deserves further study to support or refute the hypothesis, discounting it with anecdotal evidence will not make it go away.

Credibility of this report requires objectivity in reporting all *viable hypotheses. The* peer-reviewed *literature indicates predation is clearly a potential factor that could be affecting mortality of pallid sturgeon and particularly hatchery reared and stocked juveniles. As such, it deserves equal consideration with other the poorly documented hypotheses for population declines treated in this review.*

Pg 46. Population size section and specifically line 1742*. "Pallid sturgeon population size in the Missouri River is well documented." This statement and much of what is in this section is unsubstantiated. The only information reporting population size in this report that this reader remembers seeing is that of Gardner for the upper Missouri River as a personal communication.*

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See previous comments on the review's misuse of the term population size *for catch or number sampled. Statements regarding changes in numbers of fish collected in various RPMAs cannot be used to make conclusions about population size unless they are adjusted by effort expended or used as input to quantitative population estimates (e.g., mark-and-recapture studies).*

Pg 49, 1849. I recommend revising, "Develop objective and measurable recovery criteria" to add … *and a science-based, independently reviewed program that evaluates implementation of recovery criteria and develops periodic report cards of recovery success.* Objective and measurable recovery will not be successful unless accompanied by research and monitoring that is directly tied to evaluating recovery criteria and programs are made accountable to provide quantitative products that address the measurable criteria. See Barko et al (2006) for examples of an adaptive management science process being implemented in the Upper Mississippi River and Weimer et al. (2006) for guidelines to develop protocols and information products for the application of adaptive management within DOI. Both sources can aid in developing objective and measurable recovery criteria and in their effective implementation, evaluation, and revision based on new information.

Pg 49, 1849. I very much agree with this recommendation and urge the FWS and COE to examine the Tear et al. (2005) paper: Setting measurable objectives in conservation, and follows its recommendations.

Pg 49, 1861-1879. Data needed for next 5-year review. Given the exponential increase in research and monitoring on *Scaphirhynchus* sturgeons as a result of the BiOp RPAs it will be a formidable task to thoroughly evaluate pertinent information for the next 5-year review. I strongly urge you to encourage the various research, monitoring, and evaluation programs (RM&E) to perform their own rigorous 5-year analyses related to the specific objectives of each program. Moreover, I encourage the FWS to provide each of the programs with specific questions they need answers to that will facilitate these programs providing products to the COE and FWS that are meaningful for decision making. Perhaps this will make your difficult task 5 years from now somewhat less challenging?

Improving use of science in pallid sturgeon conservation. River biologists and scientists are considered to be experts in their fields and are being asked to provide decision makers with reliable advice. The extent to which their advice is reliable depends on following principles of good science. Efforts to conserve the endangered Florida panther were severely compromised due to implementation of unreliable inferences. I recommend reviewing the Conroy et al. (2006) paper where they provide guidelines that should be equally applicable to developing reliable science for pallid sturgeon recovery.

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D. Response to Peer Review

RESPONSE TO REVIEWER COMMENTS (Dr. R.G. Bramblett):

Pg. 3 and 4 While data are available that indicate population structuring range-wide, listing Distinct Population Segments (DPSs) must comply with the 1996 DPS plicy. Inherent in that policy is the criteria of discreteness and significance. Genetic data suggest an isolation by distance model indicating some historical level of gene flow among adjacent groups. This brings up the question of both discreteness and significance. At this time, the species is afforded full protection of the ESA and applicable regulations and laws. Listing DPSs at this time will not improve or increase protection. However, given the current data, it may be warranted to pursue DPS listing in the Upper Basin if data support a change in status (down listing or delisting) in other portions of the species' range.

As written on both page 8 and 9, the population trend at the time of listing was believed to be declining thus the statement that the wild population trend is relatively unchanged from the time of listing appears accurate. However, these sentences were reworded for clarity.

The identification of successful supplementation is somewhat open to debate and depends on one's definition of success. Because of the life history of pallid sturgeon and short duration that supplementation efforts have occurred, it is not yet possible to evaluate the long-term success of supplementation efforts, that is there are not sufficient data to adequately evaluate growth and survival. The language was modified to strike the word successfully. However, the catch data does indicate that stocked fish are surviving and as new data become available, better assessment of growth, survival, and ability to reach sexual maturity will be evaluated

Pg 11-12 Additional data from Shuman *et al* (2005) has been added. Extirpated was added to sentence.

Pg 13-14 Concerns were added to the data needs section of the 5-year review

Pg 15-18 Additional data has been added regarding capture of stocked fish.

The 1992 year class of hatchery reared pallid sturgeon released from Blind Pony in 1994 should be recruiting to adulthood, so yes, the 700-950 mm pallid sturgeon in Figure 10 are the only current known hatchery released fish that are of a size consistent with adults. Incidentally, in 2006 siblings of those fish (1992 year class from blind Pony) held at Gavins Point NFH were documented to have spermiated as part of propagation efforts this year.

The use of palid sturgeon to shovelnose sturgeon ratios is common in the literature. However, simply reporting the ratios without supplemental data does little to support what these ratios mean. These ratios can be misleading, and as presented are not good indicators of population status or trend. To avoid confusion, this section has been removed.

Pg 21-24 See comments above regarding DPS listing.

Pg 25 Comments incorporated into body of text

Pg 26 Comments incorporated into body of text

Pg 30-31 See comments above regarding DPS listing

Pg 32 Language has been added to highlight this issue

Pg 41 Reworded for clarity.

008201

Pg 46 Language added to help address this concern.

Pg 47 Colombo *et al (In Press)* have age data indicating that pallid sturgeon sampled from the MMR were 15 years and younger. Reference has been added.

RESPONSE TO REVIEWER COMMENTS (Gene. Zuerlein):

Editorial comments were incorporated.

1. National Pallid Sturgeon Database has been cited as USFWS 2006b and added to literature cited section. Hofpar (1997) and Reade (2000) references have replaced G. Mestl pers. comm. Language added to highlight the importance of lower Platte River as well a Snook (2002) and Swingle (2003) references. Language discussing cooperative agreements among states to protect habitat in the Platte has been incorporated into section II.C.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms) - III.C.2.a. Present or threatened destruction, modification or curtailment of its habitat or range.
2. The descriptive nature of habitat loss appears sufficient for the purpose intended. Details of documented habitat loss can be found in the Biological Opinions and thus only a general overview is provided in this document.
3. Language added relative to importance of prey species.
4. No response/changes identified.
5. No response/changes identified.
6. No response/changes identified.

RESPONSE TO REVIEWER COMMENTS (Dr. Vince Travnichek):

Editorial suggestions were incorporated.

RESPONSE TO REVIEWER COMMENTS (Dr. Jim Garvey):

General Thoughts

1. Language was added to indicate that work is being implemented to evaluate the entrainment concerns and dredge operations.
2. Implementation of appropriate supplementation activities is described in the Pallid sturgeon range-wide stocking and augmentation plan (US Fish and Wildlife Service 2006a). This plan is updated regularly to insure appropriate data are incorporated into implementing the most risk averse approaches.
3. The current data representing genetics and morphology are presented in this document. What is described here by the reviewer has been addressed in the data needed for next 5-year review section.
4. While the main-stem Missouri river dams will likely always have an effect, there are efforts underway to improve drift distance to improve early life survival. At this time, supplementation is considered a short term effort to prevent local extirpation until adequate habitat improvement measures have been implemented to restore self-sustaining populations.

008202

Specific Comments

1. Dam locations have been incorporated into Figure 1.

2. This appears to be more of a general comment from the reviewer. Language has been added to indicate the decline of wild fish in the Missouri RPMA discussions.

3. This appears to be more of a general comment from the reviewer. The 5-year review and associated bibliography should help address the reviewer's comments. However, a graph of cumulative publications through time seems outside the scope of the 5-year review process.

4. Identification of the demarcations of the upper RPMA's being based on physical features becomes more evident with the addition of dam locations in Figure 1.

5. The reference to collection of pallid sturgeon in the Kaskaskia River has been modified to more accurately reflect that pallids are collected near this river, and not implying in the river.

6. RPA implementation of the Mississippi River Opinion (USFWS 2000b) is discussed within the document. This likely will be important data for the next 5-year review.

7. Columbo *et al.* (In Press) references has been incorporated, where appropriate.

8. Because Illinois has not implemented regulations to protect *Scaphirhynchus* (at the time of drafting) it has not been identified. If changes are implemented they will be incorporated into the next 5-year review.

9. Overexploitation associated with similarity of appearance has been documented and discussed in this document. It is outside the scope of this document to suggest closing seasons. That recommendation should be considered and reviewed by the basin workgroups and Pallid Sturgeon Recovery team.

10. While this is important, the Recovery Team and Basin Workgroups are the appropriate venue to insure coordination.

11. Added to data needed for next 5-year review section.

12. Supplementation practices are described in the Pallid sturgeon range-wide stocking and augmentation plan (USFWS 2006a). Updates of this document appear to be a more appropriate venue to address this comment.

RESPONSE TO REVIEWER COMMENTS (Dr. William T. Slack):

Editorial comments provided on hard copy were incorporated.

Response to Bullet Items

Bullet 1 Labels have been removed from the top of figures.

Bullet 2 Document was edit to improve consistency on term and citation formats.

Bullet 3 Language was added to clarify Wild, Hatchery, and Unknown designations.

Bullet 4 Reworded for clarity.

Bullet 5 Language added to incorporate potential for gear selectivity/bias

Bullet 6 Figure description modified to highlight the reporting by Federal fiscal year.

Bullet 7 The term intercross is used synonymously with hybrid or intermediate. Intercross is defined in the context of the USFWS and NMFS policy on controlled propagation (Harrelson and Nammack 2000) as "Any instance of interbreeding or genetic exchange between individuals of different species, subspecies, or distinct population segments of a vertebrate species."

Bullet 8 Seems to be more of general comment. It does appear to reflect what is reported in Dugo et al. However, we currently are not fortunate enough to have adequate movement data nor adequate analysis or identification of regionally isolated alleles to fully comprehend fine scale genetic relationships within the pallid sturgeon population.

Bullet 9 Correct, historical data are lacking. However, Bramblett (1996) documented the following: pallid sturgeon prefer the Yellowstone River over the Missouri River below Fort Peck, many fish move into the lower Yellowstone River during spawning season, ripe fish occur in the Yellowstone River, and aggregations of fish during spawning season strongly suggest that pallid sturgeon spawning occurs in the lower 10-15 RKM of the Yellowstone River. *In 2003*, Swingle (2003) collected two presumed wild pallid sturgeon in the lower Platte River and subsequently followed their movement via telemetry. One of these was a gravid female collected early May 2001 that subsequently moved into the Missouri River on June 9, 2001, suggesting the lower Platte River may be an important tributary for spawning. Work by these authors suggest that these two tributaries are currently important and thus likely were historically. However, this section was modified and the word important was replaced with "were also utilized."

Bullet 10 Gerrity (2005) did not determine why juvenile pallid sturgeon utilized the lower reaches of RPMA 1 when compared with immature shovelnose sturgeon and thus it is not reported. Language was added that may help clarify how or why selection for downstream reaches, by pallid sturgeon, could influence survival. Manly this has been attributed to conversion of lotic habitats to more lentic environments when the reservoir is at higher pool levels.

Bullet 11 Introductory paragraph has been revised.

Bullet 12 Tom Keevin was the source of the number of the side channels. The asterisk is there to identify where the low water reference plane definition came from. Many readers may not be familiar with the LWRP yet it seemed cumbersome to include the Baker reference with in the sentence.

Bullet 13 This seems to be more of a question than a comment. Early in the development of the recovery plan, a cautious approach was applied regarding using range of shovelnose to describe range of pallid sturgeon. For example, there is a historical population of shovelnose sturgeon in the Bighorn River as far upstream as Wyoming. This has led some folks to consider that the Bighorn River could have been historically important for pallid sturgeon. However, this is mostly speculatory and thus does not appear in literature.

008204

Bullet 14 Data presented on page 26 and summarized on page 29 is calculated for velocities of 0.35 and0.55 m/s. I am not aware of average velocities on the Mississippi River so you may very well be right. Reference to late season larval and post-larval river sturgeon in the Mississippi River, possibly coming from the Missouri River, has been removed from section ***II.C.1.f. Other:*** where it was speculated.

Bullet 15 There are little historical data pertaining to this species to determine if it is a new colonization event or re-colonization of previously occupied habitat. However, establishment of a species believed to utilize habitats similar to pallid sturgeon as well as documented forage for pallid sturgeon suggests there likely is some potential benefit.

Bullet 16 Bank stabilization is used loosely to define those activities intended to fix a stream banks current location. Armoring with rip-rap or other materials, sheet pile walls, etc., is what is intended.

Bullet 17 The modification of flows from Gavins Point Dam to stimulate a biological response from fishes as well as potentially create new habitat is an RPA and that is what is identified in the Biological Opinion. Some minor verbiage change to promote clarity.

Bullet 18 These activities are described in the Biological Opinion.

Bullet 19 Cook reference was added.

Bullet 20 Section restructured to improve clarity and reduce redundancies.

Bullet 21 More description added to section describing Phase I and Phase II rules.

Bullet 22 No changes suggested.

Bullet 23 Significantly has been changed to substantially and structural corrections were made.

Bullet 24 Changes made to address.

Bullet 25 The current stocking and augmentation plan does not provide for supplementation within RPMA 5 or 6. Available data support a need to supplement within RPMA 4. Revisions to the stocking and augmentation plan have been made by the Pallid Sturgeon Recovery Team to better insure appropriate genetic supplementation through this program.

Bullet 26 Identification of spawning habitat added to future actions.

Bullet 27 This comment, while quite valid, is outside the scope of the 5-year review.

RESPONSE TO REVIEWER COMMENTS (Dr. D. L. Galat):

Comment 1: Species status is listed as “stable” on pg 2 I.C.2.

This designation of “stable” was not the result of this review. Instruction to authors, (not provided to peer reviewers) requests the status (increasing, decreasing, stable, presumed extinct, only in captivity, unknown) as indicated in most recent biennial Recovery Report to Congress or annual data call (note the date of this Report or data call). This determination of “stable” is on a year to year basis and by definition in this process, Stable means: “*Species for which the information available indicates that the species status neither improved nor declined over the last year (i.e., population numbers remained constant, and threats did not affect species status during reporting period).*”

During this initial development, the status was listed as "stable." This report factors the entire range of the species and not just the Missouri River. What also is not indicated in that section of this review is that the annual data call for 2006 indicates a declining long term trend, stating "*Again sufficient habitat improvements have not been made to ensure self sustaining populations. Continued stocking by hatcheries, while necessary, is maintaining an artificially robust population.*" Finally, final formatting changes for the 5-year review have removed this reference to species status.

1) Language was added to help clarify relevant policies.

2) There are few if any data available to determine if recruitment is balancing mortality. Thus this review relies on length frequency data and is assuming length to be indicative of age.

3) Language has been added, where appropriate, to discuss sampling effort bias, effectiveness of gears used on smaller size-classed sturgeon, and the apparent lack of recruitment success in the Missouri River.

4) Because of the potential for misinterpretation and lack of clarification, references to ratios of pallid to shovelnose sturgeon have been omitted in the final version.

5) Language was added for clarity to more accurately reflect and differentiate between the status in the Missouri, Mississippi, and Atchafalaya Rivers.

What is a population?

Much of the criticisms described are justifiable. Currently there do not appear to be data available for PVA type work. Also, there are currently little, if any, references to relative abundance. There are only a few instances where crude population estimates are provided (RPMA 1 and 2). Increased catch with increasing effort is to be expected and on occasions where those data are provided (RPMA 5 and 6), the determination of status remains "unknown."

Conservation Measures (Pgs 32-37)

Much of the conservation measured described herein have not had adequate time and/or data collected to be documented. Expected benefits should be detailed in the respective biological opinions and that process. Likely a more appropriate vehicle to describe measurable objectives for pallid sturgeon recovery is the Pallid Sturgeon Recovery Plan. This review recommends the measurable and objective criteria be developed and incorporated into an updated plan.

Quality Of Evidence Used To Evaluate Pallid Sturgeon Status

At present there is not an adequate mechanism to require agency funded biologists to publish in peer-reviewed outlets and thus much of the data are contained in agency reports or other "gray literature" or is contained in the collective knowledge and experience of individual biologists/researchers. Personal communications were minimized and only utilized where absolutely necessary. The ESA requires use of "…the best scientific or commercial data available." The best available scientific data for rare, poorly known species are often not peer-reviewed. There is an abundance of good data specific to individual projects that are not necessarily worthy of stand alone publication, or not ready to be published. If the information is relevant, and the source is credible, then the Service is required by the ESA to consider the information. This 5-year review considered available relevant data in assessing the appropriateness of the current classification of the species. It is outside the realm of this document to develop guidelines for pallid sturgeon science.

008206

References

Every effort was made to obtain electronic copies of referenced materials for the peer reviewers. The pallid sturgeon recovery coordinator hopes to provide electronic copies of referenced material (available for download) for those interested. This will be dependant on workload and may occur until after this review is complete.

Pg 8, 292-295

The statement in question is discussing the trend in the population and not discussing the actual population demographics. For this RPMA, there was a declining trend at the time of listing and no new data are available to suggest this declining trend has changed. Language added for clarity.

Pg 8, 298-300

It is agreed that a more formal analysis of population estimates for all RPMAs is necessary. However, confidence intervals for the data in question were not available.

Pg 13, 420-428

This section identifies the larval pallid sturgeon, identified by Dr. Snyder, and subsequent sentences merely indicate the presence of larval *Scaphirhynchus* suggesting some of those could have been pallid sturgeon and noting it is difficult to accurately identify these smaller fish.

Pg 18, 552-554

Because of these concerns and the potential for misinterpretation, the pallid sturgeon to shovelnose sturgeon ratio references have been removed from the final version of the report.

Pg 24, 800-802

This section is referring specifically Middle Mississippi River and by association the Chain-of Rocks.

Pg 24, 835-837

Change made to indicate those were hatchery-reared juveniles monitored by Gerrity.

Pg 20, 1035-1042

Changes made.

Pg 33, 1174-1176

The paper by Jordan *et al.* 2006 concludes that RPMA 3 is suitable for recovery efforts (see last line of abstract). This is not to be confused with actual recovery of the species which this paper makes no conclusions about. It basically closes with the following statement: *"However, whether conditions are present to enable a self-sustaining population, the ultimate determinate of recovery success, remains unknown."* No revision to text is warranted.

Pg 34, 1206-1208

Changes made.

Pg 34, 1223-1226

Suggested changes incorporated.

008207

Pg 35-36, Mississippi River (RPMA 5)

Language added to improve clarity.

Pg 40, 1479-1480

Language was added to address this concern.

Pg 46, Population size section and specifically line 1742.

Section wording changed to address this concern.

Pg 49, 1849

Noted and changed.

Pg 49, 1849

Seemed to be more of a general statement. Comments noted.

Pg 49, 1861-1879

Seemed to be more of a general statement. Comments noted.

Improving use of science in pallid sturgeon conservation.

Seemed to be more of a general statement. Comment noted.

APPENDIX B
Final Meeting Summary
Of August 24, 2006, Pallid Sturgeon Genetics Conference Call

Genetics Advisory Group/Pallid Sturgeon Recovery Team
Conference Call Summary

Participants

George Jordan*
Heather McSharry
Seth Willey
Bobby Reed*
Jan Dean*
Mike Ruggles
Doug Latka*
Robin Waples**
Kim Scribner**
Ed Heist**
Aaron Schrey
Bill Ardren**
Steve Krentz*
Bill Gardner*
Tracy Hill*
Dave Herzog*
Rob Wood**
Bernie Kuhajda*
Paul Hartfield
Gerald Mestl*
Jane Ledwin
Aaron Delonay*
Tim King**

* Pallid Sturgeon Recovery Team member
** Genetics Advisory Group Member

The purpose of the call was to revisit available genetic data to discuss adequacy and relevance to the pallid sturgeon 5-year review as well as what those data mean regarding management/recovery efforts.

The call was initiated at 0908 and concluded at 1245 MDT August 24, 2006. These minutes were finalized and released on September 7, 2006.

Following introductions, Dr. Ed Heist and his research assistant Aaron Schrey presented their research results. The data presented were microsatellite analysis of 16 loci for 539 tissue samples from *Scaphirhynchus* (approximately 60 from the upper Missouri River, approximately 60 from the middle Missouri River, close to 100 from the lower Missouri River, 150 from the middle Mississippi River, and 100 from the Atchafalaya River). The data presented indicate reproductive isolation among most sample areas. Significant F_{st} values were identified in all comparisons except the Lower Missouri River Samples when compared against the middle Mississippi and Atchafalaya River samples (Figure 1).

008209

	Upper Missouri	Middle Missouri	Lower Missouri	Middle Mississippi	Atchafalaya
Upper Missouri	------	**0.033***	**0.064***	**0.065***	**0.079***
Middle Missouri		------	**0.022***	**0.037***	**0.050***
Lower Missouri			------	**0.001**	**0.014**
Middle Mississippi				------	**0.029***
Atchafalaya					------

Figure 1. Pairwise F_{ST} between Samples in Pallid Sturgeon. (* = significant at $p < 0.05$). Figure and data courtesy of Dr. Ed Heist and Aaron Schrey. Dr. Heist then presented data indicating a strong patter of genetic isolation by distance (Figure 2).

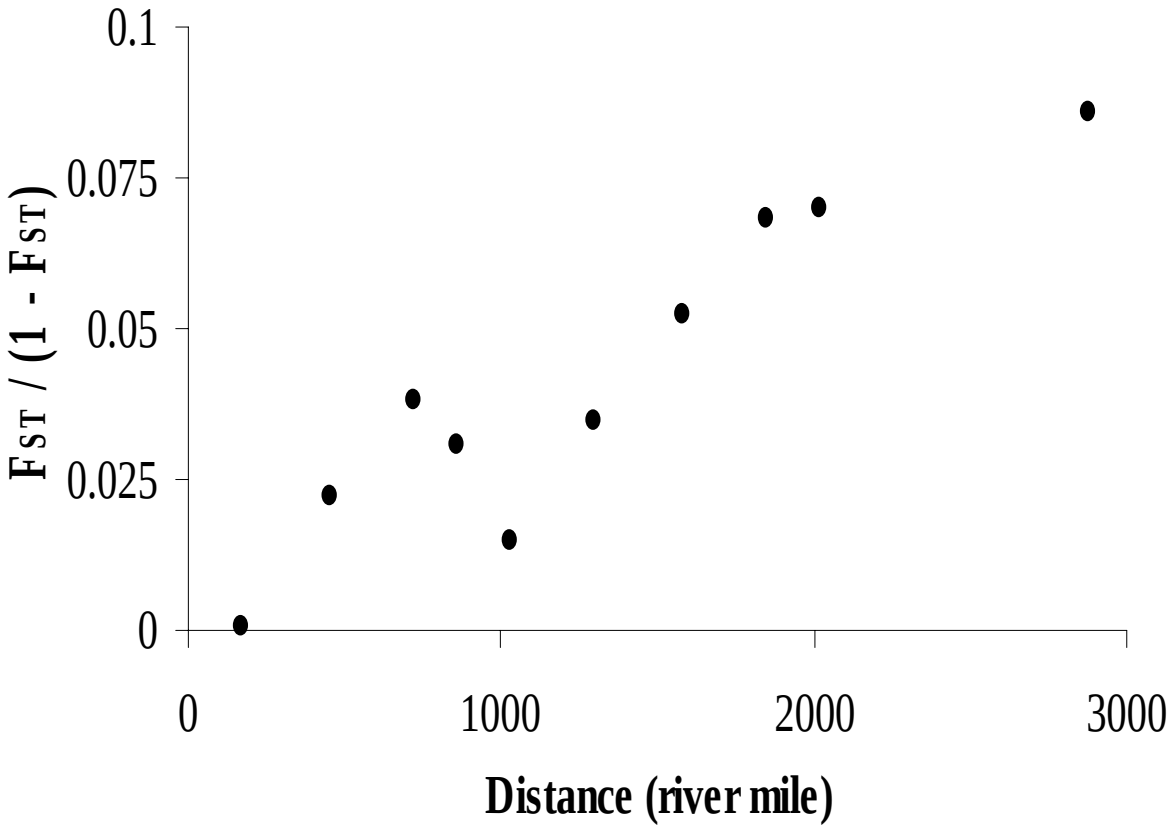

Figure 2. Graph of $F_{st}/(1-F_{st})$ over river miles to demonstrate Isolation by distance. Figure and data courtesy of Dr. Ed Heist and Aaron Schrey.

008210

Finally, genetic grouping data were presented. The results were based on output from the software package STRUCTURE. This program does not require *a priori* species identification and identifies natural groupings among samples to minimize Hardy-Weinberg deviations and linkage disequilibrium. The results presented when all Scaphirhynchus samples (pallid sturgeon, shovelnose sturgeon, and hybrids) were combined from all identified geographic areas result in two groups. However, when only putative pallid sturgeon samples were analyzed, the three genetic groups of pallid sturgeon appear across the species range. The three groupings are a well differentiated upper Missouri River Group (green) and two less differentiated lower Missouri, middle Mississippi, and Atchafalaya River group (blue and yellows) (Figure 3 and 4).

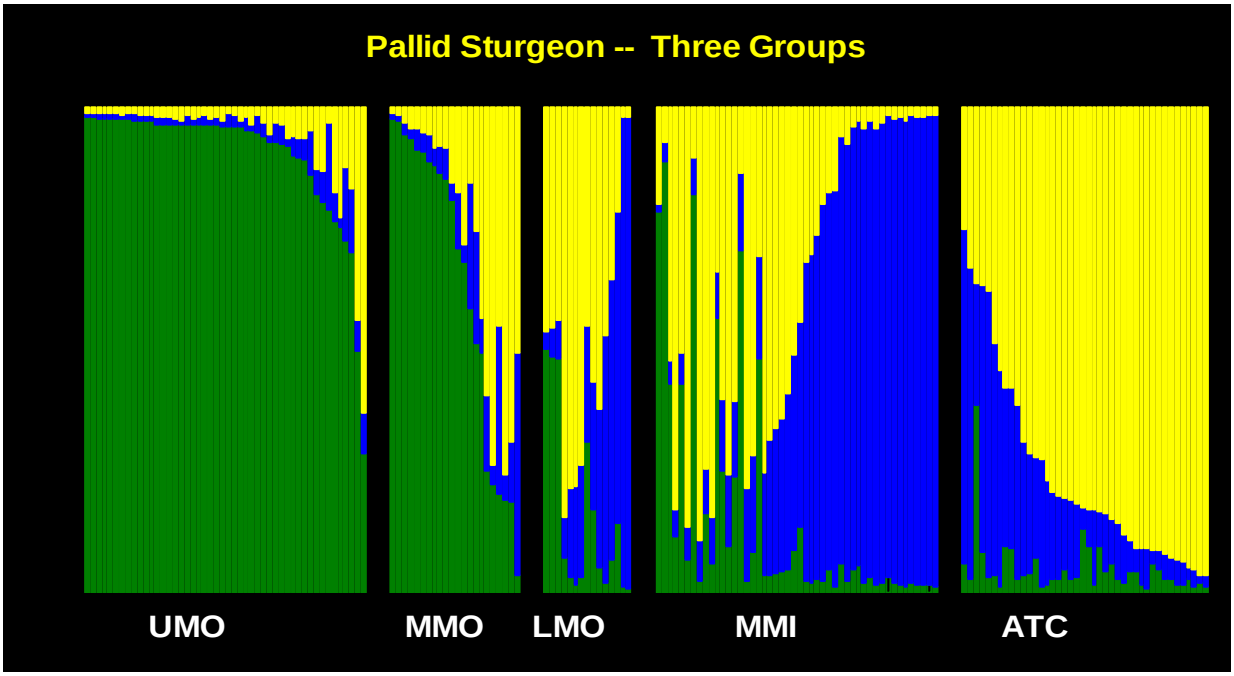

Figure 3. Genetic grouping of pallid sturgeon samples indicating one well-differentiated upper MO group (green) and two less-differentiated lower MO/Miss/ATC groups (blue and yellow). Figure and data courtesy of Dr. Ed Heist and Aaron Schrey.

008211

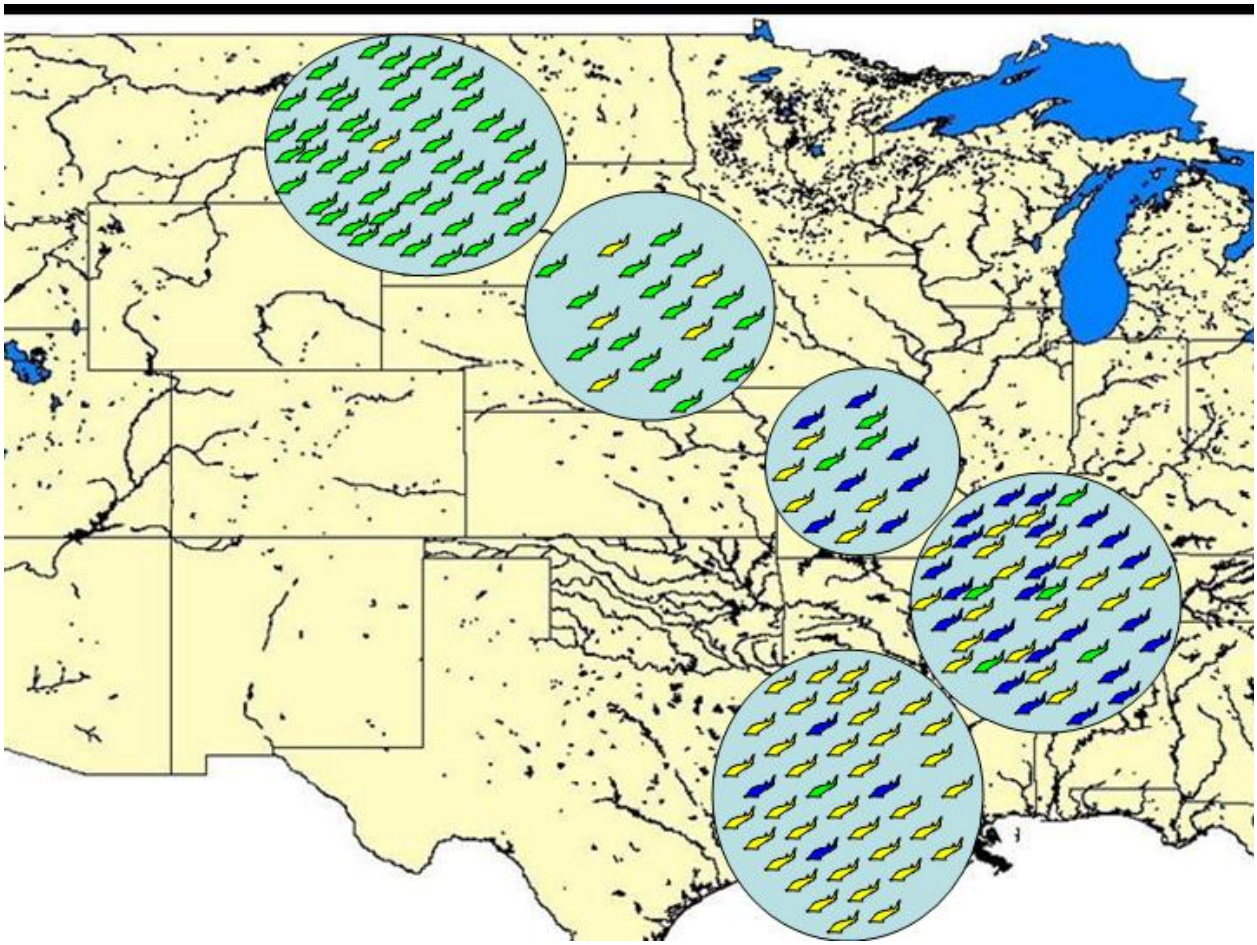

Figure 4. Genetic makeup of five geographic samples (upper Missouri, middle Missouri, lower Missouri, middle Mississippi, and Atchafalaya) of pallid sturgeon. Each fish icon represents an individual sturgeon and the color of the icon indicates which of the three apparent genetic groups to which the fish was most closely assigned. Figure and data courtesy of Dr. Ed Heist and Aaron Schrey.

The conclusions presented by Dr. Heist were:

- Pallid sturgeon exhibit significant differences in microsatellite allele frequencies among regions.
- Upper Missouri River pallid sturgeon samples are most distinct, and genetic structure among lower basin samples is less pronounced and the middle Missouri River samples appearing intermediate to upper Missouri and lower basin samples.
- Stock structure appears to exhibit an "isolation by distance effect"
- Hybridization occurs range-wide yet pallid sturgeon and shovelnose sturgeon are maintaining themselves.

008212

Following this presentation the call was opened to participants for questions and discussions. Following is a summary of the discussions:

A question about the timing of the sample collections and the effects on the data was posed. The samples were collected from pallid sturgeon in an opportunistic fashion, not specifically during spawning periods. This would result in a less detailed picture, yet despite this, there is a surprisingly clear image of isolation by distance (Figure 2).

A brief discussion of hybridization occurred. Hybrids or genetically intermediate *Scaphirhynchus* were found in the samples. Despite the presence of genetically intermediate fish, there are very good [genetically] pallid sturgeon and shovelnose, throughout the range. The data suggests that within the upper Missouri less intermediates or no evidence of "back-crossing" middle Mississippi and Atchafalaya River data suggest a higher number of genetic intermediates in those areas.

In general, there was a pretty high level of confidence in the data analyzed. However, it was noted that the identification of 3 genetic groups of pallid sturgeon should be regarded as very tentative. Robin Waples (Genetics Advisory Group member) cautioned that the software package STRUCTURE has can have difficulty accurately distinguishing among closely related gene pools.

It also was noted that there was apparent gaps in sampling locations. For example there are no lower Mississippi River data, and a large geographical separation between the middle and lower Missouri River samples. These gaps in data could be attributable to some of the differentiation being noticed and completing the samples could provide a better understanding of genetic structuring range-wide.

Following the discussion and presentation of Dr. Heist's genetic data, Dr. Kuhajda provided information on morphometric variation documented with pallid sturgeon.

Dr. Kuhajda presented photos of morphometric variation in pallid sturgeon collected at the extremes of the species range (Figures 5 and 6) as well as a sheared principal components analysis morphometric measurements collected from upper Missouri River pallid sturgeon, shovelnose sturgeon, and known hatchery-reared hybrids (MO) and lower Mississippi/Atchafalaya River pallid, shovelnose, and intermediate sturgeons (Figure 7).

008213

Figure 5. Adult pallid sturgeon, representing a northern specimen from upper Missouri River (top) and southern specimen from the Lower Mississippi/Atchafalaya River (bottom). Both specimens represent some of the largest specimens from each region. Photo courtesy of Dr. Kuhajda.

Figure 6. Adult pallid sturgeon, including northern specimen from upper Missouri River (right) and southern specimen from the Lower Mississippi/Atchafalaya River (left). Both specimens represent some of the largest specimens from each region. Photo courtesy of Dr. Kuhajda.

008214

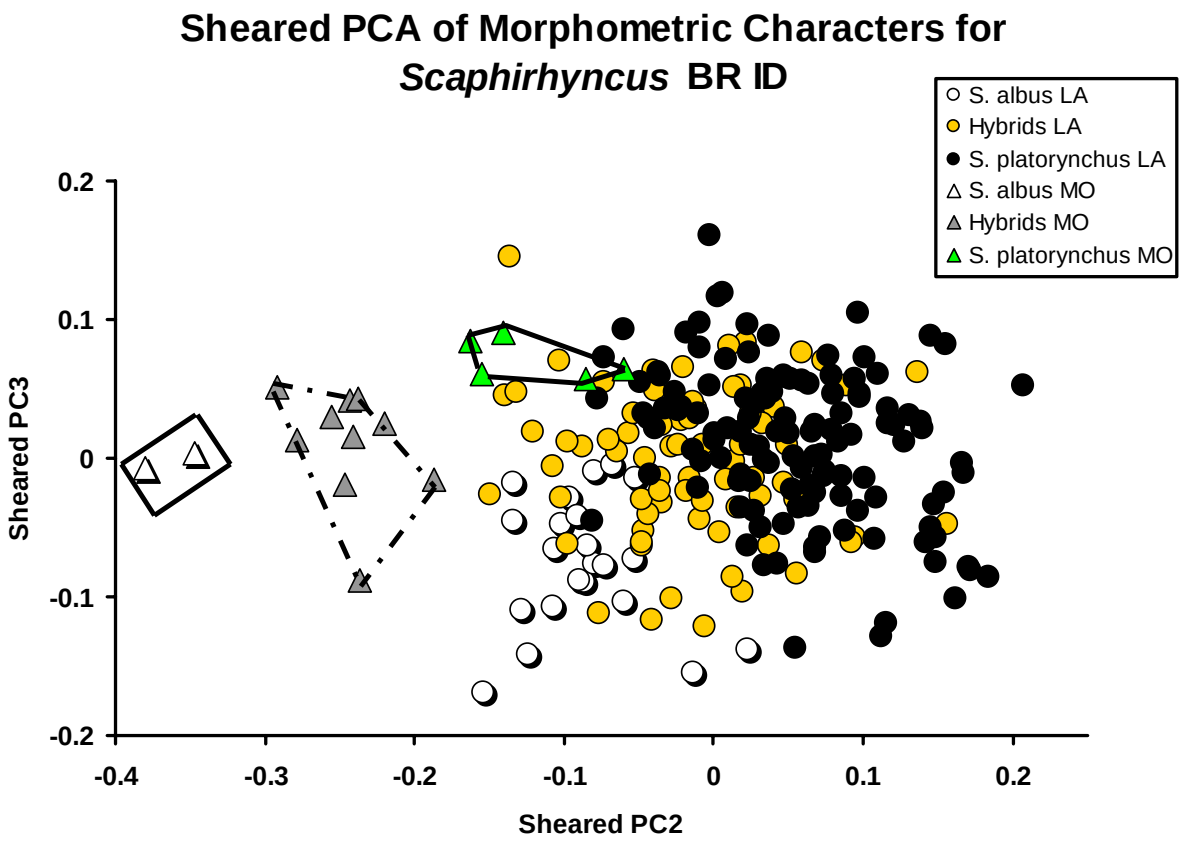

Figure 7. Sheared principal components analysis of 19 head measurements of upper Missouri River pallid sturgeon, shovelnose sturgeon, and known hatchery-reared hybrids (MO) and lower Mississippi/Atchafalaya River pallid, shovelnose, and intermediate sturgeons (LA). Each "dot" represents measurements on an individual fish. Data courtesy of Dr. Kuhajda.

There was some discussion about the photos and data presented. It was postulated that the larger fish were potentially twice as old as smaller fish. The upper basin pallid sturgeon was likely 40+ years old and current data suggest that middle Mississippi pallid sturgeon generally reach ages up to 15 years and lower Mississippi pallid sturgeon generally reach ages up to 20-25 years. Others suggested the size differences could be attributed to a shorter growing season in north latitudes. However, it was indicated that work done by Conover (1990) and others [Power and McKinley 1997] suggests that for some species the opposite is true. In lower latitudes the water temperature heats up faster and may exceed optimum growth temperatures faster than in more northern latitudes, effectively producing a shorter optimum growing season in the south. Dr. Kuhajda explained that the Principal Component Analysis removes overall body size from the equation and is not likely a factor affecting the results identifies in Figure 6.

A reference to a publication (Ruban and Sokolov 1986) also was mentioned that identified morphometric and meristic variation in Siberian Sturgeon, *Acipenser baeri*, some of which were attributed to differing (warmer) temperatures during early developmental periods and demonstrate a high plasticity in the species. Tracy Hill and Dave Herzog indicated that they

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collected pallid sturgeon in the lower Missouri and middle Mississippi river with varying rostral shapes with some looking very similar to the upper basin specimen (Figures 5 and 6); suggesting some phenotypic plasticity in the species.

Following the data presentations, the general discussion moved towards the data and what does it mean for recovery actions and the existing stocking plan?

Concerns were apparent about the designatable units identified with in the current stocking and augmentation plan. The circles on the map [page 15 of the plan] appear arbitrary. The circles were adapted from Dr. Heist's data coupled with stocked juvenile pallid sturgeon collection data. May not be the best approach.

A point was made that genetics alone should not be the only data utilized to define stock structure or recoverable units. Genetic data coupled with biogeographic data and other unique traits is a more sound approach. Utilizing the data provided by Dr. Heist and biogeographical information could more accurately help define recovery areas or recovery units. For example, it was suggested that physiographic provinces may be better lines to delineate brood collection areas and stocking boundaries. One possible dividing line could be drawn between the central lowlands and great plains physiographic provinces. This fall line pretty close aligns with the data separating the green group from the yellow and blue groups in Figure 4 above. It was suggested the Platte River might be an appropriate landmark between these provinces.

Summary

- There are data supporting reproductive isolation among pallid sturgeon groups.
- There appear to be three groups of pallid sturgeon, a well differentiated group in the upper Missouri (RPMA 1, 2, and the upper reaches of RPMA 4) and two poorly differentiated groups in the lower Missouri, Mississippi, and Atchafalaya based on the current level of data.
- Genetic structure of pallid sturgeon appears to follow an isolation by distance model.
- Genetic data alone are not sufficient for delineation of population management units. Need to consider biogeography and other traits.
- Current model in stocking plan may not best fit conservation of genetic structure as it pertains to supplementation efforts for recovery.

Recommendations

- Collect genetic samples to fill in geographic sampling voids
- May want to consider recoverable units as they relate to recovery activities.
- Revisit stocking and augmentation plan to re-evaluate current supplementation practices.

Conover, D.O. 1990. The relation for capacity for growth and length of growing season: Evidence for and implications of countergradient variation. Transactions of the American Fisheries Society 119:416-430.

008216

Power, M., and R.S. McKinley. 1997. Latitudinal variation in lake sturgeon size as related to the thermal opportunity for growth. Transactions of the American Fisheries Society 126:549-558.

Ruban, G.I., and L.I. Sokolov. 1986. Morphological variability of Siberian Sturgeon, *Acipenser baeri*, in the Lena River in relation with its culture in warm waters. UDC 639.3:597,442:591.49. Originally published in Voprosy Ikhtiologii. 3:470-475.

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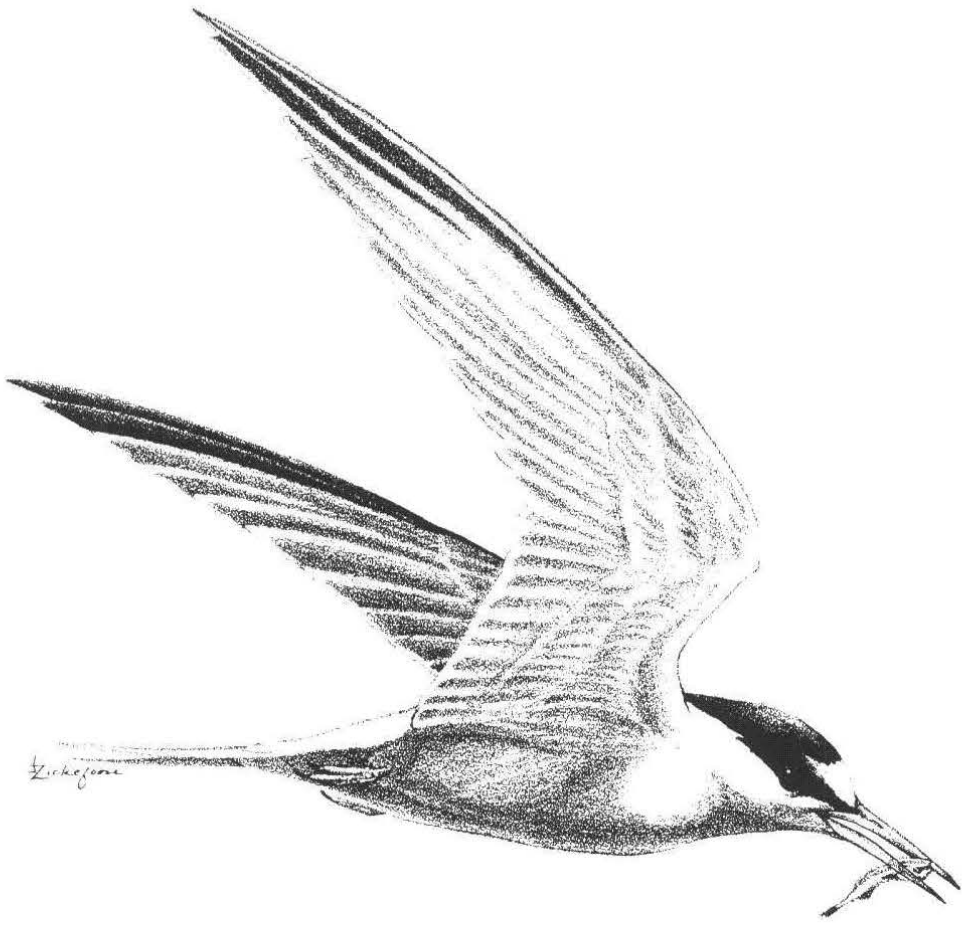
Interior Population of the Least Tern

Sterna Antillarum

Recovery Plan



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DEPARTMENT OF THE INTERIOR • U.S. FISH AND WILDLIFE SERVICE

RECOVERY PLAN FOR THE INTERIOR POPULATION OF THE

LEAST TERN (*Sterna antillarum*)

September 1990

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Regional Director Date

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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR THE LEAST TERN

CURRENT STATUS: The interior population of the least tern (Sterna antillarum), a breeding migratory bird in mid-America, was listed as endangered on June 27, 1985 (50 Federal Register 21,784-21,792). Census data currently indicate about 5,000 interior least terns.

Habitat Requirements and Limiting Factors: Interior least terns breed in the Mississippi and Rio Grande River Basins from Montana to Texas and from eastern New Mexico and Colorado to Indiana and Louisiana. From late April to August they occur primarily on barren to sparsely vegetated riverine sandbars, dike field sandbar islands, sand and gravel pits, and lake and reservoir shorelines. Threats to the survival of the species include the actual and functional loss of riverine sandbar habitat. Channelization and impoundment of rivers have directly eliminated nesting habitat. This recovery plan outlines recovery strategies to increase the interior population of the least tern to approximately 7,000 birds throughout its range.

Recovery Objective: Delisting

Recovery Criteria: Assure the protection of essential habitat by removal of current threats and habitat enhancement, establish agreed upon management plans, and attain a population of 7,000 birds at the levels listed below.

1. Adult birds in the Missouri River system will increase to 2,100 and remain stable for 10 years.
2. Current numbers of adult birds (2,200-2,500) on the Lower Mississippi River will remain stable for 10 years.
3. Adult birds in the Arkansas River system will increase to 1,600 and remain stable for 10 years.
4. Adult birds in the Red River system will increase to 300 and remain stable for 10 years.
5. Current number of adult birds in the Rio Grande River system (500) will remain stable for 10 years.

Actions Needed:

1. Determine population trends and habitat requirements.
2. Protect, enhance and increase populations during breeding.
3. Manage reservoir and river water levels to the benefit of the species.
4. Develop public awareness and implement educational programs about the interior least tern.
5. Implement law enforcement actions at nesting areas in conflict with high public use.

Cost of Recovery: Estimated to be $1,720,000 - $2,000,000, to reach recovery criteria set out above, and complete subsequent monitoring for 10 years.

Date of Recovery: Delisting should be initiated in 2005, if recovery criteria have been met.

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DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U. S. Fish and Wildlife Service **only** after they have been signed by the Regional Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature Citation should read as follows:

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Additional copies may be purchased from:

U. S. Fish and Wildlife Service Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
301/492-6403 or 1-800-582-3421

The fee for the plan varies depending on the number of pages of the plan.

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I. INTRODUCTION

The interior population of the least tern (Sterna antillarum) (hereafter referred to as the interior least tern) has been a species of concern for many years because of its perceived low numbers and the vast transformation of its riverine habitat. Barren sandbars, the interior least tern's most common nesting habitat, were once a common feature of the Mississippi, Missouri, Arkansas, Ohio, Red, Rio Grande, Platte, and other river systems in the central United States. Sandbars are still common at normal river stages on the Lower Mississippi River and on portions of other river systems. Sandbars generally are not stable features of the natural river landscape, but are formed or enlarged, disappear or migrate depending on the dynamic forces of the river. However, stabilization of major rivers to achieve objectives for navigation, hydropower, irrigation, and flood control has destroyed the dynamic nature of these processes (Smith and Stucky 1988). Many of the remaining sandbars are unsuitable for nesting because of vegetation encroachment or are too low and subject to frequent inundation. The number and distribution of interior least terns probably have declined accordingly.

The interior least tern was listed as an endangered species on June 27, 1985 (50 Federal Register 21,784-21,792) in the following States: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana (Mississippi River and it's tributaries north of Baton Rouge), Mississippi (Mississippi River), Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and Texas (except within 80 km of Gulf Coast). The States of Arkansas, Illinois, Indiana, Iowa, Missouri, Nebraska, Tennessee, Texas, Kansas, Kentucky, New Mexico, Oklahoma, and South Dakota list the interior least tern as endangered under State laws. Although not legislatively designated as endangered in North Dakota, the interior least tern is regarded as endangered by the North Dakota Game and Fish Department and conservation organizations within the State.

Section 4 of the Endangered Species Act directs the Secretary of the Interior to develop and implement recovery plans for the conservation and survival of endangered and threatened species listed pursuant to Section 4 unless he finds that such a plan will not promote the conservation of the species. The Secretary, in developing and implementing recovery plans (1) shall, to the maximum extent practicable, give priority to those endangered species or threatened species most likely to benefit from such plans, particularly those species that are, or may be, in conflict with construction or other developmental projects or other forms of economic activity. The interior least tern occurs along rivers which are heavily regulated by numerous dam and irrigation projects.

The goal of this recovery plan is to describe actions for the conservation and survival of the interior least tern and to return the species to non-endangered status throughout its range. This plan summarizes available biological data, details various actions to stabilize and/or restore the interior least tern, and establishes criteria to remove it from the federal list of endangered species.

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Description

Least terns (all currently recognized subspecies and populations) are the smallest members of the subfamily Sterninae and family Laridae of the order Charadriiformes, measuring about 21-24 cm long with a 51 cm wingspread. Sexes are alike, characterized by a black-capped crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, legs of various orange and yellow colors depending on the sex, and a black-tipped bill whose color also varies depending on sex (Watson 1966, Davis 1968, Boyd and Thompson 1985). Boyd and Thompson (1985) developed the following criteria to distinguish the sexes in the field based upon their work in Kansas:

1) Females usually have a wing chord less than 171 mm long while males usually have a wing chord greater than 174 mm.
2) A male's feet are brighter than its mate's feet; the male's are bright orange, while the female's feet are bright to pale yellow, or rarely grey.
3) A male's bill is larger than the female's; the female's bill depth at its widest point is 4.5 mm to 5.5 mm, while the male's is 6.0 mm or greater.
4) A male's bill is orange to bright yellow, whereas the female's bill is light or dull yellow, or straw-colored.

Immature birds have darker plumage than adults, a dark bill, and dark eye stripes on their white foreheads. Jackson (1976) described the developmental stages of least tern chicks. Further details on plumage development and variation were presented by Massey and Atwood (1978) and Thompson and Slack (1983).

Taxonomy

The least tern (Sterna antillarum) in North America was described by Lesson in 1847 (Ridgway 1895, American Ornithologists' Union 1957, 1983). The least tern in interior North America was described later as a race (Sterna albifrons athalassos) of the Old World little tern (Sterna albifrons) (Burleigh and Lowery 1942). Two other described New World races were the eastern or coastal least tern (Sterna albifrons antillarum), and the California least tern (Sterna albifrons browni). The coastal least tern breeds along the Atlantic and Gulf coasts and the California least tern breeds along the California coast.

As a result of studies on vocalizations and behavior of this group of terns in the Old and New Worlds, the American Ornithologists' Union (1983) now treats the New World least terns as a distinct species, Sterna antillarum. Subspecies of New World least terns recognized by the American Ornithologists' Union (1957, 1983) are the interior least tern (now Sterna antillarum athalassos), the eastern or coastal least tern (now Sterna antillarum antillarum), and the California least tern (now Sterna antillarum browni).

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However, the validity of least tern subspecies has been questioned by several authors in recent years. Massey (1976) reported no consistent morphological, behavioral, or vocal differences between S. a. antillarum and S. a. browni. In Texas, where both S. a. antillarum and S. a. athalassos occur, electrophoretic analyses indicate little genetic differentiation between least terns produced on the Texas coast and Texas Panhandle rivers (McCament and Thompson 1987, McCament-Locknane 1988). Coastal least terns have populated interior breeding sites. Boyd and Thompson (1985) reported an incubating least tern at Quivira National Wildlife Refuge, Kansas, that originally had been banded as a chick on the Texas coast. The most recent morphometric and biochemical assessment of North American least terns could not distinguish subspecies (Thompson et al. In prep)

Originally, S. a. athalassos was proposed for endangered status. Because of the taxonomic uncertainty of least tern subspecies in North America, the U. S. Fish and Wildlife Service did not list the subspecies and instead designated as endangered those least terns occurring in interior North America. The California least tern has been listed as endangered since 1970 (U. S. Fish and Wildlife Service 1980).

Distribution

The interior least tern is migratory and historically bred along the Mississippi, Red and Rio Grande River systems and rivers of central Texas. The breeding range extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana. It included the Red, Missouri, Arkansas, Mississippi, Ohio and Rio Grande River systems (American Ornithologists' Union 1957, Anderson 1971, Coues 1874, Burroughs 1961, Hardy 1957, Youngworth 1930, 1931, Ducey 1981). Incidental occurrences of least terns in Michigan, Minnesota, Wisconsin, Ohio and Arizona have been reported (Campbell 1935, Janssen 1986, Jung 1935, Mayfield 1943, Monson and Phillips 1981, Phillips et al. 1964).

Current Distribution

The interior least tern continues to breed in most of the aforementioned river systems, although its distribution generally is restricted to less altered river segments (Figure 1) (Tables 1-5).

Missouri River System: The explorers, Lewis and Clark, observed the least terns along the Missouri River frequently and believed them to be "a native of this country and probably a constant resident" (Burroughs 1961). In the Dakotas, most interior least terns occur on those segments of the Missouri River and its tributaries that are not affected by impoundments or channelization. In South Dakota, the interior least tern nests primarily on flowing segments of the Missouri River and Cheyenne River (Nebraska Game and Parks Commission, Schwalbach 1988, Schwalbach et al. 1986, 1988). Breeding areas in North Dakota constitute about 192 km of the Missouri River from Garrison Dam to the mouth of the Cannonball River

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south of Bismarck (Dryer and Dryer 1985, Mayer and Dryer 1988), and about 29 km of the Yellowstone River in North Dakota from the Montana border to the river's confluence with the Missouri River (Kreil and Dryer 1987). A few interior least terns nest on islands, shorelines and sandbars along the reservoir, Lake Oahe, an impoundment on the Missouri River in North and South Dakota (Schwalbach 1988, Mayer and Dryer 1988). In Montana, breeding interior least terns recently have been recorded on the Yellowstone River, and on the Missouri River between Fort Peck Reservoir and North Dakota. A few interior least terns have been recorded on islands and shoreline within the Fort Peck Reservoir (Charles M. Russell National Wildlife Refuge). These locations are the western most nesting sites of the interior least tern.

Interior least terns breed along the lower section of the Niobrara River, Nebraska, from Keya Paha and Rock Counties to the Missouri River (Nebraska Game and Parks Commission 1985a). Current distribution probably is similar to the historic distribution because the Niobrara River has been little changed by man (Ducey 1985). On the Platte River, Nebraska, interior least terns nest on sandbars and at sand and gravel pits from the Missouri River to North Platte (Nebraska Game and Parks Commission 1987) and along the South Platte River as far west as Ogallala. On the Loup River, a tributary of the Platte River, interior least terns breed as far west as Arcadia but are most common between Saint Paul, Nebraska and the Loup's confluence with the Platte River at Columbus, Nebraska. A few interior least terns also occur along the Elkhorn River, another tributary of the Platte River.

The interior least tern no longer nests in the Missouri reaches of the Missouri River (Smith 1985, Sidle et al. 1988, Smith and Renken 1990). The hydrology of the River in Missouri has been drastically altered by channelization, and studies show that river levels are typically too high during the breeding season to expose suitable nesting habitat (Smith and Renken 1990).

Arkansas River System: Breeding interior least terns occur along the Arkansas River system in Colorado, Kansas, Oklahoma, Arkansas and Texas (Table 2). In Colorado, interior least terns nest at Adobe Creek reservoir (Blue Lake) and have been observed at Nee Noshe reservoir (Carter 1989). Both reservoirs are located on small tributaries of the Arkansas River.

In Kansas, interior least terns nest on the Cimarron River in Meade, Comanche and Clark Counties, and Quivira National Wildlife Refuge, and in the recent past at Cheyenne Bottoms Wildlife Management Area (Boyd 1983, 1986, 1987; Schulenberg and Ptacek 1984).

The interior least tern occurs on several tributaries of the Arkansas River in Oklahoma. It breeds along the Salt Fork of the Arkansas River at the Salt Plains National Wildlife Refuge (Hill 1985, Grover and Knopf 1982); Optima Reservoir at the fork of the Coldwater Creek and Beaver River in the Oklahoma Panhandle; and on the Cimarron River in Beaver,

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Harper, Woods, Woodward, Major, Blaine, Kingfisher, Logan, and Payne Counties (Boyd 1987, L. Hill personal communication).

Along the Arkansas River in Oklahoma, the interior least tern breeds in Kay, Osage, Pawnee, Creek, Tulsa, Wagoner, Muskogee, and Sequoyah Counties (Hoffman 1986, L. Hill personal communication). In Arkansas, the breeding range on the Arkansas River is above Little Rock (Smith and Shepherd 1985, Smith et al. 1987, K. Smith 1986).

Along the Canadian River, interior least terns breed in Ellis, Roger Mills, Dewey, Cleveland, McClain, Haskell, and Sequoyah Counties, Oklahoma and in Hemphill, Roberts and Hutchinson Counties, Texas (McCament and Thompson 1985, 1987; U. S. Fish and Wildlife Service, unpublished data).

Mississippi and Ohio Rivers: On the Mississippi River, interior least terns occur almost entirely in the lower valley south of Cairo, Illinois to Vicksburg, Mississippi (Sidle et al. 1988) (Table 3). Surveys by the U. S. Army Corps of Engineers (Rumancik 1985, 1986, 1987, and 1988; M. Smith 1986) and Missouri Department of Conservation (J. Smith 1985, 1986, 1987, and 1988, Smith and Renken 1990) indicate that about one-half of all interior least terns occur along 1100 km of the Lower Mississippi River.

On the Ohio River system, the interior least tern occurs just above the confluence of the Tennessee and Ohio Rivers and at one artificial site on the Wabash River in Indiana.

Red River System: Interior least terns are known to occur on the Prairie Dog Town Fork of the Red River in the eastern Texas Panhandle and along the Texas/Oklahoma boundary as far east as Burkburnett, Texas (McCament and Thompson 1985, 1987) (Table 4).

Rio Grande River System: Interior least terns occur at three reservoirs along the Rio Grande River and along the Pecos River at the Bitter Lake National Wildlife Refuge, New Mexico (McCament and Thompson 1985, 1987; Neck and Riskind 1981, Seibert 1951, Marlatt 1984, 1987) (Table 5).

Wintering Areas: The wintering area of interior least terns is unknown. However, least terns of unknown populations or subspecies are found during the winter along the Central American coast and the northern coast of South America from Venezuela to northeastern Brazil. Roger Boyd (personal communication 1986) reports that about 35 least terns have been recaptured in South America, mostly in Guyana. One interior least tern banded by Boyd, was captured in El Salvador two years later. Also, a banded California least tern was recaptured in Guatemala.

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Table 1. Known breeding areas for interior least terns along the Missouri River system in 1985-1988.

State	County	Locations
Montana	Valley	Fort Peck Reservoir, Charles M. Russell National Wildlife Refuge
	Garfield	Fort Peck Reservoir, Charles M. Russell National Wildlife Refuge
	Prairie	Yellowstone River sandbars
	McCone	Missouri River sandbars
	Richland	Missouri River sandbars
North Dakota	McLean	Missouri River sandbars
	Burleigh	Missouri River sandbars
	Oliver	Missouri River sandbars
	Morton	Missouri River sandbars
	Emmons	Lake Oahe
	Mercer	Missouri River sandbars
	Sioux	Missouri River sandbars
	McKenzie	Yellowstone River sandbars
South Dakota	Charles Mi	Missouri River sandbars
	Bon Homme	Missouri River sandbars
	Yankton	Missouri River sandbars
	Clay	Missouri River sandbars
	Union	Missouri River sandbars
	Sully	Lake Oahe
	Hughes	Lake Oahe
	Stanley	Lake Oahe
	Walworth	Lake Oahe
	Campbell	Lake Oahe
	Corson	Lake Oahe
	Potter	Lake Oahe
	Dewey	Lake Oahe
	Ziebach	Cheyenne River sandbars
	Haakon	Cheyenne River sandbars
Nebraska	Dixon	Missouri River sandbars
	Cedar	Missouri River sandbars
	Knox	Missouri River sandbars
	Howard	Loup River sandbars and sand/gravel pits
	Nance	Loup River sandbars and sand/gravel pits
	Sherman	Loup River sandbars and sand/gravel pits
	Platte	Loup River sandbars and sand/gravel pits
	Valley	Loup River sandbars and sand/gravel pits
	Douglas	Elkhorn River sandbars and sand/gravel pits
	Cumming	Elkhorn River sandbars and sand/gravel pits
	Stanton	Elkhorn River sandbars and sand/gravel pits
	Boyd	Niobrara River sandbars

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	Holt	Niobrara River sandbars
	Keya Paha	Niobrara River sandbars
	Brown	Niobrara River sandbars
	Knox	Niobrara River sandbars
	Rock	Niobrara River sandbars
	Cass	Platte River sandbars and sand/gravel pits
	Sarpy	Platte River sandbars and sand/gravel pits
	Saunders	Platte River sandbars and sand/gravel pits
	Douglas	Platte River sandbars and sand/gravel pits
	Dodge	Platte River sandbars and sand/gravel pits
	Colfax	Platte River sandbars and sand/gravel pits
	Butler	Platte River sandbars and sand/gravel pits
	Platte	River sandbars and sand/gravel pits
	Polk	Platte River sandbars and sand/gravel pits
	Hall	Platte River sandbars and sand/gravel pits
	Buffalo	Platte River sandbars and sand/gravel pits
	Kearney	Platte River sandbars and sand/gravel pits
	Phelps	Platte River sandbars and sand/gravel pits
	Dawson	Platte River sandbars and sand/gravel pits
	Hamilton	Platte River sandbars and sand/gravel pits
	Merrick	Platte River sandbars and sand/gravel pits
	Lincoln	Platte River sandbars and sand/gravel pits
	Lincoln	So. Platte River sandbars/sand/gravel pits
	Keith	So. Platte River sandbars/sand/gravel pits
Iowa	Woodbury	Iowa Public Service ash ponds
	Pottawattamie	Iowa Power and Light ash ponds

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Table 2. Known breeding areas for interior least terns along the Mississippi and Ohio Rivers, 1985-1988.

State	County or Parish	Location
Missouri	Pemiscott	Mississippi River sandbars and dike fields
	New Madrid	Mississippi River sandbars and dike fields
	Mississippi	Mississippi River sandbars and dike fields
	Scott	Mississippi River sandbars and dike fields
Kentucky	Fulton	Mississippi River sandbars and dike fields
	Hickman	Mississippi River sandbars and dike fields
	Carlisle	Mississippi River sandbars and dike fields
Tennessee	Dyer	Mississippi River sandbars and dike fields
	Lake	Mississippi River sandbars and dike fields
	Lauderdale	Mississippi River sandbars and dike fields
	Tipton	Mississippi River sandbars and dike fields
	Shelby	Mississippi River sandbars and dike fields
Arkansas	Mississippi	Mississippi River sandbars and dike fields
	Crittenden	Mississippi River sandbars and dike fields
	Lee	Mississippi River sandbars and dike fields
	Phillips	Mississippi River sandbars and dike fields
	Deska	Mississippi River sandbars and dike fields
	Chicot	Mississippi River sandbars and dike fields
Mississippi	Desoto	Mississippi River sandbars and dike fields
	Tunica	Mississippi River sandbars and dike fields
	Coahoma	Mississippi River sandbars and dike fields
	Bolivar	Mississippi River sandbars and dike fields
	Washington	Mississippi River sandbars and dike fields
	Issaguena	Mississippi River sandbars and dike fields
	Warren	Mississippi River sandbars and dike fields
Louisiana	East Carroll	Mississippi River sandbars and dike fields
	Madison	Mississippi River sandbars and dike fields
Illinois	Alexander	Mississippi River sandbars and dike fields
	Pulaski	Ohio River sandbars and dike fields
Indiana	Gibson	Public Power plant along Wabash River at East Mt. Carmel

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Table 3. Known breeding areas for interior least terns along the Arkansas River system, 1985-1988.

State	County	Location
Arkansas	Pulaski	Arkansas River sandbars and dike fields
	Faulkner	Arkansas River sandbars and dike fields
	Conway	Arkansas River sandbars and dike fields
	Perry	Arkansas River sandbars and dike fields
	Pope	Arkansas River sandbars and dike fields
	Logan	Arkansas River sandbars and dike fields
	Johnson	Arkansas River sandbars and dike fields
	Sabastian	Arkansas River sandbars and dike fields
	Crawford	Arkansas River sandbars and dike fields
Oklahoma	Osage	Arkansas River sandbars
	Kay	Arkansas River sandbars
	Pawnee	Arkansas River sandbars
	Creek	Arkansas River sandbars
	Tulsa	Arkansas River sandbars
	Wagoner	Arkansas River sandbars
	Muskogee	Arkansas River sandbars
	Beaver	Cimarron River sandbars
	Harper	Cimarron River sandbars
	Woods	Cimarron River sandbars
	Woodward	Cimarron River sandbars
	Major	Cimarron River sandbars
	Blaine	Cimarron River sandbars
	Kingfisher	Cimarron River sandbars
	Logan	Cimarron River sandbars
	Payne	Cimarron River sandbars
	Alfalfa	Salt Plains National Wildlife Refuge
	Texas	Optima Reservoir
	Ellis	Canadian River sandbars
	Roger Mills	Canadian River sandbars
	Dewey	Canadian River sandbars
	Haskell	Sequoyah National Wildlife Refuge
	Sequoyah	Sequoyah National Wildlife Refuge
	Cleveland	Canadian River sandbars
	McClain	Canadian River sandbars
Texas	Hemphill	Canadian River sandbars
	Roberts	Canadian River sandbars
	Hutchinson	Canadian River sandbars

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Kansas	Barton	Cheyenne Bottoms
	Comanche	Cimarron River sandbars
	Clark	Cimarron River sandbars
	Meade	Cimarron River sandbars
	Stafford	Quivira National Wildlife Refuge
Colorado	Kiowa	Adobe Creek Reservoir
		Nee Noshe Reservoir
	Bent	Adobe Creek Reservoir

Table 4. Known breeding areas for interior least terns along the Red River system, 1985-1988.

State	County	Location
Texas	Childress	Prairie Dog Town Fork sandbars
	Hall	Prairie Dog Town Fork sandbars
	Briscoe	Prairie Dog Town Fork sandbars

Table 5. Known breeding areas for interior least terns along the Rio Grande system, 1985-1988.

State	County	Location
Texas	Zapata	Falcon Reservoir
	Webb	Lake Casa Blanca
	Val Verde	Amistad Reservoir
New Mexico	Chaves	Bitter Lake National Wildlife Refuge

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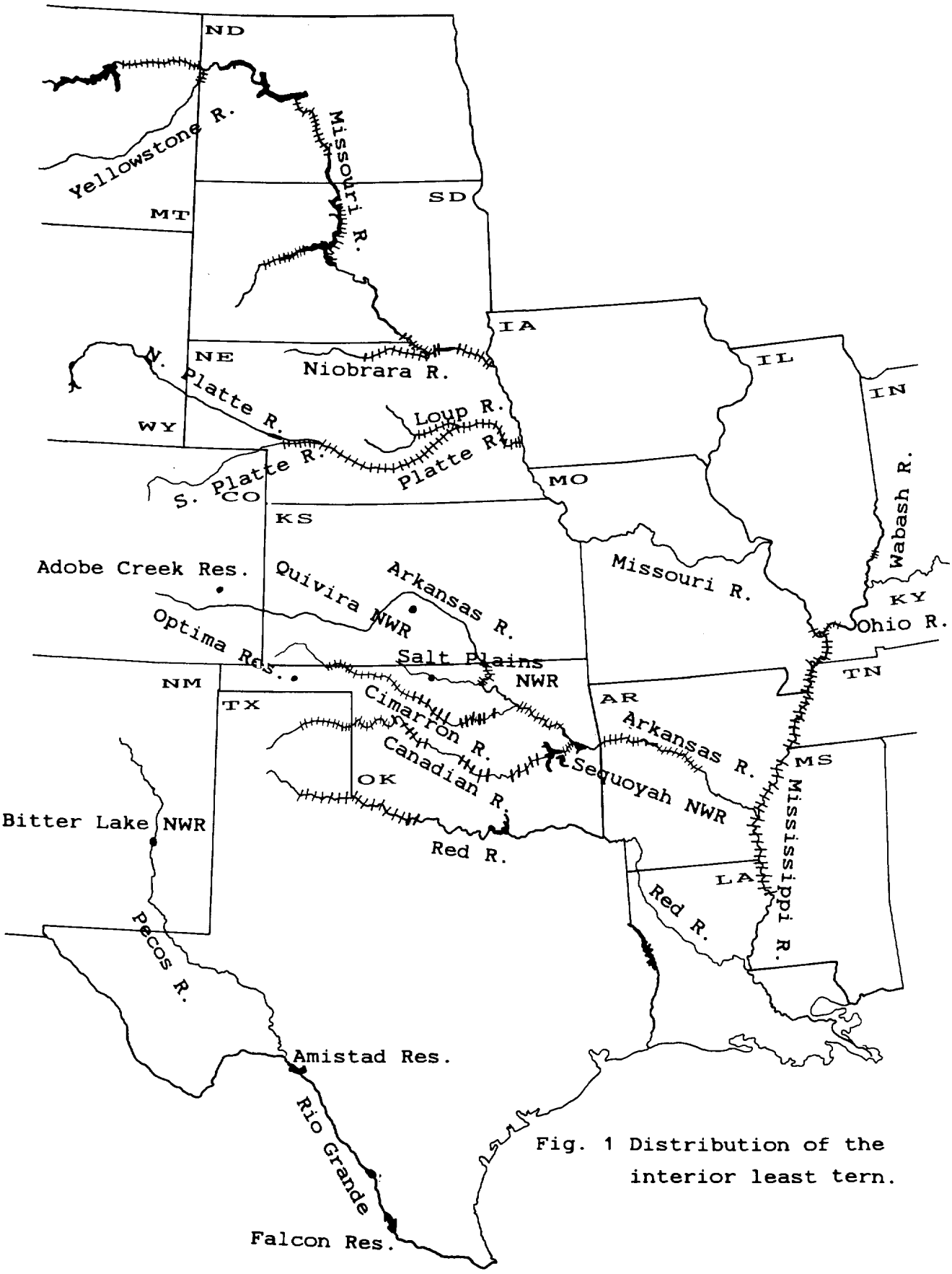

Fig. 1 Distribution of the interior least tern.

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Life History

Breeding Behavior: Interior least terns spend about 4-5 months at their breeding sites. They arrive at breeding areas from late April to early June (Faanes 1983, Hardy 1957, U. S. Fish and Wildlife Service 1987a, Wilson 1984, Wycoff 1960, Youngworth 1930). Courtship behavior of least terns is similar throughout North America. Courtship occurs at the nesting site or at some distance from the nest site (Tomkins 1959). It includes the fish flight, an aerial display involving pursuit and maneuvers culminating in a fish transfer on the ground between two displaying birds. Other courtship behaviors include nest scraping, copulation and a variety of postures, and vocalizations (Ducey 1981, Hardy 1957, Wolk 1974).

The nest is a shallow and inconspicuous depression in an open, sandy area, gravelly patch, or exposed flat. Small stones, twigs, pieces of wood and debris usually lie near the nest. Least terns nest in colonies or terneries, and nests can be as close as just a few meters apart or widely scattered up to hundreds of meters (Ducey 1988, Anderson 1983, Hardy 1957, Kirsch 1990, Smith and Renken 1990, Stiles 1939). The benefit of semi-colonial nesting in least terns may be related to anti-predator behavior and social facilitation (Burger 1988).

Interior least tern eggs are pale to olive buff and speckled or streaked with dark purplish-brown, chocolate, or blue-grey markings (Hardy 1957, Whitman 1988). Occasionally, eggs are pink instead of pale to olive buff (P. Mayer and M. Schwalbach, personal communication), The birds usually lay two or three eggs (Anderson 1983, Faanes 1983, Hardy 1957, Kirsch 1987-89, Sweet 1985, Smith 1985). The average clutch size for interior least terns nesting on the Mississippi River during 1986-1989 was 2.4 eggs (Smith and Renken 1990). Egg-laying begins by late May. Both sexes share incubation which generally lasts 20-25 days but has ranged from 17 to 28 days (Faanes 1983, Hardy 1957, Moser 1940, Schwalbach 1988, G.R. Lingle, personal communication).

The precocial behavior of interior least tern chicks is similar to that of other least terns. They hatch within one day of each other, are brooded for about one week, and usually remain within the nesting territory but as they mature, wander further. Fledging occurs after three weeks, although parental attention continues until migration (Hardy 1957, Massey 1972, 1974; Tomkins 1959). Departure from colonies by both adults and fledglings varies but is usually complete by early September (Bent 1921, Hardy 1957, Stiles 1939). Thompson (1982) presented the following longevity data for coastal least terns revealed by band recoveries:

	Percentage of Recoveries
Age (years)	Known and Assumed Dead (N)
0-5	74 percent (58)
5-10	9 percent (7)
10-15	10 percent (8)
15-20	4 percent (3)
>20	3 percent

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Population Biology: The interior least tern's annual reproductive success varies greatly along a given river or shoreline (Table 6). Because tern's use ephemeral habitats, they are susceptible to frequent nest and chick loss. Consequently there are great local differences in productivity. In 1987, total number of interior least terns reached 4,800 (Table 7). This is considerably higher than the 1,200 interior least terns estimated by a partial survey in 1975 by Downing (1980). There are no comprehensive historic numbers to compare with these figures, although early qualitative descriptions indicate that the interior least tern was rather common (Burroughs 1961, Hardy 1957). Increased censusing efforts during the past few years probably account for the differences among recent census figures and earlier surveys.

Table 6. Some examples of the productivity of interior least terns.

Locations	Year	Nest Success	Fledgings per Pair	Frequency of Visits	% Population Monitored	Source
Missouri River North Dakota	1988 1989	0.62 0.56	0.42 0.21	7-10 days "	100% "	Mayer and Dryer 1989
Missouri River South Dakota	1986 1987		0.20 0.64	7-10 days "	100% "	Schwalbach 1988
Missouri River South Dakota	1988 1989	0.36 0.51	0.44 0.55	7-10 days "	100% "	Dirks 1990
Lower Platte River River Nebraska	1987 1988 1989	0.57 0.67 0.43	0.29 0.71 0.47	2-3 days " "	39% 44% 42%	Kirsch 1987-89
Cimarron River Kansas	1982-83	0.18	1.09-0.56	--	--	Schulenberg and Ptacek 1984
Salt Plains NWR, Oklahoma	1987	0.44-0.33	0.44-0.15	1-3 days		Hill 1987

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Dispersal Patterns: Breeding site fidelity of coastal and California least terns is very high (Atwood et al. 1984, Burger 1984). This may also be true for the interior least tern in its riverine environment. An interior least tern banded in 1988 as a breeding adult on the Missouri River in North Dakota returned in 1989 to breed on a Missouri River sandbar in North Dakota (Mayer and Dryer 1990). In the Mississippi River valley, a bird banded as a breeding adult in 1987 was observed nesting at the same site in 1989, and three others banded as breeding adults in 1988 returned to nest within the same stretch of the Mississippi River in 1989 (Smith and Renken 1990). Two of those birds had returned to within 4.8 km of their former nesting site. Along the Platte River in Nebraska, interior least terns demonstrate a strong return pattern to previous nesting sites on the river and at sand and gravel pits regardless of reproductive success (E.Kirsch, G. Lingle, personal communication). One interior least tern captured in 1987 as a breeding adult at a Mississippi River ternery in Missouri had been banded as a chick in 1980 by Marsha Waldron; this bird was nesting at a site 131 km upriver from its natal Tennessee colony (Smith 1987, Smith and Renken 1990). Chick dispersal may be as far as that reported by Boyd and Thompson (1985) for a breeding Kansas bird that had been banded as a chick on the Texas coast.

Home Range and Territoriality: The interior least tern's home range during the breeding season usually is limited to a reach of river near the sandbar nesting site. At Salt Plains National Wildlife Refuge, home ranges were highly variable, ranging from 11 to 1,015 ha (Talent and Hill 1985). Variation likely was due to food limitations and chick loss. The home range may change if renesting birds select a different breeding site. At sand and gravel pits along the central Platte River in Nebraska, nesting interior least terns utilize the pit area as well as an adjacent stretch of river. Nesting territories are defended and birds defend any nest in the colony. In defending the territory, the incubating bird will fly up and give an obvious alarm call followed by repeated dives at the intruder (Hardy 1957). The strong defense of territories facilitates locating terneries during census surveys.

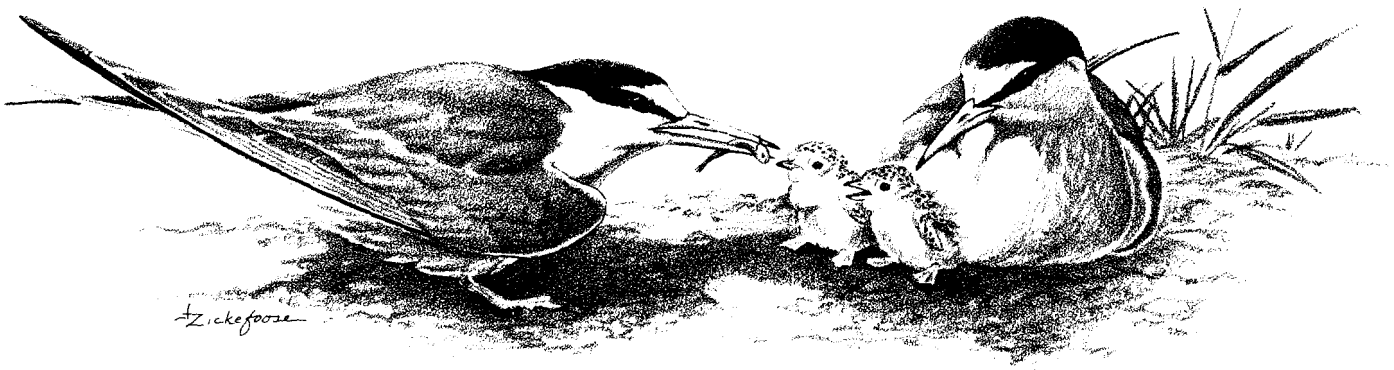

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Table 7. Census data on the interior population of the least tern, 1985-1988[1].

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
Mississippi River Basin						
1. Ft. Peck Reservoir, Missouri River, Montana	-*	--**	4	2	-	(Alfonso, unpublished data, Montana Piping Plover Recovery Committee 1988)
2. Below Ft. Peck Reservoir, Missouri River, Montana	-	--	--	18	22	(D. Christopherson, unpublished data)
3. Yellowstone River, Montana	-	--	--	12	-	(Gorges, unpublished data)
4. Below Garrison Dam, Missouri River, North Dakota	114	169	175	142	192	(Dryer and Dryer 1985, Mayer and Dryer 1988)
5. Lake Sakakawea, Missouri River, North Dakota	-	-	-	7	-	(Mayer and Dryer 1988)
6. Lake Oahe, Missouri River	-	-	-	7	-	(Mayer and Dryer 1988)
7. Yellowstone River, North Dakota	-	22	20	24	30	(Kreil and Dryer 1987, Mayer and Dryer 1988)
8. Cheyenne River, South Dakota	-	31	54	27	26	(Schwalbach et al. 1986, 1988; Schwalbach 1988)

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Table 7 (continued)

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
9. Lake Oahe, Missouri River, South Dakota	-	16	21	61	-	(Schwalbach et al. 1986, 1988; Schwalbach 1988)
10. Below Fort Randall and Gavins Point Dam, MO River, South Dakota to Ponca, NE	202	206	292	297	140	(Schwalbach et al. 1986, 1988; Schwalbach 1988)
11. Power plant ash lagoons near Council Bluffs, Iowa	18	28	22	22		(Dinsmore and Dinsmore 1989, Wilson 1984)
12. Niobrara R., Nebraska	174	-	143	200	190	(Nebraska Game and Parks Commission 1985a)
13. Platte River, Nebraska	256	438	606	635	502	(Nebraska Game and Parks Commission 1988; G. R. Lingle, personal communication)
14. Loup River, Nebraska	-	-	100	155	70	(S. Gauthreaux and Nebraska Game and Parks Commission, unpublished data)
15. Elkhorn River, Nebraska	2	8	4	-	-	(J. Dinan, Nebraska Game and Parks Commission, personal communication)
16. Mississippi R., Cape Girardeau, Missouri to Vicksburg, Mississippi	1264	2244	2488	2356	1100	(Rumancik 1985, 1986; J.W. Smith 1985, 1986, 1987, 1988; M. Smith 1986; W. King personal communication; Smith and Renken 1990)
17. Power plant, Wabash River, E. Mt. Carmel, IN	2	4	4	-	-	(Johnson 1987, Mills 1987)

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Table 7 (continued)

	Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
18.	Arkansas River, Arkansas (above Little Rock)	50	80	130	119	256	(Smith and Shepherd 1985, K. Smith 1986, Smith et al. 1987)
19.	Arkansas River, Oklahoma	-	78	200	200	119	(Hoffman 1986, L. Hill personal communication)
20.	Quivira National Wildlife Refuge, Kansas (Rattlesnake Creek of Arkansas River)	48	48	54		-	(Boyd 1986, 1987)
21.	Adobe Creek Reservoir Colorado	-	-	6	10	-	(Barbara Campbell, personal communication)
22.	Salt Plains National Wildlife Refuge, Oklahoma (Salt Fork of the Arkansas River)	-	140	210	-	-	(Boyd 1986, 1987)
23.	Cimarron River, Kansas and Oklahoma	82	150	132	-	121	(Boyd 1986, 1987)
24.	Optima Reservoir, Oklahoma (Beaver River)	46	52	60	38	-	(Boyd 1986, 1987; L. Hill)
25.	Canadian River, western Oklahoma and Texas	127	182	20	16	253	(McCament and Thompson 1985, 1987; U. S. Fish and Wildlife Service, unpublished data)

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Table 7 (continued)

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
26. Canadian River, Eufaula Dam to Arkansas River, including Sequoyah National Wildlife Refuge	-	-	105	34	43	(L. Hill personal communication)
27. Canadian River at Norman, Oklahoma	-	-	-	12	3	(L. Hill, personal communication)
28. Prairie Dog Town Fork of Red River, Texas	44	50	12	16	241	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)
Rio Grande River Basin						
29. Falcon Reservoir, Rio Grande River	500	150	50	222	-	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)
30. Lake Casa Blanca	5	-	14	50	-	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)
31. Amistad Reservoir, Rio Grande River	20	9	-	14	-	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)

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Table 7 (continued)

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
32. Bitter Lake National Wildlife Refuge, New Mexico (Pecos River)	-	8	6	6	-	(Shomo, 1988 and S. Williams, New Mexico Game and Fish Department, unpublished report)
Total	2952	4113	4932	4702	3308	

[1]The census results should be viewed in light of the extent and frequency of census efforts. Increases or decreases from year to year may not be related to reproductive performance.
* no census conducted in that year.
** area surveyed but no birds found

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Diet: The interior least tern is piscivorous, feeding in shallow waters of rivers, streams and lakes. Other least terns also feed on crustaceans, insects, mollusks and annelids (Whitman 1988). The terns usually feed close to their nesting sites. Fish prey is small sized and important genera include Fundulus, Notropis, Campostoma, Pimephales, Gambusia, Blonesox, Morone, Dorosoma, Lepomis and Carpiodes (Grover 1979, Hardy 1957, Rumancik 1988, 1989; Schulenberg et al. 1980, Smith and Renken 1990, Wilson et al. 1989). Moseley (1976) believed least terns to be opportunistic feeders, exploiting any fish within a certain size range. Fishing occurs close to the riverine colony. Terns nesting at sand and gravel pits and other artificial habitats may fly up to 3.2 km to fish. Radio-tagged terns at Salt Plains National Wildlife Refuge often traveled 3.2-6.4 km to fish (Talent and Hill 1985). Fishing behavior involves hovering and diving over standing or flowing water.

Interspecific Interactions: Interior least terns are breeding associates of the piping plover (Charadrius melodus) in the Missouri River system (Dryer and Dryer 1985, Faanes 1983, Nebraska Game and Parks Commission 1987, Schwalbach 1988) and the snowy plover (Charadrius alexandrius) and American avocet (Recurvirostra americana) in the Arkansas River system (Grover and Knopf 1982, Hill 1985). Nesting piping plovers usually can be found within or near nesting interior least terns at sand and gravel pits and on riverine sandbars.

Habitat Requirements

Least terns throughout North America nest in areas with similar habitat attributes.

Coastal Areas: Coastal and California least terns usually nest on elevated portions of level, unvegetated substrates near foraging areas (Carreker 1985). Beaches, sand pits, sandbars, islands and peninsulas are the principal breeding habitats (Moseley 1976). Nesting can be close to water but is usually between the dune environment and the high tide line (Akers 1975, Blodget 1978). Unconsolidated substrate such as small stones, gravel, sand, debris and shells comprise the nesting substrate. A mixture of coarse sand, shells and other fragments may be preferred over fine-grained substrates because of better cryptic qualities, stability in wind, and water permeability (Burroughs 1966, Craig 1971, Gochfeld 1983, Jernigan et al. 1978, Soots and Parnell 1975, Swickard 1972, Thompson and Slack 1982).

Vegetation at California and coastal least tern nesting sites is sparse, scattered and short. Vegetation cover is usually less than 20% at the time of nesting (Craig 1971, Thompson and Slack 1982, Gochfeld 1983). Least tern colonies in denser vegetation may be a response to habitat loss or a function of strong site tenacity.

Rivers: The riverine nesting areas of interior least terns are sparsely vegetated sand and gravel bars within a wide unobstructed river channel, or salt flats along lake shorelines. Nesting locations usually are at the higher elevations and away from the water's edge because

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nesting starts when the river flows are high and small amounts of sand are exposed. The size of nesting areas depends on water levels and the extent of associated sandbars. An examination of the interior least tern's nesting ecology on the Missouri River (Schwalbach et al. 1988) illustrates the changes caused by varying river flows. Along one stretch of the Missouri River in South Dakota the average size of nesting sandbars was 12 and 31 ha in 1986 and 1987, respectively; nest elevation and nest to water distance differed by a factor of three in both years.

The Lower Mississippi River is very wide and carries a tremendous volume of water and sand. Sandbars form annually, are washed away, and shift position. Many sandbars are over 3.2 km long and 1.2 km wide. Nest sites are often several hundred meters from the water (Rumancik 1987, 1988). Thus, nesting areas usually are several hundred hectares in size. Mississippi River levels at the onset of nesting also influences the number of nests at a colony. Smith and Renken (1990) observed Mississippi River colonies that averaged 100 nests/colony when habitat was restricted by high water early in the nesting period, but which averaged only 19.3 nests/colony during a year of more moderate river levels.

Artificial Nesting Habitat: Least terns nest on artificial habitats such as sand and gravel pits and dredge islands (Dryer and Dryer 1985, Haddon and Knight 1983, Kirsch 1987-89, Larkins 1984, Morris 1980). In North America the coastal and California least terns commonly nest on a variety of artificial nesting habitats, even roof-tops (Altman and Gano 1984, Atwood et al. 1979, Fisk 1975, 1978; Jernigan 1977, Massey and Atwood 1980, 1983; Swickard 1974).

The interior least tern nests on dike fields along the Mississippi River (Smith and Stucky 1988; Smith and Renken 1990), at sand and gravel pits (Kirsch 1987-89), ash disposal areas of power plants (Dinsmore and Dinsmore 1988, Johnson 1987, Wilson 1984), along the shores of reservoirs (Boyd 1987, Chase and Loeffler 1978, Neck and Riskind 1981, Schwalbach 1988) and at other manmade sites (Shomo 1988). The percentage of interior least terns nesting on pits adjacent to the lower reach (Columbus to Plattsmouth) of the Platte River varies depending on the flow and amount of exposed sandbar habitat (Kirsch 1987-89). Suitable nesting habitat in the upper Platte River channel has been severely reduced (Sidle et al. 1989) and in many stretches of the river, sand and gravel pits annually provide the only nesting habitat (Lingle 1989). It is unknown to what extent sand and gravel pits, dike fields, reservoir shorelines and other artificial habitats have replaced natural habitat. In the lower Mississippi River alone, 7,518 ha of bar and island habitat were lost in diked reaches between 1962 and 1976 (Nunnally and Beverly 1986, Smith and Stucky 1988).

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Reasons For Current Status

Habitat alteration and destruction: Channelization, irrigation, and the construction of reservoirs and pools have contributed to the elimination of much of the tern's sandbar nesting habitat in the Missouri, Arkansas, and Red River systems (Funk and Robinson 1974, Hallber et al 1979, Sandheinrich and Atchison 1986). Ducey (1985), for example, describes the changes in the channel characteristics of the Missouri River since the early 1900s under the Missouri River Bank Stabilization and Navigation Project. The wide and braided character of the Missouri River was engineered into a single narrow navigation channel. Most sandbars virtually disappeared between Sioux City, Iowa and Saint Louis, Missouri (Sandheinrich and Atchison 1986, Smith and Stucky 1988).

Where sandbars still occur along the Nebraska-South Dakota boundary (Missouri River), approximately 3,156 ha of sandbar habitat have been lost between 1956 and 1975 (Schmulbach et al. 1981). Sandbars along the Nebraska-Iowa Missouri River boundary have been virtually eliminated with the exception of 890 ha inventoried along the 80-km Missouri National Recreation Area (Schmulbach et al. 1981).

Current regulation of Missouri River dam discharges pose additional problems for interior least terns nesting in remaining habitats (Nebraska Game and Parks Commission 1985c, Schwalbach et al. 1988). Before regulation of river flows, summer flow patterns were more predictable. Peak flows occurred in March from local runoff and then again in May and June when mountain snowmelt occurs. Flows then declined during the rest of the summer allowing interior least terns to nest as water levels dropped and sandbars became available (Stiles 1939, Hardy 1957). Currently, the main stem system is supposed to be regulated for hydropower, navigation, water quality and supply, flood evacuation, irrigation, fish and wildlife conservation, and public recreation. However, system releases are designed to provide equitable service to power and navigation demands, except when they conflict with flood control functions of the system.

The demands are unpredictable and flows can fluctuate greatly. Flow regimes differ greatly from historic regimes. High flow periods may now extend into the normal nesting period, thereby reducing the quality of existing nest sites and forcing interior least terns to initiate nests in poor quality locations. Extreme fluctuations can flood existing nests, inundate potential nesting areas, or dewater feeding areas. Interior least terns along the Arkansas River in Oklahoma and Arkansas contend with dam discharge problems similar to those on the Missouri River.

Along the Lower Mississippi River, and elsewhere, natural river discharge may exert considerable influence on reproductive success. A wet spring may delay river fall and habitat may not be available until later. Rises in the river during the spring and summer may inundate nests and wash away chicks (Rumancik 1986, 1989, Smith and Renken 1990). Renesting, however, does occur and may be an adaptation to river fluctuations. Dike

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construction has created many sandbars between the dikes and many nesting colonies are located on these sandbars (Landin et al. 1985, Rumancik 1986, 1987, 1988, 1989; J. Smith 1985, 1986, 1987). The extent to which these sandbars are attaching to the riverbank and reducing tern habitat is not known but according to Smith and Stucky (1988) the processes of dike field terrestrialization are well underway at several least tern colony sites in the lower Mississippi River.

Reservoir storage of flows responsible for scouring sandbars has resulted in the encroachment of vegetation along many rivers such as the Platte River, Nebraska and greatly reduced channel width (Currier et al. 1985, O'Brien and Currier 1987, Eschner et al. 1981, Lyons and Randle 1988, Sidle et al. 1989, Stinnett et al. 1987). In addition, river main stem reservoirs now trap much of the sediment load resulting in less aggradation and more degradation of the river bed and subsequently less formation of suitable sandbar nesting habitat. Riverine habitat along the central Platte River may require extensive vegetation clearing and other intensive management. In contrast, the lower Platte River (Columbus, Nebraska to the Missouri River confluence) has not undergone as extensive habitat changes as the central Platte. During 1987-1989, riverine sandbar habitat hosted 72% of the nests on the lower Platte and only 12% of the nests on the central Platte (Kirsch 1989, Lingle 1989).

Human disturbance: Many rivers have become the focus of recreational activities. Human presence reduces reproductive success (Mayer and Dryer 1988, Smith and Renken 1990). In mid-America, sandbars are fast becoming the recreational counterpart of coastal beaches. Even sand and gravel pits and other artificial nesting sites receive a high level of human disturbance.

Conservation Efforts

During the past few years there has been a great increase in the number of interior least tern surveys, research projects and public relations endeavors to protect the birds on the part of both public and private conservation organizations. Proposed federal listing of the interior least tern prompted much of the interest in the northern Great Plains and elsewhere. Today, many state, federal and private organizations are collaborating to census the birds, curtail human disturbance and conduct research.

Under authority of Section 7 of the Endangered Species Act, the U. S. Fish and Wildlife Service is consulting with the U. S. Army Corps of Engineers on whether dam operations on the Missouri and Arkansas Rivers jeopardize the continued existence of the interior least tern (U.S Fish and Wildlife Service 1989, 1990). The outcome of these formal consultations is crucial to the recovery of the interior least tern. Areas of habitat along the Missouri River, for example, continue to degrade due to physical controls on the river and present water management schemes. Changes in the water release regime and physical manipulation of habitat will be necessary.

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Aside from the Section 7 consultation on the Missouri River, the Corps Master Manual for river operations is under review. If upper Missouri River Basin states have their way for holding water in the reservoirs for recreation and fisheries, navigation in the Missouri River could be reduced and maintenance of the commercial navigation project above Omaha could become infeasible. The reach between Sioux City, Iowa and the mouth of the Platte River could once more be available to interior least terns.

Montana: Current efforts include surveys to determine the number and distribution of interior least terns along the Missouri and Yellowstone Rivers and along the shores of the Fort Peck Reservoir.

North Dakota: Censusing has been conducted along the Missouri River since 1982 and along the Yellowstone River since 1986. Habitat requirements are being estimated and recommendations are being made for the management of Missouri River habitat. Research continues on reproductive success and on methods to increase productivity. Resource agencies are involved with a variety of public relations efforts to curtail human disturbance on Missouri River sandbars and islands.

South Dakota: Detailed studies of interior least tern nesting ecology continue at Missouri and Cheyenne River sandbars and along the reservoir shoreline of Lake Oahe. Resource agencies are involved with public relations efforts to curtail human disturbance on the Missouri River. Management activities include the posting of nesting sites and informational signs at boat ramps and elsewhere. This has been complemented with enforcement actions being taken by state and federal officials. Recent amendments to South Dakota law prohibit the harassment of least tern nesting and rearing sites on the Missouri River.

Nebraska: Nebraska supports one of the largest breeding populations of interior least terns. Annual surveys have been carried out since 1979. Efforts are underway to quantify available nesting habitat on the Platte River at various river flows. Research on reproductive success, habitat selection, foraging ecology, predation and the value of sand and gravel pits continues along the Platte River (Kirsch 1987-89, Lingle 1989, Wilson et al. 1989).

A flow management plan has been prepared for the Missouri River (Nebraska Game and Parks Commission 1985c) and certain instream flows have been determined on the Platte River for the interior least tern, its habitat and forage fish, and for other wildlife and resources (Table 8). In 1990 the Federal Energy Regulatory Commission (FERC) ordered the Nebraska Public Power District to maintain the instream flows in Table 8 for interior least terns (50 FERC Report (CCH) 61,180) (Sidle et al. 1990). The District seeks a new license to operate diversion dams and other facilities associated with the Lake McConaughy reservoir on the North Platte River. Lake McConaughy was constructed in the late 1930s and licensed for 50 years. The dam, diversion structures, and other facilities have had a major impact on the downstream habitat of the

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interior least tern. When granting a new power license the Federal Power Act requires FERC to give equal consideration to the protection, mitigation of damage to, and enhancement of, fish and wildlife.

Posting, extensive news media efforts, posters, brochures, information signs at river entry points, and law enforcement patrols are some of the additional activities being carried out in Nebraska. The Platte River Whooping Crane Habitat Trust is trying to rehabilitate sandbars in the central Platte River (Lexington to Grand Island) by removing vegetation over extensive areas of the river channel. FERC also ordered the Nebraska Public Power District to construct eight permanent five- to ten-acre sites for interior least tern nesting in the central Platte River where nesting habitat has been severely degraded, in part by the upstream Lake McConaughy and associated water diversion canals and offstream reservoirs.

Finally, Nebraska law requires state agencies to consult with the Nebraska Game and Parks Commission on any action authorized, funded, or carried out by the state agencies. This insures that such actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of habitat. The Commission reviews state sponsored or authorized projects that may impact endangered or threatened species and issues biological opinions to the state agencies.

Colorado: The interior least tern is known to breed at Adobe Creek reservoir and has been observed at Nee Noshe reservoir. Public relation efforts and other endeavors are underway to address fluctuating water levels, human disturbance, vegetation encroachment, and predation.

Iowa: Largely devoid of natural interior least tern habitat, Iowa's conservation efforts have focused on monitoring and protecting the few nest sites located on fly-ash disposal sites of two power generating stations along the Missouri River at Council Bluffs and Sioux City. Both sites are monitored to record the number of nesting pairs and reproductive success. The Council Bluffs nesting habitat also is protected by a management plan. The plan specifies that both people and heavy equipment will be kept out of the nesting area during the breeding season.

Interior least tern decoys have been set out at the DeSoto National Wildlife Refuge to attract terns which formerly nested there in the 1970s. Woody vegetation has been cleared and the areas are disked to maintain open habitat.

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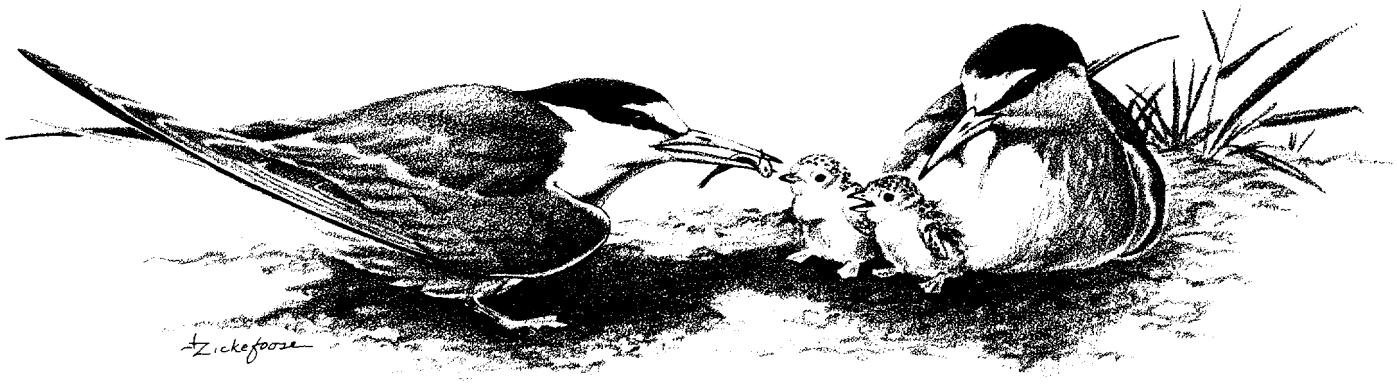
Table 8. Recommended annual flow regime for Central Platte River, Nebraska[1]

Time Period	Flow(cfs[2])	Species/Resources of Concern	Existing Median Flow(cfs) (1958-1985)
Jan 1-Mar 22	1,100	Bald Eagle, wet meadow sandhill crane, waterfowl, least tern forage fish, sport fish	1,710
Mar 23-May 10	2,000	Whooping crane, sandhill crane, waterfowl, least tern forage fish, sport fish	1,823
May 11-May 14	800	Least tern forage fish, sport fish	1,433
May 15-Sep 15	800	Least tern, piping plover, tern forage fish, sport fish	781
Sep 16-Nov 15	2,000	Whooping crane, sandhill crane, waterfowl, least tern forage fish, sport fish	893
Nov 16-Dec 9	1,000	Waterfowl, least tern forage fish, sport fish	1,186
Dec 10- Dec 31	1,100	Bald eagle, waterfowl, least tern forage fish, sport fish	1,253

[1]As measured at the U. S. Geological Survey gage at Grand Island.
[2]Cubic feet per second



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Missouri: The Missouri Department of Conservation maintains an active conservation, management and research program for interior least terns. The Missouri River has been thoroughly surveyed for potential habitat; Mississippi River colonies are closely monitored and under detailed study; and management plans have been developed. Regulations provide special protective status for least tern nesting areas on Department owned islands and sandbars. Public information programs about the interior least tern are widespread.

Kansas: The Kansas Department of Wildlife and Parks has funded research on distribution, reproductive success, banding and inter-colonial movements, foraging ecology, and predation since 1980. Annual surveys along the Cimarron River and at the Quivira National Wildlife Refuge have been conducted since 1980. Successful habitat alteration and management has been on-going since 1985. Studies also have focused on the issue of inadequate instream flows in both the Cimarron and Arkansas rivers in Kansas.

Oklahoma: The largest concentration of least terns in Oklahoma is at Salt Plains National Wildlife Refuge. This area has been studied intermittently since 1977. Research at river nesting sites has been on-going since 1982. The Cimarron and Arkansas rivers have received more survey and distribution effort than the Red and Canadian rivers. Various studies of reproductive success, inter-colonial movements and foraging ecology have been conducted at Salt Plains, Optima Reservoir and the western reaches of the Cimarron River. Posting, fencing and extensive news media efforts have been successful at Optima Reservoir and the western reaches of the Cimarron River. Nesting sites on the Cimarron River continue to be threatened by several river diversion and impoundment proposals. A memorandum of understanding has been developed between The Nature Conservancy, U. S. Army Corps of Engineers, Oklahoma Department of Wildlife Conservation, U. S. Fish and Wildlife Service, Tulsa Audubon Society, River Parks Authority and riverbed landowners for protection and management of essential habitat on the Arkansas River in Tulsa County.

Mississippi River States: The U. S. Army Corps of Engineers has undertaken extensive census work along the Mississippi River between Illinois and Vicksburg, Mississippi, and along the Arkansas River to the Oklahoma border. Their surveys have provided the only information on the tern on the Mississippi River below the State of Missouri. The locations of colonies are monitored and the information is used by regulatory personnel to evaluate permit applications and in planning operations and maintenance activities on the lower Mississippi River.

Texas and New Mexico: The Texas Parks and Wildlife Department has examined the numbers and distribution of interior least terns along the Rio Grande River and rivers in the Texas Panhandle, and investigated genetic characteristics of coastal and interior least terns. The New Mexico Department of Game and Fish has conducted several years of surveys and studies and developed management recommendations for interior least terns at and near the Bitter Lake National Wildlife Refuge along Pecos River (Jungemann 1988).

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II. RECOVERY

Recovery objective

The purpose of this plan is to describe actions necessary to achieve recovery of interior least terns. The first step in this approach is to set a quantifiable goal (i. e., recovery objective) that, when reached, will assure populations remain stable. The remainder of this plan outlines steps necessary to achieve the recovery objective. Recovery goals, objectives and tasks may change as we learn more about the interior least terns.

Recognizing that the interior least tern has a broad distribution, the recovery objective was set by taking into account: 1) current data on distribution and abundance of interior least terns in each river system; 2) knowledge of how thoroughly each river system has been surveyed; 3) historic population data, when available; 4) loss of viable habitat; 5) an assessment of the potential to increase breeding pairs at currently occupied sites; 6) assessment of the potential to establish breeding pairs at unoccupied sites. Technical experts and state and federal resource agencies were consulted to determine the status of current populations and habitats, as well as the potential for population increase.

Therefore, in order to be considered for removal from the endangered species list, interior least tern essential habitat will be properly protected and managed and populations will have increased to 7,000 birds:

I. Missouri River System
   A. Number of birds in the Missouri River system will increase to 2,100 adults.
   B. Essential breeding habitat (Appendix 4) will be protected, enhanced and restored.
   C. The breeding pairs will be maintained in the following distribution for 10 years (assuming at least four major censuses will have been conducted during this time):
      Montana - 50 adults
      North Dakota - 250 adults
      South Dakota - 680 adults (includes 400 shared with Nebraska on the Missouri River).
      Missouri River below Gavin's Pt. Dam - 400 adults
      Lake Oahe - 100 adults
      Missouri River below Ft. Randall - 80 adults
      Other Missouri River sites - 20 adults
      Cheyenne River - 80 adults
      Nebraska - 1520 adults (includes 400 adults shared with South Dakota on the Missouri River).
      Missouri River - 400 adults
      Niobrara River - 200 adults
      Loup River - 170 adults
      Platte River - 750 adults
      Missouri and Iowa - Opportunities for habitat restoration and reestablishment of breeding pairs will be determined.

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II. Mississippi and Ohio Rivers
   A. Current number of adult birds (2,200-2,500) on the Lower Mississippi River will remain stable for the next ten years.
   B. Essential breeding habitat (Appendix 4) will be protected, enhanced, and restored.

III. Arkansas River System
   A. Numbers of birds on the Arkansas River system will increase to 1,600 adults.
   B. Essential breeding habitat (Appendix 4) will be protected, enhanced and restored.
   C. The 1,600 breeding adults will be maintained in the following distribution for 10 years:
      Arkansas River, Arkansas - 150 adults
      Arkansas River, Oklahoma - 250 adults
      Quivira National Wildlife Refuge - 100 adults
      Salt Plains National Wildlife Refuge - 300 adults
      Cimarron River Basin - 400 adults
      Canadian River - 300 adults
      Beaver/ North Canadian River - 100 adults

IV. Red River System
   A. Number of birds in the Red River system will increase to 300 breeding adults.
   B. Essential Breeding habitat (Appendix 4) will be protected, enhanced and restored.
   C. The 300 adults will be distributed along the Prairie Dog Town Fork where interior least terns currently occur and at other essential habitat sites yet to be determined.

V. Rio Grande River System
   A. Current number of adult birds (500) in the Rio Grande River system will remain stable for 10 years.
   B. Essential breeding habitat will be protected, enhanced and restored.
   C. The birds will be distributed along the Rio Grande and Pecos Rivers.

Step-Down Outline

The step-down outline lists tasks necessary to meet the recovery objective. Steps (or tasks) are not presented in order of importance. Some steps are underway, while others may take years before they are begun. An explanation of these steps is presented in the Narrative section of this plan. Following the Narrative, the Implementation Schedule lists and sets priorities to be taken in the next three years. The step-down outline is very similar to the step-down outline in the Great Lakes/Northern Great Plains Piping Plover recovery plan (U. S. Fish and Wildlife Service 1988a) because both species breed in the same habitat areas in the Missouri River system and require similar recovery tasks.

1. Determine current distribution and population trends of the interior least tern.
   11. Assess status and distribution of breeding populations.
      111. Survey sandbars, reservoir shorelines, sand and gravel pits and other suitable habitats to determine breeding

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distribution.

112. Develop a method for standardization of census techniques and timing of censuses.
113. Census known and potential breeding sites.
114. Monitor reproductive success.
115. Assess dispersal patterns and genetic diversity.
116. Assess mortality.
117. Further identify life history parameters and develop population models.

12. Assess status and distribution for the migration period.
13. Assess status and distribution during the winter.
131. Survey beaches and other suitable habitat to determine winter distribution.
132. Census known wintering areas.
133. Monitor movement of birds between wintering sites and assess mixing of populations.
134. Assess mortality on wintering areas.

2. Determine current habitat requirements and status.
21. Determine breeding habitat requirements and status.
211. Assess the characteristics, including prey resources, of breeding habitat.
212. Quantify and evaluate available breeding habitat.
213. Examine historic aerial photography and hydrographic surveys of river systems to determine the previous extent of potential habitat and vegetational changes.
22. Determine current migration habitat requirements and status.
221. Assess the characteristics, including prey resources, of migration habitat.
222. Quantify and evaluate available migration habitat.
23. Determine current habitat requirements and status on wintering areas.
231. Assess the characteristics, including prey resources, of winter habitat.
232. Quantify and evaluate winter habitat.

3. Protect, enhance, and increase interior least tern populations.
31. Protect, enhance, and increase populations during the breeding season.
311. Increase reproduction and survival at occupied breeding sites.
3111. Evaluate predator impacts on eggs and chicks and identify species responsible for the predation.
3112. Evaluate techniques for predator management and implement where appropriate.
3113. Restrict public use within nesting areas and investigate enforcement options.
3114. Manage water levels and river flows to reduce nest and chick loss.
3115. Modify or eliminate construction activities that adversely impact reproductive success.

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3116. Investigate the effects of environmental contaminants at breeding areas.

32. Protect and enhance populations during migration and winter.
    321. Manage areas to maximize survival of birds during migration.
    322. Manage winter areas to maximize survival of birds during winter.
        3221. Investigate the effects of human activities on winter survival.
        3222. Investigate the effects of environmental contaminants.

4. Preserve and enhance habitat.
    41. Provide protection and management of breeding habitat.
        411. Identify areas of essential breeding habitat.
        412. Continue to evaluate areas for consideration as essential breeding habitat.
        413. Establish liaison with agencies and organizations with land and water management responsibilities.
        414. Revise, establish, or utilize land and water laws and regulations to provide protection along rivers and lakes.
        415. Develop criteria and priorities for breeding habitat protection.
        416. Develop management plans for breeding habitat.
            4161. Determine direct, indirect and cumulative effects of manipulation of river hydraulics, flow regimes, and sediment discharge on breeding and foraging habitat.
            4162. Identify river flow regimes that will protect and enhance breeding and foraging habitat.
            4163. Determine the relationship of existing artificial breeding sites to river sites.
            4164. Identify need and techniques of improving habitat by management of substrate and by vegetation control through physical and/or non-toxic chemical means.
            4165. Study feasibility and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.
            4166. Develop lake and reservoir control policies where existing and potential interior least tern habitat is threatened.
            4167. Identify needs and techniques for managing water levels.
        417. Evaluate success of protection and management techniques.
    42. Provide protection and management of migration habitat.
    43. Provide protection and management of winter habitat.
        431. Identify areas of essential winter habitat.
        432. Develop criteria and priorities for winter habitat protection.
        433. Develop management techniques.
        434. Modify construction activities that may reduce or negatively alter winter habitat.
        435. Evaluate success of protection and management techniques.

5. Develop and implement an education program that publicizes information on the interior least tern, including its life history, reasons for

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current status, and options for recovery.

51. Inform and educate the public on the bird's plight and recovery efforts.
    511. Identify target audiences among the general public.
    512. Develop and distribute educational materials appropriate to various audiences.
    513. Develop materials for newspapers, radio, and television that highlight specific interior least tern projects.
    514. Provide controlled viewing opportunities if and when appropriate.
52. Inform and educate public resource management agencies.
    521. Identify critical resource agency constituents.
    522. Develop educational materials appropriate to respective agencies and their management authority.
    523. Provide public resource agencies with periodic updates on the interior least tern's status and progress of recovery efforts.

6. Coordinate recovery efforts.
    61. Designate a recovery plan coordinator.
        611. Coordinate research and management activities with federal,state, local and private organizations.
        612. Coordinate international research and management activities.
        613. Coordinate development of a public information program at the national and international level.

Narrative

The Narrative gives further details and justification for each task in the Step-Down Outline. The steps critical for recovery in the next three years are outlined and given priority in the Implementation Schedule.

1. Determine current distribution and population trends of the interior least tern.

The effectiveness of current conservation efforts will not be well-understood until comprehensive distribution and census data have been collected. Future plans for recovery also will be curtailed until a more accurate picture of the species status is defined.

11. Assess status and distribution of breeding populations.

Most interior least tern censusing has been carried out during the breeding season. Results indicate interior least terns are widely distributed, as scattered pairs or in concentrations at breeding areas. The terns probably disperse great distances as suggested by Boyd and Thompson (1985). Continued search for new breeding areas and evaluation of known areas are necessary to complete our knowledge of the birds' status.

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111. Survey sandbars, reservoir shorelines, sand and gravel pits and other suitable habitats to determine breeding distribution.
Currently, the distribution of the interior least tern on most of the Missouri River system is well-known and monitored, although reservoir shorelines in the Dakotas and Montana should be further surveyed for accurate population estimates especially during drought years when reservoir levels are low. Additional survey work is needed on the Loup River in Nebraska and elsewhere in the Platte River system. The Arkansas River system needs further survey work in Arkansas, Kansas, Oklahoma and Texas. The length of the Red River requires a thorough survey as does the Rio Grande River system and rivers in central Texas. Additional survey work is needed on the Lower Mississippi River to determine distribution when the river rises and floods nesting colonies. The Missouri Department of Conservation has a study in progress to address this need. The status of potential sites should be monitored and updated at least once every five years.

112. Develop a method for standardization of census techniques and timing.
The exposure of sandbars in the spring follows the reduction of river flows. The breeding cycle may commence at different times throughout the interior least tern's range. Differences in breeding chronology from south to north must be determined. Because of the length of time involved in surveying long stretches of rivers, surveys should be correlated with reported river levels and the exposure of sandbars. Surveys should account for renesting birds and later nesting by younger adults (Massey and Atwood 1981, Smith and Renken 1990).

113. Census known and potential breeding sites.
Once sites are identified as containing breeding pairs, annual censuses of breeding and non-breeding adults should be carried out at essential breeding habitat (Appendix 4) for several years. If the birds are established for several years, censusing should continue at least once every year.

114. Monitor reproductive success.
Census data provide an indication of an area's population size, but estimates of reproductive success are also necessary. More adults may be present in nesting areas than actually breed. Frequent nest destruction further lowers productivity of a site, rendering simple counts of breeding pairs less meaningful than censuses of adults and fledged chicks. Reproductive success or recruitment (measured in terms of number of chicks fledged per pair) should be monitored annually at essential sites and at least every three years, on a rotating basis, at other sites. Causes of reproductive failure should be identified whenever possible. Because of possible early fledgling departure from colonies, multiple counts of fledglings should be made for

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determination of the fledging rate (Thompson 1982, Thompson and Slack 1983).

115. Assess dispersal patterns and genetic diversity.
Little is known about the interaction between coastal least terns and the interior least tern. Boyd and Thompson (1985) found a nesting least tern in Kansas which had been banded as a chick on the Texas coast. It would be useful to know if coastal least terns serve as a reservoir to replenish the interior least tern population; and if the status of the coastal least tern population determines the numbers and distribution of interior least terns. Monitoring movements of marked birds in major breeding areas will fill the gap in our understanding of dispersal. Knowledge of how new nest sites are colonized, and where new birds originated will be useful in developing population management plans and models.

116. Assess mortality.
Factors such as human disturbance, predation, and water level regulation have reduced success of interior least tern eggs and chicks (Mayer and Dryer 1990). Factors affecting adult mortality, however, have never been fully addressed for any part of the annual cycle. Predation is a problem for some California and coastal least terns (Burger 1984, Minsky 1980, Massey 1981) and the closely allied little tern in Europe (Haddon and Knight 1983). During the breeding season, predation on interior least terns by coyote (Canis latrans), crow (Corvus brachyrhynchos), and raptors has been reported (G. R. Lingle, personal communication, Hill 1985, Kirsch 1990, Mayer and Dryer 1990) and predation on nesting adults by barred owls (Strix varia) has been recorded (Smith and Renken 1990). Predation is significant on the Missouri National Recreational River (U. S. Fish and Wildlife Service, unpublished data). It is important to determine the extent and cause of adult and juvenile mortality during the breeding season.

117. Further identify life history parameters and develop population models.
Field studies of interior least terns should be carried out without reducing reproductive success or site tenacity. Future breeding studies only should be undertaken after researchers have identified specific critical factors that require resolution in order to rehabilitate the species. It would be useful to compile all available life history data and develop a model to estimate potential population trends.

12. Assess status and distribution for the migration period.
Less is known about the migratory ecology for the interior least tern than for any other phase of the annual cycle. Migratory routes have not been adequately described for spring or fall. It is not known if interior least terns follow major river systems during migration or if they migrate directly north and south. Further, it is unknown if interior least terns join coastal least terns prior to coastal least tern migration to Latin America or if interior least terns have their own migration route. Before

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intensive individual field studies are undertaken, it may be beneficial to coordinate surveys of potential sites with natural resource employees or local birders to determine if interior least terns are stopping en route to wintering sites.

13. Assess status and distribution during the winter.
Interior least terns spend 6-7 months at wintering sites. Most field research, however, has been carried out on breeding birds. Factors limiting non-breeding birds may be as severe or worse than threats encountered during other times of the year. Field studies should begin to at least locate wintering sites.

131. Survey beaches and other suitable habitat to determine winter distribution.
Biologists familiar with the avifauna of Atlantic and Caribbean coastal Latin America should be contacted to assist in determining the winter distribution of least terns. A survey of the north coast of South America should be carried out to identify those habitat types used by least terns. However, the surveys may be difficult. Accessibility of coastal areas along central America and the northern coast of South America may be problematic for geographical and political reasons. Color-banded individuals would provide the means to distinguish interior least terns from other races or populations.

132. Census known wintering areas.
Once winter sites are known, censuses of important areas will provide an indication of their continuing importance and status as post-breeding sites.

133. Monitor movement of birds between wintering sites and assess mixing of populations.
It is not known if post-breeding interior least terns mix with coastal least terns at wintering sites. Once the habitat types of interior least terns are known, habitat protection can begin. Monitoring movements of birds between different sites will provide this information, as well as indicate the degree to which individuals from various breeding populations mix during the winter.

134. Assess mortality on wintering areas.
The extent and cause of mortality to post-breeding interior least terns has not been addressed. It is not clear if adults and juveniles suffer differential mortality, or if post-breeding birds face greater threats than do breeding birds. Any information leading to further delineation of threats to the species during this time will be important.

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2. Determine current habitat requirements and status.

Habitat alteration has been identified as one of the principal causes of the current status of the interior least tern (U. S. Fish and Wildlife Service 1985, Whitman 1988). Recovery of the species will be affected substantially by the ability to identify and protect essential breeding habitat and to intensively manage that habitat to maximize productivity and survival. Setting priorities for protection of remaining sites and determining habitat management actions will require detailed knowledge of interior least tern habitat requirements and the availability and quality of existing sites.

21. Determine breeding habitat requirements and status.

Our knowledge of interior least tern breeding habitat requirements has increased greatly during the past five years. Data on seemingly adequate but unoccupied habitat is needed. Comparison of habitat conditions among used sites along with data on reproductive success will provide the information necessary to set priorities for protection, and determine site-specific management actions to enhance breeding habitat.

211. Assess the characteristics, including prey resources, of breeding habitat.

The characteristics of breeding habitat must be investigated across the entire range of the interior least tern. At riverine sites, habitat variables to be measured should include: nesting area and height above water level, vegetative cover and distribution, substrate type, and river level fluctuations. Other variables may be of particular interest at local breeding areas. Measurements taken and methods employed at various breeding sites should be standardized to allow comparisons among areas. Few data are available on food resources at interior least tern breeding areas. Information on prey species occurrence and abundance are needed, as are estimates of the likelihood of food being a limiting habitat factor. The goals of these investigations should be identification of the range of habitat conditions tolerated by interior least terns, determination of habitat factors that affect nest densities, and elucidation of habitat conditions that may be related to maximum reproductive success rates.

212. Quantify and evaluate available breeding habitat.

As habitat assessment is undertaken, efforts to quantify existing interior least tern habitat should be initiated. The first task should be quantification of known and potential breeding habitat. As habitat quality data become available, existing sites should be evaluated with respect to habitat adequacy and deficiencies. Based on this information, recommendations for site protection or management actions should be given priorities. Remote sensing techniques such as aerial videography (Sidle and Ziewitz 1990) can be useful to quantify and, if possible, rate interior least tern breeding habitat. Sandbars are easily visible on satellite imagery of the Mississippi and Missouri Rivers. A catalog or compendium of interior least

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tern nesting areas should be developed.

213. Examine historic aerial photography and hydrographic surveys of river systems to determine the previous extent of potential habitat and vegetational changes.
For many rivers periodic aerial photographs and hydrographic surveys are available. It would be useful for predictive purposes to measure the change, if any, in the quantity and quality of sandbar habitat since photo and hydrographic coverage began (Hamel et al. in press, Rodekohr and Engelbrecht 1988, Sidle et al. 1989). Such an endeavor would allow an accurate forecast of habitat trends.

22. Determine current migration habitat requirements and status.
Because migration patterns of interior least terns are not understood, no information on habitat requirements or status is available. Once stop-over sites, if they exist, are determined, evaluation of habitat requirements should be undertaken.

221. Assess the characteristics, including prey resources, of migration habitat.
If stop-over sites are identified, the habitats used should be described and variables characterizing those habitats quantified. Quantification (time activity budgets) of how interior least terns use the available habitats and their length of stay at stop-over sites also should be determined.

222. Quantify and evaluate available migration habitat.
Once migratory habitats are identified and characterized, the availability of such habitats should be determined. Initially, habitat availability in the vicinity of known stop-over sites should be quantified and its quality assessed. If migratory habitat in the vicinity of current stop-over sites is limited, a large scale survey of available habitat along suspected migratory corridors should be made.

23. Determine current habitat requirements and status on wintering areas.
No data are available on interior least tern winter habitat requirements. This task should be undertaken followed by a determination of the extent to which wintering habitats are traditionally used. Information on the role of winter habitat abundance, distribution, and quality in interior least tern population dynamics is totally lacking. Data relating winter habitat conditions to population status are needed.

231. Assess the characteristics, including prey resources, of winter habitat.
As primary wintering areas are identified, characteristics of the habitats used by interior least terns must be quantified and variables affecting quality of those habitats elucidated. Winter habitats should be assessed with regard to interior least tern prey abundance and distribution, roost site needs, and location of feeding and roosting habitat. Habitat characteristics near occupied sites, but not currently used by interior least terns, also should be assessed. Quantitative data on interior least tern use of winter habitats also are needed. Information on movements

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among wintering areas, movements among habitats, time-activity budgets, the use of pre-migration staging areas, etc., may provide important information on habitat quality. The goal of these studies should be identification of habitat features that affect winter survival of interior least terns, assure adequate pre-breeding condition, and favor mixing among individuals from local breeding populations.

232. Quantify and evaluate winter habitat.
After baseline information on habitat characteristics and quality is available, the amount and distribution of winter habitat should be determined. Additionally, the quality of existing habitat should be rated and deficiencies identified. This effort may involve development of remote sensing techniques to identify and monitor winter habitat. Based on data generated under steps 231 and 232 the likelihood of winter habitat quantity limiting the growth of the interior least tern population should be evaluated. If winter habitat is found to be limited, further recommendations should be developed on the need for habitat protection or management of specific sites.

233. Eliminate current or potential threats to winter habitat.
As winter habitat is identified, current and potential threats to each site should be determined. Priority should be given to sites currently used by interior least terns. It is important to not only identify threats that could destroy winter habitats, but also those that could result in lowering the quality of remaining sites. Habitat ownership will have to be taken into consideration when assessing threats to the species.

3. Protect, enhance, and increase interior least tern populations.
Legal protection is often not enough to ensure perpetuation of breeding populations. Active management actions, including predator management, restricted access, and water level management are critical components of a comprehensive protection plan.

31. Protect, enhance, and increase populations during the breeding season.
To date, breeding activity of interior least terns has been more thoroughly investigated than activities at other times of the year. Current surveys have now identified most of the nesting areas in the U. S. Extensive survey work and research investigations of several major breeding areas have helped delineate many factors contributing to the species' current status, thus enabling the development of specific recommendations that may enhance the species' survival during the reproductive season.

311. Increase reproduction and survival at occupied breeding sites.
Activities that reduce interior least tern reproductive success and survival on its breeding grounds are probably among the principal factors responsible for the species' current status. Actions directed at eliminating or

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minimizing such impacts are essential to the interior least tern's recovery.

3111. Evaluate predator impacts on eggs and chicks and identify species responsible for the predation.
Predation can be high in California and coastal least tern colonies (Atwood et al. 1979, Burger 1984, Massey 1981). Surveys on the Lower Mississippi River revealed that nest predation, especially by coyotes, has substantially reduced reproductive success at certain colonies. The vulnerability of terneries to such predation increases when island habitat accretes to the shoreline during periods of low water (Smith and Renken 1990). Studies conducted in the Missouri River system have documented a high percentage of interior least tern egg and chick loss to predation (Nebraska Game and Parks Commission, unpublished data, Mayer and Dryer 1990). During 1987-1989, predation accounted for most of the nest losses on the Platte River except riverine nests on the central Platte where flooding caused the mortality (Kirsch 1990, Lingle 1989). Both avian and mammalian species are among the suspected predators. Further studies that document such losses should continue. Investigations that focus specifically on identifying predators, and the cues they use in locating nests and/or chicks, determining the time of predation, etc., are necessary if egg and chick mortality are to be curtailed.

3112. Evaluate techniques for predator management and implement where appropriate.
Lethal and non-lethal methods for managing mammalian predators have been extensively developed for other wildlife management purposes. They include: eliminating or relocating the animal, erecting electric fences, and developing taste aversions. Electric fences have been used to protect nesting California and coastal least terns (Massey and Atwood 1980, 1982; Minsky 1980). The applicability of these and other techniques (e. g. predator exclusion cages) to the interior least tern should be investigated. Few management efforts have focused on managing avian predators, such as common ravens (Corvus corax), American crows, great horned owls (Bubo virginianus), great blue herons (Ardea herodias), California gulls (Larus californicus), and ring-billed gulls (L. delawarensis). Appropriate management measures should be implemented at interior least tern sites that are now experiencing significant and repeated loss due to predation.

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3113. Restrict public use within nesting areas and investigate enforcement options.

Disturbance of California and coastal least tern colonies caused by foot traffic and recreational vehicles has been well-documented (Massey and Atwood 1979, Goodrich 1982, Burger 1984) and is also true for interior least terns (Schwalbach 1988, Kirsch 1987-90, Lingle 1989, Smith and Renken 1990). Losses incurred by these activities can be direct, by destroying eggs and chicks, as well as indirect, by inhibiting territory establishment, feeding behavior, incubation and other reproductive behavior. A variety of techniques that restrict access to nesting areas have been successful in a few states and should be implemented on a wider scale. These include posting, restricted access, and fencing (Morris 1979, 1980; Larkins 1984, Massey and Atwood 1979). Because many interior least tern nesting areas are located in remote areas, strict enforcement of regulations is often impractical. Although the site may receive substantial recreational use, budget restrictions rarely allow full-time monitoring by professional staff. It is essential, therefore, that actions to restrict recreational activities always be accompanied by an aggressive public relations effort that will effectively reach all potential visitors to an area and adequately explain the purpose of the regulations. "Tern wardens" who patrol nesting areas to explain the restrictions, should be considered for particularly important breeding areas (McCulloch 1982). The U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service, and state wildlife agencies could become involved in public relations efforts and patrols to protect interior least tern nesting areas on the river systems. Agents of the Missouri Department of Conservation maintain an active enforcement program at Mississippi River terneries. Similar state and federal enforcement endeavors have begun on the Missouri River in North and South Dakota, and Nebraska, and on the Platte River in Nebraska. Field research on interior least terns should be carefully examined for its effects on the reproductive success of the birds (Brubeck et al. 1981). Research proposals should be scrutinized for their benefit to interior least tern recovery.

3114. Manage water levels and river flows to reduce nest and chick loss.

A significant proportion of the interior least tern population resides along rivers where much habitat has been destroyed by reservoir construction, channelization, water depletion, vegetative

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encroachment, and modification of flow regimes (Currier et al. 1985, Nebraska Game and Parks Commission 1985b, Schwalbach et al. 1986, 1988, Eschner et al. 1981, Smith and Stucky 1988, Sidle et al. 1989). This riverine habitat is subject to a number of additional threats, including untimely water releases from dams that flood sandbar nesting habitat (Dryer and Dryer 1985, Schwalbach et al. 1986, 1988; Schwalbach 1988, G. R. Lingle, personal communication). Managing water levels early in the spring along some rivers could help to resolve this problem. Nesting habitat, expected to be flooded late in the season, could be submerged when interior least terns begin establishing territories in early May, forcing them to seek higher grounds that would be safe throughout the nesting season. It is essential, however, that sufficient nesting habitat is available above the fluctuation zone. High waters in spring also helps keep sandbars devoid of vegetation by reducing sprouting of young herbaceous growth and by increasing deposition of coarse sediments (Currier et al. 1985, O'Brien and Currier 1987).

Annual flow regimes need to be developed for many river segments where interior least terns occur. For example, along the central Platte River the Service has developed flow recommendations to support a variety of wildlife including least tern nesting habitat and the bird's forage fish (Table 8). These recommendations have been accepted by the Federal Energy Regulatory Commission as part of the annual relicensing of upstream water projects in Nebraska (Sidle et al. 1990). The water releases will occur on the North Platte River, far upstream of interior least tern nesting habitat. The Ohio River has a major effect on the availability of interior least tern habitat in the lower Mississippi River. Management of this river and other rivers throughout the bird's range need to be examined for their effect on the interior least tern and its habitat.

3115. Modify or eliminate construction activities that adversely impact reproductive success of interior least terns.

Recreational and residential development along river fronts should be discouraged in nesting areas. Proposals for maintenance or development activities that do not directly disturb breeding habitat but that occur in the vicinity of nest sites should be closely scrutinized for their potential impact.

3116. Investigate the effects of environmental contaminants during the breeding season.

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Contaminant effects on interior least terns are unknown. It would be useful to at least collect addled eggs during surveys and field studies for later contaminant analysis.

32. Protect and enhance populations during migration and winter.
Each year, 30 percent or less of the interior least tern's time is spent on the breeding grounds. A comprehensive protection plan also should focus on the species survival during migration and winter. However, migration and winter are the most poorly understood stages of the bird's life cycle and little can be recommended until migratory patterns are determined. The delineation of key areas where interior least terns spend non-breeding months is a critical step to enable the protection measures necessary for the birds' survival year-round.

321. Manage areas to maximize survival during migration.
Nothing is currently known about either the extent or causes of mortality that interior least terns might encounter during migration. Work that focuses on delineating migration routes (Step 12) should be expanded to focus on causes of mortality as well. When appropriate, measures should then be taken to lessen the impact upon the species.

322. Manage winter areas to maximize survival during winter.
During winter, interior least terns probably use open habitats. Sand, gravel, and/or cobbled marine beaches may be selected, as well as intertidal beach bars and flats.

3221. Investigate effects of human activities on winter survival.
Recreational, residential, and industrial developments each pose a potential threat to interior least terns by increasing the level of human activity. Moreover, hunting of terns in Latin America may be a factor. To date, research studies have focused primarily on describing the impacts of human activities on nesting grounds. Future efforts also should be directed at collecting similar data from wintering areas, once such areas are discovered.

3222. Investigate the effects of environmental contaminants in wintering areas.
During surveys for interior least tern wintering areas, attention should be paid to coastal pollution. Chemical use and its impacts on foreign wintering areas should be evaluated.

4. Preserve and enhance habitat.
Because of major habitat losses and increasing demands on available habitat, protecting and enhancing existing and potential interior least tern habitat is a major concern. Important breeding areas have been identified but enhancement and protection of essential habitat has been limited. Little is known about those areas along the migration route or on the wintering grounds.

41. Provide protection and management of breeding habitat.
Essential breeding habitat (Appendix 4) will need delineation,

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protection, and enhancement to provide for recovery of the species. Efforts should include increased management activities to provide better use and protection of existing and potential areas. Compatibility of other uses (e.g., recreation) for breeding areas should be defined. All essential habitat needs permanent protection, where possible, through appropriate fee title acquisition, permanent easement, cooperative agreements, and memorandums of agreement or understanding among federal agencies and private organizations (Appendix 2).

411. Identify areas of essential breeding habitat.
Essential Habitat is listed in Appendix 4 to highlight known areas to be protected.

412. Continue to evaluate areas for consideration as essential breeding habitat.
Recognizing the fragile nature of much of the interior least tern's breeding habitat, continued evaluation and designation of essential habitat in primary breeding areas will protect areas from detrimental development.

413. Establish liaison with agencies and organizations with land and water management responsibilities.
Due to increasing pressure for development and use of land and water resources to meet human needs, efforts should be made to communicate with agencies, organizations, and individuals whose decisions affect the future of interior least tern habitat. The purpose would be to resolve conflicts between known development actions and future conflicts through planning of land and water development.

414. Revise, establish, or utilize land and water laws and regulations to provide protection along rivers and lakes.
Increasing demands for agricultural land and urban development, wetland drainage, power generation, water for irrigation, recreational space, and operation of river reservoirs have threatened or destroyed interior least tern habitat. Enforcement of laws and regulations, particularly those involving instream flow protection, 404 permits, and endangered or threatened species habitat protection, is needed to restrict or modify such developments on the remaining essential interior least tern habitat. All land- and water-use legislation should be scrutinized for potential impact to interior least tern habitat. Undesirable legislation should be modified and laws enacted that will expand the consideration given wildlife during water and land development planning.

415. Develop criteria and priorities for breeding habitat protection.
To provide adequate protection, some habitat will have to be purchased in fee title, or placed under a protective easement or cooperative landowner agreement. Although permanent protection of essential areas usually will be preferred, in some instances, temporary protection of ephemeral nesting areas may be achieved through agreements with private parties and public authorities. Protection of

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areas listed as essential habitat (Appendix 4) is based upon tradition of occupancy, number of birds present, site productivity, proximity to other protected sites, imminence of habitat destruction, and ephemeral nature of the site.

416. Develop management plans for riverine breeding habitat. Techniques may vary from site to site depending on need and opportunity, but plans should be developed for management of essential riverine habitat (see Step 2).

4161. Determine direct, indirect, and cumulative effects of manipulation of river hydraulics, flow regimes, and sediment discharge on breeding and foraging habitat.

Manipulation of river flow regimes and river hydraulics through water diversion, storage of flows by dams, discharge from dams for power generation, navigation and irrigation demands, bank stabilization, and channelization has significantly altered the natural dynamic processes responsible for loss and creation of sandbars used for nesting (Nunnally and Beverly 1986, Sandheinrich and Atchison 1986, Smith and Stucky 1988). As a result, breeding habitat could be lost at a higher rate than what is being created. Modifications of river flow regimes through operation of reservoirs and lock and dams also has caused concern for long-term effects of riverbed degradation on interior least tern habitat. Although many direct effects of human manipulations have been identified, suspected indirect and cumulative impacts of ongoing and future river developments need to be determined. Under Section 7 of the Endangered Species Act the U. S. Fish and Wildlife Service and the U. S. Army Corps of Engineers have consulted on the effects of proposed dams in the Platte River system, and are consulting on the effects of main stem dam operations on interior least terns along the Arkansas and Missouri Rivers (U. S. Fish and Wildlife Service 1987b, 1987c, 1989, 1990). Section 7 consultation provides an opportunity to protect much of the interior least tern's breeding habitat.

4162. Identify river flow regimes that will protect and enhance breeding and foraging habitat.

Control of river flows is desirable to prevent inundation of nests and young (Nebraska Game and Parks Commission 1985c), discourage growth of woody vegetation, and to maintain a river with a nutrient base necessary for production of fish used as food by interior least terns. Proper instream flow is a major goal of ongoing Section 7 consultations regarding the interior least tern.

4163. Determine the relationship of existing artificial breeding sites to river sites.

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California and coastal least terns readily use man-made habitats. Islands, spoil piles, and beaches formed by dredged sand and gravel, and located immediately adjacent to the Platte River in Nebraska and elsewhere are used by interior least terns. A large percentage of the Platte River breeding population of interior least terns nests at sand and gravel pits. Dike fields are commonly used along the Mississippi River (Hamel et al. in press, Landin et al. 1985, Rumancik 1987, Smith and Renken 1990). Terns may use barges filled with sand on river segments now devoid of sandbar habitat. The importance of artificial habitat to recovery of the species, and to what extent such habitat can replace lost natural sandbars, should be determined.

4164. Identify need and techniques of improving habitat by management of substrate and by vegetation control through physical and/or non-toxic chemical means.

Existing woody vegetation may have to be removed from sandbars to provide suitable nesting habitat through physical or chemical means. Annual control may be necessary. Dredging and spreading sand or gravel of particular particle size could improve substrates for nesting and increase the height of sandbars to prevent continuous inundation. Currently, the U. S. Army Corps of Engineers and the Platte River Whooping Crane Habitat Maintenance Trust have been clearing islands on the Missouri and Platte Rivers, respectively.

4165. Study feasibility and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.

A variety of techniques have been used to create artificial nesting sites for the California and coastal least terns and to attract terns to the sites (Massey 1981, Fancher 1984, Kotliar and Burger 1984). Creation of artificial habitat may be necessary in areas where manageable habitat is non-existent. This may be particularly important in areas where natural habitat has been lost to channelization and water diversion. For example, most of the lower Missouri River (Iowa, Kansas, Missouri, and Nebraska) is now a channel and artificially created sites (e.g., ash disposal sites at power stations in Iowa) (Wilson 1984, 1986; Dinsmore and Dinsmore 1989) are the only habitat available. As part of the annual relicensing effort for upstream water projects along the Platte River in Nebraska, restored least tern nesting habitat has been ordered by the Federal Energy Regulatory Commission for each bridge segment in the central Platte (Sidle et al. 1990). Additional restoration

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will be needed elsewhere along the Platte River. Habitat on the Cimarron River appears to be progressively deteriorating from upstream to downstream as the channel narrows and woody vegetation encroaches. Vegetation control likely will be necessary to maintain essential habitat. Likewise, habitat restoration will be necessary if least terns are to recover in the Iowa and Missouri reaches of the Missouri River. In the Mississippi River, the Missouri Department of Conservation and the U. S. Army Corps of Engineers have developed a cooperative proposal to construct two artificial islands between St. Louis and Cape Girardeau, Missouri. Smith and Stucky (1988) discussed other recommendations, including modification of dike structures.

4166. Develop lake and reservoir control policies where existing and potential habitat is threatened.
Water levels affect interior least tern reproductive success by increasing or decreasing the amount of habitat available on the shoreline of reservoirs (e. g., Lakes Oahe and Sakakawea in the Dakotas, and Salt Plains National Wildlife Refuge, Oklahoma) and in dike fields. Changes in these levels during critical periods may delay initiation of nesting, flood nest sites or feeding areas, or increase the distance from nest sites to the water's edge. Lakes and reservoirs with interior least tern habitat must be identified and any policies controlling water levels need to be scrutinized to determine the effect on interior least tern reproductive success.

4167. Identify needs and techniques for managing water levels.
Lakes and reservoirs currently supporting nesting interior least terns or that provide suitable nesting habitat should be evaluated to determine if water level management is feasible. Where feasible, techniques should be developed to manage water levels to improve reproductive success.

418. Evaluate success of protection and management techniques.
Monitoring must be sufficient to detect and measure the positive effects of protection and management and to avoid potentially detrimental impacts on interior least tern habitat. Daily and seasonal activity patterns of interior least terns, along with locations of specific nesting areas, will provide key measures of the birds' response to various management practices. Monitoring vegetation to determine where changing habitat conditions exist and monitoring potential predator levels in the area should be considered. All techniques used to improve interior least tern habitat should be evaluated to determine their cost-efficiency.

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42. Provide protection and management of migration habitat.
If migration sites are identified, their protection and enhancement will be essential. At that point, assessment of further needs of migrating interior least terns will be carried out. As stop-over habitats are identified, current and potential threats to those sites should be delineated. On publicly-owned sites, current land-use patterns or management actions that could conflict with interior least tern use of existing habitats should be identified. Feasibility of protecting major privately-owned stop-over sites should be assessed.

43. Provide protection and management of winter habitat.
Survival and continued existence of the species may depend on availability of suitable winter habitat. Furthermore, reproductive success of adults may partially be a function of their physical condition as they begin spring migration. Consequently, the quality and quantity of winter habitat may limit recovery of the species.

431. Identify areas of essential winter habitat.
Essential winter habitat first needs to be identified by surveys in Latin America.

432. Develop criteria and priorities for winter habitat protection.
Once further research is carried out in wintering areas, factors will be identified as being essential for winter habitat. At that point, a land protection strategy should be developed. Areas that support the greatest number of interior least terns, especially those supporting individuals from important sub-populations should be given priorities in a habitat management/protection plan.

433. Develop management techniques.
Once actual and/or potential interior least tern wintering habitat is identified, methods of managing those habitats should be developed and improved so that wintering habitat is of sufficient quantity and quality to accommodate and promote expansion of interior least tern populations to more stable levels.

5. Develop and implement an education program that publicizes information about the interior least tern, including its life history, reasons for current status and options for recovery.
Conservation of coastal least terns has benefitted greatly from public information endeavors (Jackson and Jackson 1985, Toups 1976). The interior least tern's successful recovery will depend on curtailing and/or redirecting human recreation and development activities. Therefore, resource managers and the general public should be provided with sufficient information to explain and justify changes in previous actions. Current efforts to develop a public information program have made an impressive start in this direction but must be intensified. These efforts also could benefit from better coordination at the national level to target specific audiences.

51. Inform and educate the public on the bird's plight and recovery efforts.
The first priority in developing a public information program

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should be to educate the general public about the significance and value of the interior least tern. The public's support and cooperation ultimately will be essential to the species full recovery.

511. Identify target audiences among the general public.
Materials prepared to increase public awareness and appreciation of the interior least tern can be more effective if they are developed to meet specific interests and concerns of a particular audience. Time should be spent delineating which public groups are affected, either directly or indirectly, by interior least tern conservation efforts and how each audience can best be reached.

512. Develop and distribute educational materials appropriate for various audiences.
Current efforts should be expanded to make greater use of the various media, including newspapers, radio, and television. The primary focus of this task should be to provide background information describing the interior least tern's life history and habitat requirements and to describe how human activity/disturbance can threaten the survival of interior least terns. The public should also be made aware of the necessity to enact local regulations to protect the interior least tern. However, information materials should not increase the potential for observer disturbance to nesting birds. The Service's Tulsa office has produced an information brochure useful throughout the range of the interior least tern.

513. Develop materials for newspapers, radio, and television, that highlight specific interior least tern projects.
In several states, cooperative projects between state and federal agencies, as well as private organizations and individuals are underway to protect interior least terns. Such efforts which generate public support should be applauded and widely publicized, particularly at the local level.

514. Provide controlled viewing opportunities if and when appropriate.
Guided opportunities for observing interior least terns may be one of the best vehicles for generating public support and concern. Led by a qualified biologist under conditions that minimize or prevent disturbance to the birds, such trips can educate visitors first-hand about the need for strong protection and curtailment of some recreational activities.

52. Inform and educate public resource management agencies.
Some interior least terns occur on lands that are protected and/or managed by state and federal resource agencies. Recreation permitted on these areas (e.g., hiking, vehicle use, camping) can reduce the bird's reproductive success. In some areas an agency's own activities may also pose a threat (e.g., control of water levels in lakes and along rivers). Contact with

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these agencies will facilitate better management of the areas for interior least terns.

521. Identify critical resource agency constituents.
Each resource agency (including state, federal, and private organizations) whose activities can impact the interior least tern should be identified.

522. Develop educational materials appropriate to respective agencies and their management authority.
Resource managers need to be provided with basic life history information about the interior least tern as well as specific management information and recommendations directly pertinent to their area of responsibility.

523. Provide public resource agencies with periodic updates on the interior least tern's status and progress of recovery efforts.
It is important that each public agency responsible for ensuring the interior least tern's survival, either directly or indirectly, be kept abreast of the success of their efforts at both the local and national level. Periodic updates not only inform them of progress being made, but also remind them of their responsibilities to the conservation of interior least terns.

6. Coordinate recovery efforts.
Development of a recovery plan for interior least terns involves coordination of biologists, agencies, and governments so that the most comprehensive, up-to-date information is collected and disseminated in an efficient way. Proper coordination would also help ensure rapid implementation of those actions necessary for full recovery.

61. Designate a recovery plan coordinator.
Designation of a coordinator is recommended. Duties of the coordinator would include: a) coordination of the implementation of the recovery plan; b) naming an individual in each state to coordinate and implement recovery tasks; c) monitoring execution of the plan's implementation schedule; d) maintaining collaboration with state, federal, and international agencies; disseminating critical annual data; and coordinating range-wide research activities for interior least terns. A least tern contact person should also be designated for each state.

611. Coordinate research and management activities with federal, state, local, and private organizations.
Efficient achievement of recovery goals will be enhanced through coordination of research and management with private and governmental agencies. For example, it would be useful to establish and coordinate an international banding scheme whereby birds can be easily identified throughout the annual cycle. The recovery plan outlines many facets of interior least tern conservation that require urgent investigation. Repetition of efforts due to lack of coordination will slow the recovery process and may cause undue disturbance to the birds.

612. Coordinate international research and management activities.
Development of population management plans on an

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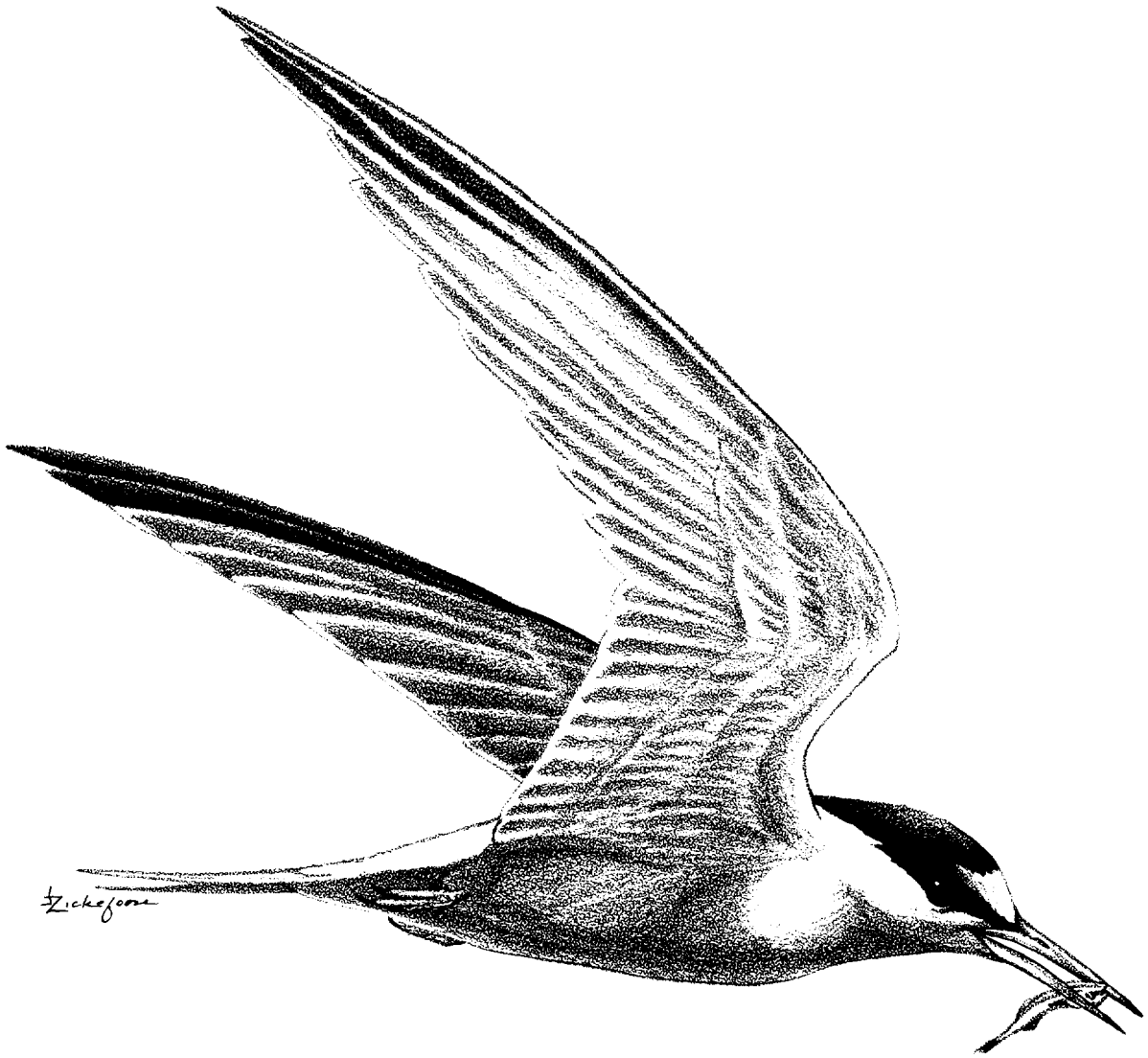
international scale may be necessary. Interior least terns probably winter in Latin America and coordination with various nations and international conservation organizations may be necessary.

613. Coordinate development of a public information program at the national and international level.
Information and educational materials developed in one river system could be of equal benefit in other river systems. Some materials also may be helpful to states that support wintering populations. Coordination at the federal level will reduce duplication of effort and encourage more efficient use of time and money at the state level. A coordinated approach to raising an awareness of the interior least tern's plight at the international level would ensure protection throughout its range.



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III. IMPLEMENTATION

The Implementation Schedule outlines and gives priorities to tasks deemed necessary to be undertaken in the next three years to maximize recovery of the interior least tern. This process will be reviewed every three years until the recovery objective is met. Therefore, priorities and tasks may change in the future.

KEY TO IMPLEMENTATION SCHEDULE
General Category (Column 1):

Information and Research (I,R)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomy
6. Demographic studies
7. Propagation
8. Migration
9. Wintering
10. Predation
11. Competition
12. Disease
13. Environmental contaminant
14. Reintroduction
15. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

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Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Desease control
7. Pollution control
8. Public information
9. Other information

Priority (column 4) :

1. Those actions absolutely necessary to prevent extinction of the species in the foreseeable future.

2. Those actions necessary to maintain the species' current population status.

3. All other actions necessary to provide for full recovery of the species.

Agency Responsibility (column 6):

USFWS Regional Office 2 - Albuquerque
3 - Twin Cities
4 - Atlanta
6 - Denver
USFWS Research = 8
USFWS Office of Migratory Bird Management = OMBM
USFWS Office of International Affairs = IA
SA = State Wildlife Agency
BR = Bureau of Reclamation
COE = U. S. Army Corps of Engineers
NPS = National Park Service
WCHT = Platte River Whooping Crane Habitat Maintenance Trust
CW = Colonial Waterbirds

MO = Missouri River System
MS = Mississippi River System
AR = Arkansas River System
RE = Red River System
RG = Rio Grande River System

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IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3
I1	Survey, census and monitor breeding populations	111-114	2 (MO)	Annual	Regions 3,6	SA, COE	$15K	$15K	$15K
			2 (MS)	Annual	Regions 3,4	SA, COE	$15K	$15K	$15K
			2 (AR)	Annual	Regions 2,4	SA, COE	$20K	$20K	$20K
			2 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA	$10K	$10K	$10K
I6, R6	Assess mortality and identify life history parameters (including population modeling)	116-117	3 (MO)	Annual	Regions 3,6	SA, WCHT	$10K	$10K	$10K
			3 (MS)	Annual	Regions 3,4	SA, COE	$10K	$10K	$10K
			3 (AR)	Annual	Regions 2,4,6	SA, COE	$10K	$10K	$10K
			3 (RE)	Annual	Region 2,4	SA, COE	$10K	$10K	$10K
			3 (RG)	Annual	Region 2	SA	$10K	$10K	$10K
R9, R1 R6	Survey and census winter populations	131-132	2	Annual	8,OMBM,IA	CW	$35K	$35K	$15K
I2, R3	Quantify and evaluate breeding habitat and threats	211-213	2 (MO)	2 years	Regions 3,6	SA, BR, WCHT	$15K	$10K	$10K
			2 (MS)	2 years	Regions 3,4	SA, COE	$15K	$15K	$15K
			2 (AR)	2 years	Regions 2,4,6	SA, COE	$15K	$15K	$15K
			2 (RE)	2 years	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	2 years	Region 2	SA	$10K	$10K	$10K
M4, R10	Evaluate predator impacts; evaluate predator management techniques and implement	3111-3112	2 (MO)	Annual	Regions 3,6	SA, WCHT	$15K	$15K	$10K
			2 (MS)	Annual	Regions 3,4	SA, COE	$10K	$10K	$10K
			2 (AR)	Annual	Regions 2,4,6	SA, COE	$15K	$15K	$15K
			2 (RE)	Annual	Regions 2,4	SA	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA	$ 5K	$ 5K	$ 5K

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IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3
M8, M9	Restrict human and vehicular access to nesting areas	3113	2 (MO)	Annual	Regions 3,6	SA, COE	$15K	$15K	$15K
			2 (MS)	Annual	Regions 3,4	SA	$10K	$10K	$10K
			2 (AR)	Annual	Regions 2,4,6	SA, COE	$15K	$15K	$15K
			2 (RE)	Annual	Regions 2,4	SA	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA	$ 5K	$ 5K	$ 5K
M3, M9	Manage water levels to réduce nest and chick loss	3114	1 (MO)	Annual	Regions 3,6	COE	$20K	$20K	$20K
			1 (MS)	Annual	Regions 3,4	COE	$15K	$15K	$15K
			1 (AR)	Annual	Regions 2,4,6	COE, BR	$10K	$10K	$10K
			1 (RE)	Annual	Regions 2,4	COE	$ 5K	$ 5K	$ 5K
			1 (RG)	Annual	Region 2	COE	$ 5K	$ 5K	$ 5K
I2	Identify essential breeding habitat	411-412	2 (MO)	Ongoing	Regions 3,6	SA			
			2 (MS)	Ongoing	Regions 3,4	SA			
			2 (AR)	Ongoing	Regions 2,4,6	SA			
			2 (RE)	Annual	Regions 2,4	SA			
			2 (RG)	Annual	Region 2	SA			
M3	Establish liaison to protect breeding habitat	413	3 (MO)	Annual	Regions 3,6	SA, COE, BR			
			3 (MS)	Annual	Regions 3,4	SA, COE			
			3 (AR)	Annual	Regions 2,4,6	SA, COE, BR			
			3 (RE)	Annual	Regions 2,4	SA, COE			
			3 (RG)	Annual	Region 2	SA			
M9	Revise or establish laws to protect breeding habitat	414	3 (MO)	Annual	Regions 3,6	SA			
			3 (MS)	Annual	Regions 3,4	SA			
			3 (AR)	Annual	Regions 2,4,6	SA			
			3 (RE)	Annual	Regions 2,4	SA			
			3 (RG)	Annual	Region 2	SA			

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IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3
R2, R3	Develop criteria and priorities for habitat protection	415	3 (MO)	1 year	Regions 3,6	SA			
			3 (MS)	1 year	Regions 3,4	SA			
			3 (AR)	1 year	Regions 2,4,6	SA			
			3 (RE)	1 year	Regions 2,4	SA			
			3 (RG)	1 year	Region 2	SA			
R3, M3	Develop river management plans	416	1 (MO)	Annual	Region 6	SA, COE, WCHT	$15K	$15K	$15K
			1 (MS)	Annual	Region 4	SA, COE	$10K	$10K	$10K
			1 (AR)	Annual	Regions 2,4,6	SA, COE, BR	$10K	$10K	$10K
			1 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			1 (RG)	Annual	Region 2	SA, COE, BR	$ 5K	$ 5K	$ 5K
R1, R2	Determine effects of river hydraulics and sediment discharge on breeding habitat; identify flow regimes to protect habitat	4161-4162	1 (MO)	Annual	Region 6	SA, COE, BR WCHT	$25K	$25K	$25K
			1 (MS)	Annual	Region 4	SA, COE	$20K	$20K	$20K
			1 (AR)	Annual	Region 2,6	SA, COE, BR	$20K	$20K	$20K
			1 (RE)	Annual	Region 2	SA, COE	$10K	$10K	$10K
			1 (RG)	Annual	Region 2	SA, COE	$10K	$10K	$10K
R3	Determine relationship of existing artificial breeding sites to riverine sites	4163	2 (MO)	2 years	Region 6	SA	$10K	$10K	$10K
			2 (MS)	3 years	Region 4	SA, COE	$10K	$10K	$10K
			2 (AR)	2 years	Regions 2,6	SA	$10K	$10K	$10K
			2 (RE)	2 years	Region 2	SA	$ 5K	$ 5K	$ 5K
			2 (RG)	2 years	Region 2	SA	$ 5K	$ 5K	$ 5K
M3	Modify and/or eliminate construction activities that impact breeding habitat	418	2 (MO)	Annual	Regions 3,6	SA, COE	$ 5K	$ 5K	$ 5K
			2 (MS)	Annual	Regions 3,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (AR)	Annual	Regions 2,4,6	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA, COE	$ 5K	$ 5K	$ 5K

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IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3
M8	Inform and educate the public	511-513	2 (MO)	Annual	Regions 3,6	SA, COE	$ 5K	$ 5K	$ 5K
			2 (MS)	Annual	Regions 3,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (AR)	Annual	Regions 2,4,6	SA, COE, BR	$ 5K	$ 5K	$ 5K
			2 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA, COE	$ 5K	$ 5K	$ 5K
M8, M9	Inform and educate public resource management agencies	52	3 (MO)	Annual	Regions 3,6	SA, COE			
			3 (MS)	Annual	Regions 3,4	SA, COE			
			3 (AR)	Annual	Regions 2,4,6	SA, COE			
			3 (RE)	Annual	Region 2	SA, COE			
			3 (RG)	Annual	Region 2	SA, COE			
M9	Coordinate recovery efforts	61	2	Annual	Regions 2,4,6	SA, COE			

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APPENDIX 1

Contact People

The following individuals have offered to provide interested parties with information pertaining to interior least terns in their area.

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APPENDIX 2

Agreements Necessary For Protection Of Essential Habitat

1. Memorandum of Understanding should be developed between the U. S. Army Corps of Engineers, National Park Service, U. S. Fish and Wildlife Service, and the State wildlife agency, for permanent protection and management (vegetation clearing, law enforcement, public relations, etc.) of all essential habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

2. U. S. Fish and Wildlife Service, National Park Service, and U. S. Army Corps of Engineers should acquire easements and/or fee title of essential interior least tern habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

3. Memorandum of Understanding should be developed between the U. S. Army Corps of Engineers, U. S. Bureau of Reclamation, U. S. Fish and Wildlife Service, Platte River Whooping Crane Habitat Maintenance Trust, and the state wildlife agency, for the permanent protection and management of all essential habitat on the Platte River system in Nebraska.

4. The U. S. Fish and Wildlife Service should provide land protection of essential interior least tern habitat on the Platte River system.

5. Memorandum of Understanding should be developed between the U. S. Army Corps of Engineers, State natural resource agency, and the U. S. Fish and Wildlife Service for the permanent protection and management of essential habitat on the Mississippi and Ohio Rivers.

6. Memorandum of Understanding should be developed between the U. S. Fish and Wildlife Service, State wildlife agency, and the U. S. Army Corps of Engineers governing the deposition of dredge spoils on the Mississippi and Ohio Rivers for purposes of enhancing or creating interior least tern habitat.

7. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U. S. Section of the International Boundary and Water Commission, State wildlife agencies, and appropriate agencies in Mexico for permanent protection and management of all essential habitat in the Arkansas, Red, and Rio Grande Rivers basins in Kansas, Oklahoma, Arkansas, and Texas.

8. U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and The Nature Conservancy should acquire easements and/or fee title of essential interior least tern habitat in the Arkansas, Red, and Rio Grande river basins in Kansas, Oklahoma, Arkansas, and Texas.

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9. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service, State wildlife agencies, and the U.S. Army Corps of Engineers governing removal and deposition of dredge spoil from the McClellan-Kerr Arkansas River Navigation System, in Oklahoma and Arkansas, for purposes of enhancing or creating least tern habitat.

Appendix 3. Example of a memorandum of understanding

MEMORANDUM OF UNDERSTANDING

The Nature Conservancy
U.S. Army Corps of Engineers
Oklahoma Department of Wildlife Conservation
U.S. Fish and Wildlife Service
Tulsa Audubon Society
River Parks Authority

WHEREAS _____, an Oklahoma corporation, ("Owner") has acquired certain lands and riverbeds on the Arkansas River floodplain in Tulsa County, Oklahoma, as more particularly shown on the plat attached hereto as Exhibit A (the "Property"); and

WHEREAS said Property has special value for wildlife including nesting populations of the endangered Interior Least Tern, Stern antillarum athalassos; and

WHEREAS The Nature Conservancy ("Conservancy"), a private, nonprofit organization committed to the conservation and management of rare and endangered species, communities, and ecosystems, has expressed an interest to coordinate the efforts of local, state, and federal agencies in protecting the Least Tern; and

WHEREAS The United States Army Corps of Engineers ("Corps") has certain water management responsibilities on the Arkansas River that might affect the habitat of the Least Tern; and

WHEREAS the U.S. Fish and Wildlife Service ("USFWS") has federal management responsibilities over federally-listed endangered species such as the Least Tern, and the Oklahoma Department of Wildlife Conservation ("ODWC") has state management responsibilities over state-listed endangered species such as the Least Tern; and

WHEREAS the Tulsa Audubon Society ("TAS"), a private, nonprofit organization, has expertise in the preservation of birds such as the Least Tern; and

WHEREAS the River Parks Authority ("RPA") is a public trust charged with the responsibility of protecting and enhancing interalia, natural communities and species along the Arkansas River and its environment in Tulsa County, Oklahoma.

WHEREAS the Owner, ODWC, USFWS, Conservancy, TAS, the Corps and RPA all have an interest in protecting nesting populations of the rare and endangered Interior Least Tern on the Arkansas River; and

WHEREAS The Owner is agreeable to manage jointly these lands to protect the Least Tern.

NOW THEREFORE, the Owner hereby grants to The River Parks Authority, an

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exclusive license and permit, consisting of the following rights for the purposes described, in and to the lands described in Exhibit A attached hereto and made a part hereof, to-wit:

RIGHTS GRANTED TO THE RIVER PARKS AUTHORITY

1. The River Parks Authority shall have the right to enter upon and use said lands for the purpose of protecting all Least Tern nesting, fledging, feeding, resting and cover sites, located on said property. Said purposes shall include but not be limited to inspection, monitoring, research and, if deemed necessary, manipulation of the sites to enhance the Least Tern population. The River Parks Authority, upon consultation with the USFWS, may authorize personnel from the Corps, USFWS, ODWC, TAS, the Conservancy and others to enter said lands for the purposes described herein. Such consultation is necessary to alleviate potential for violations of the Endangered Species Act.

2. The River Parks Authority shall have the right to control and limit access to Least Tern nesting sites in breeding season, as necessary, and to erect and place any signs, posters, or other devices to identify the land as a protected area.

SAID RIGHTS ARE SUBJECT TO THE FOLLOWING LIMITATION, HOWEVER:

1. No one will construct facilities on said premises nor modify the land surface or habitat thereon until a proposal thereof has been reviewed and approved by USFWS and Owner.

2. All existing RPA regulations (e.g., no vehicle, dogs on leash, curfew clauses) will apply.

OBLIGATIONS OF RIVER PARKS AUTHORITY

AS PARTIAL CONSIDERATION for the rights hereby granted by the Owner, RPA agrees to:

Solicit expert advice regarding the protection, management and enhancement of the Least Tern population on the lands from the agencies and organizations that are party to this agreement and from other sources available to it, and shall exercise its best efforts to implement said recommendations consistent with the terms of this agreement.

OBLIGATIONS OF THE OWNER

THE OWNER agrees that:

1. In its planning and use of said lands, it shall, whenever practicable, take into consideration protection of said preserve area for endangered bird species.

2. It shall exercise its best efforts to implement recommendations of the River Parks Authority.

GENERAL PROVISIONS

1. Neither Owner nor any other party to this agreement is required to

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obligate or spend funds under this agreement, it being the intent of the parties that staff time and expertise be the primary contribution of each party to the effective implementation of this Agreement.

2. This permit may be terminated, in whole or in part, by the Owner or by the River Parks Authority upon 90 days written notice to the other party.

3. All notices required under this agreement shall be effective when mailed to the following persons:

To Owner:

_____
_____
_____
_____

To River Parks Authority:

Jackie Bubenik, Executive Director
River Parks Authority
707 South Houston, Suite 202
Tulsa, Oklahoma 74127

4. By their signatures hereto, the Corps, USFWS, ODWC, TAS, and the Conservancy agree to assist the Owner and The River Parks Authority by providing expertise and assistance toward the common goal of protecting, managing, and enhancing the Least Tern population on the lands described.

IN WITNESS WHEREOF, the parties hereto have subscribed their names as of the dates indicated:

_____

By: _____ Dated: _____
Its: _____

THE NATURE CONSERVANCY Dated: _____

Attest:

By: _____ By: _____
Its Vice President Its Assistant Secretary

U.S. ARMY CORPS OF ENGINEERS Dated: _____

By: _____
Its: _____

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

By: _____ Dated: _____
Its: _____

U.S. FISH AND WILDLIFE SERVICE

By: _____ Dated: _____
Its: _____

TULSA AUDUBON SOCIETY Dated: _____

Attest:

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By: _____ By: _____
Its: _____ Its: _____

RIVER PARKS AUTHORITY Dated: _____

Attest:

By: _____ Dated: _____
Its: _____

APPENDIX 4

Essential Breeding Habitat for Interior Least Terns

Riverine sandbars, river channel environment including open channel area, channel width, and appropriate instream flows, and lake shorelines and other habitats provide essential habitat for the interior least tern. The interior least tern is completely dependent on these habitats for food and nesting sites. Therefore, destruction or adverse modification of remaining habitats will cause continued reduction of the species range and eventually a reduction in population numbers. The areas described and mapped herein as essential habitat will provide the space necessary for continued existence and growth of interior least tern populations required to meet the recovery objective. The following maps depict essential habitat for the interior least tern. Hatch marks along river segments and certain national wildlife refuges indicate the areas where essential habitat intermittently occurs depending on water conditions. For example, sandbars and interior least terns do not occur along every kilometer of the indicated segments of rivers. Locations of nesting birds may change from year to year within the indicated segment.

I. Missouri River System
- Montana - Missouri River between Fort Peck Dam and North Dakota
- North Dakota - Yellowstone River and Missouri River between Garrison Dam and the Cannonball River.
- South Dakota - Cheyenne River from the Belle Fourche River to Lake Oahe; Missouri River from Ft. Randall Dam to mouth of the Niobrara River and from Gavin's Pt. Dam to Ponca, Nebraska.
- Nebraska - Missouri River from South Dakota to mouth of the Niobrara River and from Gavin's Pt. Dam to Ponca; Niobrara River from Highway 183 bridge to Missouri River; Loup River from St. Paul to Platte River; Platte River from Lexington to Chapman and from Columbus (Highway 81 bridge to Missouri River.

II. Mississippi River - From Highway 146 bridge, Missouri and Illinois to Vicksburg, Mississippi

III. Arkansas River system
- Kansas - Quivira National Wildlife Refuge and Cimarron River
- Oklahoma - Salt Plains National Wildlife Refuge; from below Kaw Dam to Arkansas River and Arkansas River from Tulsa to Muskogee; Cimarron River in Beaver, Harper, Woods, Woodward, Major, Kingfisher, Logan, and Payne counties; Canadian River in Ellis, Roger Mills, Dewey, Cleveland, McClain, Haskell, Pittsburgh, Hughes, Muskogee, and Sequoyah counties; Sequoyah National Wildlife Refuge;

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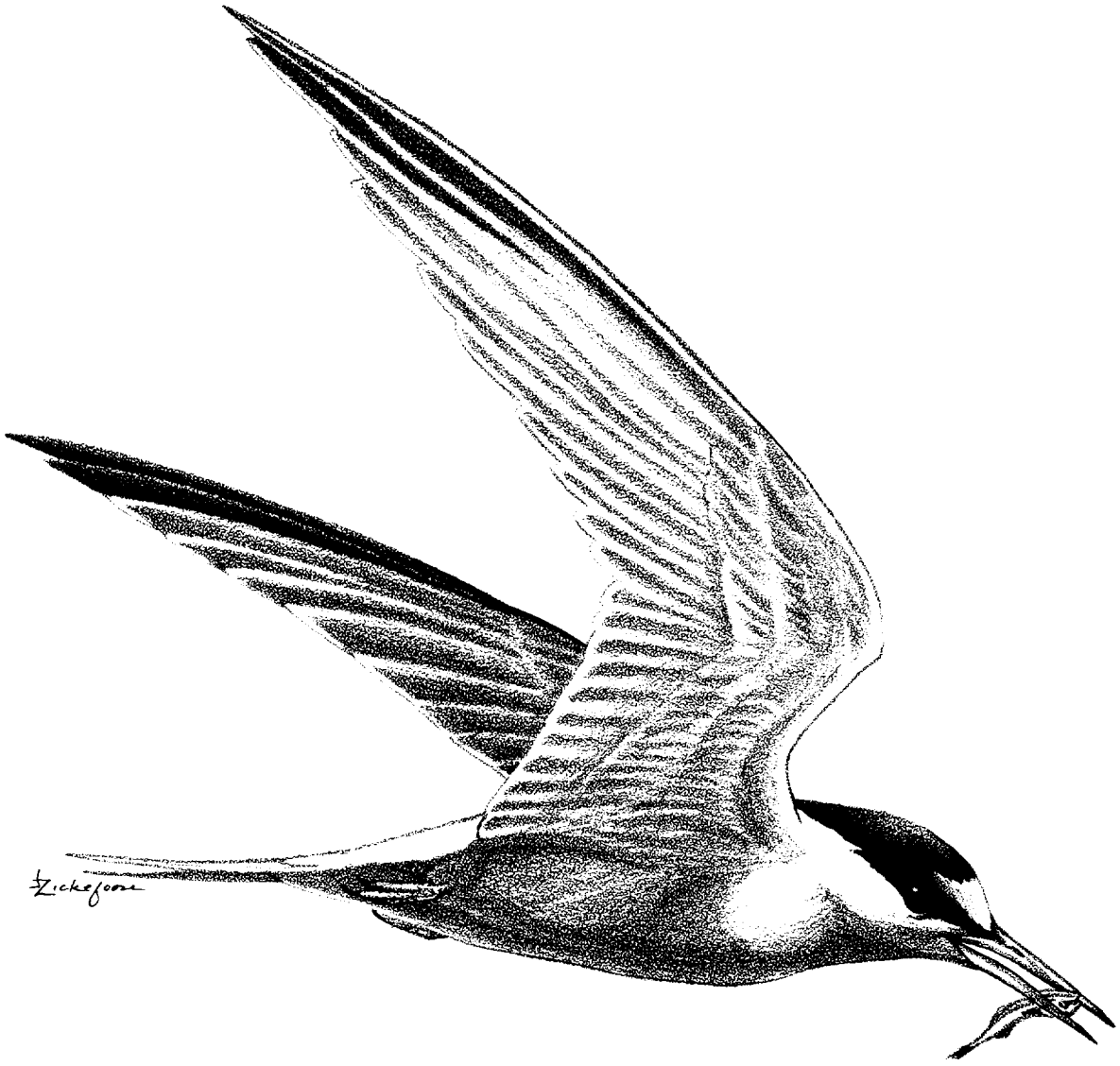
Red River from Harmon county to Highway 277/281 bridge.
Texas - Canadian River from Sanford Dam to Oklahoma; Prairie Dog Town Fork/Red River from Briscoe/Armstrong county boundary to Burkburnett, Texas.

IV. Pecos River - Bitter Lake National Wildlife Refuge, New Mexico.



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Essential Habitat in Montana:
Indicated Segments of the Missouri River
MISSOURI
RIVER
Fort Peck
Lake
YELLOWSTONE RIVER

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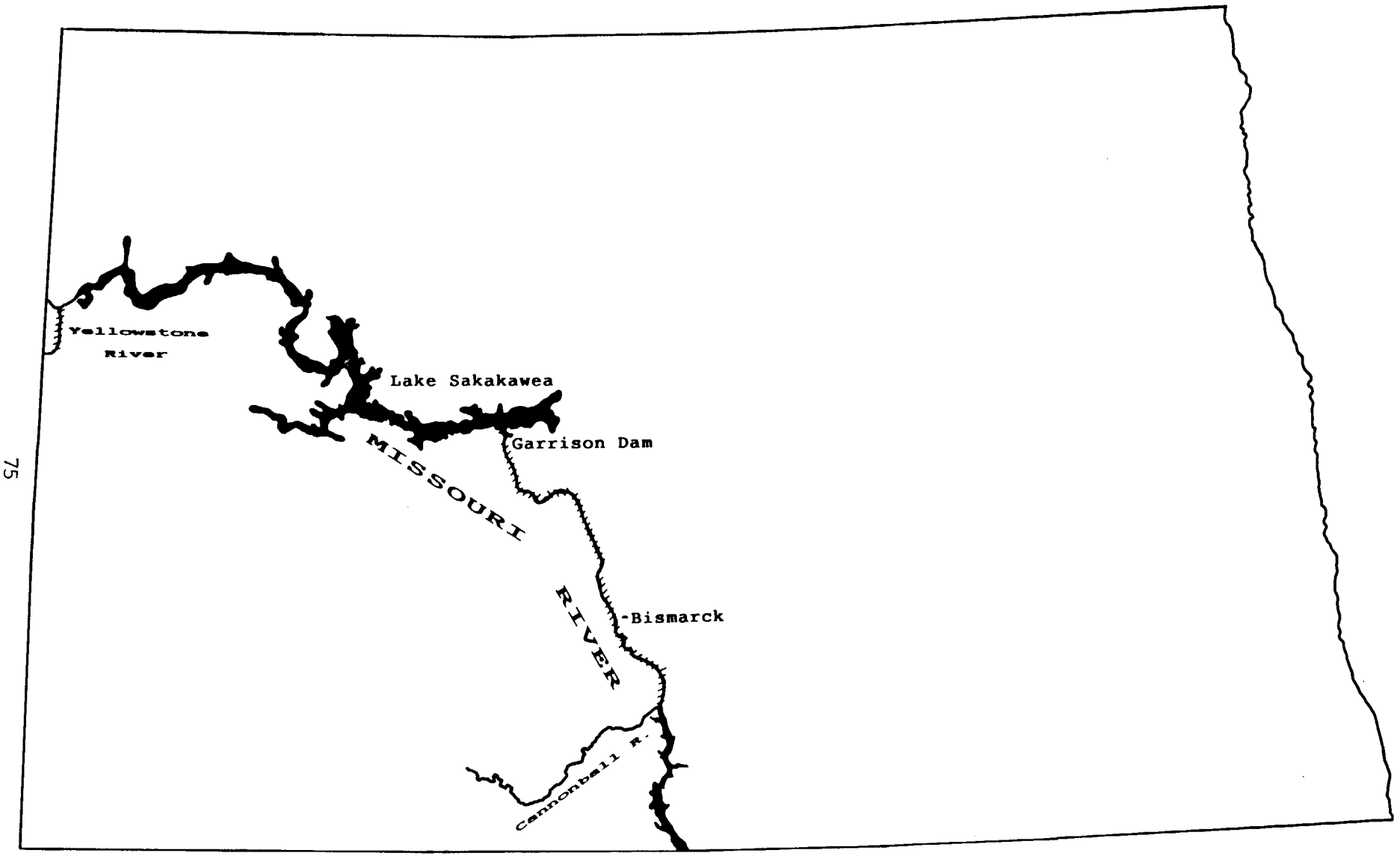
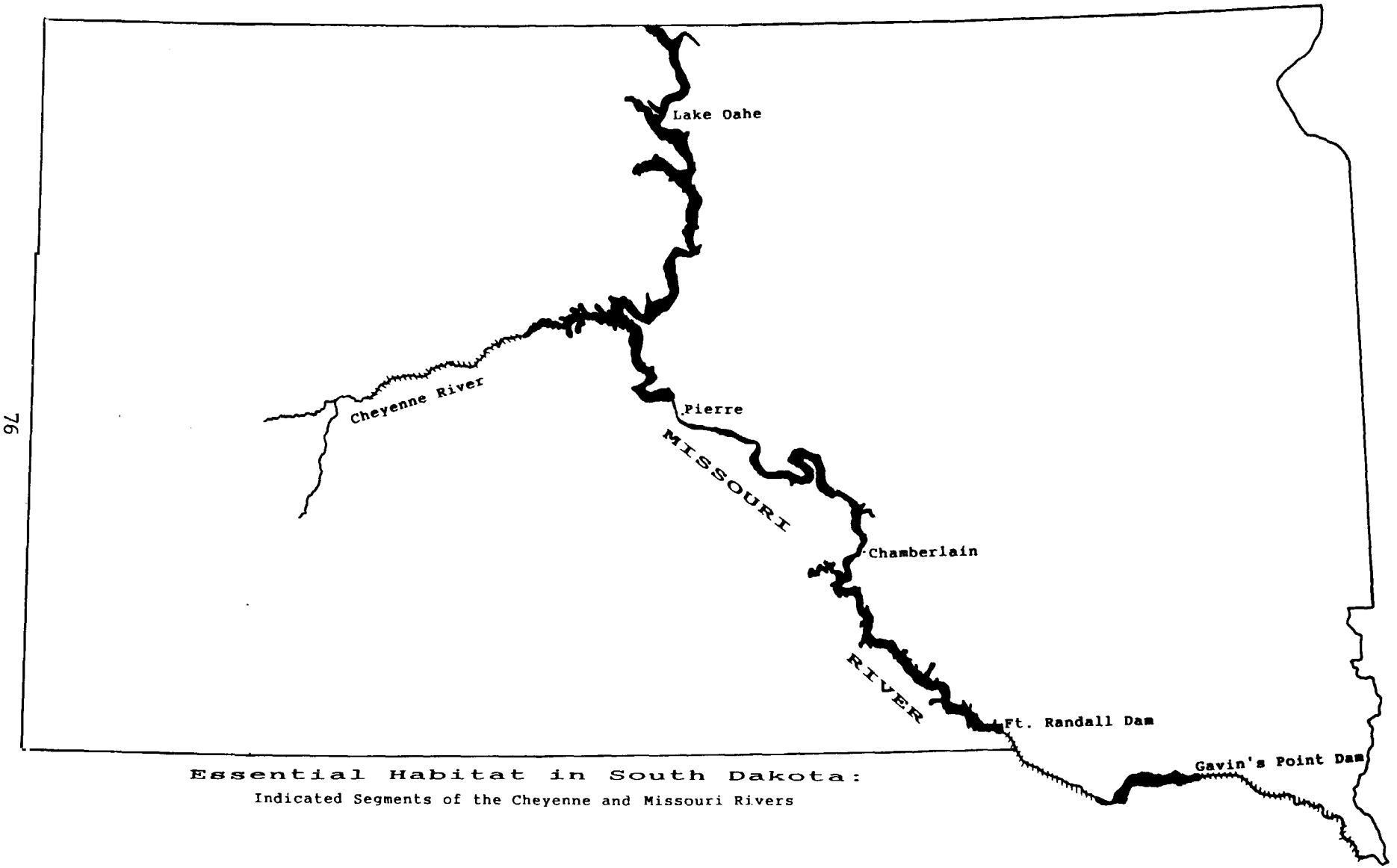


Essential Habitat in North Dakota:
Indicated Segments of the Missouri and Yellowstone Rivers

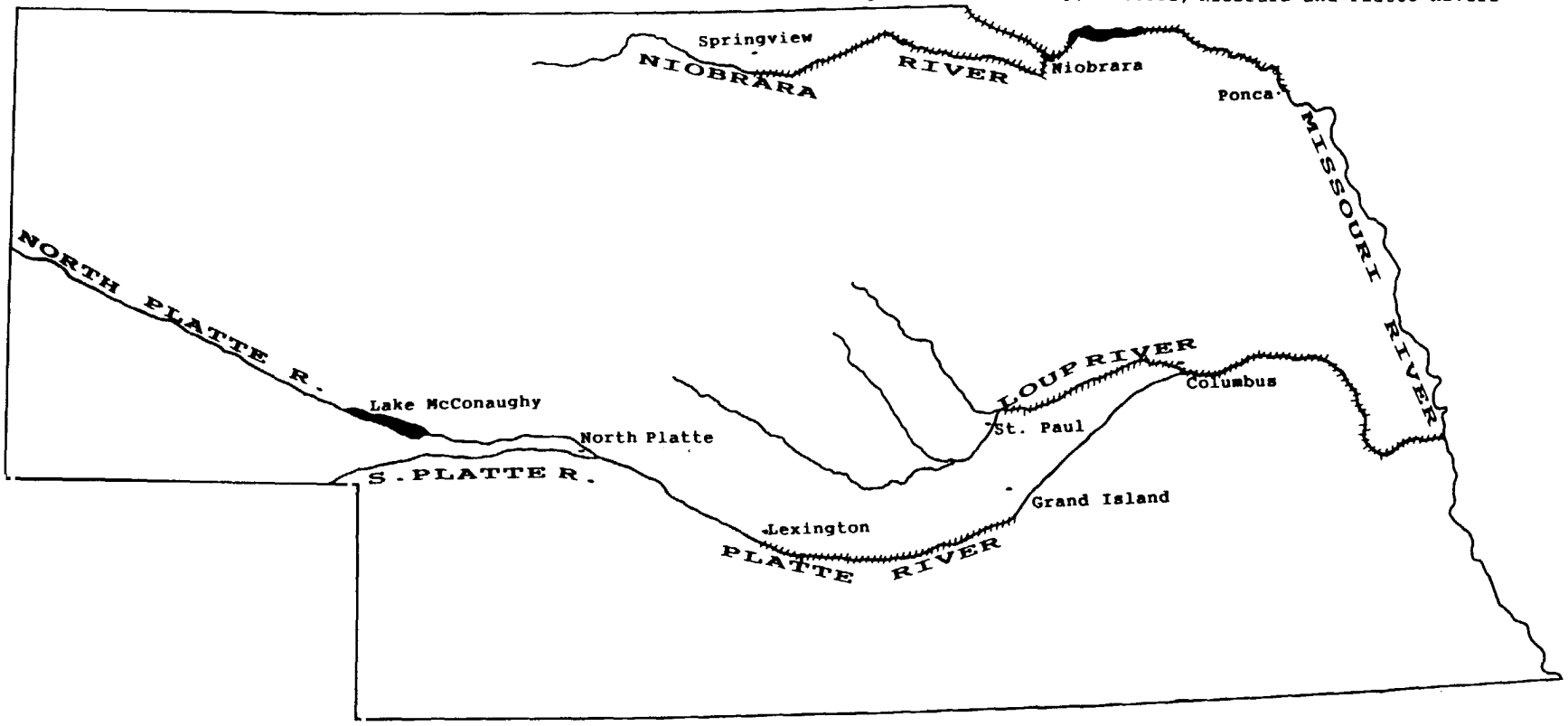
008297



Essential Habitat in South Dakota:
Indicated Segments of the Cheyenne and Missouri Rivers

008298

Essential Habitat in Nebraska: Indicated Segments of the Loup, Missouri, Niobrara and Platte Rivers



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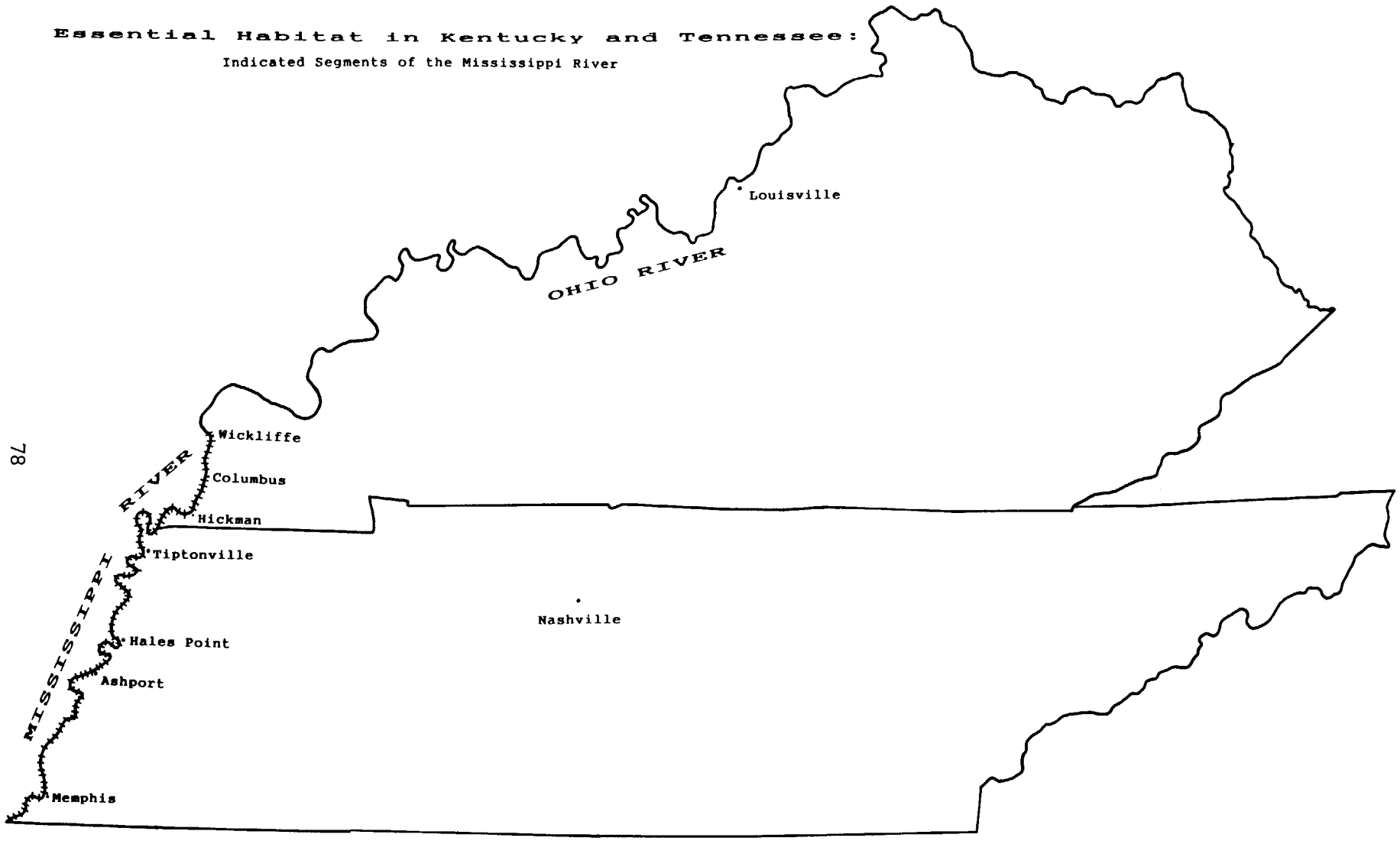
Essential Habitat in Kentucky and Tennessee:
Indicated Segments of the Mississippi River
Louisville
OHIO RIVER
Wickliffe
Columbus
Hickman
Tiptonville
Hales Point
Ashport
Memphis
Nashville
MISSISSIPPI RIVER

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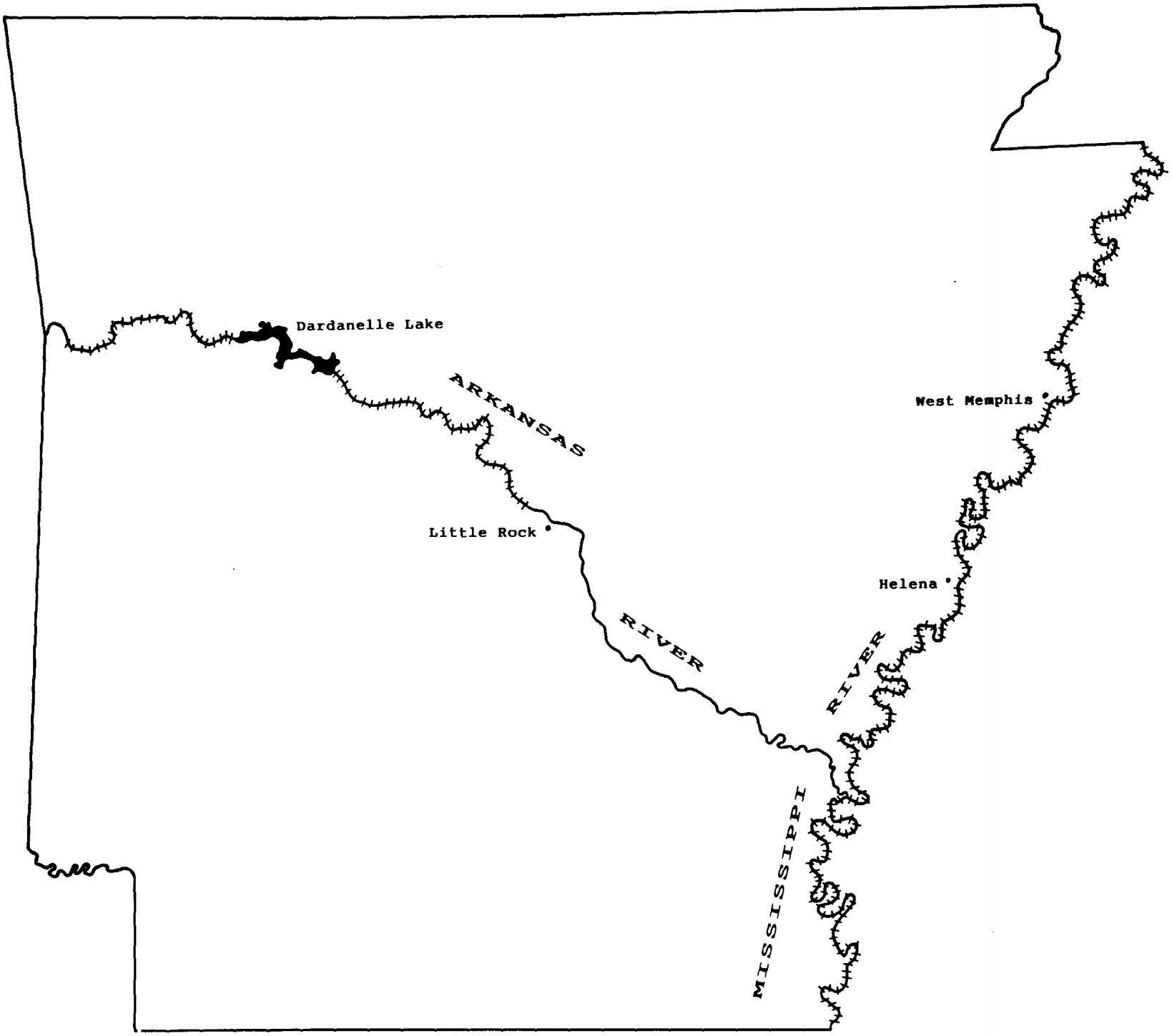
MISSISSIPPI
RIVER
St. Louis
Wilson City
MISSOURI
Kansas City
Essential Habitat in Missouri:
Indicated Segment of the Mississippi River

008301

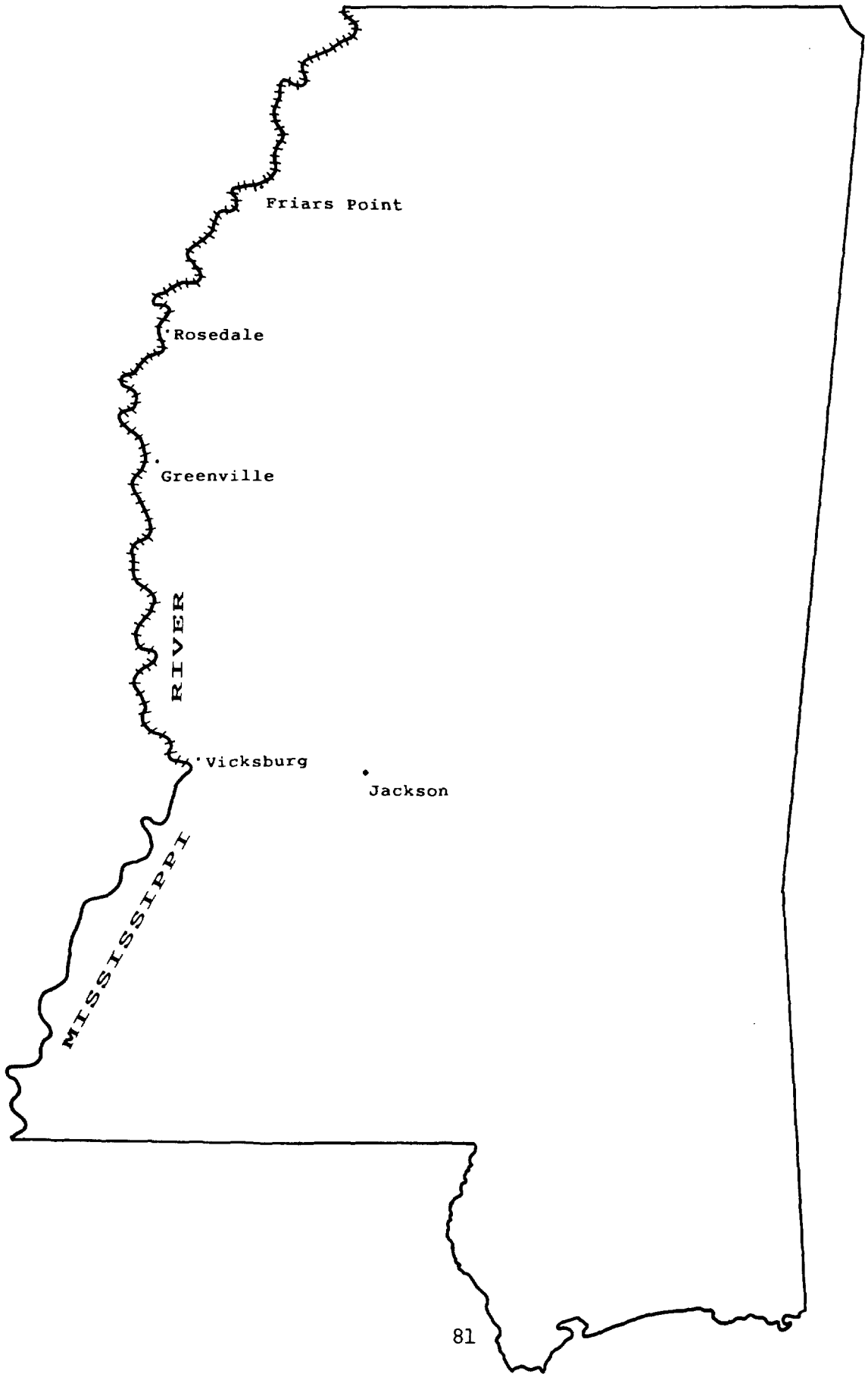


Essential Habitat in Arkansas:

Indicated Segments of the Arkansas and Mississippi Rivers

Essential Habitat in Mississippi

Indicated Segment of the Mississippi River



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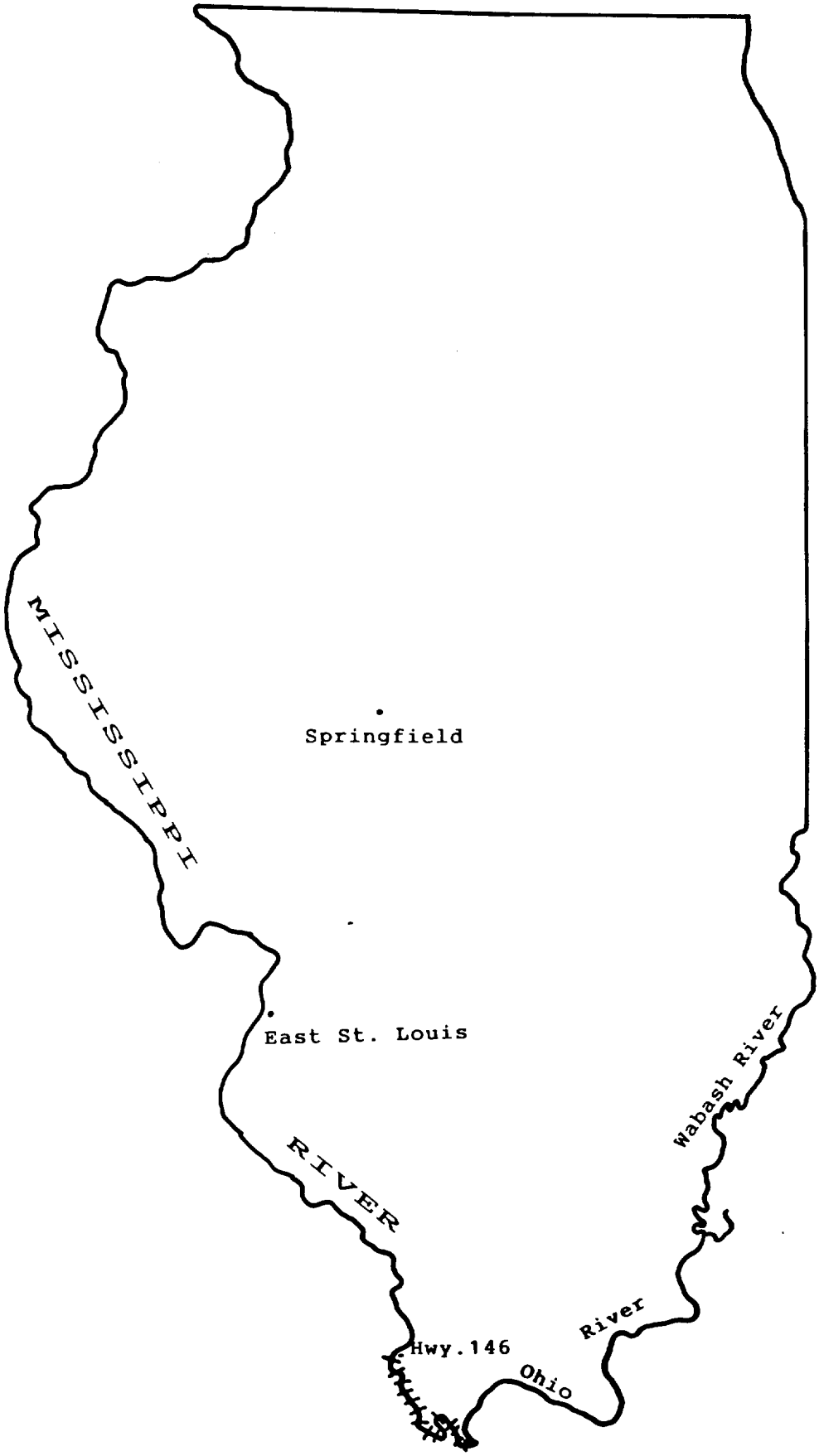
Lake Providence
Mound
Mississippi River
Baton Rouge
New Orleans
Sabine River
Essential Habitat in Louisiana:
Indicated Segment of the Mississippi River

008304



Essential Habitat in ILLinois:

Indicated Segment of the Mississippi River

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Essential Habitat in Oklahoma:

Sequoyah & Salt Plains National Wildlife Refuge

Indicated Segments of the Arkansas, Canadian, Cimarron and Red Rivers

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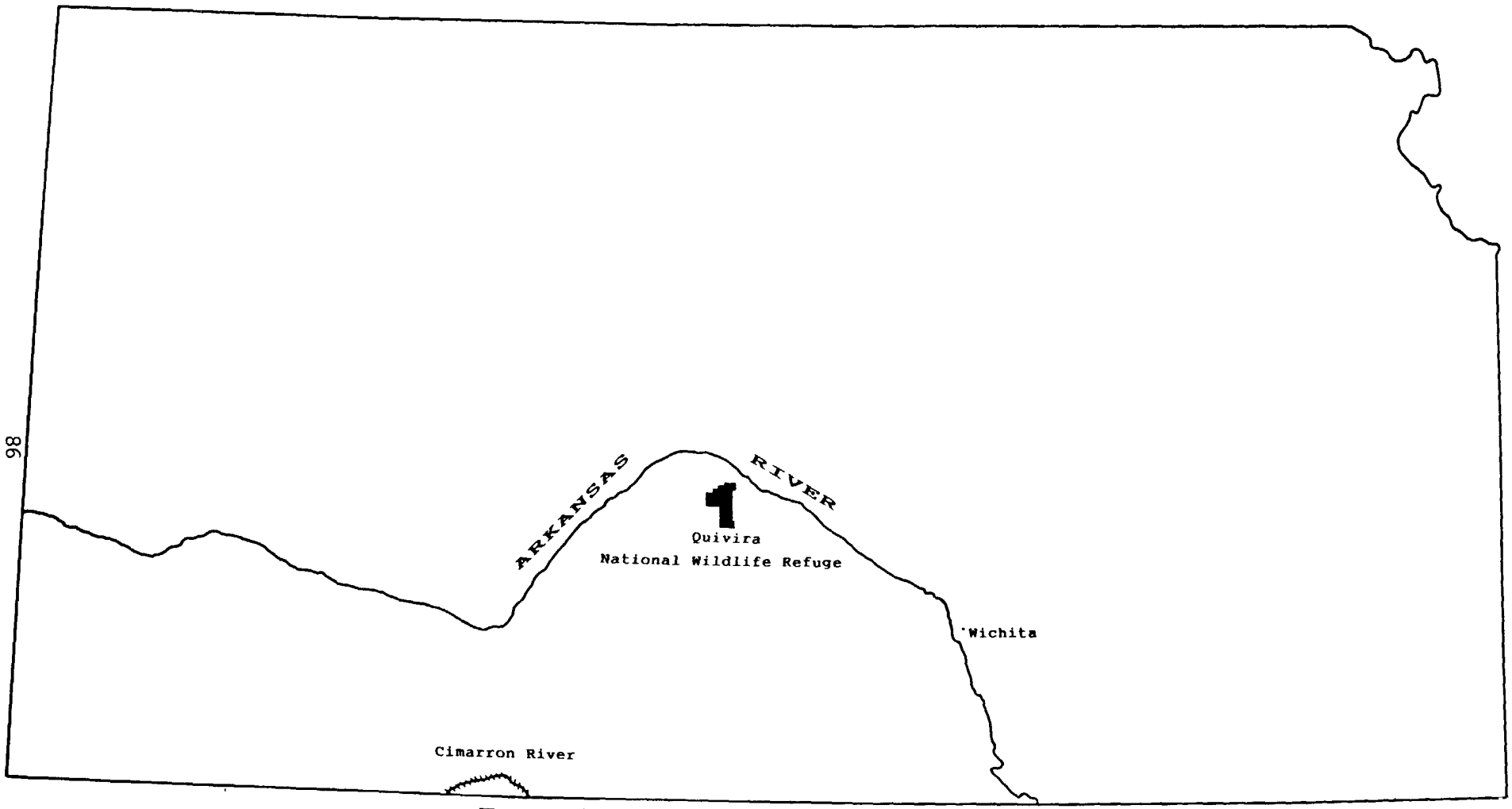
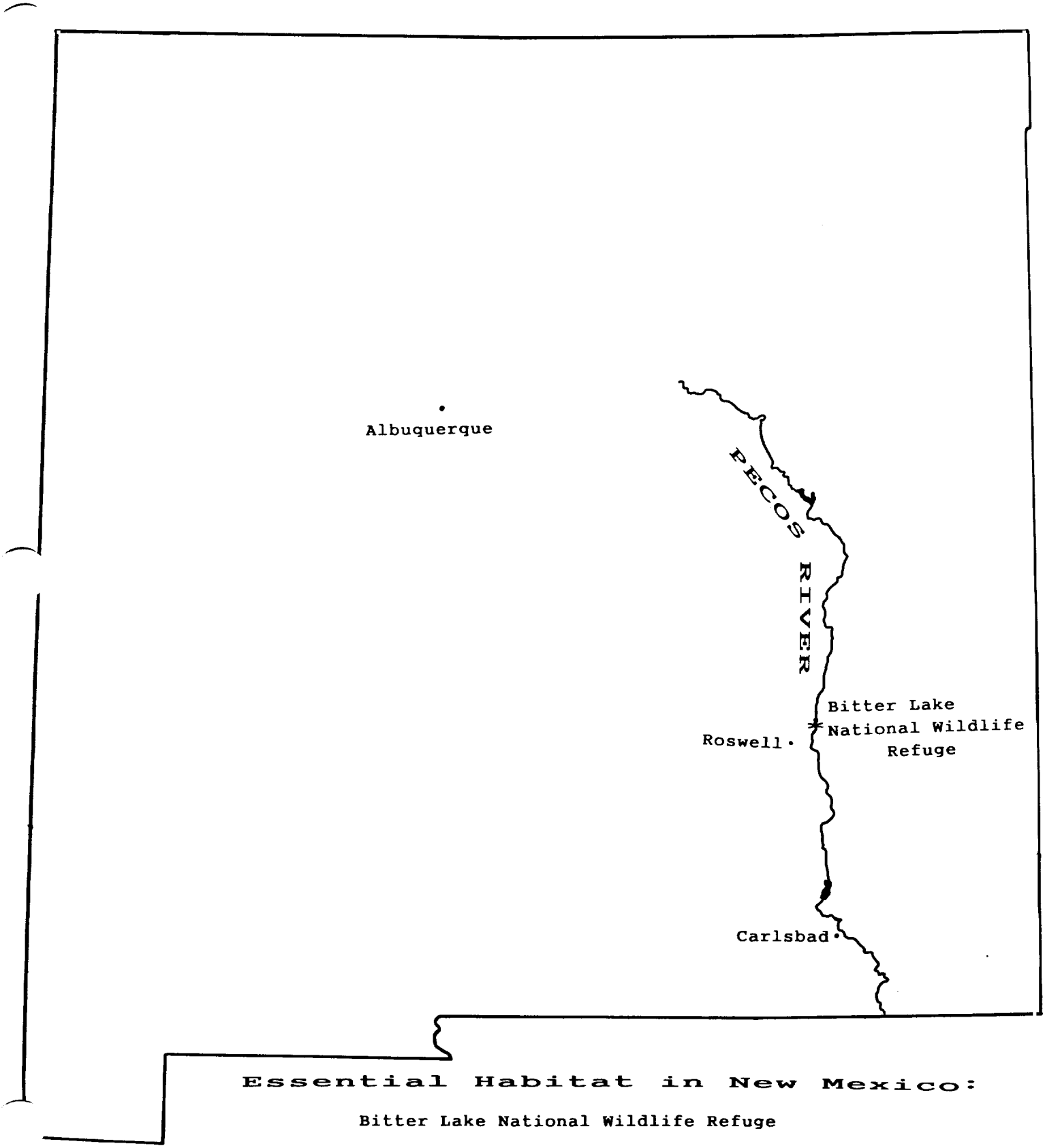
Sabine River
Red River
Lake Texoma
Burkburnett
Austin
Falcon Reservoir
Amistad Reservoir
RIO GRANDE
Canadian River
Amarillo
Prairie Dog Town Fork
Essential Habitat in Texas:
Indicated Segments of the Canadian, Prairie Dog Town Fork and Red Rivers

008307



Essential Habitat in Kansas:
Quivira National Wildlife Refuge and Cimarron River

008308



Essential Habitat in New Mexico:

Bitter Lake National Wildlife Refuge

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Appendix 5

LIST OF REVIEWERS

Mr. Sam Barkley
Endangered Species Coordinator
Arkansas Game and Fish Commission
No. 2 Natural Resources Drive
Little Rock, Arkansas 72205

Dr. Dean Roosa
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Endangered Species Coordinator
Ilinois DOC
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Springfield, Illinois 62706

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Endangered Species Coordinator
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Little Rock, Arkansas 72203-0867

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Corps of Engineers
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Mr. Michael Sweet
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Endangered Species Coordinator
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Ellington Agricultural Center
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Bismarck, North Dakota 58501-5095

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Mississippi Dept. of Wildlife
Conservation
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Jackson, Mississippi 39205-0451

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Wildlife Division Director
South Dakota Dept of
Game Fish & Parks
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Pierre, South Dakota 57501-3185

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Executive Director
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Austin, Texas 78744

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Oklahoma Dept. of Wildlife
Conservation
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Oklahoma City, Oklahoma 73105

Dr. Roger L. Boyd
Baker University
Baldwin City, Kansas 66006

Mr. Gary Willson
Endangered Species Coordinator
Midwest Region-National Park Service
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Omaha, Nebraska 68102-2571

Mr. Conrad J. Keyes, Jr.
Principal Engineer, Planning
International Boundary and Water
Commission, United States and Mexico
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El Paso, Texas 79902

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Fisheries and Wildlife Division
Kansas Wildlife and Parks
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Pratt, Kansas 67124

008311

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Nebraska Game and Parks Commission
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Cedar Creek, Nebraska 68016

Mr. Gerald E. Jasmer
State Wildlife Biologist
Soil Conservation Service
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Lincoln, Nebraska 68508-3866

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Arkansas Natural Heritage
Commission
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225 East markham
Little Rock, Arkansas 72201

Ms. Eileen Dowd
South Dakota Natural Heritage
South Dakota Dept. of Game, Fish &
Parks
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Pierre, South Dakota 57501-3185

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North Dakota Game & Fish Dept.
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Bismarck, North Dakota 58501-5095

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Lower Mississippi Valley Division
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National Aquarium in Baltimore
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Baltimore, Maryland 21202

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City Manager
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Yankton, South Dakota 57078

Mr. Michael Bean
Enviromental Defense Fund
1616 P Street NW
Washington, DC 20036

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Interior Population of the Least Tern Determined To Be Endangered

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: The Service determines endangered status for the interior population of the least tern (*Sterna antillarum*), a small bird. Formerly well distributed in the Mississippi basin, the tern has been eliminated from most stretches of the Mississippi River and its tributaries. Many nesting islands in rivers have been permanently inundated or destroyed by reservoirs and channelization projects. Alteration of natural river dynamics has caused unfavorable vegetational succession on many remaining islands, curtailing their use as nesting sites by terns. Recreational use of sandbars is a major threat to the reproductive success of the tern. The annual spring floods of the watershed are often delayed past the onset of normal breeding, and many islands are not exposed as suitable sites in time for nesting. This final rule will provide the protection of the Endangered Species Act to this species. The Service will initiate recovery efforts for the interior least tern population.

DATE: The effective date of this rule is June 27, 1985.

ADDRESS: The complete file for this rule is available for inspection, by appointment, during business hours (7:00 a.m.—4:30 p.m.) at the Endangered Species Division, U.S. Fish and Wildlife Service, Federal Building, Fort Snelling, Twin Cities, Minnesota 55111 (612/725–3276 or FTS 725–3276).

FOR FURTHER INFORMATION CONTACT: Mr. James M. Engel, Endangered Species Division (see **ADDRESSES** section), (612/725–3276 or FTS 725–3276).

SUPPLEMENTARY INFORMATION:

Background

The interior population of the least tern was first described as a race (*Sterna albifrons*) of the Old World little tern (*Sterna albifrons*) (Burleigh and Lowery, 1942). Two other described New World races were the eastern or coastal least tern (*Sterna albifrons antillarum*) and the California least tern (*Sterna albifrons browni*). As a result of recent studies on vocalizations and behavior of the terns in the Old and New Worlds, the American Ornithologists' Union (1983) now treats the New World least tern population as distinct species, *Sterna antillarum*. The old world species is called the little tern, *Sterna albifrons*. Subspecies of New World least terns recognized by the American Ornithologists' Union (1957) were the interior least tern (now *Sterna antillarum athalassos*), the eastern or coastal least tern (now *Sterna antillarum antillarum*), and the California least tern (now *Sterna antillarum browni*).

Massey (1976) reported no consistent morphological, behavioral, or vocal differences between *S. antillarum antillarum* and *S. antillarum browni*. In Texas where *S. antillarum antillarum* and *S. antillarum athalassos* are sympatric, the differentiation of specimens of the two subspecies is not possible and the present taxonomy is probably tentative (Thompson, 1981). Because of the taxonomic uncertainty of least tern subspecies in eastern North America, the Service decides not to specify the subspecies in this final rule. Instead the Service designates as endangered the population of least terns (hereinafter referred to as interior least tern) occurring in the interior of the United States. This designation is reflected in the rule promulgation at the end of this document.

The interior least tern historically bred along the Colorado (in Texas), Red, Rio Grande, Arkansas, Missouri, Ohio, and Mississippi Rivers systems from Montana southward through South Dakota, Nebraska, eastern Colorado, Iowa, Kansas, Missouri, Illinois, Indiana, and Kentucky to eastern New Mexico, Oklahoma, Arkansas, Tennessee, central Texas, central Louisiana, and central Mississippi (American Ornithologists' Union, 1957). The actual wintering area for this population is unknown. However, least terns of unknown populations or subspecies are found during the winter along the Central American coast and the northern coast of South America from Venezuela to northeastern Brazil.

The eastern least tern breeds along the Atlantic coast from Massachusetts to Florida, along the Gulf coast from Florida to Texas, and in the Bahamas and Caribbean Islands. The California least tern, which has been listed as an endangered species since 1970 (32 FR 16047), breeds along the Pacific coast from central California to Baja California.

Least terns are the smallest members of the subfamily Sterninae, measuring 20–22 cm long with a 50 cm wingspread. Sexes are alike, characterized in the breeding plumage by a black crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, orange legs, and a black-tipped yellow bill. Immature birds have darker plumage, a dark bill, and dark eye stripes on their white heads.

Hardy (1957) presents the results of the first substantial field study of the interior least tern. His observations were mostly made on the lower Ohio River. Other research has been conducted in Nebraska, Kansas, Oklahoma, and Illinois (Grover and Knopf, 1982; Anderson, 1983; Faanes, 1983; Schulenberg and Ptacek, 1984). Ducey (1981) provides a current and comprehensive summary of available published and unpublished information on the interior least tern. The tern exhibits a localized pattern of distribution, and its breeding biology generally centers around three ecological factors.

These include: (1) The presence of bare or nearly bare alluvial islands or sandbars, (2) the existence of favorable water levels during the nesting seasons, and (3) the availability of food.

Under natural river conditions, islands are created and destroyed by the river's erosion and deposition processes. Periodic inundation maintains some islands in the barren or sparsely vegetated condition required by terns for nesting. Although most nesting is in rivers, the interior least tern also nests on the barren flats of saline lakes and ponds such as on the Salt Plains National Wildlife Refuge, Oklahoma.

The nest is a simple unlined scrape usually containing three brown spotted buffy eggs. Breeding colonies or terneries are usually small (up to 20 nests) with nests spaced far apart. However, colonies of 75 nests have been reported on the Mississippi River. Egg-laying and incubation occur from late May to early August, depending on the geographical location and availability of habitat. After a 20-day incubation period the chicks hatch and will fledge in another 20 days. Little is known about the tern's specific food preferences, but small fish such as minnows constitute its prey.

The Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended, requires determination of whether species of wildlife and plants are endangered or threatened, based on the best available scientific and commercial data. The Service was originally petitioned in 1975 by the Oklahoma Ornithological Society to list the interior least tern as an endangered species. The Service indicated at that time its general

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intent to propose the species for listing, once sufficient data were available. On December 30, 1982, the Service published a notice of review in the **Federal Register** (47 FR 58454) identifying vertebrate taxa, native to the U.S. being considered for addition to the List of Endangered and Threatened Wildlife. The notice included the interior least tern as a category 2 species (i.e., a species still needing some data before a proposal could be made). Since December 30, 1982, the Service has reviewed further data on the status of the tern in Illinois, Iowa, Kansas, Nebraska, North Dakota, and Oklahoma.

On May 29, 1984, the Service published a proposed rule in the **Federal Register** (49 FR 22444) advising that sufficient information was now on file to support a determination that the interior least tern is an endangered species pursuant to the Endangered Species Act of 1973, as amended. The proposal solicited comments from any interested parties concerning threats to this species, its distribution and range, whether or not critical habitat should be designated, and activities which might impact the species.

Summary of Comments and Recommendations

In the May 29, 1984, proposal all interested parties were requested to submit information on the status of the interior least tern that might contribute to the development of a final rule. Subsequently, letters were sent to appropriate state resource agencies in the tern's historic range of Arkansas, Colorado, Iowa, Illinois, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and Texas, and to the U.S. Army Corps of Engineers, other appropriate Federal agencies, county governments and other interested parties notifying them of the proposal and soliciting their comments and suggestions. Newspaper notices inviting general public comment were published in 17 newspapers within the breeding range of the interior least tern.

Seventy-two comments were received by mail during the public comment period, which was extended until September 25, 1984, in order to accommodate a public hearing. Cook and Kopf, P.C., of Lexington, Nebraska, representing the Central Platte Natural Resources District, requested a public hearing, ". . . to supply and solicit information regarding the designation of the interior least tern as endangered relative to the alleged use by the interior least tern of the Central Platte Region of the Platte River." Notice of public hearing and reopening of the comment period was published in the **Federal Register** on August 22, 1984 (49 FR 33296). A correction to the location of that hearing was published on September 5, 1984 (49 FR 35031).

The public hearing was held on September 11, 1984, at the Peter Kiewit Conference Center, Omaha, Nebraska. Forty-five people attended the hearing. Twelve people presented oral comments. Six of them also submitted written comments. The hearing centered largely on the decline and numbers of the interior least tern and on the ecology, status, and management of the tern in Nebraska, especially on the Platte River. The 12 public hearing comments and the 72 comments received by mail are summarized below. Most comments supported Federal listing of the interior least tern, with the exception of those from the Central Platte Natural Resources District, Nebraska Water Resources Association, other Nebraska water organizations, Denver Water Department, and Denver Metropolitan Water Providers, although some comments could be rated "neutral" in respect to support of the proposal.

The wildlife or related resource agencies of Arkansas, Iowa, Illinois, Kentucky, Mississippi, Missouri, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and Texas endorsed Federal listing of the interior least tern. Senator Nancy Landon Kassebaum of Kansas wrote that the Kansas Fish and Game Commission would not oppose the listing. Remaining States in the tern's historic range did not respond.

The Central Platte Natural Resources District, Denver Water Department, and Nebraska Water Resources Association criticized the adequacy of the data on the numbers and decline of the interior least tern. They viewed the 1975 survey of the tern by Downing (1980) as inadequate and cursory and urged the Service to monitor population trends on a regular basis. They suggested that there has been no decline of terns and that the population may be increasing. The Denver Water Department examined the public comments received by the Service in response to the proposed rule, and commented that there are over 1,700 terns instead of the 1,250 reported by Downing (1980) and referenced by the Service in the proposed rule.

Service response: The Service references Downing's 1975 survey (published in 1980) in the May 29, 1984, proposed rule because it is a concise report presenting the still valid fact that numbers of interior least terns are very low. The 1975 survey was the basis of the Oklahoma Ornithological Society's 1975 petition to list the interior least tern as endangered. The Sevice, however, did not immediately propose listing of the tern, deciding instead to further evaluate the status of the tern. Since 1975, many States and individuals have conducted a variety of surveys throughout the tern's breeding range. These studies and surveys (some of the results submitted in response to the proposed rule), while indicating a similar tern population in the areas surveyed by Downing in 1975 but a higher population (1,400–1,800 terns) throughout the entire tern's breeding range, support Downing's conclusion of low numbers of terns and continued threats to the bird's habitat and breeding success.

The Service recognizes the difficulty in assessing the exact population status of species with widely scattered individuals, such as terns (Thompson, 1982). Moveover, as stated in the May 29, 1984, proposed rule, historical trends of the interior least tern population are poorly known. Reliable estimates of original numbers are generally not available. However, historical records indicate that the interior least tern once bred over a much larger area and in far greater densities of colonies than it does today (Ducey, 1981; Hardy, 1957). The best available information indicates that the interior least tern population is low, reproductive success is low in many areas, and the tern's remnant breeding habitat is threatened with modification, destruction, or curtailment. The Service is obliged by the Endangered Species Act to make listing decisions solely on the basis of the best scientific and commercial data available on the species in question.

By way of comparison, the California least tern was listed as endangered in 1970 when its population stood at 600 pairs (more than 1,500 individuals when non-breeding birds are included). That subspecies now numbers over 2,400 individuals but is still threatened with the loss of habitat.

In Louisiana, the interior least tern was a common breeding bird throughout the Mississippi and Red River valleys. It is now absent from the State. In Arkansas, the interior least tern no longer breeds on the Ouachita and White Rivers and is nearly absent on the Arkansas River, where only 30 terns have been recently censused (Arkansas Natural Heritage Commission, unpub. data, 1984). In Mississippi, the tern commonly bred on the Mississippi River

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but is now absent. Ganier (1930) believed the tern to have colonies every 10–15 miles along the Mississippi River. Today, there are about 350–450 terns, concentrated at only a few sites from Osceola, Arkansas, to Cairo, Illinois (Arkansas Natural Heritage Commission, Missouri and Tennessee Departments of Conservation, Kentucky Department of Fish and Wildlife Resources, U.S. Army Corps of Engineers, unpub. data, 1984).

The interior least tern formerly bred along the Ohio River from its confluence with the Mississippi River to along the Indiana-Kentucky boundary. In 1983 about 10 terns frequented the lower Ohio River; none were present between Indiana and Kentucky (Illinois Department of Conservation, unpub. data, 1984).

The interior least tern was formerly common on the Mississippi River from Cairo, Illinois, to Iowa. It bred on the Des Moines River and at many locations in central and eastern Iowa. The tern now occurs only near the southern tip of Illinois, where 30 birds were recently censused (Illinois Department of Conservation, unpub. data, 1984, Thompson and Landin, 1978).

The interior least tern was formerly a common breeder on the Missouri River and many of its tributaries from St. Louis, Missouri, to Montana. Lewis and Clark frequently observed the tern along the length of the Missouri River and described the species in detail (Burroughs, 1961). Near the mouth of the Platte River they remarked that the tern is "a native of this country and probably a constant resident." The interior least tern is now entirely absent as a breeding bird on the Missouri River from St. Louis to Sioux City, Iowa. It disappeared along the Iowa-Nebraska boundary (Missouri River) over the past 35 years (Ducey, 1981; Hardy, 1957). On the Missouri River north of Sioux City, Iowa, the interior least tern population numbers 100–200 birds between Yankton, South Dakota, and Ponca, Nebraska (Nebraska Game and Parks Commission, unpub. data, 1980–1984). Because the remainder of the Missouri River in North and South Dakota is largely a reservoir where nesting habitat has almost completely disappeared since 1950, the tern is now a rare breeding bird. However, on the remaining 90-mile natural segment of the Missouri River in North Dakota, from Garrison Dam to the headwaters of the Oahe Reservoir, 90–130 terns have bred on sandbars in recent years (North Dakota Parks and Recreation Department, unpub. data, 1984). The Cheyenne River, a tributary of the Missouri River in South Dakota, harbors about 30-70 terns (Ducey, 1981; A. Chappelle, pers. comm., 1984). Small numbers of terns may be scattered along the Oahe Reservoir. The tern is absent from Montana, although it historically occurred there (Coues, 1874).

On the Platte River, Nebraska, the interior least tern numbers about 160–240 birds (Nebraska Game and Parks Commission, unpub. data, 1980–1984). Their distribution on the Platte formerly included western Nebraska. Today, the tern is found only in the Central and Lower Platte River regions. Changes in nesting distribution and loss of historic nesting sites on the Platte River are detailed by the Nebraska Game and Parks Commission (1984, 1985). About 100 terns occur on the Niobrara River, Nebraska (Wingfield, 1982).

In Kansas, recent research on the interior least tern indicated low numbers (100 birds), low reproductive success, and continued threats to the tern's breeding habitat (Schulenberg and Ptacek, 1984, Roger L. Boyd, pers. comm., 1984). The tern no longer breeds along the river systems in the northern part of the State. It is currently only found on the Cimarron River, in Cheyenne Bottoms Wildlife Management Area, and in the Quivira National Wildlife Refuge.

In Oklahoma, 180–300 interior least terns occur on the Salt Plains National Wildlife Refuge (Grover and Knopf, 1982; L. Hill, pers. comm., 1984). Another 100 terns breed on the Cimarron River and Lake Optima in the Oklahoma panhandle (Oklahoma Department of Wildlife Conservation, unpub. data, 1984; Roger L. Boyd, pers. comm., 1984). The tern is absent from several former breeding sites along the Red River between Texas and Oklahoma.

In Texas, the interior least tern is rare, numbering about 80 birds on segments of the Canadian and Red Rivers in the Texas panhandle and 60 birds on the Rio Grande River (Texas Parks and Wildlife Dept., unpub. data, 1984).

In New Mexico, 20 interior least terns breed on the Bitter Lake National Wildlife Refuge.

Colorado is on the periphery of the interior least tern's breeding range. The tern breeds rarely in the southwestern part of the State near the Arkansas River.

In summary, the current breeding distribution of the interior least tern is a remnant of a more widespread range in the interior of the U.S. This change in the breeding range has taken place over a period of many decades, concurrent with man's development and modification of river systems. In the case of the Missouri River, the only areas where the species breeds are the few stretches of river that are not channelized or inundated by reservoirs. The current breeding distribution of the interior least tern is also restricted to segments of the Niobrara, Platte Arkansas, Mississippi, Ohio, Red, Rio Grande, Canadian, and Red Rivers; and the Cheyenne Bottoms Wildlife Management Area and Quivira National Wildlife Refuge, Kansas; Lake Optima, Salt Plains National Wildlife Refuge, and Edith Salt Plains, Oklahoma; and the Bitter Lake National Wildlife Refuge, New Mexico.

The low numbers of the interior least tern and the continued loss and curtailment of its habitat has led to considerable concern for the species. Since 1975, the States have recognized the plight of the interior least tern. The interior least tern is officially listed as endangered in South Dakota, Iowa, Illinois, Missouri, Texas and New Mexico and officially listed as threatened in Kansas and Nebraska. Indiana officially lists the interior least tern as extirpated. State Natural Heritage Programs unofficially list the interior least tern as endangered in Tennessee and threatened in Kentucky and North Dakota.

The Central Platte Natural Resources District (CPNRD) stated that the Service is relying on hydrologic and biological data relative to vegetative encroachment and flows in the Platte River that are outdated and misunderstood by the Service. The CPNRD commented that the Platte River is in a transition from continuously unvegetated, to intermittently unvegetated (transitional), to annually vegetated. The CPNRD contends that it is not the lack of scouring by the river or spring flooding that has caused vegetation encroachment on the Platte River. Rather, the causative factor behind the development of the woody floodplain vegetation is the presence of water in the river on a year-round basis. The CPNRD submitted two reports by Ecological Analysts (1983) and Henningson, Durham & Richardson (1983), and several testimonies on the matter before the Nebraska State Department of Water Resources, which detail CPRND's contention.

Service response: While the precise cause may be of consequence to future section 7 consultations, the fact of reduced habitat remains and is of direct relevance to this final rule. Both the CPNRD (Ecological Analysts, 1983) and the Service recognize that water development projects on the Platte River have resulted in vegetational changes. In

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the present judgment of the Service, the dewatering and regulation of the Platte River over the past 50 years has been a causative agent in the reduction of available wetlands and sandbars for the least tern and many other forms of wildlife. The Nebraska Game and Parks Commission (1984, 1985) notes that loss or modification of tern nesting habitat has occurred along the Platte River because of vegetation encroachment caused by modifications in the flow regime.

The Service conducted a 3-year investigation (1978–1980) of the Platte River (U.S. Fish and Wildlife Service, 1981) "to define habitat-use patterns and habitat requirements of migratory bird populations utilizing the North Platte and Platte River valleys and to assess factors influencing woody vegetation establishment along these rivers." The report stated:

> With approximately 70 percent of the Platte's annual flows diverted for various consumptive uses upstream in Colorado, Wyoming, and western Nebraska, channel width in many areas has been reduced to 10–20 percent of former size. Habitat conditions within the existing channel have also changed as a result of reduced scouring of sandbars and shifting of alluvial sediments. A broad band of mature deciduous woodland now occupies tens of thousands of acres that formerly were part of the river and numerous islands overgrown with woody vegetation exist within the channel.

A concurrent study by the U.S. Geological Survey (1983) substantiates the results of the Service's conclusion on vegetation encroachment. Williams (1978) provides photographs and other documentation on the altered nature of the Platte River. Currier (1982) describes in detail many aspects of the Platte's plant ecology, including plant succession. The Service's report concluded that "species that nest on the open sandbars of the Platte River have been affected adversely by the encroachment of woody vegetation. The most profound impact has been on the distribution and abundance of the least tern and piping plover. Both species require broad expanses of unvegetated river channel and sparsely vegetated sandbars." Faanes (1983) further details the nesting ecology of the interior least tern and the present modification and curtailment of the bare sandbar habitat on the Platte River.

While endorsing Federal listing of the interior least tern, the Nebraska Game and Parks Commission commented that there had been significant loss and modification of the tern's breeding habitat and that its range in Nebraska had been reduced. The Commission further commented that much of the existing breeding habitat remains threatened because of man's manipulation of river flows and disturbances and that, due to severe encroachment of woody vegetation, many of the historic nesting areas on the Platte are now unsuitable for terns. The Commission noted that encroachment of vegetation has been encouraged through significant modifications of the river flow regime, particularly by the loss of annual scouring flows.

The Nebraska Water Resources Association (NWRA) commented that the habitat needs of three endangered species, the whooping crane (*Grus americana*), bald eagle (*Haliaeetus leucocephalus*), and interior least tern, are contradictory and that the species cannot co-exist in the same habitat or areas on the Platte River. The CPNRD submitted a report by Ecological Analysts (1983) discussing the incompatible river flow and habitat conditions required by the three birds on the Platte River.

Service response: Bald eagles primarily use mature trees of riparian woodlands for communal roosts during the winter. Whooping cranes roost on unvegetated sandbars during their migration in April and October (Lingle *et al.*, 1984). Critical habitat has been designated for the whooping crane along the Platte River (43 FR 20938–20942). The interior least tern and piping plover breed on sparsely vegetated sandbars during the summer. The maintenace of sandbar habitat will aid the recovery of the whooping crane, the interior least tern, and, if listed, the piping plover. The well-established and extensive floodplain forest will probably continue to serve as a wintering area for bald eagles. The recovery plan for the bald eagle does not call for increasing the acreage of forest along the Platte River, and the whooping crane recover plan does not call for mature forest removal (U.S. Fish and Wildlife Service, 1980b, 1983). The removal or curtailment of early successional woody vegetation, however, will be necessary for the benefit of the whooping crane and interior least tern (U.S. Fish and Wildlife Service, 1981).

The Service sees no biological conflict in protecting all the avian species. Currently the bald eagle roosts within the critical habitat reach of the Platte River. There is no incompatibility here or in suitable tern nesting habitat, which is also found in the whooping crane's critical habitat. The Platte River Whooping Crane Habitat Maintenance Trust currently manages for the least tern, bald eagle, and whooping crane and sees no biological conflict in protecting these species. Moreover, even if such a conflict did exist, this would not constitute a basis for refusing to list such species if they met the criteria for listing. The conflicts, if any, would be matters to be considered during forumlation of recovery plans.

The CPNRD commented that the Service had not determined whether present State regulatory mechanisms are adequate to protect against loss of interior least tern habitat. The CPNRD cited the laws of Nebraska which specifically require consultation between the Nebraska Game and Parks Commission and the Nebraska Department of Water Resources respecting actions which might impact on flows in the Platte River as such flows may have relevance to sandbar habitat.

Service response: Nebraska's laws are unique among the States where the interior least tern occurs. Other States do not have such a consultation process. The Service views existing laws now protecting this tern as inadequate to protect its habitat when compared to the Endangered Species Act protection now being given under this rule.

The CPNRD commented that the Service "does not know the winter range of the interior least tern and does not know whether the winter range of the interior least term impacts upon the species."

Service response: Although there may be factors affecting the tern on the winter range, based on the best available information the Service believes that the major threats to the interior least tern are on the breeding range. Although the winter range is unknown, it is likely the same as that of the more numerous coastal least tern. The Service notes that the migration routes and winter distribution of the endangered California least tern also remain unknown, although recovery of the species is proceeding well, concurrent with protection of breeding areas. The Service's recovery plan for the interior least tern will investigate migration and winter distribution, and possible threats during these periods. Moreover, the relevant criterion for listing is the degree of species endangerment, not the delineation of each and every possible cause. The possibility of additional threats to the species is not a basis to refuse listing if known threats are themselves sufficient to show danger of extinction.

The Nebraska Ornithologists' Union, Platte River Whooping Crane Habitat Maintenance Trust, Iowa Conservation Commission, U.S. Army Corps of Engineers, and others commented on the value of dredge and other spoil as

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breeding sites for interior least terns. The NWRA stated that the Service did not consider the fact that "the development and operation and maintenance of water projects and related sand and gravel facilities in Nebraska has contributed to the establishment of new habitat for the interior least tern. Nebraska and our neighboring States are dotted with thousands of sandpits and gravel pits. The operations of our numerous public power and irrigration project diversions and canals create river sandbars and dredge banks that provide habitat for the least terns."

Service response: The Service has long recognized that least terns readily accept man-created bare ground areas as nesting sites. Creating or restoring such habitat is one facet of the California least tern recovery plan (U.S. Fish and Wildlife Service, 1980a) and coastal least terns readily use dredge spoil (Gochfeld, 1983). However, not all sand and gravel pits are used by terns. In Nebraska, for example, terns do not breed at the numerous sand and gravel pits located away from the Platte River. The terns are restricted to the immediate environs of the Platte River. They appear to prefer natural islands or sandbars but will nest on man-made sites in the floodplains. Such sites, however, are usually connected to the shore and accessible to predators and human disturbance. Studies of tern colonies on sand and gravel pits adjacent to the Platte River indicated very poor productivity in 1984. High mortality of eggs and young and desertion of nest sites caused by predators and human disturbances was noted (Nebraska Game and Parks Commission, 1985). The Service will examine the suitability of man-made nesting sites as they relate to the recovery of the interior least tern.

The Platte River Whooping Crane Habitat Maintenance Trust provided census data on the interior least tern from Shoemaker and Mormon Islands in the Platte River. The Trust commented that rapid willow establishment and growth is a problem for the tern and endorsed the listing. The Trust indicated that in light of proposed water projects, the tern's habitat will continue to deteriorate. The Trust also reported their success in mechanically removing vegetation from an island and attracting nesting terns to the island. They indicated that former nesting habitat can be restored; however, such habitat will require continued and intensive management and maintenance.

One comment provided a list compiled by the Nebraska Department of Water Resources giving the number of proposed water diversion projects on the Platte and South Platte Rivers. The comments indicated that if all the projects are constructed, the loss of water would impact the fishery habitat necessary for the tern and allow further vegetation encroachment.

Service response: The Service and the Nebraska Game and Parks Commission recognize the conflict on the Platte River between water development and wildlife conservation. Through its State consultation process, the Commission has endeavored to protect water flows on the Platte River which will ensure the needs of wildlife (Nebraska Game and Parks Commission, 1984, 1985). However, the final decision is up to the Nebraska Water Resources Department with respect to State or local water projects that are without Federal involvement such as section 404 permits.

The NWRA and the Public Service Company of Colorado expressed concern about the impact that the listing of the interior least tern would have on Federal water projects. The NWRA objected to the proposed rule because of the delays and costs that would be involved in assessing the impacts of Federal activities on the interior least tern. The NWRA also questioned the effectiveness and benefit of a recovery plan and how worthwhile it would be in terms of costs. The NWRA indicated that listing may deter projects of benefit to other wildlife species and human needs.

Service response: The outcome of a recovery effort or future costs for a species or affected projects may not be considered in deciding whether to list a species under the Endangered Species Act. The Service emphasizes that listing a species, as required under the Act, is to be based solely on biological considerations.

The Endangered Species Act prohibits considerations of economic or other nonbiological factors from affecting decisions regarding the determination of endangered or threatened status. The Service indicated in the proposed rule a number of activities that may require consultation between the Service and Federal agencies under section 7(a)(4) of the Act. Although there are provisions in the Act to exempt Federal activities from the section 7 consultation requirements in the event of a jeopardy opinion on a given activity, these provisions are completely independent of the identification and listing of species that are unlikely to survive without the protection of the Act.

The Lower Mississippi Valley Division (LMVD) of the U.S. Army Corps of Engineers conservatively estimates sandbar habitat available for nesting interior least terns above river mile 315 on the Mississippi River at 160 acres per river mile during low water. Suitable nesting habitat is abundant; however, the problem is availability of habitat when the tern is ready to nest. River stage determines location and abundance of habitat. In wet years, river fall may not occur until late July, which would effectively eliminate most of the nesting activity on the river. (The tern would be searching in May for nest sites.) The LMVD stated that channel improvement and dredging activities would have minimal or no impact on the interior least tern. Channel improvement and dredging could continue to provide additional nesting habitat, particularly in the area between Osceola, Arkansas, and Cairo, Illinois, where a large proportion of the remaining terns is known. The LMVD alluded to its existing, successful program of creating nesting sites for the coastal least tern, and indicated its support to prevent damage to and enhance the habitat of the interior least tern.

The Corps' Missouri River Division (MRD) stated its intention of protecting selected sandbars from Gavins Point Dam, South Dakota, to Ponca State Park, Nebraska, by limiting recreational use to help ensure the continued reproductive success of the tern. The MRD stated that listing the interior least tern would complicate the annual review of the operation of Missouri River main stem dams. MRD added that balancing the various project purposes such as navigation and hydropower production may make it impossible to consistently operate in a manner that would maximize interior least tern reproduction.

The Southwestern Division of the Corps acknowledged that a variety of projects in Oklahoma, Kansas, and Texas would have to take the interior least tern's well-being into consideration.

The U.S. Department of Energy (Western Area Power Administration); Basin Electric Power Cooperative, Bismarck, North Dakota; and the U.S. Army Corps of Engineers commented that listing the interior least tern may have adverse impacts on electric power generation at dams on the Missouri River Main Stem System. Modifications of water releases from dams to benefit tern habitat could jeopardize, for example, Western's ability to meet firm electric power contractual commitments that extend through the year 2000. There could also be impacts on revenues and

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additional expenses for purchased electric power.

Service response: Listing the interior least tern as endangered will not automatically impose water release restrictions on main stem dams. Main stem dam operations are only one activity that may be found to be subject to the consultation requirement to the extent Federal licensing, activity, or funding is involved. Release schedules have, in the past, imposed problems for nesting terns when the average daily discharge was increased during the nesting season. Last year, for example, during the initiation of nesting the average daily discharge from Garrison Dam on the Missouri River was approximately 13,000 cubic feet per second (cfs), but before the young were fledged the average daily discharge had been increased to nearly 30,000 cfs. At least three tern colonies were known to have been completely inundated. It is these unnatural seasonal fluctuations of the average daily discharge that are, at times, of concern, not the repeated short-term fluctuations attributable to daily hydropower generation. If a jeopardy opinion on a given action or activity is determined, the Service would be required to suggest those reasonable and prudent alternatives that could be taken and still not violate section 7 of the Endangered Species Act.

The National Audubon Society and The Nature Conservancy (TNC) endorsed the listing. Citing the decline of small populations of coastal least terns on the northeast coast of the U.S., TNC stressed the role of predation in limiting small populations of interior least terns. TNC and others, including CPNRD (Ecological Analysts, 1983) emphasized the deleterious impact of humans, dogs, and vehicles on nesting terns. The general public is unknowingly using the habitat of tern colonies for picnics, parties, sandbar golf, camping, and other activities. One comment indicated that cooperative efforts have begun in North Dakota to inform the public of the presence of terns on the Missouri River.

The Texas Parks and Wildlife Department commented that due to the sympatry of the coastal least tern and interior least tern and the questionable distinction between the subspecies (either morphometrically or biochemically) a clear dividing line needs to be established between the two subspecies. Two other comments also suggested that the Service clarify those areas of Louisiana, Mississippi, and Texas that are not included in the interior least tern's range, so that any least tern occurring in those areas would not be subject to the Endangered Species Act.

Service response: In the proposed rule the Service exempted the Gulf Coastal Plain in Louisiana, Mississippi, and Texas from the historical range of the interior least tern in order to separate the coastal least tern from the interior least tern. However, the Service agrees that the term "Gulf Coastal Plain is not sufficiently definitive to separate the interior least tern population. Therefore, the Service will consider the historic range of the interior least tern in Louisiana to only include the Mississippi River and tributaries commencing north of Baton Rouge; in Mississippi the historic range only includes the Mississippi River; and in Texas the interior least tern's historic range includes the entire State except the Texas coast and a 50-mile zone inland from the coast. These changes are reflected in the rule promulgation at the end of this document. All least terns occurring within these areas will be protected by the Endangered Species Act.

Ten comments disagreed with the Service's reasons for not proposing critical habitat. They maintained that there are permanent sites, such as Salt Plains National Wildlife Refuge, Oklahoma; Bitter Lake National Wildlife Refuge, New Mexico; and Quivira National Wildlife Refuge, Kansas, where interior least terns have consistently bred for over 20 years. The Illinois Department of Conservation stated that many islands of the Mississippi are not ephemeral but stable, although becoming increasing over-vegetated, due to current channel maintenance procedures. Thus, certain interior least tern nesting islands could be identified as critical habitat. The Nebraska Ornithologists' Union and others commented that general localities, specifically certain river reaches, can be designated as critical habitat. For example, the lower 100 miles of the Niobrara River, Nebraska, 200 miles of the Central and Lower Platte River reaches, and 90 miles of the Missouri River in North Dakota from Garrison Dam to the headwaters of the Oahe Reservoir are definable locations that are consistently used by terns, even though the exact island or sandbar may vary from year to year. The same can be said of other river reaches in the current range of the interior least tern.

Service response: The Service maintains that at this time the designation of critical habitat would not provide an overall benefit to the tern and, therefore, is not prudent. Affected National Wildlife Refuge managers and other involved parties have been and will be notified of the tern's management requirements. A fragmented critical habitat approach would not recognize all areas important to the species. See also discussion in the Critical Habitat section below.

Summary of Factors Affecting the Species

After a thorough review and consideration of all information available, the Service has determined that the interior least tern should be classified as an endangered species because the tern is in danger of extinction throughout a significant portion of its range. Procedures found at section 4(a)(1) of the Endangered Species Act (16 U.S.C. 1531 *et seq.*) and regulations promulgated to implement the listing provisions of the Act (codified at 50 CFR Part 424; revision published October 1, 1984; 49 FR 38900–38912) were followed. A species may be determined to be endangered or threatened due to one or more of the five factors described in section 4(a)(1). These factors and their application to the interior least tern are as follows:

A. *The present or threatened destruction, modification, or curtailment of its habitat or range.* The construction of reservoirs and pools along rivers has permanently eliminated some islands and prevents the formation of others. Such reservoirs and pools exist along hundreds of miles of rivers of the Mississippi Basin. Stretches of river below dams are so regulated that a river's natural erosion and deposition processes, which are responsible for creating, destroying, and maintaining nesting islands, no longer occur. The controls on the river have reduced the spring floods, which would normally scour vegetation from islands, and have limited the amount of alluvium for island formation. Consequently, on most of the remaining islands, herbaceous vegetation is followed by shrub and tree species, which ultimately form the permanent vegetation of the island, a condition unsuitable for nesting interior least terns.

Johnson *et al.*, (1976) reported that in North Dakota, a lack of new alluvial deposits is leading to a floodplain forest of advanced successional stage along the Missouri River below Garrison Dam. Plant succession is believed to be the cause of the loss of the interior least tern colony at DeSoto Bend National Wildlife Refuge in Iowa. The braided nature of the Platte River in most of Nebraska has been largely eliminated. Its historic flow has been reduced 60 to 80 percent by irrigation withdrawals. As a result, the width of the river has been reduced, and

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most of the islands are heavily vegetated (U.S. Fish and Wildlife Service, 1981). Plant succession on islands and riverbanks is occurring on other midwest rivers. Even dredge islands develop late seral stages of vegetation within a few years and have been subsequently avoided by terns. The vegetative character on natural and manmade islands in regulated rivers will continue to change to a point of unsuitability for nesting terns as observed by Wycoff (1960) during a period of 17 years on the Platte River. Along the Niobrara River in Nebraska, vegetation encroachment is not presently a problem as there are no major control structures on that river.

A series of locks, dams and channel maintenance activities on the Mississippi River and its major tributaries (Ohio and Missouri) have resulted in a river flow state that inundates islands, shrinks the river width, and restricts the amount of alluvium for island formation. Construction under the Missouri River Bank Stabilization and Navigation Act during the last 50 years has apparently eliminated nearly all the sandbar and sandbeach habitat. For example, one section of the Missouri River (Nebraska-Iowa border) was estimated to have had 25,000 acres of potential nesting habitat at the turn of this century. Approximately 99 percent of this habitat has now been lost. Where sandbars still occur along the Nebraska-South Dakota boundary, 7,800 acres of sandbar habitat have been lost between 1956 and 1975, including losses within the Missouri National Recreation River. Sandbars along Nebraska's entire Missouri River boundary have been virtually eliminated with the exception of the remaining 2,200 acres of exposed sandbars inventoried in 1980 along the 50-mile Missouri National Recreation River (Schmulbach *et al.*, 1981).

In summary, bare sand islands and other bare areas will continue to decline and many of those islands that do survive will undergo plant succession unfavorable to the interior least tern. Moreover, human use of river islands has been increasing and may hinder reproductive success (Anderson, 1983). Vehicular and other recreational activities are widespread along the Platte, Missouri, and Mississippi Rivers and occur largely on the barren islands favored by terns. Terns nesting on Salt Plains National Wildlife Refuge and Edith Salt Plain in Oklahoma are threatened by chloride control projects, which will either flood their habitat or reduce their food resources and may fail to provide replacement habitat.

B. *Overutilization for commercial, recreational, scientific, or educational purposes.* Not applicable for the species.

C. *Disease or predation.* Disease has not been a problem known to occur in this species. Coyotes and foxes prey on interior least tern eggs, and evidence exists that such predation can have a serious impact on nest success. Dogs and other domestic animals accompanying human use of sandbars can disrupt tern nesting through disturbance or predation. Dogs and cats were blamed for disrupting some colonies of the endangered California least term (U.S. Fish and Wildlife Service, 1980).

D. *The inadequacy of existing regulatory mechanisms.* The interior least tern is listed as threatened or endangered by the States of South Dakota, Nebraska, Iowa, Illinois, Missouri, Kansas, New Mexico, and Texas. As a general rule, however, such listings do not result in State protection of the habitat of this species. The Migratory Bird Treaty Act (16 U.S.C. 703 *et seq.*) protects the bird and its parts, nests, and eggs from taking and trade. However, this Act does not protect against habitat loss, which is the main threat to the tern, and, by itself, will not be adequate to prevent the species' further decline. The Endangered Species Act would offer additional protection for the species, largely through the recovery and consultation processes.

E. *Other natural or manmade factors affecting its continued existence.* None is known.

The Service has carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by this species in determining to make this rule final. Endangered status is appropriate because of the low numbers and scattered distribution of the tern and the continued threat to the bird's breeding habitat. None of the comments received by the Service recommended threatened status. Although many States already list the species, their laws do not provide the high degree of protection afforded by the Endangered Species Act. Not to list this bird would be contrary to the evidence gathered to date.

Critical Habitat

Section 4(a)(3) of the Endangered Species Act, as amended, requires that to the maximum extent prudent and determinable, the Secretary shall specify any habitat of a species which is considered to be critical at the time the species is determined to be endangered or threatened. For this particular situation, however, the Service generally has concluded that there is no demonstrable overall benefit to the tern in designating critical habitat and that such an action is not prudent. Affected land management agencies and other involved parties are aware or will be notified of the location of areas needing special management to accommodate the needs of the tern. No additional notification benefits would accrue from a critical habitat designation beyond those from the listing. The interior least tern is a wide ranging species whose occupied habitat would be difficult to delineate and may vary over time. Service recovery actions will continuously update and address the tern's habitat management needs. Possible increased vandalism and taking could occur due to designating critical habitat. The Service feels there is no net benefit from designating critical habitat at this time. Should the Service receive additional information on this subject, which would warrant reconsideration of this decision, the Service could propose critical habitat in the future.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Endangered Species Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in conservation actions by Federal, State, and private agencies, groups, and individuals. The Endangered Species Act provides for possible land acquisition and cooperation with the States and requires that recovery actions be carried out for all listed species. Such actions are initiated by the Service following listing. The protection required of Federal agencies and the prohibitions against taking and harm are discussed, in part below.

The Migratory Bird Treaty Act makes it illegal to take, possess, sell, deliver, carry, transport, or ship interior least terns, their parts, eggs, nests, and young. However, it affords no protection to their habitat. Section 7(a) of the Endangered Species Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR Part 402 and are now under revision (see proposal at 48 FR 29990; June 29, 1983). Section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species. If a Federal action may

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affect a listed species, the responsible Federal agency must enter into formal consultation with the Service.

It is not possible now to state with certainty which particular ongoing or planned projects or areas of activity would require consultation and possible modification. The following represent some activities which, based upon knowledge of the tern's needs, may be found to be subject to the consultation requirement to the extent Federal licensing, activity, or funding is involved:

Desalinization or chloride control projects on the Arkansas River and the Red River Basin;

Channelization, stabilization, and flood control projects on the Missouri River;

Construction, maintenance, and operation of navigation channels on the Mississippi and lower Missouri Rivers, particularly those which prevent formation or maintenance of bare sandbars;

Operation of locks, dams, and energy diversions in the Mississippi Basin;

Construction and operation of the bypass channel for Edith Salt Plains, Oklahoma; and

Water release operations from the Gavins Point Dam and the Lewis and Clark Reservoir and the Garrison and Oahe Dams, particularly during the tern nesting season, when releases may inundate nests.

This does not indicate that all such actions will, in fact, be found to require consultation and still fewer consultations would require the termination of any such project. Modification of the Federal actions rather than termination has been the experience of the Service. Affirmative conservation plans may be implemented to avoid causing jeopardy to the tern.

The Act and implementing regulations found at 50 CFR 17.21 set forth a series of general prohibitions and exceptions that apply to all endangered species. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to take, import or export, ship in interstate commerce in the course of a commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that had been taken illegally. Certain exceptions apply to agent of the Service and State conservation agencies.

Permits may be issued to carry out otherwise prohibited activities involving endangered species under certain circumstances. Regulations governing permits are at 50 CFR 17.22 and 17.23. Such permits are available for scientific purposes, to enhance the propagation or survival of the species, and/or for incidental take in connection with otherwise lawful activities.

The final rule brings sections 5 and 6 of the Endangered Species Act into effect with respect to the interior least tern. Section 5 authorizes the acquisition of lands for the purpose of conserving endangered species. Pursuant to section 6, the Service will be able to grant funds, when available, to affected States for management actions aiding the protection and required recovery actions for the interior least tern.

The development of a recovery plan for this bird will begin and bring together State and Federal efforts for the conservation of the tern. The plan will establish an administrative framework, sanctioned by the Act, for agencies to coordinate activities and cooperate with each other in conservation efforts. The plan will set recovery priorities and estimate the cost of the various tasks necessary to accomplish them. It will designate appropriate functions to each agency and a time frame within which to complete them. If the recovery plan action has the desired effect, then the threats to the tern might become lessened such that the bird could be considered for threatened status or for removal from the List of Endangered and Threatened Wildlife, with the latter action being one of the principal goals of the Service.

National Environmental Policy Act

The Fish and Wildlife Service has determined that an Environmental Assessment, as defined by the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. A notice outlining the Service's reasons for this determination was published in the **Federal Register** on October 25, 1983 (48 FR 49244).

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The primary author of this fianl rule is Mr. John G. Sidle, Endangered Species Division (see **ADDRESSES** section).

List of Subjects in 50 CFR Part 17

Endangered and threatened wildlife, Fish, Marine mammals, Plants (agriculture).

Regulation Promulgation

PART 17—[AMENDED]

Accordingly, Part 17, Subpart B of Chapter I, Title 50 of the Code of Federal Regulations, is amended as set forth below:

1. The authority citation for Part 17 continues to read as follows:

Authority: Pub. L. 93–205, 87 Stat. 884; Pub. L. 94–359, 90 Stat. 911; Pub. L. 95–632, 92 Stat. 3751; Pub. L. 96–159, 93 Stat. 1225; Pub. L. 97–304, 96 Stat. 1411 (16 U.S.C. 1531 *et seq.*)

2. Amend § 17.11(h) by adding the following, in alphabetical order under "BIRDS," to the List of Endangered and Threatened Wildlife:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
Birds:							
*	*	*	*	*	*		
Tern, least	*Sterna antillarum*	U.S.A. (Atlantic and Gulf coasts, Mississippi Basin, and CA), Greater and Lesser Antilles, Bahamas, Mexico; winters Central America or northern South America.	U.S.A. [AR, CO, IA, IL, IN, KS, KY, LA (Mississippi R. and tributaries N of Baton Rouge), MS (Miss. R), MO, MT, NE, NM, ND, OK, SD, TN, TX (Except within 50 miles of coast)].	E		NA	NA
*	*	*	*	*	*		

Dated: May 22, 1985.

J. Craig Potter,

Acting Assistant Secretary for Fish and Wildlife and Parks.

[FR Doc. 85–12860 Filed 5–24–85; 8:45 am]

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008321

Comprehensive Conservation Plan

Huron Wetland Management District
Madison Wetland Management District
Sand Lake Wetland Management District

South Dakota

January 2012

Approved by

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Comprehensive Conservation Plan

Huron Wetland Management District
Madison Wetland Management District
Sand Lake Wetland Management District

South Dakota

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Summary

Ryan Hagerty/USFWS

White-tailed Deer

Every year, millions of migratory waterfowl and other waterbirds find their way to a mosaic of wetlands and grasslands in eastern South Dakota. These habitats provide the untiring winged travelers with the sanctuary and nourishment necessary to procreate, giving rise to the future generations of migratory birds that will populate North America's Central Flyway. These lands are also of critical importance to a myriad of other endemic fish, wildlife, and plant species, and they provide thousands of sportsmen and wildlife enthusiasts with places to experience the wonders of the natural world and partake in its bounty.

It is the responsibility of the U.S. Fish and Wildlife Service to preserve the integrity of these important habitats for the benefit of fish and wildlife, as well as for the continuation of compatible outdoor recreational uses derived therein. The Service accomplishes this through a network of federally managed lands dedicated to the preservation of fish, wildlife, plants, and the habitats upon which they depend—the National Wildlife Refuge System.

The Districts

The Huron Wetland Management District, Madison Wetland Management District, and Sand Lake Wetland Management District are units of the Refuge System that manage small tracts of fee-owned Federal lands called waterfowl production areas, administer easement programs to preserve privately owned wetlands and grasslands, and conserve other tracts of lands ceded to the Service through different authorities, such as former Farmers Home Administration lands. Together, these three districts encompass 27 counties in eastern South Dakota, where their staffs manage approximately 1.5 million acres of land including more than 378,000 acres in wetlands easements, nearly 630,000 acres in grassland easements, more than 100,000 acres of fee-owned lands distributed in 445 waterfowl production areas, and miscellaneous other tracts of land.

All 445 waterfowl production areas managed by these districts are open to the public to engage in compatible wildlife-dependent recreational uses, of which hunting and fishing, followed by wildlife observation and photography, are the ones that attract the greatest number of visitors each year. Biannual bird migrations each spring and fall attract thousands of local residents as well as tourists from around the world to experience this breathtaking display of one of nature's profound cycles. Environmental education and interpretation are other compatible public uses that take place at certain designated sites within each district, usually requiring closer involvement of district staffers.

Vision for the Districts

Clear blue skies frame spectacular views of grasslands and wetlands teeming with migratory waterfowl and other wildlife in the Huron, Madison, and Sand Lake Wetland Management Districts. Here, future generations will experience the whistle of the northern pintail, the song of the western meadowlark, and the distant boom of the prairie chicken. Located in the Prairie Pothole Region of South Dakota, these districts preserve timeless landscapes in the face of change. Conservation of these lands is achieved through hard work and the support of friends and neighbors who value natural places as an essential component of their quality of life.

Goals for the Districts

Native Prairie
Conserve, restore, and improve the biological integrity and ecological function of the native prairies to support healthy populations of native plants and wildlife and promote the natural role of fire and grazing in shaping and managing these landscapes.

Planted Grasslands
Manage planted grasslands to contribute to the production and growth of continental waterfowl populations, other migratory birds, threatened and endangered species, and other wildlife.

Wetlands
Protect, restore, and enhance prairie pothole wetlands to support diverse plant communities and provide habitat to waterfowl, shorebirds, wading birds, and associated wetland-dependent wildlife.

Research and Monitoring
Provide a learning platform that uses science, monitoring, applied research, and adaptive management to advance understanding of the Prairie Pothole Region and management of these areas.

Consumptive Uses
Provide visitors with quality opportunities to enjoy hunting, fishing, and trapping in waterfowl production areas and expand their knowledge and appreciation of the prairie landscape and the National Wildlife Refuge System.

Nonconsumptive Uses
Provide visitors with quality opportunities to enjoy, observe, photograph, and appreciate the prairie ecosystem while expanding their knowledge of and support for the National Wildlife Refuge System.

Operations and Administration
Through effective communication and innovative partnerships, secure and efficiently utilize funding, staffing, and volunteer programs for the benefit of all natural resources in the districts.

Partnerships
Promote and develop partnerships with landowners, public and private organizations, and other interested individuals to maintain, restore, and enhance a diverse and productive landscape in the Prairie Pothole Region.

Environmental Education and Interpretation
Provide quality educational opportunities for persons of all abilities to learn about, understand, and appreciate prairie landscapes and the role of the National Wildlife Refuge System.

Planning Process and Issues

The comprehensive conservation planning process for these districts began in April 2008 with public notices on the Service's intent to prepare this plan, seek public input, hold public meetings, and identify key issues to be addressed in the plan. The following is a summary of the issues identified and that are covered within the scope of this plan.

Wetland and Upland Habitats

Wetland and upland habitats within the planning area are in need of protection and enhancement. The current and likely future staffing situation at the districts requires that habitat management and protection be carefully evaluated and eventually follow a system of prioritization so that the districts can fulfill the purposes for which they were established.

Invasive Plants

Previously farmed lands that have been restored to a semblance of native prairie are compromised by invasive plant species such as leafy spurge, Canada thistle, sow thistle, and absinth wormwood. Other invasive plants of concern to the districts, and that substantially degrade the quality and suitability of habitats for wildlife species, include smooth brome, Kentucky bluegrass, and crested wheatgrass.

Energy Development

Increasing demand for energy, particularly in the form of biofuel and wind energy production, is becoming a great concern for the districts due to these industries'

potential to affect wildlife habitat quality and integrity. The Service needs to study and analyze ways in which to support our Nation's increasing energy needs while affording adequate protection to fish, wildlife, plants, and the habitats on which they depend.

Prairie Conversion

Conversion of native prairie to agricultural, urban, and other uses is of great concern to the Service and to many conservation and traditional ranching advocacy groups. The districts play a preeminent role in helping to preserve and enhance remaining prairie lands in South Dakota, as well as in helping to restore degraded or previously converted lands back to native prairie.

Predator Management

Because of modifications to native prairie and other factors, the populations of several predatory species have increased above their historical levels. This situation adversely affects the ability and success of grassland-nesting bird species, including waterfowl and other migratory birds, to maintain or increase sustainable population levels. The Service needs to find ways to counter these deleterious effects in order to fulfill the purposes for which the districts were established.

Visitor Services

There is an increasing demand by local residents and tourists for places to engage in outdoor recreational opportunities. The districts, through the six wildlife-dependent priority uses—hunting, fishing, wildlife observation, photography, environmental education, and interpretation—are uses currently authorized on lands administered by the districts. A growing demand for public recreation in South Dakota and the nation makes these six wildlife-dependent recreational uses, as specified in the National Wildlife Refuge System Improvement Act, an issue of primary interest.

Partnerships

The Service puts a high priority on working in partnership with conservation and agricultural groups to support conservation programs such as Federal Farm Bill legislation, South Dakota Game, Fish and Parks projects, water quality and watershed projects, and private conservation efforts.

Operations

Funding and staff are not sufficient to fulfill the districts' purposes or to meet their goals. Consequently, identification of priorities and efficient direction of resources will always be an issue. The Service's staff needs to identify and describe unfunded needs to be able to compete effectively for additional money from within the Service as well as from partners and other sources. District facilities need to be evaluated and upgraded.

© Chris Bailey

American Kestrel

Monitoring and Research

Monitoring habitat and wildlife populations is an essential element in achieving the districts' primary goals and objectives. Basic data about recruitment, mortality, and habitat use for a representative group of species must be collected and analyzed on a regular basis to make appropriate decisions for maintaining the viability of the habitats on which these species depend. Using the districts for field research could contribute to new directions in management and expand the knowledge of field biologists.

Management Direction

Management of the three districts will emphasize developing and implementing an improved, science-based priority system to restore native prairie habitats for the benefit of waterfowl and other migratory birds. District staff will focus on high-priority tracts and, when possible, on medium-priority tracts. The focus of this alternative is to restore ecological processes and native grassland species to the greatest extent possible within the parameters of available resources and existing constraints. District staff will seek to maintain the existing levels and types of public use programs, ensuring that programs offered to the public are of consistently high quality.

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Abbreviations

Administration Act	National Wildlife Refuge System Administration Act of 1966
AF	acre-foot
APHIS	Animal and Plant Health Inspection Service
BAER	Burned Area Emergency Response
BAR	Burned Area Rehabilitation
BCC	Birds of Conservation Concern
BCR	bird conservation region
BIDEH	Biological Integrity, Diversity, and Environmental Health
BMP	best management practice
CCP	comprehensive conservation plan
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CRP	Conservation Reserve Program
CWCS	comprehensive wildlife conservation strategy
CWD	chronic wasting disease
Department	U.S. Department of the Interior
districts	Huron, Madison, and Sand Lake Wetland Management Districts
DNC	dense nesting cover
DOI	U.S. Department of Interior
DPS	distinct population segment
Duck Stamp Act	Migratory Bird Hunting and Conservation Stamp Act
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FmHA	Farmers Home Administration
FMP	fire management plan
FTE	full-time equivalent
GIS	geographic information system
HAPET	Habitat and Population Evaluation Team
HFI	Healthy Forests Initiative
HPAI	highly pathogenic avian influenza
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
IPM	integrated pest management
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NAWCA	North American Wetlands Conservation Act
NAWMP	North American Waterfowl Management Plan
NEPA	National Environmental Policy Act of 1969
NFP	National Fire Plan
NGO	nongovernmental organization
NHPA	National Historic Preservation Act

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NPAM	Native Prairie Adaptive Management
NWR	national wildlife refuge
Partners Program	Partners for Fish and Wildlife Program
P.L.	Public Law
PPJV	Prairie Pothole Joint Venture
RECD	Rural Economic and Community Development
Refuge System	National Wildlife Refuge System
RLGIS	Refuge Land Geographic Information System
SDDOT	South Dakota Department of Transportation
SDGFP	South Dakota Game, Fish and Parks
Service	U.S. Fish and Wildlife Service
SIP	State Implementation Plan
SUP	special use permit
SWG	State Wildlife Grant
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VCS	visitor contact station
VOR	visual obstruction reading
WMD	wetland management district
WNV	West Nile virus
WPA	waterfowl production area

Definitions of these and other terms are in the glossary, located after chapter 4.

CHAPTER 2—The Districts

USFWS

Wildlife protection is a priority of district management.

Every unit of the Refuge System has a purpose for which it was established. This purpose is the foundation upon which all programs are built, from biology and public use to maintenance and facilities. No action that the Service or the public takes may conflict with this purpose. The goals, objectives, and strategies identified in this CCP are intended to support the purposes for which each district was established.

A wetland management district provides oversight for all of the Service's small land tracts in a multicounty area. The three districts manage 445 WPAs (100,094 acres) and more than 1 million acres of conservation easements in 25 counties in South Dakota. These district lands (totaling 1,136,965 acres) are part of the National Wildlife Refuge System, a network of lands set aside to conserve fish and wildlife and their habitat.

The Service purchases WPAs with funds generated from the sale of Federal Duck Stamps to protect and restore waterfowl habitat. These areas are managed primarily for the production of migratory birds. Conservation easements, also purchased using Duck Stamp funds, are on private lands where landowners have sold some of their property rights to the Service for protection and restoration of wildlife habitat.

This chapter describes the history, special values, purposes, vision, goals, and planning issues for the three South Dakota districts.

2.1 Establishment, Acquisition, and Management History

The Huron, Madison, and Sand Lake WMDs were established with the major objectives of wetland preservation, waterfowl and wildlife production, and maintenance of breeding grounds for migratory birds. The districts also provide a northern staging area and habitat for migration.

HABITAT PROTECTION

The Service manages the WPAs for the benefit of waterfowl, other migratory birds, threatened and endangered species, and resident wildlife. The districts protect habitat primarily with two tools—WPAs and conservation easements—briefly described below.

- WPAs are public lands purchased by the Federal Government for increasing the production of migratory birds, especially waterfowl. The purchase of land is also known as "ownership in fee title," where the Federal Government holds ownership of land on behalf of the American public. Money to buy WPA lands generally comes from the sale

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Mallard drakes in flight.

of Federal Duck Stamps. This important program was developed to ensure the long-term protection of waterfowl and other migratory bird breeding habitat, primarily in the Prairie Pothole Region of the northern Great Plains (figure 3). All WPAs are within districts managed by Service staff. WPAs are open to the public for hunting, fishing, bird watching, trapping, hiking, and most other nonmotorized and noncommercial outdoor recreation. (Recreational trapping has been authorized by 50 CFR part 31.16.)

- Conservation easements are acquired to protect migratory bird species habitat on private land. Typically used where acquisition in fee title is not desirable or needed, perpetual easements are bought from willing landowners within a wetland management district. Conservation easements have several advantages over the outright purchase of lands by the Service. First, they are more cost effective in terms of both initial purchase and long-term management responsibilities. While conservation easement contracts do require attentive enforcement to ensure their integrity, they do not carry the other burdens of ownership—for example, maintenance of facilities such as fences and signs, control of invasive plants, and mowing of ditches. Second, the operator owns and manages the land in much the same way as was done before the conservation easement purchase. The program was developed and carried out by managers, biologists, and realty specialists with an interest in protecting resources at the landscape scale while minimally affecting, and even complementing, other agricultural practices. A single-habitat conservation easement is often referred to as either a "wetland easement" or a "grassland easement." Wetland easements generally prohibit draining, burning, and leveling. Grassland easements generally prohibit the cultivation of grassland habitat, while still permitting the landowner traditional grazing uses.

The Service initially focused only on the protection of wetlands in the Prairie Pothole Region. However, data also revealed the importance of upland grasslands to successful nesting of waterfowl. With the continued conversion of grassland to cropland and consistent declines in the populations of grassland-dependent birds, the need to protect adjacent grassland habitats became evident. Like a wetland easement, a grassland easement transfers limited perpetual rights to the Service for a one-time, lump-sum payment. The purpose of a grassland easement is to prevent the conversion of grassland to cropland while minimally restricting existing agricultural practices. More specifically, the purposes of the grassland easement are to improve the water quality of wetlands by reducing soil erosion and the use of chemicals and fertilizers on surrounding uplands; to improve upland nesting habitat for all ground-nesting birds, especially waterfowl, and enhance nesting success on private lands; to perpetuate grassland cover established by other Federal programs (for example, the Conservation Reserve Program [CRP]); and to provide an alternative to the purchase of uplands in fee title, thus maintaining lands in private ownership. Grassland easements restrict the landowner from altering the grass by digging, plowing, disking, or otherwise destroying the vegetative cover. Haying, mowing, and seed harvest are restricted until July 16 of each year. The landowner can graze without restriction.

Wetland easements are administered similarly to grassland easements. These easements restrict the landowner from altering wetlands through draining, burning, or filling. When they are dry, the landowner can farm wetlands without restriction. Areas of wetland habitats supporting more than 25 duck pairs per square mile are eligible for the program.

The Federal Migratory Bird Conservation Fund finances the acquisition of WPAs and conservation easements by providing the U.S. Department of the Interior (Department) with monies to acquire migratory bird habitat. The 1958 amendment to the Migratory Bird Hunting and Conservation Stamp Act (Duck Stamp Act) (16 United States Code [U.S.C.] 718) authorized the Small Wetlands Acquisition Program and provided for the acquisition of WPAs in addition to the previously authorized habitats. Receipts from the sale of Duck Stamps are used to acquire habitat under the provisions of the Migratory Bird Treaty Act (16 U.S.C. 715). The Service's perpetual conservation easements are key components of the Small Wetlands Acquisition Program; these easements, together with WPAs, have contributed greatly to the conservation and maintenance of prairie-nesting migratory birds.

The districts administer other conservation easements that were not acquired through the Small Wetlands Acquisition Program. The most common of these are Farmers Home Administration conservation

Table 2. Grassland and wetland easements in the three districts.

District	County	Purchase date	Tract	Number of acres	Number of tracts	Total acres
First Grassland Easement Purchase						
Huron	Sanborn	12/05/1990	188G	529.00	455	141,944.89
Madison	McCook	12/30/1991	191G	129.20	243	53,612.46
Sand Lake	Walworth	06/22/1990	83G	436.00	905	332,314.83
Total					1,603	527,872.18
First Wetland Easement Purchase						
Huron	Hand	10/09/1963	11X	29.00	1,424	85,579.90
Madison	Deuel	01/18/1963	10X	31.00	1,573	55,218.10
Sand Lake	McPherson	07/20/1962	12X	242.00	3,497	231,761.16
Total					6,494	372,559.16

easements—also known as Rural Economic and Community Development easements, Farm Service Agency "Ag-Credit easements," and U.S. Department of Agriculture (USDA) conservation easements, depending on the status of the USDA program responsible for these properties at the time they were in Federal inventory. The 1985 Farm Bill Consolidated Farm and Rural Development Act was the initial authorization for Farmers Home Administration easements. The Farmers Home Administration was given authority to establish easements for conservation, recreation, and wildlife purposes on properties that were foreclosed on by the Federal Government ("inventory" properties), and the Service was designated easement manager for those easements worthy of inclusion into the Refuge System.

District Descriptions

The three districts support all the waterfowl species that occur in the Prairie Pothole Region. The three districts manage more than 1.5 million acres within the 27-county planning area in South Dakota (for an accurate breakdown of these acres please see "Service Activities in South Dakota" in chapter 1). Each of the three districts is described below.

Huron WMD

The Huron WMD was established in 1992. The district was established encompassing lands that were previously under the management of both the Lake Andes and Sand Lake WMDs. This area was too far from the previous management offices to afford reliable and efficient management, resulting in minimal management of lands acquired prior to district establishment.

Huron WMD encompasses eight counties—Beadle, Buffalo, Hand, Hughes, Hyde, Jerauld, Sanborn, and Sully—in east-central South Dakota, an area of approximately 6,869 square miles. In 2010, the district administered 62 WPAs totaling approximately 17,574 acres, wetland easements totaling approximately 86,333 acres, grassland easements totaling approximately 145,205 acres, and conservation easements totaling approximately 10,100 acres (figure 5). Although at least one WPA is located in every county, the majority are currently in Beadle, Hand, and Jerauld Counties.

Important features of Huron WMD include the following:

- The district contains the smallest number of fee-title acres. Due to the smaller size of this district, staff has the ability to manage and monitor intensively.
- The district is subject to the most rapid agricultural growth and development of the three districts; this growth is expected to continue.
- The district presents opportunities to increase easement acres—meaning an opportunity to protect more native prairie.
- Management focuses on restoration of native prairie with fire and grazing.
- The Huron WMD is one of only three districts with an active Friends Group.

Issues faced by Huron WMD include the following:

- The location is challenging. Many hours of travel are required to manage and monitor district lands.
- Significant conversion of grasslands to agriculture continues within the district.

Madison WMD

The Madison WMD was established in 1969. It evolved from the withdrawal of four counties from Waubay WMD and five counties from Lake Andes WMD. Deuel, Brookings, Hamlin, Kingsbury, Miner, Moody, McCook, Lake, and Minnehaha Counties are included within the district, covering an area of 5,804 square miles. Minnehaha is the largest South Dakota county by population, with 148,281 inhabitants. The district extends west from the Minnesota border through the Big Sioux Basin and Prairie Coteau ecoregions (see discussion in chapter 4). Tallgrass prairie and agricultural lands comprise most of the district. As of January 2010, the Madison WMD administered 221 WPAs totaling

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approximately 38,778 acres, wetland easements totaling approximately 57,074 acres, grassland easements totaling approximately 72,263 acres, tallgrass prairie easements totaling approximately 11,006 acres, and Farmers Home Administration easements totaling approximately 6,500 acres (figure 6).

Important characteristics of Madison WMD include the following:

- The district consists primarily of tallgrass prairie (with some mixed-grass prairie). The district contains Prairie Coteau, James River Lowland, Big Sioux Basin, and Loess Prairies.
- The district has the largest human population of the three South Dakota districts.
- The district is home to many lakes and semipermanent or permanent wetlands.
- The district contains the least amount of native prairie of the three districts.
- Such notables as early pioneer artist Harvey Dunn and author Laura Ingalls Wilder of "Little House on the Prairie" are from this area. Wilder's book, "On the Shores of Silver Lake," was written about her childhood memories of life next to a beautiful prairie wetland that still attracts many visitors each year.

Issues faced by Madison WMD include the following:

- The largest human population leads to issues with encroaching urban development.
- More lakes mean more people—meaning more jet skis and more wildlife disturbance.
- Wetland drainage issues require more enforcement. Wetlands may be wet only about 50 percent of the time; people want to drain wetlands so that they can produce crops.
- There is extensive agricultural tillage; native grass is diminishing at an alarming rate.

Sand Lake WMD

The Sand Lake WMD was established in 1961. The largest district in the country, it originally encompassed 11 counties—Brown, Spink, McPherson, Edmunds, Faulk, Campbell, Walworth, Potter, Corson, Dewey, and Sully—in north-central South Dakota, covering an area of approximately 12,000 square miles. In 1992, Sully County was transferred to the newly established Huron WMD. The current 10-county district extends west to the Missouri River and includes part of the James River Basin to the east. The western portion of the district is characterized by mixed-grass prairie. Transition prairie and agricultural lands characterize the eastern portion. In 2010, the district administered 162 WPAs totaling approximately 43,742 acres, wetland easements totaling approximately 234,986 acres, grassland easements totaling approximately 398,589 acres, and conservation easements totaling approximately 14,815 acres (figure 7).

Important characteristics of Sand Lake WMD include the following:

- The district extends from James River Lowland in the southeastern corner to the Missouri Plateau in the northwestern corner, with most of its fee title and easement lands in the Missouri Coteau and Drift Plains.
- The district straddles the Missouri River and includes some easements west of the Missouri River.
- Wetland drainage and tiling are not as great an issue as in other districts.

Issues faced by Sand Lake WMD include the following:

- The Sand Lake WMD is a very large entity, and it currently shares staff with the Sand Lake National Wildlife Refuge. This shared arrangement provides minimal operational staffing for the district.
- Headquarters are at the Sand Lake refuge. This location is not ideal, because it is far from the majority of landholdings.
- Controlling invasive plants is an ongoing effort for district staff.
- Tillage is occurring at an accelerated rate.

2.2 Special Values

Early in the planning process, the planning team and public identified the outstanding qualities of the three districts. District qualities are the characteristics and features of each district that make it special, valuable for wildlife, and worthy of inclusion in the Refuge System. It was important to identify the special values of each district to recognize its worth and to ensure that the special values of the districts are preserved, protected, and enhanced through the planning process. District qualities can be distinct and important biological values, as well as simple values such as providing a quiet place to see a variety of birds and enjoy nature.

The following summarizes the qualities that make the districts unique and valued:

- The districts have a very high density of wetlands to support waterfowl and migratory birds.
- Very large blocks of intact native prairie ecosystem are protected through the districts' conservation easements and fee-title ownership.
- The districts provide protected and managed wetlands and uplands for breeding and staging habitat for waterfowl and shorebirds during migration along the central flyway.
- The districts provide diverse and abundant possibilities for public use.
- The districts provide for quality environmental education.

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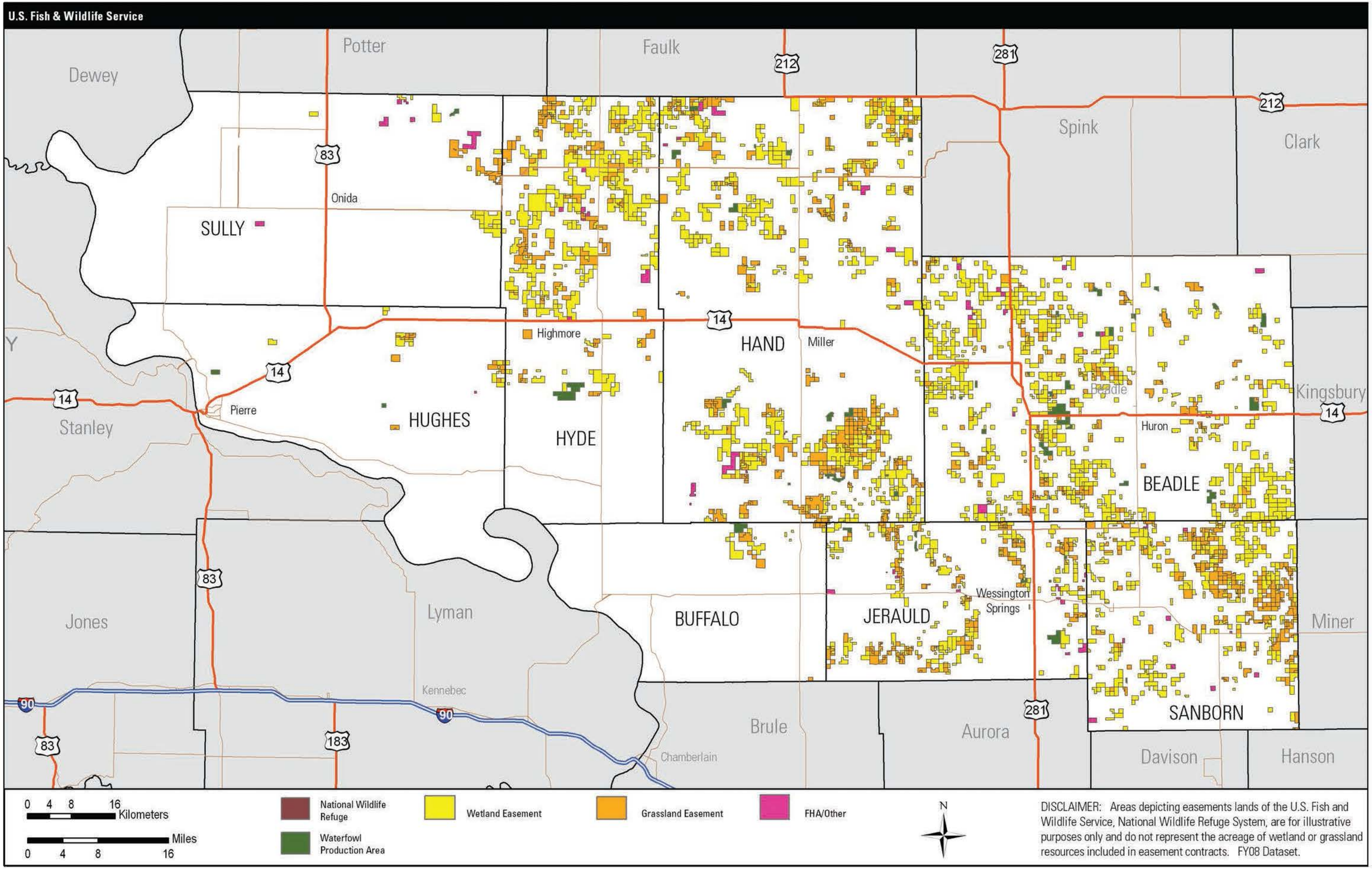

Figure 5. Service-managed lands in the Huron WMD.

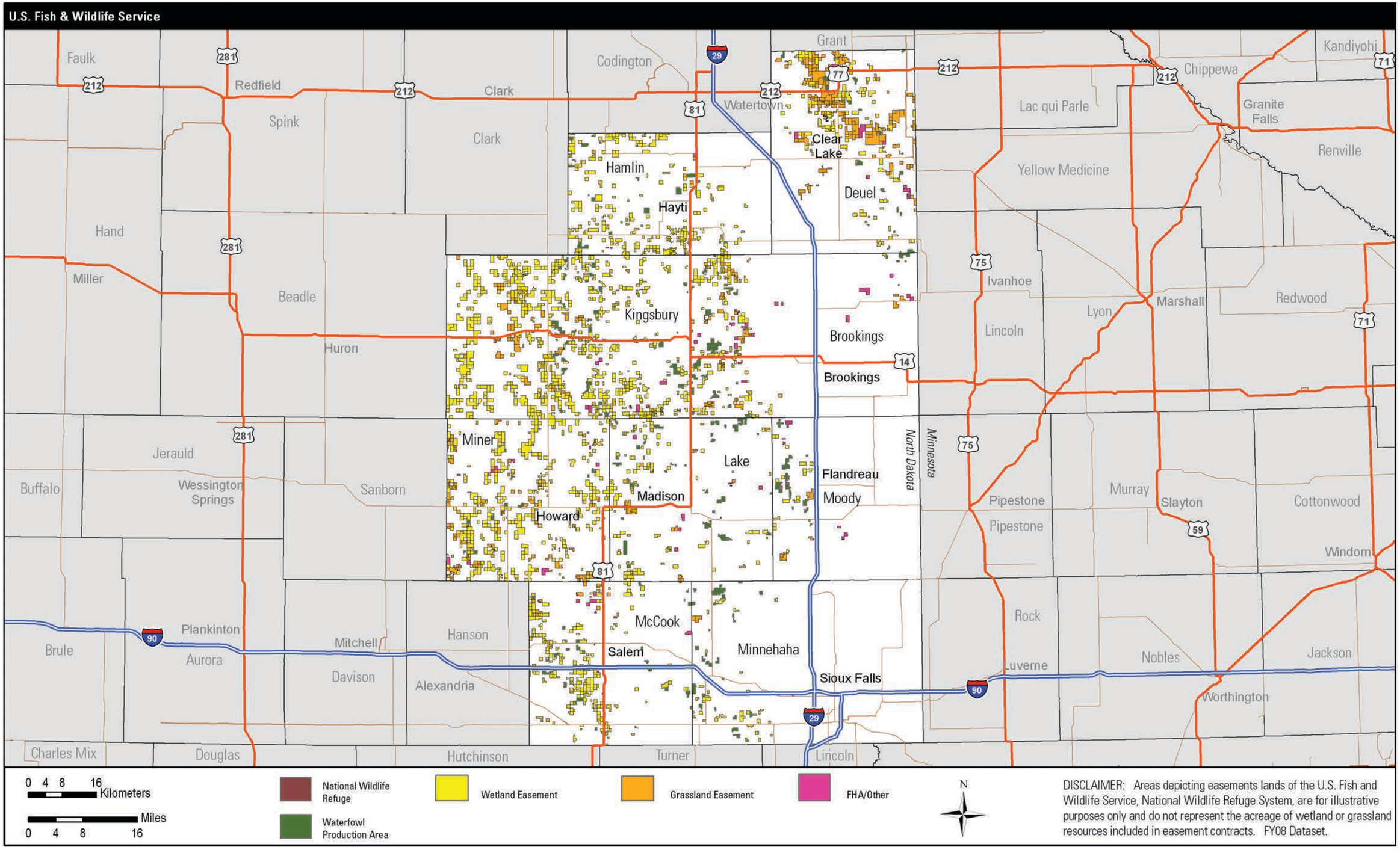

Figure 6. Service-managed lands in the Madison WMD.

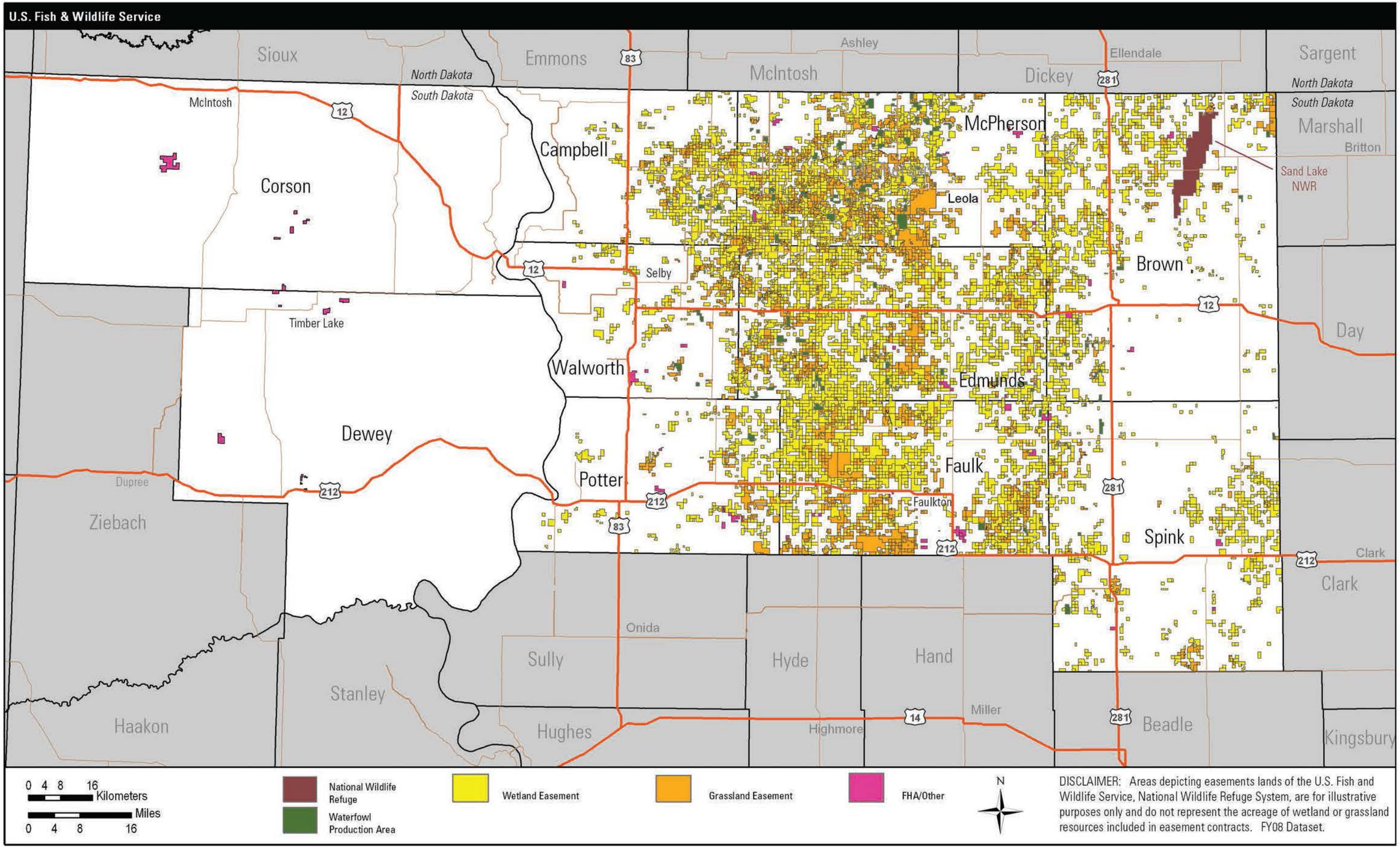

Figure 7. Service-managed lands in the Sand Lake WMD.

2.3 Purposes

The districts were created to administer the Small Wetlands Acquisition Program to save wetlands from various threats—particularly drainage. By 1991, grassland easements were also being protected under this program. The main authorities in establishment of the program are briefly discussed below:

- Migratory Bird Hunting and Conservation Stamp Act (16 U.S.C. 718d[c])—"as waterfowl production areas subject to all provisions of the Migratory Bird Conservation Act … except the inviolate sanctuary provisions." The Duck Stamp Act provides for the conservation, protection, and propagation of native species of fish and wildlife, including migratory birds that are threatened with extinction.
- Migratory Bird Conservation Act (16 U.S.C. 715d[2])—"for any other management purposes, for migratory birds." This act addresses the obligations of the United States under the Migratory Bird Treaty Act through the following mechanisms:
  - Lessening the dangers threatening migratory game birds from drainage and other causes.
  - The acquisition of areas of land and water to furnish in perpetuity reservations for the adequate protection of such birds.
  - Authorizing appropriations for the establishment of such areas, their maintenance and improvement, and for other purposes.

© Chris Bailey

Western meadowlark singing.

The purpose of the districts is "to assure the long-term viability of the breeding waterfowl population and production through the acquisition and management of waterfowl production areas, while considering the needs of other migratory birds, threatened and endangered species, and other wildlife" (memorandum from Region 6 Assistant Regional Director Richard A. Coleman, December 2006). This purpose statement was developed for all Region 6 wetland management districts. Because the purposes and management capabilities and challenges are similar for the three districts, the Service has elected to address them collectively in this CCP.

2.4 Vision

At the beginning of the planning process, the Service developed a vision for the three districts. The vision is a concept that describes the essence of what the Service is trying to accomplish in the three districts. It is a future-oriented statement intended to be realized by the end of the 15-year CCP planning horizon.

Clear blue skies frame spectacular views of grasslands and wetlands teeming with migratory waterfowl and other wildlife in the Huron, Madison, and Sand Lake Wetland Management Districts. Here, future generations will experience the whistle of the northern pintail, the song of the western meadowlark, and the distant boom of the prairie chicken. Located in the Prairie Pothole Region of South Dakota, these districts preserve timeless landscapes in the face of change. Conservation of these lands is achieved through hard work and the support of friends and neighbors who value natural places as an essential component of their quality of life.

2.5 Goals

The following goals have been developed to guide management decisions as they pertain to natural communities, uses, and management activities.

Native Prairie

Conserve, restore, and improve the biological integrity and ecological function of the native prairies to support

healthy populations of native plants and wildlife and promote the natural role of fire and grazing in shaping and managing these landscapes.

Planted Grasslands

Manage planted grasslands to contribute to the production and growth of continental waterfowl populations, other migratory birds, threatened and endangered species, and other wildlife.

Wetlands

Protect, restore, and enhance prairie pothole wetlands to support diverse plant communities and provide habitat to waterfowl, shorebirds, wading birds, and associated wetland-dependent wildlife.

Research and Monitoring

Provide a learning platform that uses science, monitoring, applied research, and adaptive management to advance understanding of the Prairie Pothole Region and management of these areas.

Consumptive Uses

Provide visitors with quality opportunities to enjoy hunting, fishing, and trapping in waterfowl production areas and expand their knowledge and appreciation of the prairie landscape and the National Wildlife Refuge System.

Bridgette Flanders-Wanner / USFWS

Biologist Shilo Comeau on a wetland field visit.

Nonconsumptive Uses

Provide visitors with quality opportunities to enjoy, observe, photograph, and appreciate the prairie ecosystem while expanding their knowledge of and support for the National Wildlife Refuge System.

Operations and Administration

Through effective communication and innovative partnerships, secure and efficiently utilize funding, staffing, and volunteer programs for the benefit of all natural resources in the districts.

Partnerships

Promote and develop partnerships with landowners, public and private organizations, and other interested individuals to maintain, restore, and enhance a diverse and productive landscape in the Prairie Pothole Region.

Environmental Education and Interpretation

Provide quality educational opportunities for persons of all abilities to learn about, understand, and appreciate prairie landscapes and the role of the National Wildlife Refuge System.

2.6 Planning Issues

Several key issues were identified through the analysis of comments collected from Service staff and the public and a review of the requirements of the Improvement Act and NEPA. Substantive comments (those that could be addressed within the authority and management capabilities of the Service) were considered during the formulation of the alternatives for future management. Summaries of these key issues are below.

Wetland and Upland Habitats

All three districts have a primary purpose to provide optimal habitat conditions for the needs of a suite of waterfowl and other migratory birds and, to a lesser extent, native resident wildlife. Aggressive management of wetland and upland habitats must be conducted to achieve goals and objectives. Wetland and upland habitats need to be protected and enhanced through management. Habitat protection needs to be evaluated through a system of prioritization so that different approaches to protection—either fee-title acquisition or conservation easement—can be evaluated.

Invasive Plants

The districts include uplands that were previously farmed. Farmed uplands have since been restored to mixes of tame and native grasses. These areas are interspersed with native uplands, the bulk of which are largely dominated by native vegetation character

but are compromised by invading species. The primary invasive forbs are leafy spurge, Canada thistle, sow thistle, and absinth wormwood. Smooth brome, Kentucky bluegrass, and crested wheatgrass are primary invasive grass species. These nonnative forbs and grasses substantially degrade the quality and suitability of upland habitat for many native wildlife species.

Energy Development

While the Service works to minimize the negative effects of energy development, the demand for energy is an increasing factor in habitat quality and preservation in the districts. The production of biofuels and wind energy has the potential to impact the effectiveness of many district programs. The Service supports research that helps to understand the effects on wildlife of renewable energy projects such as wind farms and the conversion of grassland to cropland for ethanol production. For example, the effects of wind turbines on birds remains a challenging matter to investigate. Through studies and analysis, the Service is currently evaluating wind turbines to determine their effects on wildlife. In addition, it is unknown if wind power will affect the potential for future habitat protection through conservation easements.

Prairie Conversion

Native prairie is suffering conversion to other uses at an alarming rate. Prairie is being converted for crop production, creating additional demand for irrigation water. Conservation groups should assume an active role, in partnership with the agricultural community, to protect the Federal Farm Bill and its conservation provisions, such as the CRP and the "Swampbuster" and "Sod Saver" provisions in the 1985 Farm Bill (amended 1990, 1996, 2002).

© Chris Bailey

Red foxes thrive in human-influenced environments.

Predator Management

Several species—particularly red fox, coyote, striped skunk, Franklin's ground squirrel, mink, badger, and raccoon—occur at higher than historical levels due to modifications of habitat and other factors. These species can adversely affect—primarily by predation on nests of grassland-nesting bird species—waterfowl and other migratory bird populations. Such predation reduces the likelihood that the Service can attain wildlife population goals and objectives for the districts. Woody vegetation has a negative influence on grassland songbirds because it provides habitat for predators and attracts forest-edge bird species that may displace grassland species.

Visitor Services

Hunting, fishing, wildlife observation and photography, and environmental education and interpretation are uses currently authorized on lands administered

Bridgette Flanders-Wanner/USFWS

District lands serve multiple purposes.

by the districts. A growing demand for public recreation in South Dakota and the nation makes these six wildlife-dependent recreational uses, as specified in the Improvement Act, an issue of primary interest.

Partnerships

The Service puts a high priority on working in partnership with conservation and agricultural groups to support conservation programs such as Federal Farm Bill legislation, SDGFP projects, water quality and watershed projects, and private conservation efforts.

Operations

Funding and staff are not sufficient to fulfill the purposes and meet the goals of the districts. Identification of priorities and efficient direction of resources will always be an issue for the districts. The Service's staff needs to identify and describe unfunded needs to be able to compete effectively for additional money from within the Service as well as from partners and other sources. District facilities need to be evaluated and upgraded.

Monitoring and Research

Monitoring habitat and wildlife populations is an essential element in achieving the districts' primary goals and objectives. Basic data about recruitment, mortality, and habitat use for a representative group of species must be collected and analyzed on a regular basis to make appropriate decisions for maintaining the viability of the habitats on which these species depend. Using the districts for field research could contribute valuable strides in development of new directions in management and expansion of the knowledge of field biologists.

008348

Fisheries and Aquatic Resources Adaptive Management System

2014-2018

East River Fisheries Management Area Strategic Plan

South Dakota Game, Fish and Parks Wildlife Division

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Brian Blackwell, Co-Chair
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Mark Ermer
Bruce Johnson
Jason Jungwirth
Matt Ward
Dan Jost

Formally adopted by GFP Commission: April 4, 2014

DIVISION OF WILDLIFE

Agency Mission

The purpose of the Department of Game, Fish and Parks is to perpetuate, conserve, manage, protect, and enhance South Dakota's wildlife resources, parks, and outdoor recreational opportunities for the use, benefit, and enjoyment of the people of this state and its visitors, and to give the highest priority to the welfare of this state's wildlife and parks, and their environment, in planning and decisions.

Division of Wildlife Mission

The Division of Wildlife will manage South Dakota's wildlife and fisheries resources and their associated habitats for their sustained and equitable use, and for the benefit, welfare and enjoyment of the citizens of this state and its visitors.

Our Motto: "Serving People, Managing Wildlife"

008351

I. Introduction

The East River Fisheries Management Area comprises the area of South Dakota east of the Missouri River, and contains more than 210,000 surface acres of lakes and thousands of miles of streams (Figure 1). The variety of aquatic habitats and diverse fisheries provides an estimated 1 million angler days and generates over 50 million dollars in economic benefit each year.

The purpose of this strategic plan is to guide fisheries management based on the missions of the South Dakota Department of Game, Fish and Parks (GFP) and the Division of Wildlife. As part of a fisheries management program that is efficient, effective, friendly, and known for its science-based management recommendations, this plan reflects the values and guiding principles of the Division of Wildlife (SDGFP 2013).

This plan is a dynamic tool addressing the issues, challenges, and opportunities in managing the East River Fisheries Management Area. The components of this plan include an **Inventory** Section, which describes the resources present in this management area, and reviews both historical and current management activities. This section is subdivided into three categories: **People**, **Fish**, and **Habitat**. Following the Inventory Section is the **Issues** Section, listing the current issues involving East River fisheries. Lastly, measurable and time-bound **Objectives**, along with specific **Strategies,** are listed. Progress in meeting these objectives will be evaluated prior to developing subsequent plans.

While this plan will guide staff working on fisheries and aquatic resource issues in the East River Fisheries Management Area, it is also intended to provide the public with information on current fisheries management directions and activities. Members of the public are encouraged to comment on the plan both during development and during implementation.

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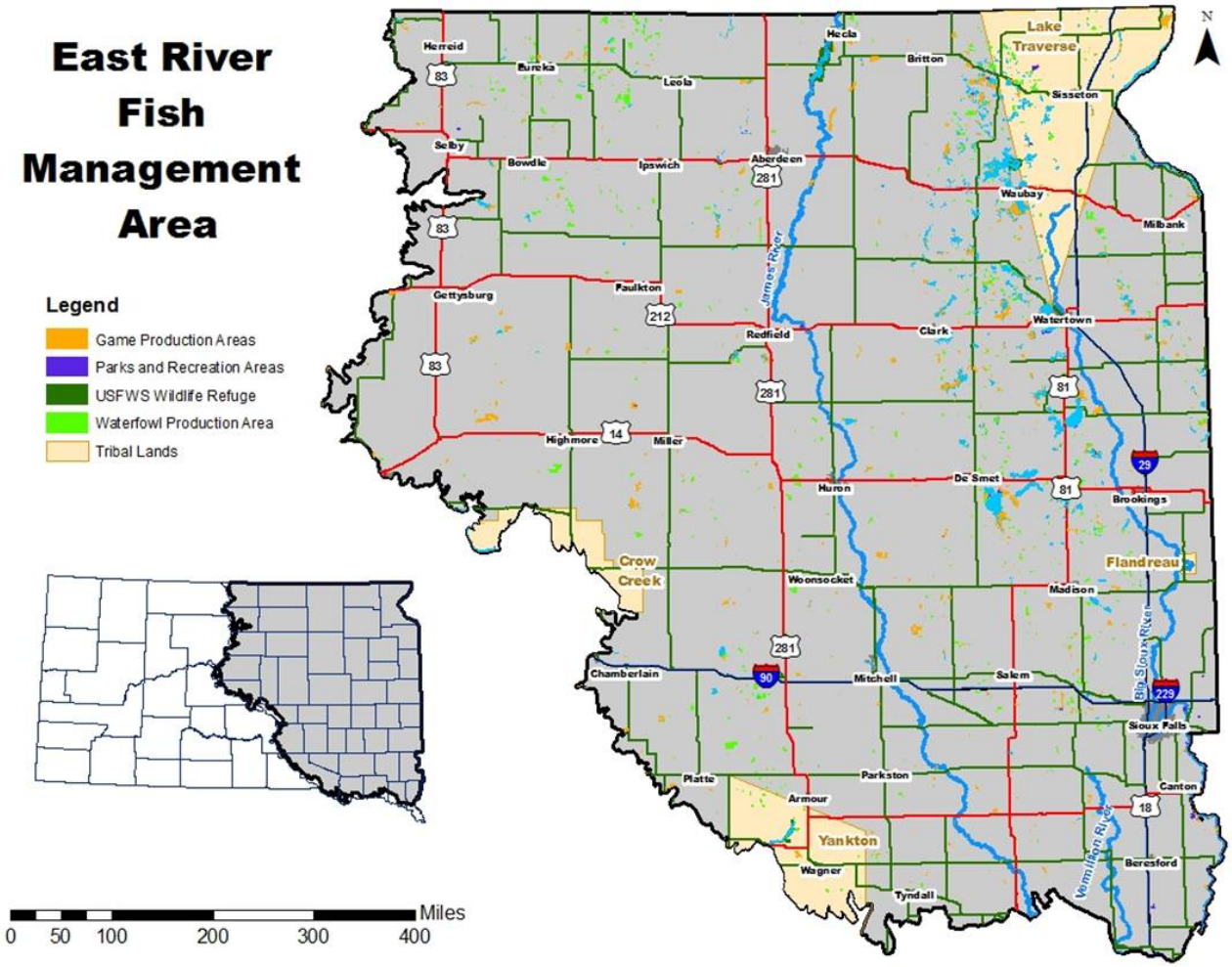

Figure 1. The area encompassed by the East River Fish Management Area (ERFMA) including selected cities, roads, public lands, tribal lands, and waters.

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II. Inventory

Habitat

Lakes: The East River Fisheries Management Area has experienced two periods of glaciation, the Illinois Period approximately 400,000 years ago and the Wisconsin Period about 10,000 years ago. The Prairie Coteau is a prominent feature and was formed by materials deposited along a 200-mile stretch east of the James River extending from northern South Dakota to northern Iowa. The Prairie Coteau traverses the eastern half of the East River Fisheries Management Area and is characterized by its many lakes and wetlands.

The lakes of the Prairie Coteau were formed by glacial drift and ice. Some lakes were created over porous deposits giving them a relatively stable water level due to their connection to subsurface aquifers (e.g. Enemy Swim Lake). Other waters, considered closed basins because they lack outlets, are located over impermeable substrates. During periods of above normal precipitation, these basins fill and excess water floods surrounding land creating highly-productive fish habitat (e.g. Bitter Lake). During wet periods, the amount of fish habitat in the East River Fisheries Management Area dramatically increases with the flooding of these closed basins.

The area to the west of the Prairie Coteau contains fewer lakes, but still has abundant wetlands. During periods of above normal precipitation, some of the larger wetlands can support temporary sport fisheries. Manmade impoundments also provide important fisheries habitat.

In 2011, GFP actively managed the fisheries in 257 standing waters in the East River Fisheries Management Area with a combined acreage of 210,631 acres (Table 1). Large (>150 acres) natural lakes account for about 93% of surface area of managed waters, and nearly 70% are located in northeastern South Dakota. This portion of the East River Fisheries Management Area has also experienced the greatest increase in large natural lake acreage during the recent wet period.

Southeastern South Dakota has the greatest number and acres of small natural lakes (<150 acres; Table 1). About 60% of these small, natural lakes are classified as marginal, which means they are shallow and frequently winterkill. Small impoundments (<150 acres) are the most abundant closer to the Missouri River, while urban lakes and ponds are most abundant in the southeast portion of the management area.

008354

Table 1. Number and acres of lakes, by type and classification, actively managed in the East River Fisheries Management Area (small lakes are ≤ 150 acres, large lakes are > 150 acres).

Type	Classification	Number	Acres
Small natural lakes	Marginal	17	1,441
	Permanent & Semi-Permanent	11	1,160
	Total	**28**	**2,601**
Large natural lakes	Marginal	60	60,370
	Permanent & Semi-Permanent	73	129,681
	Total	**133**	**197,231**
Small impoundments	Marginal	15	890
	Permanent & Semi-Permanent	35	1,848
	Total	**50**	**2,738**
Large impoundments	Marginal	2	405
	Permanent & Semi-Permanent	13	7,315
	Total	**15**	**7,720**
Urban lakes and ponds		**31**	**341**
	Grand Total	**257**	**210,631**

Streams: The East River Fisheries Management Area contains portions of two watersheds. The northeastern tip, which is less than one percent of the entire state, is part of the Hudson Bay watershed and water drains to the north. The remainder of the Area lies in the Gulf of Mexico watershed and the water drains south. Two sub-drainages can be found within the Gulf of Mexico watershed. The Upper Mississippi River drainage in northeast South Dakota includes the Minnesota River drainage that flows through Minnesota to the Mississippi River. The Missouri River sub-drainage covers most of the Area, with the Missouri River marking the edge of the East River Fisheries Management Area. Within the Missouri River sub-drainage, there are three prominent rivers, the Big Sioux, James, and Vermillion. Each river has hundreds of tributaries that contain more fish species and more miles of shoreline than all of the lakes combined (see Appendix 1 for eight digit HUC maps of named tributaries). The James River begins in North Dakota and flows south to the Missouri River east of

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Yankton. It is a remnant feature of ancient Lake Dakota which collected water from melting glaciers, and is characterized by its low gradient and tendency for flooding. The Big Sioux River begins in Roberts County and flows south to the Missouri River in northwest Iowa. Falls created by natural granite formations in Sioux Falls are a natural barrier to upstream fish movement. The Vermillion River begins as East and West forks originating in Kingsbury County before combining to form a single river prior to entering the Missouri River near Burbank.

Fish

Lakes: As few as only six fish species may have been present following the last glaciation. After the retreat of the glaciers, fish began migrating into eastern South Dakota through waterways within the two watersheds. Today, the distribution of game fish has been impacted by natural migrations, authorized and unauthorized fish stockings, dams, road crossings, and other fisheries management activities.

Lakes and impoundments in eastern South Dakota are typically managed for multiple species, with Walleye, Yellow Perch, Largemouth Bass and Northern Pike the most common (Tables 2 and 3). Natural lakes tend to be managed for Walleye and Yellow Perch, while marginal waters have an increased emphasis on Yellow Perch and Northern Pike. Largemouth Bass and Bluegill are the most commonly-managed species in impoundments (Table 2). Several large natural lakes, as well as large and small impoundments, are also managed for black crappie. Urban and community lakes and ponds are managed for a variety of species and often stocked with adult fish.

Fish stocking is an important management practice in the Management Area. Marginal waters frequently experience fish kills, requiring stocking to maintain a fishery. Fish stockings also occur to introduce new species, enhance existing fish populations, or provide large fish that can be caught immediately. Sources of fish for stocking include state and federal fish hatcheries, natural rearing ponds, and other public waters where adult fish can be netted and transferred to new locations. The size and age of fish stocked depends on management objectives, availability, and the fish community in the receiving water. Adult fish are typically stocked in urban or community lakes where a variety of species are used. Spring and fall stockings of rainbow trout into these waters provide anglers with a species not normally present. Eleven game fish species were stocked into the East River Fisheries Management Area waters between 2008 and 2010, with large natural lakes the primary recipient of walleye and yellow perch stockings (Table 4).

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Table 2. The number of lakes managed for a fish species by lake type and classification in the East River Fisheries Management Area (small lakes are ≤ 150 acres, large lakes are > 150 acres).

		Number										
Type	Classification	Black Crappie	Bluegill	Channel Catfish	Largemouth Bass	Musky	Northern Pike	Rainbow Trout	Smallmouth Bass	Walleye	White Bass	Yellow Perch
Small natural lakes	Marginal	0	0	0	0	0	5	0	0	8	0	12
	Permanent & Semi-Permanent	0	0	1	1	0	0	0	0	9	0	11
	Total	**0**	**0**	**1**	**1**	**0**	**5**	**0**	**0**	**17**	**0**	**23**
Large natural lakes	Marginal	3	2	0	1	0	32	0	1	40	0	49
	Permanent & Semi-Permanent	16	9	0	5	3	14	0	9	67	0	59
	Total	**19**	**11**	**0**	**6**	**3**	**46**	**0**	**10**	**107**	**0**	**108**
Small impoundments	Marginal	2	6	1	10	0	2	0	0	0	0	2
	Permanent & Semi-Permanent	13	22	2	25	0	3	1	0	3	0	9
	Total	**25**	**28**	**3**	**35**	**0**	**5**	**1**	**0**	**3**	**0**	**11**
Large impoundments	Marginal	1	0	0	1	0	1	0	1	0	0	1
	Permanent & Semi-Permanent	10	7	2	5	1	2	0	0	9	0	4
	Total:	**11**	**7**	**2**	**6**	**1**	**3**	**0**	**1**	**9**	**0**	**5**
Urban lakes and ponds		**8**	**11**	**2**	**7**	**0**	**17**	**6**	**0**	**0**	**4**	**7**

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Table 3. Acres of water managed for a fish species by lake type and classification in the East River Fisheries Management Area (small lakes are ≤ 150 acres, large lakes are > 150 acres).

		Acres										
Type	Classification	Black Crappie	Bluegill	Channel Catfish	Largemouth Bass	Musky	Northern Pike	Rainbow Trout	Smallmouth Bass	Walleye	White Bass	Yellow Perch
Small natural lakes	Marginal	0	0	0	0	0	538	0	0	776	0	1,034
	Permanent & Semi-Permanent	0	0	86	36	0	0	0	0	827	0	903
	Total	**0**	**0**	**86**	**36**	**0**	**538**	**0**	**0**	**1,603**	**0**	**1,937**
Large natural lakes	Marginal	1,302	840	0	640	0	46,778	0	640	43,637	0	57,636
	Permanent & Semi-Permanent	15,116	26,316	0	5,575	2,740	10,939	0	36,174	128,016	0	116,431
	Total	**16,418**	**27,156**	**0**	**6,215**	**2,740**	**57,717**	**0**	**36,814**	**171,653**	**0**	**174,067**
Small impoundments	Marginal	174	400	27	613	0	137	0	0	0	0	137
	Permanent & Semi-Permanent	944	1,313	130	1,547	0	97	5	0	184	0	508
	Total	**1,118**	**1,713**	**157**	**2,160**	**0**	**234**	**5**	**0**	**184**	**0**	**645**
Large impoundments	Marginal	200	0	0	200	0	205	0	200	0	0	205
	Permanent & Semi-Permanent	6,610	3,377	1,003	2,032	235	2,150	0	0	5,927	0	2,341
	Total	**6,810**	**3,377**	**1,003**	**2,232**	**235**	**2,355**	**0**	**200**	**5,927**	**0**	**2,546**
Urban lakes and ponds		**60**	**80**	**43**	**72**	**0**	**167**	**43**	**0**	**0**	**76**	**19**

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Table 4. Fish species stocked in the East River Fisheries Management Area from 2008 to 2010 (small lakes are ≤ 150 acres, large lakes are > 150 acres).

Type	Classification	Fish Species
Small natural lakes	Marginal	Largemouth Bass, Northern Pike, Walleye, Yellow Perch
Large natural lakes	Marginal	Black Crappie, Northern Pike, Walleye, Yellow Perch
	Permanent & Semi-Permanent	Black Crappie, Bluegill, Musky, Smallmouth Bass, Walleye, Yellow Perch
Small impoundments	Marginal	Bluegill, Largemouth Bass, Rainbow Trout, White Bass
	Permanent & Semi-Permanent	Bluegill, Largemouth Bass, Walleye, Yellow Perch
Large impoundments	Marginal	Walleye
	Permanent & Semi-Permanent	Black Crappie, Bluegill, Musky, Walleye
Urban lakes and ponds		Black Crappie, Bluegill, Channel Catfish, Largemouth Bass, Northern Pike, Rainbow Trout, White Bass, Yellow Perch

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Streams: The Big Sioux, Vermillion and James River basins contain the highest species diversity found in the East River Fisheries Management Area. Aside from setting and enforcing regulations, GFP currently does little to manage stream fisheries. Although not actively managed, eastern South Dakota streams contain fishable populations of Channel and Flathead Catfish, Black Bullhead, Northern Pike, Walleye, Freshwater Drum and several species of panfish (Hansen 1981; Braaten 1993; Christianson 1995; Dieterman and Berry 1995; Doorenbos et al. 1996; Arterburn 2001). The movement of walleyes into rivers during high water periods likely helps to supplement stream populations (Blackwell 2001).

From the early 1900s through the 1950s, eastern South Dakota streams were stocked with a variety of species, including Walleye, Yellow Perch, Black Crappie, Largemouth Bass, Channel Catfish, Bullhead, and Rainbow Trout. After 1960, these stockings were mostly limited to Walleye and Smallmouth Bass. No fish have been stocked into the three major rivers since 1988. However, Smallmouth Bass were stocked into Split Rock Creek (Minnehaha County) through 1998 and trout were stocked into Gary Creek (Deuel County) through 2005.

Many of the 23 aquatic species listed as threatened, endangered, rare, or Species of Greatest Conservation Need (SGCN) by South Dakota's State Wildlife Action Plan (WAP) and the South Dakota Natural Heritage Program are found in East River Fisheries Management Area streams (Table 5; SDGFP 2006). Topeka Shiners are found solely in streams and recent sampling efforts have found they are more common in South Dakota than in the rest of their range. Studies done after federal listing have documented their presence in 80% of historically known streams and have also documented them in other streams where they had not been previously reported (Shearer 2003). Topeka Shiners are found in tributaries of the Big Sioux, Vermillion and James Rivers. Blausey (2001) found that Topeka Shiners were associated with areas of low livestock use, overhanging vegetation, low siltation, and run/glide habitats composed of fine gravel and cobble substrates. Topeka Shiners were also collected in backwater areas and from streams with degraded habitats like incised channels, highly-eroded banks and intensively-grazed riparian zones (Shearer 2003). The State of South Dakota has developed a management plan to maintain habitat integrity in Topeka Shiner streams and establish a point-based management goal for the state to contribute towards national recovery efforts (Shearer 2003).

A recent study by the Department of Environment and Natural Resources and South Dakota State University has contributed greatly to knowledge of fish communities in eastern South Dakota streams. Krause (2013) sampled 54 sites on eastern South Dakota streams in the development of a fish Index of Biological Integrity (IBI) which is used to index stream health. Fish community information was collected at all sites, establishing baseline data for long-term monitoring of stream fish communities.

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Table 5. South Dakota Natural Heritage Program and Federally listed species in the East River Fisheries Management Area. Status abbreviations: LE= federally endangered; LT-federally threatened; SE = state endangered; ST = state threatened; SGCN = Species of Greatest Conservation Need.

Common Name	Scientific Name	Federal Status	State Status
Fish			
Banded Killfish	*Fundulus diaphanus*		SE, SGCN
Blacknose Shiner	*Notropis heterolepis*		SE, SGCN
Blackside Darter	*Percina maculata*		SGCN
Blue Sucker	*Cycleptus elongatus*		
Carmine Shiner	*Notropis percobromus*		SGCN
Central Mudminnow	*Umbra limi*		SGCN
Hornyhead Chub	*Nocomis biguttatus*		SGCN
Logperch	*Percina caprodes*		SGCN
Northern Redbelly Dace	*Chrosomus eos*		ST, SGCN
Pallid Sturgeon	*Scaphirhynchus albus*	LE	SE, SGCN
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	LT	SGCN
Southern Redbelly Dace	*Chrosomus erythrogaster*		SGCN
Topeka Shiner	*Notropis topeka*	LE	SGCN
Trout-perch	*Percopsis omiscomaycus*		SGCN
Turtles			
False Map Turtle	*Graptemys pseudogeographica*		ST, SGCN
Smooth Softshell	*Apalone mutica*		SGCN
Mussels			
Creek Heelsplitter	*Lasmigona compressa*		SGCN
Elktoe	*Alasmidonta marginata*		SGCN
Hickorynut	*Obovaria olivaria*		SGCN
Mapleleaf	*Quadrula quadrula*		SGCN
Pimpleback	*Quadrula pustulosa*		SGCN
Rock Pocketbook	*Arcidens confragosus*		SGCN
Yellow Sandshell	*Lampsilis teres*		SGCN

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Bighead and Silver Carp have recently been found in the Big Sioux, Vermillion and James River basins. The rapid expansion of Asian carp throughout these basins was likely expedited by recent flooding. Asian carp inhabit all sections of the James River, but upstream movement in the Big Sioux River has been stopped by the falls in Sioux Falls and by the East Lake Vermillion dam on the Vermillion River. Young-of-the-year Asian carp were collected from several small tributaries, suggesting that these streams may be an important part of the carp lifecycle.

People

About 568,000 people live in the East River Fisheries Management Area, and 40% of these are in the Sioux Falls metropolitan area. Nearly 120,000 people reside in Aberdeen, Brookings, Huron, Mitchell, Pierre, Watertown and Yankton. Compared to population losses from rural areas, recent population growth in these urban areas has occurred and is likely to continue. In addition to increased populations, ethnic diversity in urban areas has also increased, creating new challenges for fisheries management.

With 70% of South Dakota's population living in the East River Fisheries Management Area, providing ample fishing opportunities is essential. In addition to abundant fish populations, access is needed both to attract anglers and enhance the quality of the fishing experience. Fishing access features commonly provided on lakes include a boat ramp, boat dock, and space for shore fishing adjacent to the launch site. Over 50% of large natural lakes have boat launching facilities, compared to only 21% of the small natural lakes (Table 6).

Most lakes have public shore fishing access, even if it is only a small area next to a boat ramp. Shore fishing sites that are mowed or otherwise improved are rare, but commonly requested by the public, as is vehicle parking close to the water for shore fishing. Small and large impoundments are most likely to provide shoreline access for vehicles.

Fishing piers are popular with anglers, but have only been installed on a few lakes. Large impoundments with a state park are most likely to have a fishing pier. Fish attracting structures have also been added to some lakes. Most lakes do not have handicapped access, and only 40% of waters managed by GFP have a public toilet.

Fisheries within the East River Fisheries Management Area can be subjected to high fishing pressure, especially when they provide fast fishing for walleye, yellow perch or crappie or are located in urban areas. Although urban and community fisheries only comprise a small portion of managed waters, they typically support the greatest amount of fishing pressure per acre of water (Table 7). Fishing pressure is typically much higher during the summer than the winter. As the most abundant type of water in eastern South Dakota, natural lakes support the majority of angling pressure.

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Table 6. Percent of lakes by type having various fishing access components in the South Dakota East River Fisheries Management Area (small lakes ≤ 150 acres, large lakes > 150 acres).

Access	Natural Lakes Small	Natural Lakes Large	Impoundments Small	Impoundments Large	Urban Ponds
Number of lakes	133	50	15	31	
Boat launch	21.4	58.6	70.0	93.3	16.1
Shore fishing	75.0	100.0	94.0	100	96.8
Dock	17.9	55.6	50.0	86.7	3.2
Fishing pier	10.7	6.0	2.0	40.0	12.9
Toilet	10.7	36.1	46.0	86.7	54.8
Picnic area	3.6	14.3	22.0	6.0	26.0
Improved fishing site	7.1	6.8	6.0	33.3	12.9
Park present	3.6	15.0	26.0	66.7	61.3
Near-shore vehicle access	14.3	36.8	60.0	86.7	12.9
Fish holding structures	39.3	25.6	12.0	26.7	16.1
Handicapped access	7.1	5.3	6.0	26.7	6.5

The Big Sioux, Vermillion and James Rivers also support considerable fishing pressure, although fishing pressure has never been measured on the Vermillion River. Doorenbos et al. (1996) estimated that anglers spent over 120,000 hours fishing the Big Sioux River from March through October of 1995. Hansen (1981) found that anglers spent about 140,000 hours open-water fishing on the James River in 1976-77. These rivers may account for more than 10% of the total fishing pressure in the East River Fisheries Management Area. Most anglers traveled less than 26 miles and the majority was satisfied with their fishing trips (Doorenbos et al. 1996). At both of these rivers, the hours spent picnicking, exercising, camping, and just relaxing outside far exceeded the hours spent fishing.

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The economic value of the East River Fisheries Management Area exceeds $56 million annually, with fishing at natural lakes responsible for 75% of the expenditures.

Table 7. Average fishing pressure by lake type and season.

	Season	Hours per acre	Total hours	Trip length (hours)	Angler days	Economic value ($)
	Summer	10.3	2,036,495	3.75	543,065	33,126,992
	Winter	3.4	672,241	4.34	154,894	9,448,551
	Combined		2,708,737		697,960	42,575,543
Small impoundments	Summer	67.4	184,619	3.07	60,137	3,668,334
	Winter	22.5	61,540	3.07	20,046	1,222,778
	Combined		246,159		80,182	4,891,112
Large impoundments	Summer	32.3	249,652	2.79	89,481	5,458,331
	Winter	8.4	64,744	2.73	23,716	1,446,667
	Combined		314,396		113,197	6,904,998
Urban lakes and ponds	Summer	161.3	55,003	1.64	33,539	2,045,854
	Winter	28.9	9,855	1.75	5,631	343,514
	Combined		64,858		39,170	2,389,368
Total			**3,334,150**		**930,509**	**56,761,021**

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III. Issues and Opportunities

Since the first strategic plan was developed in 1994, some of the fisheries management concerns have changed. For example, planners in 1994 identified inconsistent recruitment of game fish, inadequate public input, and poor public relations as some of the most important issues (SDGFP 1994). None of those issues were identified as important in the current plan. This is likely because efforts to gather public input through angler surveys, and to interact with the public using open houses and regional advisory panels, have addressed two of these issues. Access to small waters, information and education, and regulation compliance were also identified as high priority issues in 1994. Focused efforts since then have hopefully reduced their importance.

Many issues deemed important in 1994 continue to rank highly however. Concerns about degradation and loss of aquatic habitat are still prevalent. Although efforts have been taken to address these issues, “watershed scale” management practices have not been achieved. Therefore, problems with the loss of shoreline habitat, siltation, degradation of the riparian corridor, and alteration of stream flows (due to agricultural practices and urbanization) persist, and in some cases, have accelerated. Also, a decline in the number of people using the fisheries resource, identified in the prior plan, has continued, and remains a major issue.

Issues identified for the East River Fisheries Management Area were placed into the categories of habitat, fish and people. However, many of the issues could fit into more than one category.

Habitat

1. *Issue*: Loss of shoreline habitat.

   A lack of understanding of ecological impacts or a lack of concern for fisheries by modern lakeshore property owners is reflected by current shoreline development practices. Replacing native shoreline plants and trees with fertilized lawns, rip-rapping and seawalls for shoreline stabilization, sand beaches, and the removal of submergent and emergent aquatic vegetation have degraded shoreline habitat. Considerable research in the last 10 years has shown that these practices negatively impact fish populations. Challenges to reversing these impacts include a resistance to change by property owners and a lack of coordination between responsible agencies.

   Opportunities:

   Water quality is an important issue to most South Dakotans. GFP can promote shoreline projects to lakeshore property owners and lake associations as actions to improve water quality. GFP can provide examples of successful lakeshore

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renovations through pilot projects, workshops, and on the GFP website. Shoreline easements could also be pursued to protect shoreline habitat. GFP needs to use the expertise and funds acquired by actively participating in the Glacial Lakes and Great Plains Fish Habitat Partnerships to complete shoreline renovation and protection projects.

2. *Issue:* Watershed degradation.

   Intensive agricultural practices, such as ditching, tiling, and plowing of native prairie or Conservation Reserve Program plantings, have resulted in the loss of riparian habitat, leading to increased siltation, increased nutrient loadings, and alteration of stream hydrology. Watershed degradation has increased the frequency of winterkill, reduced the utility and lifespan of small impoundments, and decreased the diversity and distribution of native stream fishes. Inadvertently or illegally introduced exotic nuisance species and diseases also have negative impacts. Challenges to correcting these issues include resistance to change, inadequate information, and a lack of coordination between responsible agencies.

   Opportunities:

   Watershed-related activities may include developing a procedural manual to guide fisheries staff implementing projects to protect and enhance riparian habitat. Also, a program, like the Conservation Reserve Enhancement Program, to maintain the integrity of riparian areas can be developed, focusing on water quality. Additionally, promoting the development of Environmental Protection Agency 319 projects in impaired watersheds can occur. The impact of sedimentation on impoundments can be mitigated through the construction of sediment dams or water-level management. Organizations such as Walleyes Unlimited, the BASS Federation, the Izaak Walton League and the Nature Conservancy should be involved in these efforts, and the expertise and funds acquired through active participation in the Glacial Lakes and Great Plains Fish Habitat Partnerships needs to be used. Finally, the interaction, communication, and cooperation between natural resource and other agencies needs to be promoted to solve complex habitat issues.

3. *Issue:* Deteriorating quality of impoundments.

   Many impoundments are over 70 years old and nearing the end of their useful lifespan. Their infrastructure is deteriorating, with siltation and nutrient-loading degrading habitat and increasing the frequency of fish kills. These waters now provide only limited fishing opportunity.

   Opportunities:

   Actions are needed to restore some small impoundments. The Iowa DNR has successfully restored small impoundments by improving watershed conditions, reconstructing the lake basin, and eliminating undesirable fishes. However, large-

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scale restoration projects can be expensive and require considerable time to complete. Public support for such projects might be obtained by completing a short-term demonstration project to restore fish populations. As the utility of traditional management options (i.e. fish stocking, regulations, etc.) diminishes, long-term and large-scale restoration of small impoundments will require a concerted effort on behalf of resource managers, anglers, and the public.

4. *Issue:* Introduction of exotic plants and animals.

   The introduction of common carp well over a century ago has had a large impact on fisheries habitat in Eastern South Dakota. More recently, exotic plants such as brittle naiad and curlyleaf pondweed, and fish species including bighead carp and silver carp, are now found in the East River Fisheries Management Area. The full impact of these exotic invasive species remains to be seen.

   Opportunities:

   To reduce the chance of exotic plant and animal introductions or their spread, regulations governing the movement and introduction of these exotics need to be continually reviewed and updated. Educational programs to make resource users more aware of these issues should be developed, and the use of the Internet to inform resource users expanded.

Fish

1. *Issue*: Problems with accurately assessing the benefits of management actions.

   Natural systems are highly variable, making estimating the benefits of a management action often a complex, time-consuming, and costly task. Examples of current practices that need evaluation include the use of minimum length limits, the use of trap and transfer stocking to supplement existing fish populations, and the effectiveness of current fish management strategies in marginal waters. Past studies to investigate these practices have often provided inconclusive results.

2. Issue: Standardization of data collection methods and storage.

   Methods to standardize fish survey data collection techniques were implemented in the 1990s. However, further standardization of techniques may be merited and beneficial. Requests for broad-scale fisheries data by students, researchers, and professional organizations are steadily increasing. Assembling this data from various sources and in multiple formats can be time-consuming and costly.

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Opportunities:

The current effort to develop a standardized database should be completed. This will simplify data retrieval, facilitate more comprehensive analysis, and streamline reporting.

3. *Issue:* Balancing the need for monitoring with taking beneficial action.

   Annual fish population surveys provide useful and needed information for fisheries management. However, they also consume time that might otherwise be used to complete projects that would benefit our customers and the resource.

4. *Issue:* Poor panfish size structure in small impoundments and lakes.

   Many small impoundments and some natural lakes do not produce larger panfish preferred by anglers. Slow growth and high adult mortality inhibit the production of larger fish. These fisheries could provide more angling opportunity if larger panfish could be produced. Biomanipulation techniques such as predator stocking, reducing panfish numbers by netting removals, and prey fish stocking have been effective on small impoundments, but only for a limited time.

   Opportunities:

   Low productivity in small impoundments is often related to poor water quality. Projects with the potential to improve water quality include silt retention dams, low-level outlets, aeration, and circulation. Prey fish stocking also has the potential to increase panfish growth and average size. Evaluation of juvenile largemouth bass stockings to improve predator-prey relationships in these waters can also continue.

5. *Issue:* High natural mortality of yellow perch and crappie in natural lakes.

   Yellow perch and crappies seldom live longer than 4 or 5 years in many East River Fisheries Management Area natural lakes. This short lifespan combined with sporadic recruitment often produce inconsistent fishing opportunity.

6. *Issue:* Lack of stream inventories and monitoring, especially for Natural Heritage-listed and federally-threatened or endangered species.

   Many tributaries of the three major rivers in the Fisheries Management Area have never been surveyed. The few surveys that have been completed only contain qualitative data (e.g., lists of fish species present). Without density data or population estimates, there is no baseline to measure potential changes in stream fish communities. Federally-endangered Topeka Shiners are more abundant in the East River Fisheries Management Area than anywhere else. Increased planting of

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row crops, agricultural drainage and tiling, and urban sprawl could affect their status. This may affect the ability to meet the state management plan goal of maintaining existing stream habitat, with the intent of delisting the species pursuant to the Endangered Species Act (Shearer 2003). Moreover, information on the status of heritage-listed species in these streams can serve as a valuable indicator of stream and watershed health.

7. *Issue:* The lack of current and historical information on river and stream fish populations and sport fisheries.

   GFP does not actively manage game fish populations in the Big Sioux, Vermillion and James Rivers. Thus, stream fisheries regulations are the same as those for lakes and impoundments in order to maintain uniformity. Information on stream game fish populations and fisheries is needed before management activities can be considered.

People

1. *Issue:* Cultural changes causing a decline in the use of fisheries resources.

   Urbanization, single parent families, video games, organized sports, and low household incomes have all been cited as reasons for declining numbers of young anglers. Fewer young anglers will mean lower revenues and less support for the sport of angling in the future.

   Opportunities:

   GFP has recently increased efforts to recruit young anglers. Programs like Step Outside have been implemented in cities and towns across the East River Fisheries Management Area. The GFP Outdoor Campus in Sioux Falls teaches about 150 fishing classes to nearly 3,000 children each year. GFP is trying to provide youth fishing opportunities that are easily accessible. Urban and community waters are aggressively stocked with adult fish to provide easy access to fishing for youth. GFP also promotes fishing in urban waters by stocking catchable rainbow trout and other species into lakes within the city limits of Watertown, Brookings, and Sioux Falls. Creel surveys have shown that urban waters are popular with young anglers and may serve as a potential recruitment tool. New programs to direct educational efforts at kids who are not actively participating in the outdoors may be possible through organizations like the Boys and Girls Clubs. These efforts will be evaluated and, if successful, continued or expanded.

   Other opportunities exist to simplify and make fishing trips more enjoyable for beginning, novice, or casual anglers. Shore fishing access areas can be made more “user friendly” with the addition of fishing piers (some with canopies), enhanced shoreline access points (large flat rocks or concrete pads), close-to-shore vehicle access, trails from parking areas to fishing sites, and fish

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attracting habitat. Likewise, snow removal from access points can increase the use of winter fisheries. Steps must also be taken to improve the fishing experience for the growing number of anglers from diverse ethnic backgrounds. A potential first step could be to develop fishing regulation booklets in various languages.

Recruitment programs should be monitored to evaluate their success in achieving objectives. Effective evaluation methodologies should be developed to identify successful programs and eliminate unsuccessful ones. Creel surveys and statewide angler surveys can help provide this type of information.

Methods to more effectively communicate with our customers should be investigated. Social media can be used to inform, teach, and advertise. The Internet can be used to convey resource locations and management reports. The GFP website can provide permits and application forms, and give instructions for completing them. Information on regulation changes or Aquatic Nuisance Species can also be communicated using the website.

2. *Issue:* Access issues where waters on private property adjoin public property under high water conditions.

Waters over private property accessible from adjoining public land with active fisheries have become sources of conflict between anglers and landowners. The less-than-clear legality of the public's right to use these waters adds to the controversy.

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IV. Goal, Objectives and Strategies

Goal: Manage fisheries and aquatic resources in the East River Fish Management Area of South Dakota for long-term sustainable use and enjoyment.

Objective 1: Identify and participate in watershed maintenance and restoration efforts by 2018.

Strategy 1.1 Assemble a team to work on watershed issues.

Strategy 1.2 Determine the potential roles GFP can play in watershed management.

Strategy 1.3 Develop new partnerships with groups already working in the watersheds.

Strategy 1.4 Continue to utilize the expertise and funding of organizations like the Glacial Lakes Fish Habitat Partnership, other state agencies, and watershed development districts to implement watershed projects.

Strategy 1.5 Build relationships with lake associations by attending their meetings and functions.

Strategy 1.6 Participate in two watershed management/enhancement projects in the East River Fisheries Management Area.

Objective 2: Develop and standardize surveys to inventory and monitor stream and riverine fishes by 2018.

Strategy 2.1 Develop and prioritize a list of fish species to focus on (e.g. SGCN and riverine game species).

Strategy 2.2 Design a standardized survey and sampling protocol.

Strategy 2.3 Incorporate existing Index of Biotic Integrity data into the analysis.

Strategy 2.4 Identify and collaborate with partners to develop and conduct surveys.

Strategy 2.5 Conduct multiple surveys over time so changes in the watershed, aquatic habitats and fish community can be evaluated.

008371

Objective 3: Utilize fish community and angler survey information to direct watershed and aquatic habitat work by 2018.

Strategy 3.1 Share survey information with potentially affected individuals.

Strategy 3.2 Prioritize efforts based on survey results.

Objective 4: Conduct projects to assess the condition of stream and riverine communities by 2018.

Strategy 4.1 Conduct a statewide mussel survey.

Strategy 4.2 Continue to monitor Topeka shiners under an improved protocol.

Strategy 4.3 Revisit Index of Biological Integrity study sites by 2018 to search for changes in site scores.

Strategy 4.4 Conduct 1-2 projects designed to assess population dynamics of Species of Greatest Conservation Need by 2018.

Strategy 4.5 Conduct studies to assess changing fish communities, especially in areas recently invaded by exotic species.

Objective 5: Identify critical shoreline habitat around heavily-developed lakes to direct shoreline enhancement and protection efforts by 2018.

Strategy 5.1 Use remote sensing to evaluate changes in shoreline habitat.

Strategy 5.2 Develop a protocol to accurately assess changes to the shoreline.

Strategy 5.3 Identify critical shoreline areas and the thresholds needed to support quality game fish and panfish populations.

Strategy 5.4 Prioritize potential shoreline enhancement and protection projects.

Strategy 5.5 Implement projects to protect and enhance the most critical shoreline habitats.

Objective 6: Increase angler use on small impoundments by 2018.

Strategy 6.1 Evaluate current angler use on small impoundments.

008372

Strategy 6.2 Abandon bass and panfish management on some small impoundments with limited aquatic habitat and implement a perch and walleye stocking strategy.

Strategy 6.3 Evaluate the stocking of prey fish species, such as fathead minnows or gizzard shad, into small impoundments where game fish growth is below average.

Strategy 6.4 Reduce panfish abundance to increase the population size structure in small impoundments where growth is density-dependent.

Strategy 6.5 Evaluate the effects of aeration or circulation technology to prevent summer stratification on one small impoundment.

Strategy 6.6 Evaluate the use of aeration or circulation technology to prevent winterkill on small impoundments.

Strategy 6.7 Conduct a demonstration project (e.g. drawdown or settling pond) aimed at restoring small impoundment fish populations.

Strategy 6.8 Conduct projects to improve shoreline fishing access on small impoundments affected by excessive aquatic vegetation during the summer.

Strategy 6.9 Conduct projects to improve vehicle and boat access.

Strategy 6.10 Evaluate angler use after implementation of management strategies to determine if any increases can be detected.

Strategy 6.11 Rehabilitate aging small impoundments in areas that lack fishing opportunity.

Strategy 6.12 Use social marketing techniques to increase angler awareness about the harm caused by unauthorized fish introductions into small impoundments and other waters.

Objective 7: Investigate the cause of high natural mortality in panfish populations and identify potential mediation methods by 2018.

Strategy 7.1 Identify populations having high natural mortality.

Strategy 7.2 Examine current and historic data to determine if high mortality is cyclical.

008373

Strategy 7.3 Develop research projects (e.g., yellow perch genetics) to identify potential causes of observed mortality schedules.

Objective 8: Evaluate the effectiveness of stocking adult fish into existing fish populations by 2018.

Strategy 8.1 Compare stocking records with lake survey results and the return rates of stocked fish to anglers.

Strategy 8.2 Use new technologies (e.g. otolith microchemistry, marking, etc.) to evaluate the contribution of adult fish stocking into existing populations.

Objective 9: Evaluate the effectiveness of hatchery-produced yellow perch stocking by 2018.

Strategy 9.1 Develop effective sampling techniques for age-0 yellow perch.

Strategy 9.2 Determine the contribution of stocked eggs, fry or fingerling perch to existing populations.

Strategy 9.3 Evaluate the stocking of yellow perch eyed eggs into waters without yellow perch.

Strategy 9.4 Evaluate, in relation to the highest probability of increasing population abundance, the stocking of yellow perch eyed eggs, fry, and fingerlings at various rates.

Objective 10: Evaluate the feasibility and cost benefit of improving game fish populations in one to three small lakes dominated by nuisance fish species by 2018.

Strategy 10.1 Identify one to three small lakes with a history of overabundant nuisance fish species.

Strategy 10.2 Implement various nuisance fish control methods (e.g. netting, increased predator abundance, fish barriers, etc.) and evaluate.

Objective 11: Improve game fish populations and fishing opportunity on one to three marginal waters by 2018.

008374

Strategy 11.1 Research current aeration and circulation technologies and evaluate their potential to reduce fish kills.

Strategy 11.2 Implement and evaluate various aggressive stocking strategies (e.g. annual stocking, increased stocking rates, etc.).

Strategy 11.3 Review current research and techniques on marginal lake restoration and management, and evaluate their potential for implementation in South Dakota.

Objective 12: Improve angler access on natural lakes.

Strategy 12.1 Work with counties and townships to create access sites along public road right-of-ways.

Strategy 12.2 Work with willing landowners to buy or lease property for access.

Strategy 12.3 Determine ways to increase funding for access development and maintenance.

Strategy 12.4 Develop shore fishing opportunities at one to five locations each year.

Strategy 12.5 Create shore fishing opportunities by clearing terrestrial and aquatic vegetation from shoreline areas.

Strategy 12.6 Continue to clear snow from access sites at selected lakes using GFP personnel and private contractors.

Objective 13: Improve information transfer about urban and community fisheries to fishery users by 2018.

Strategy 13.1 Use a survey to gather urban and community angler input on preferred methods for receiving information (e.g. signage, QR codes, news media, social media, etc.).

Strategy 13.2 Based on survey results, implement the communication methods preferred by most urban and community anglers.

008375

Objective 14: Create five additional urban and community fishing opportunities by 2018.

Strategy 14.1 Inventory existing urban and community fisheries, and identify additional locations where fishing opportunity is needed.

Strategy 14.2 Investigate identified locations for urban and community fishery potential (e.g. existing ponds, pond construction potential, local government cooperation, etc.).

Strategy 14.3 Plan and establish new urban and community fisheries.

Objective 15: Improve angler access to four existing urban and community fisheries by 2018.

Strategy 15.1 Evaluate angler accessibility at existing urban and community fisheries and identify potential improvements (e.g. handicapped accessibility, fishing piers, shoreline access, trails, etc.).

Strategy 15.2 Prioritize potential improvement projects.

Strategy 15.3 Plan and implement the four highest priority access improvement projects.

Objective 16: Determine the most effective fish stocking strategies for urban and community fisheries by 2018.

Strategy 16.1 Conduct surveys to gather urban and community angler preference for species, size of fish caught, catch rates, and other pertinent information.

Strategy 16.2 Use survey results to develop a fish stocking plan for each fishery.

Strategy 16.3 Determine the most cost-effective stocking strategy for providing fish that produce the highest angler satisfaction.

008376

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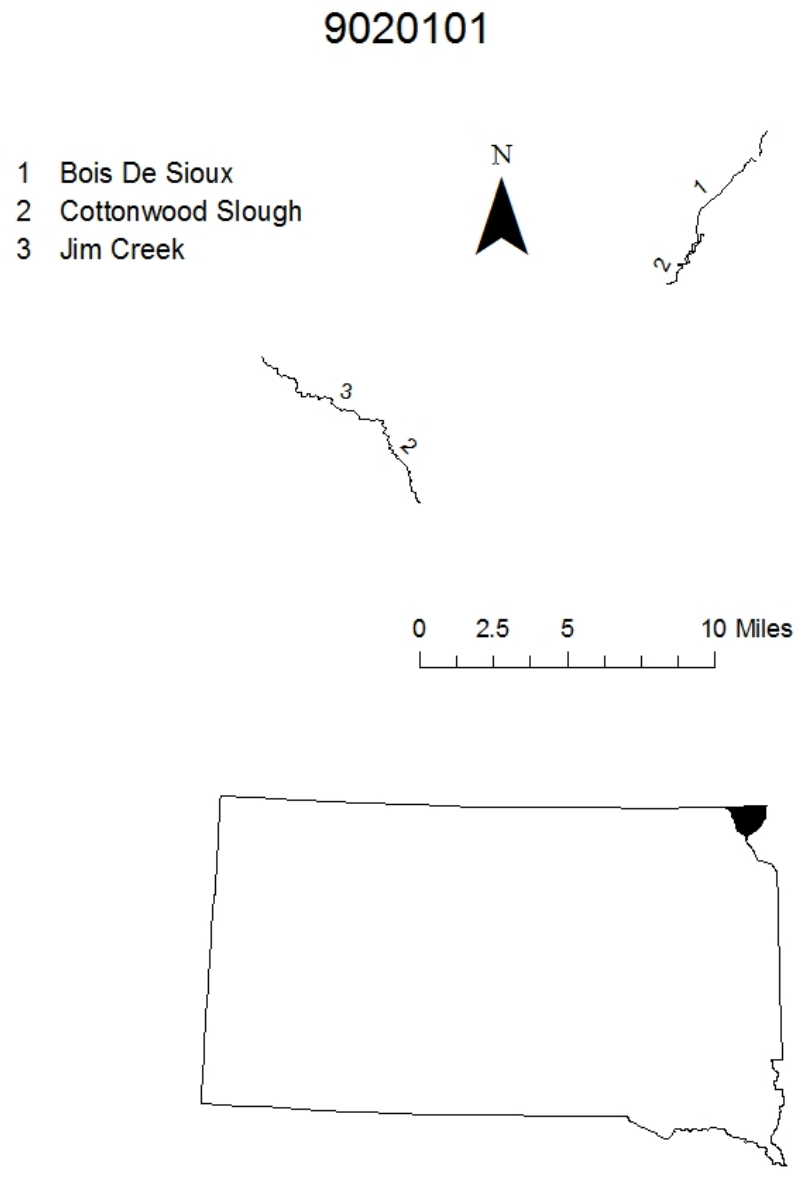
Appendix 1. Eight digit HUC maps of named streams in eastern South Dakota



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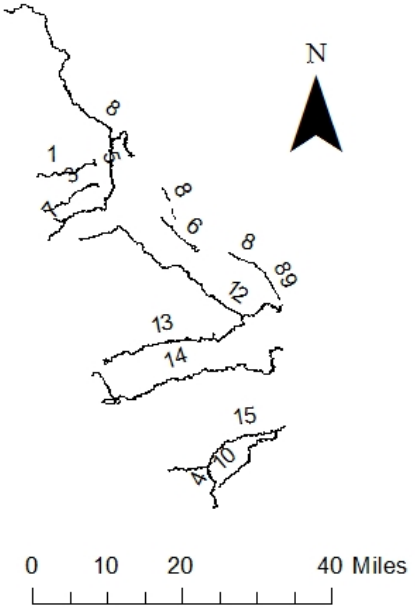
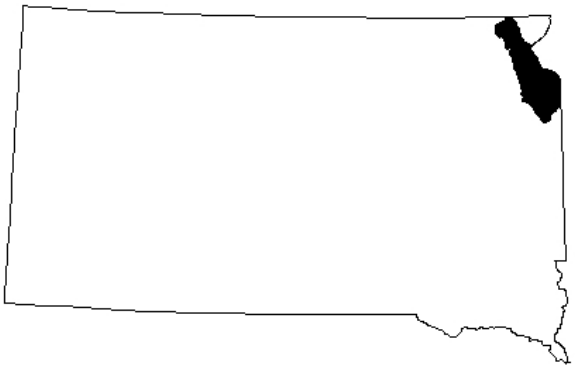
Appendix 1. Continued

7020001

1 Agency Creek
2 Big Coulee Creek
3 Big Spring Creek
4 Caine Creek
5 Goodwill Creek
6 Hartford Beach Creek
7 Jorgenson River
8 Little Minnesota River
9 Minnesota River
10 Mud Creek
11 Whetstone River
12 Whetstone River, North Fork
13 Whetstone River, South Fork
14 Yellow Bank River, South Fork
15 Yellow Bank River, North Fork





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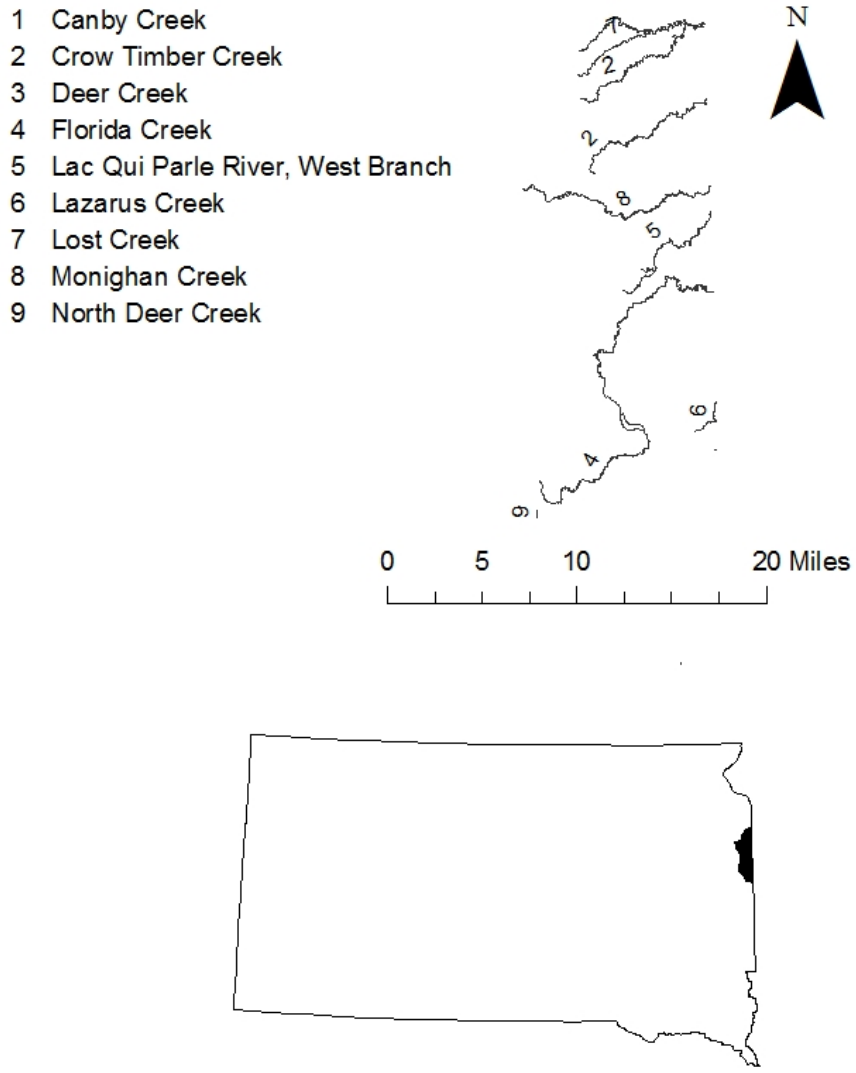

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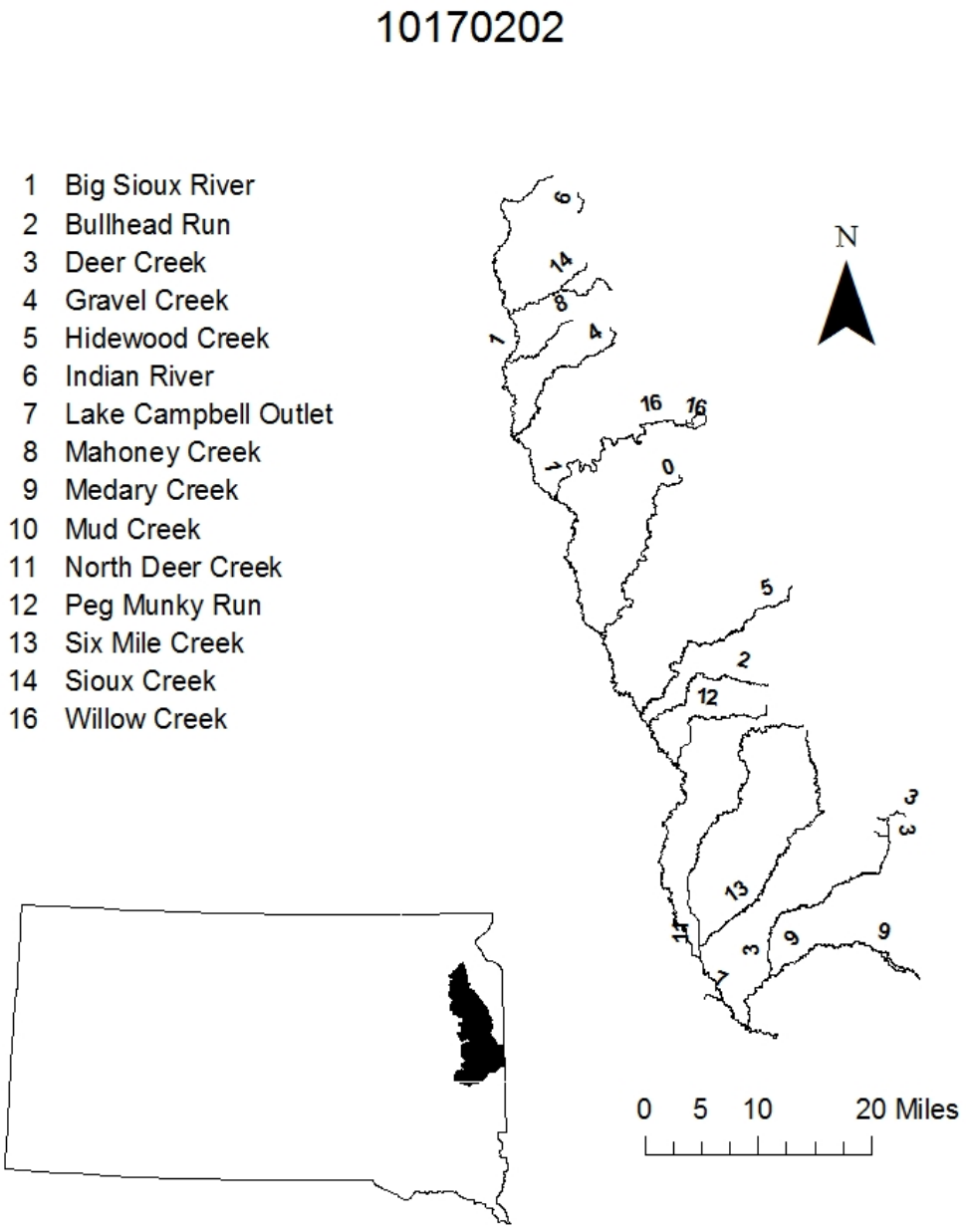

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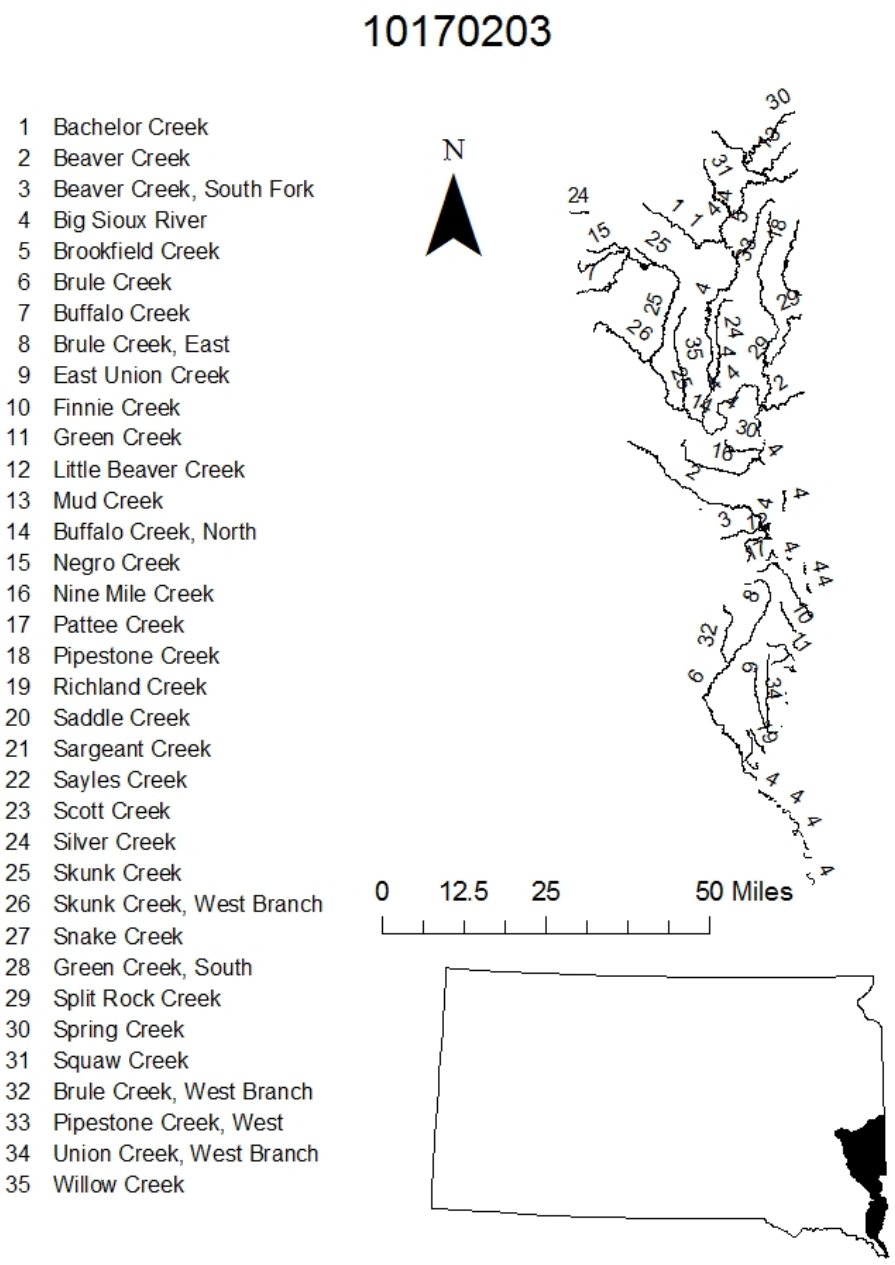

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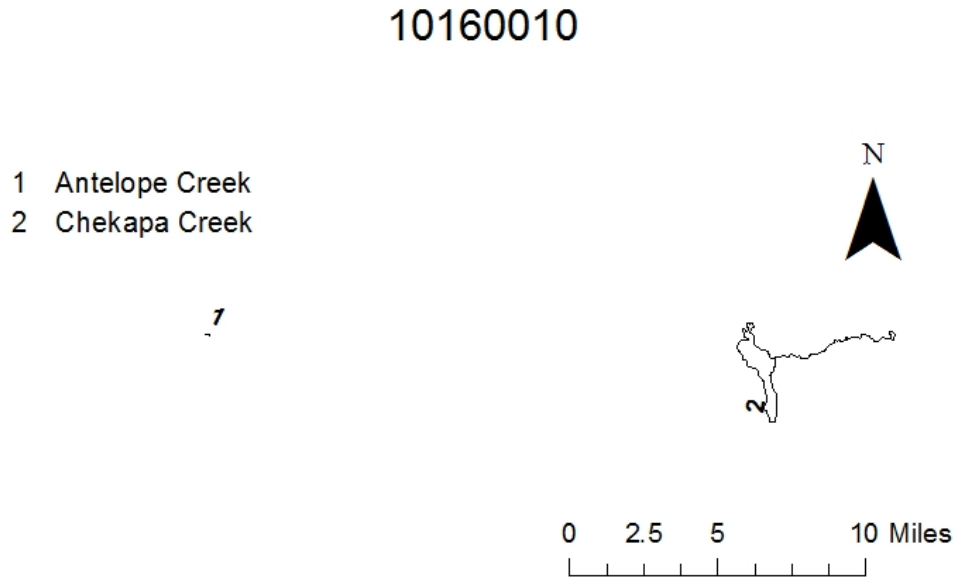

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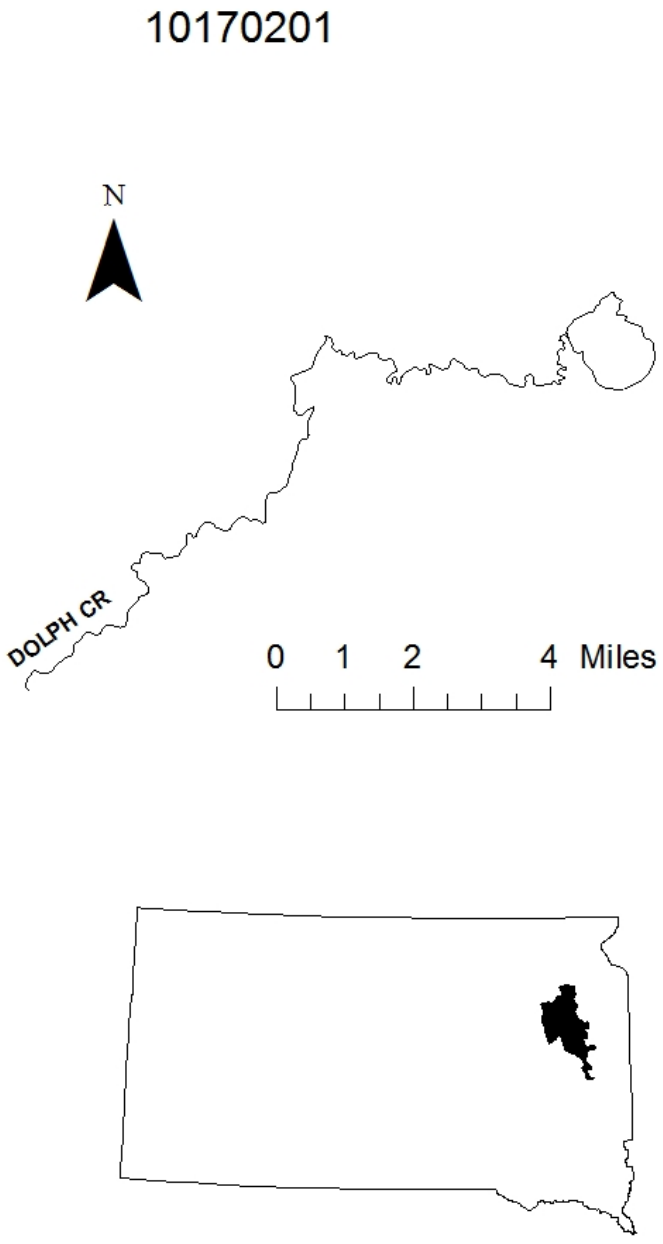

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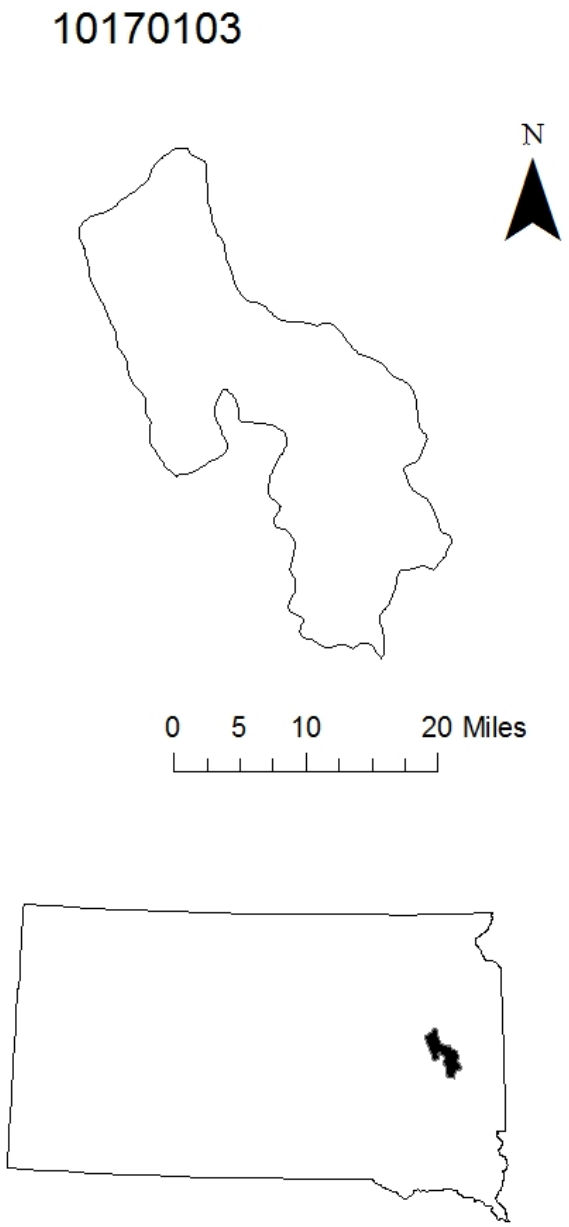

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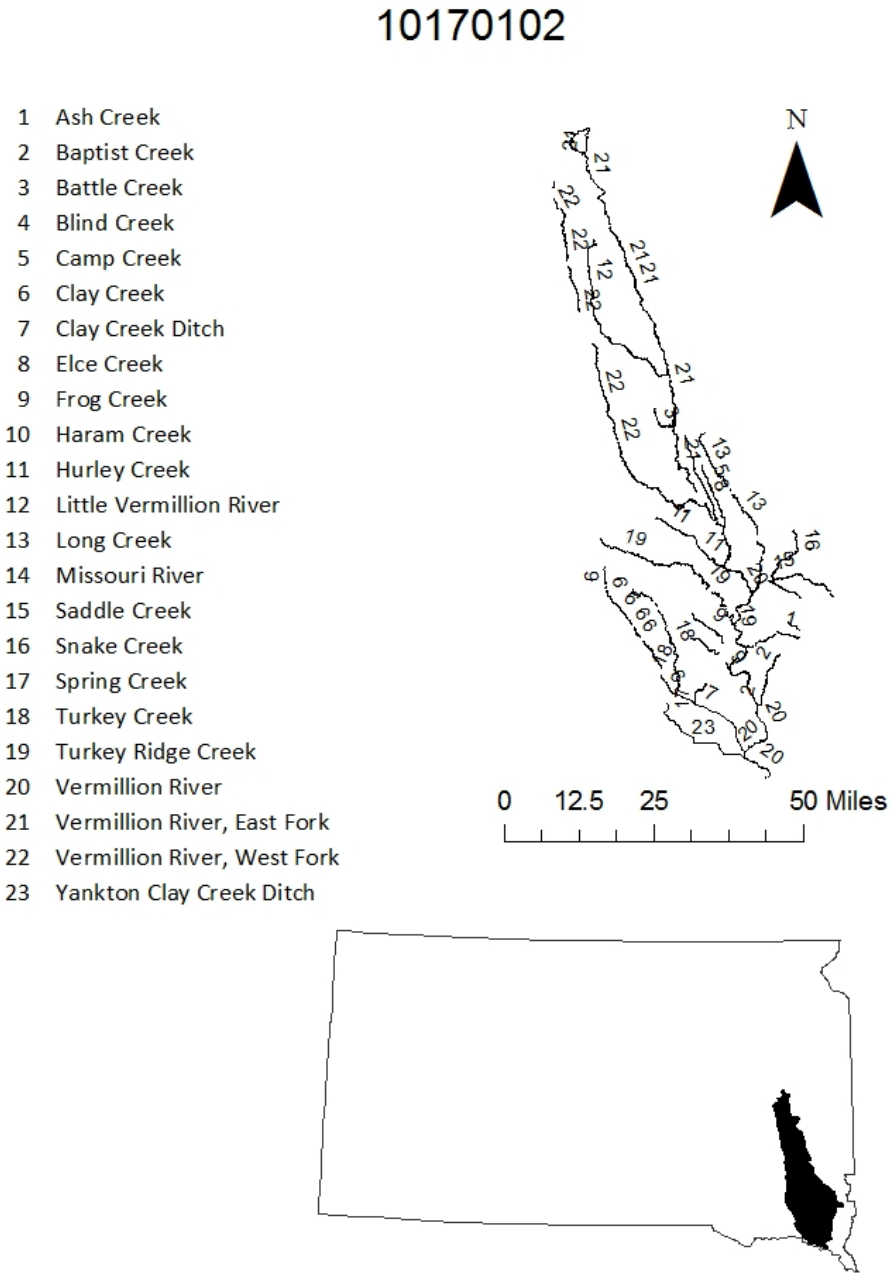

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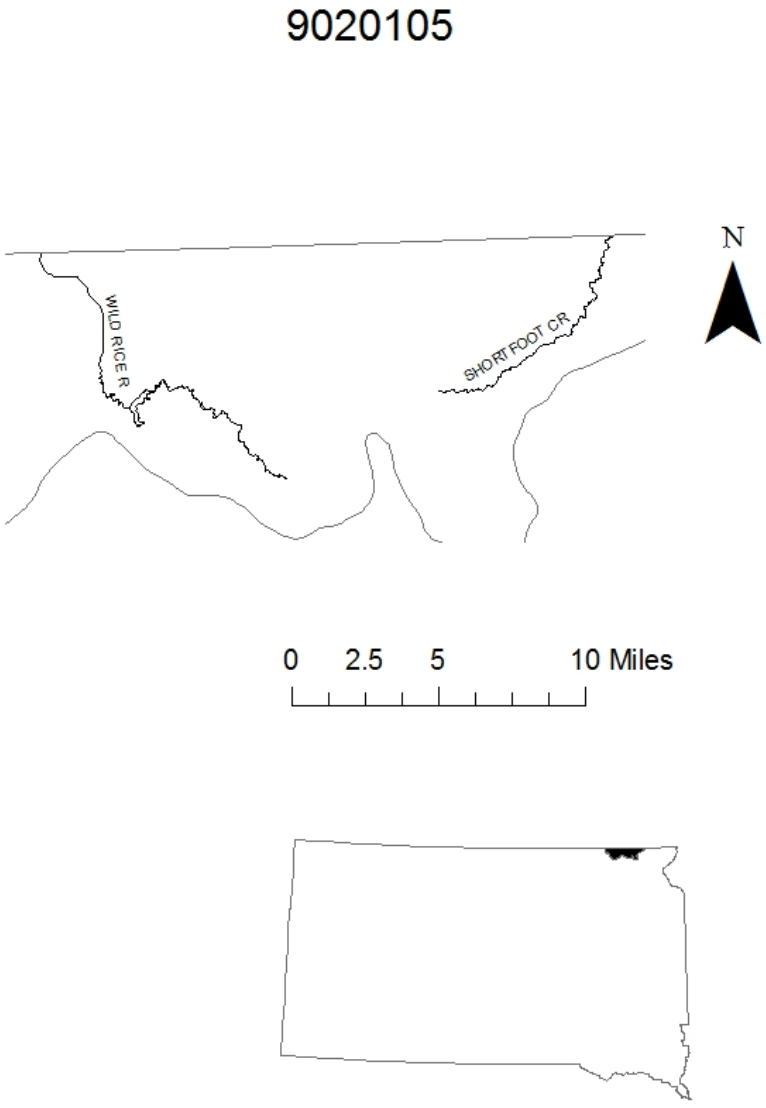

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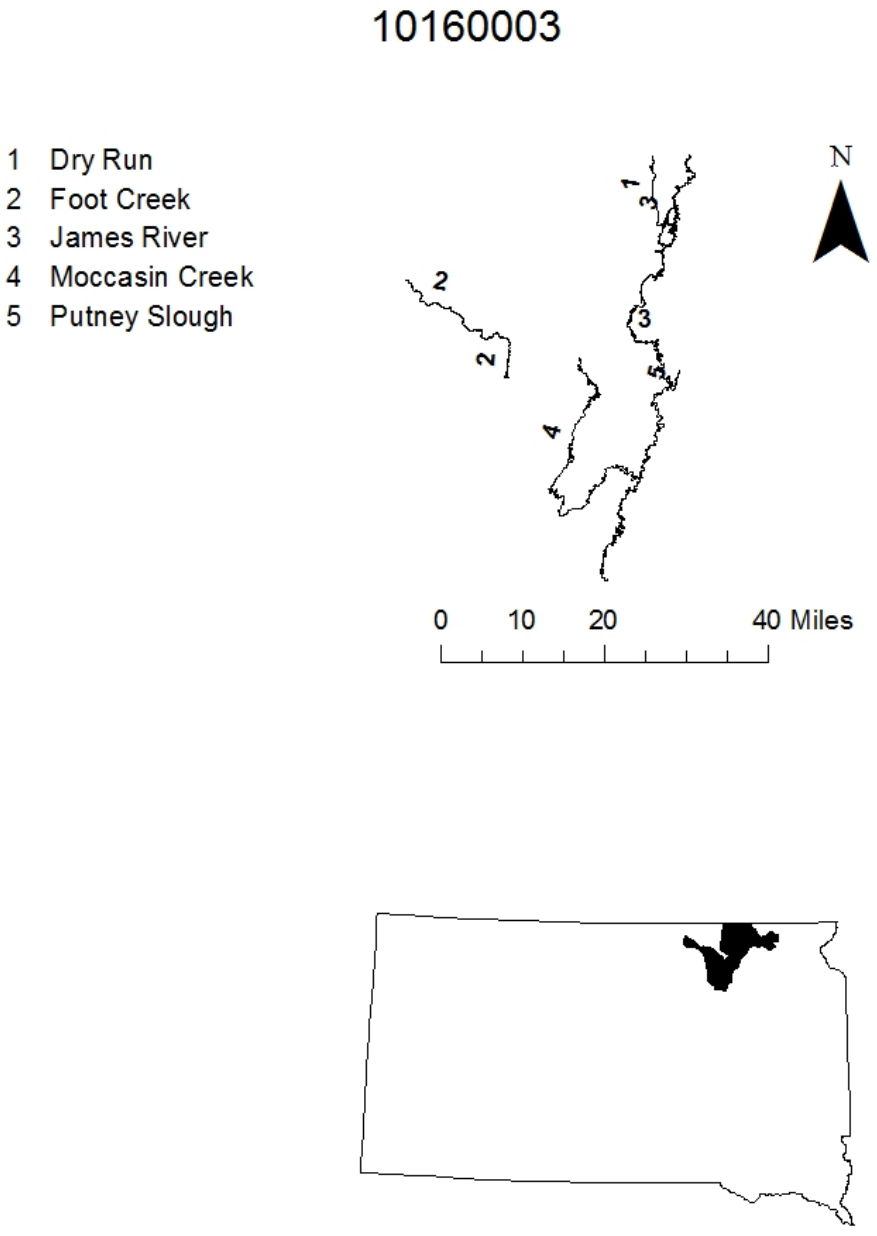

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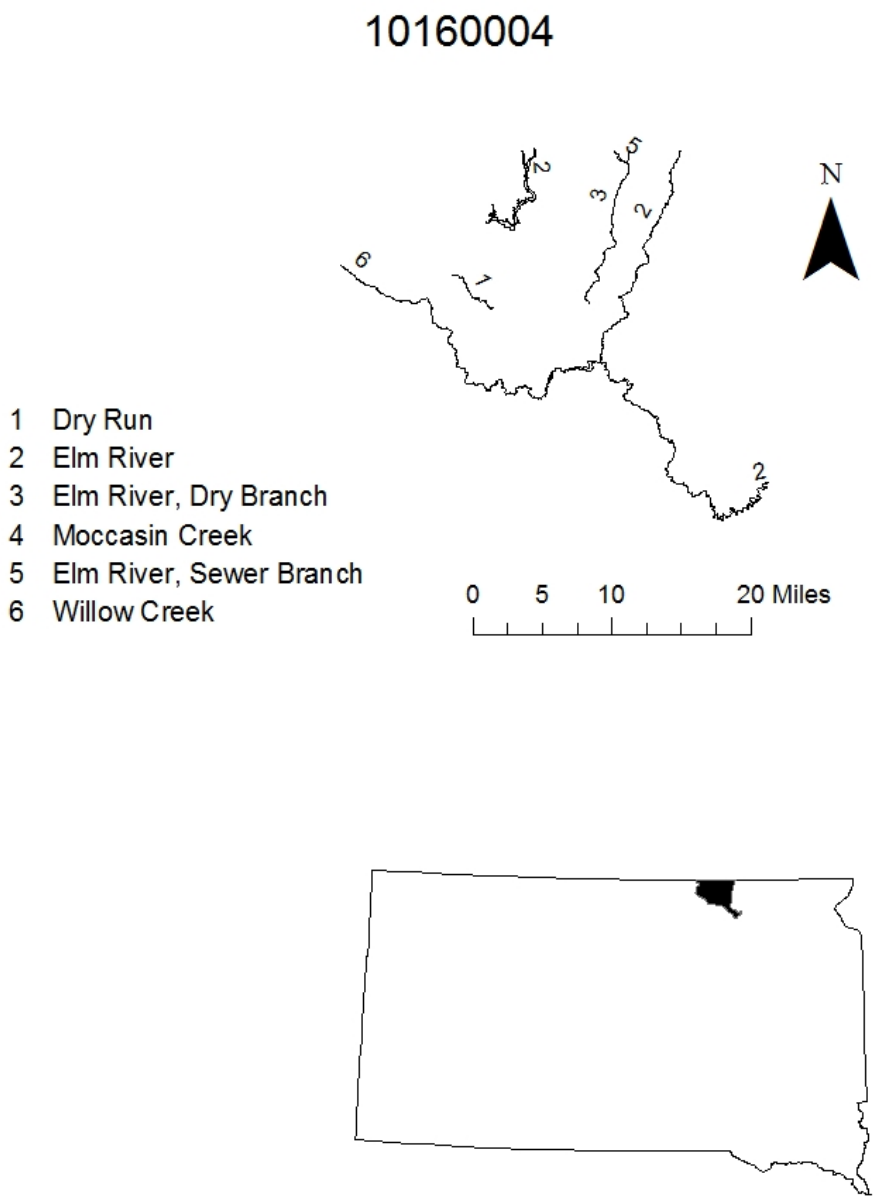

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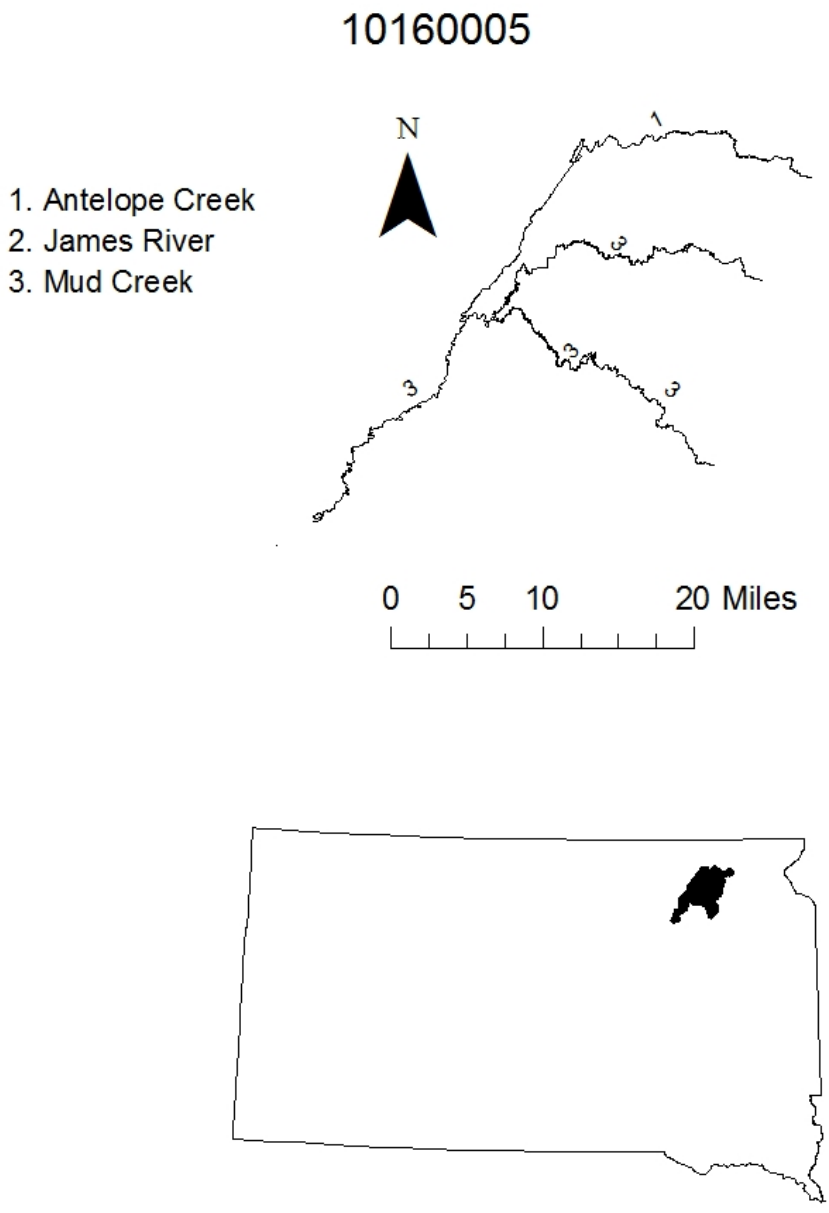

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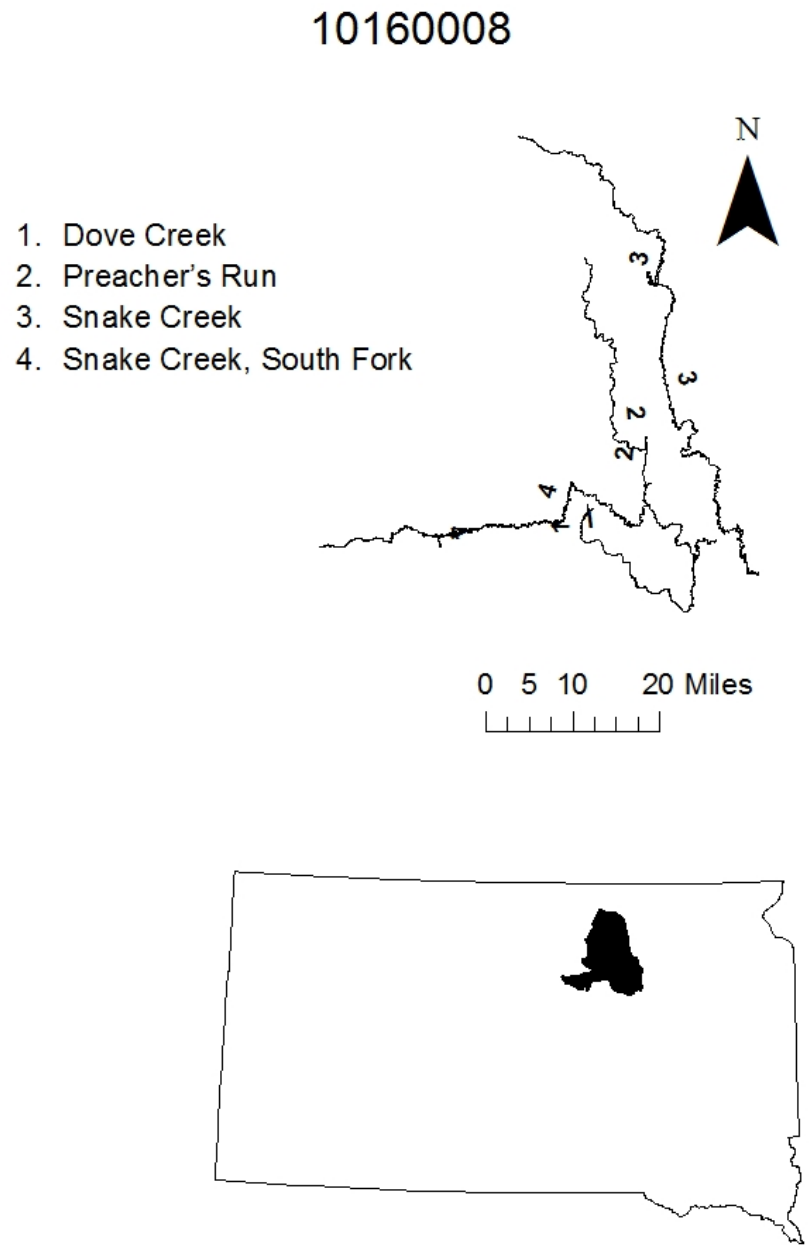

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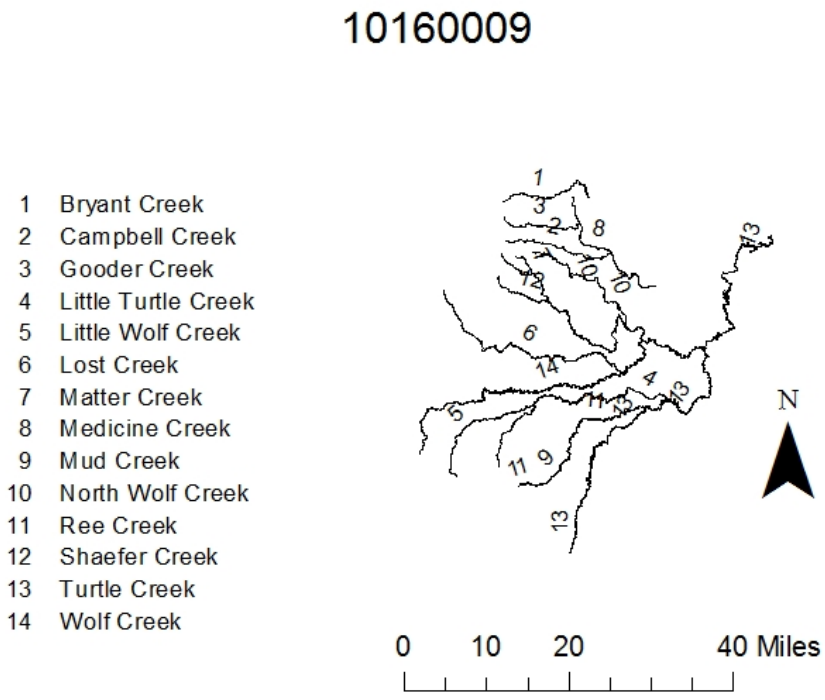

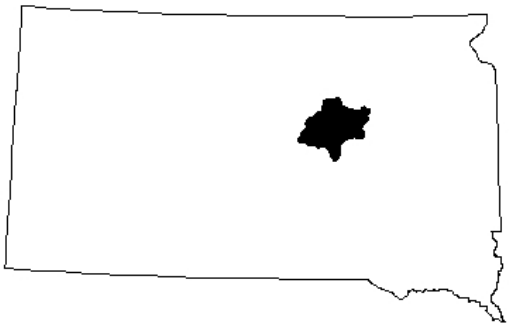

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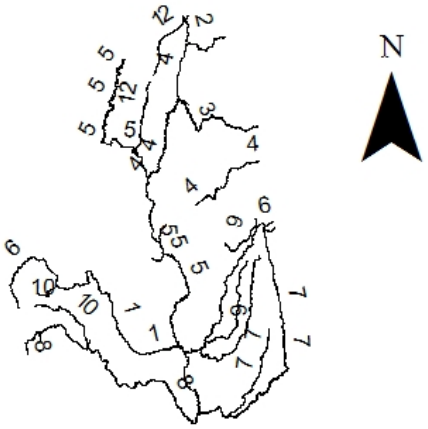
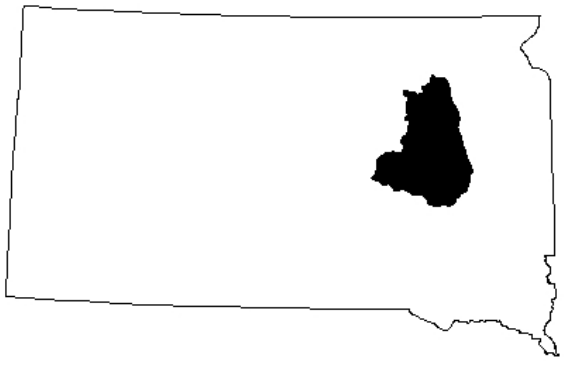
Appendix 1. Continued

10160006

1 Cain Creek
2 Dry Run
3 Fordham Creek
4 Foster Creek
5 James River
6 Pearl Creek
7 Red Stone Creek
8 Sand Creek
9 Shue Creek
10 Silver Creek
11 Snake Creek
12 Timber Creek





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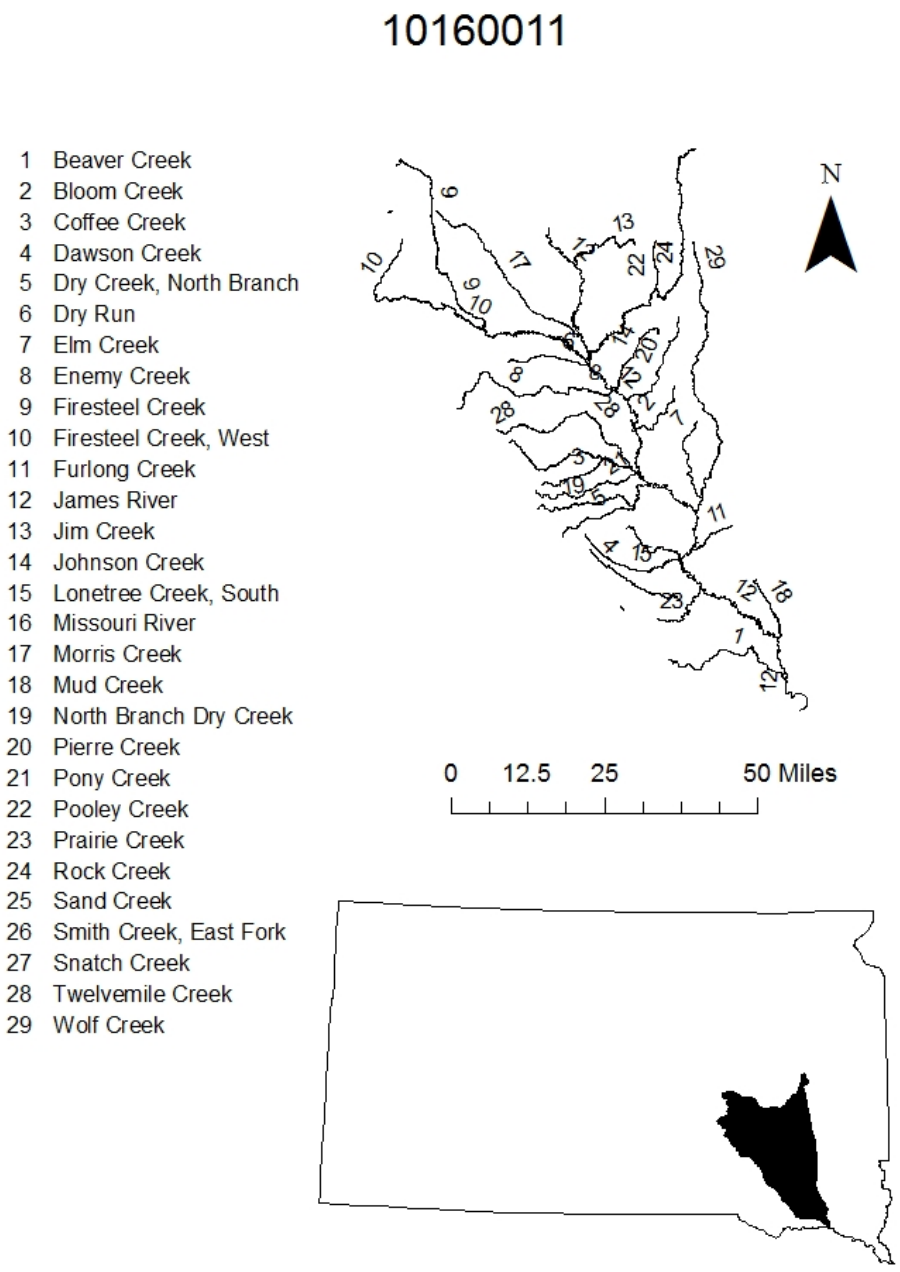

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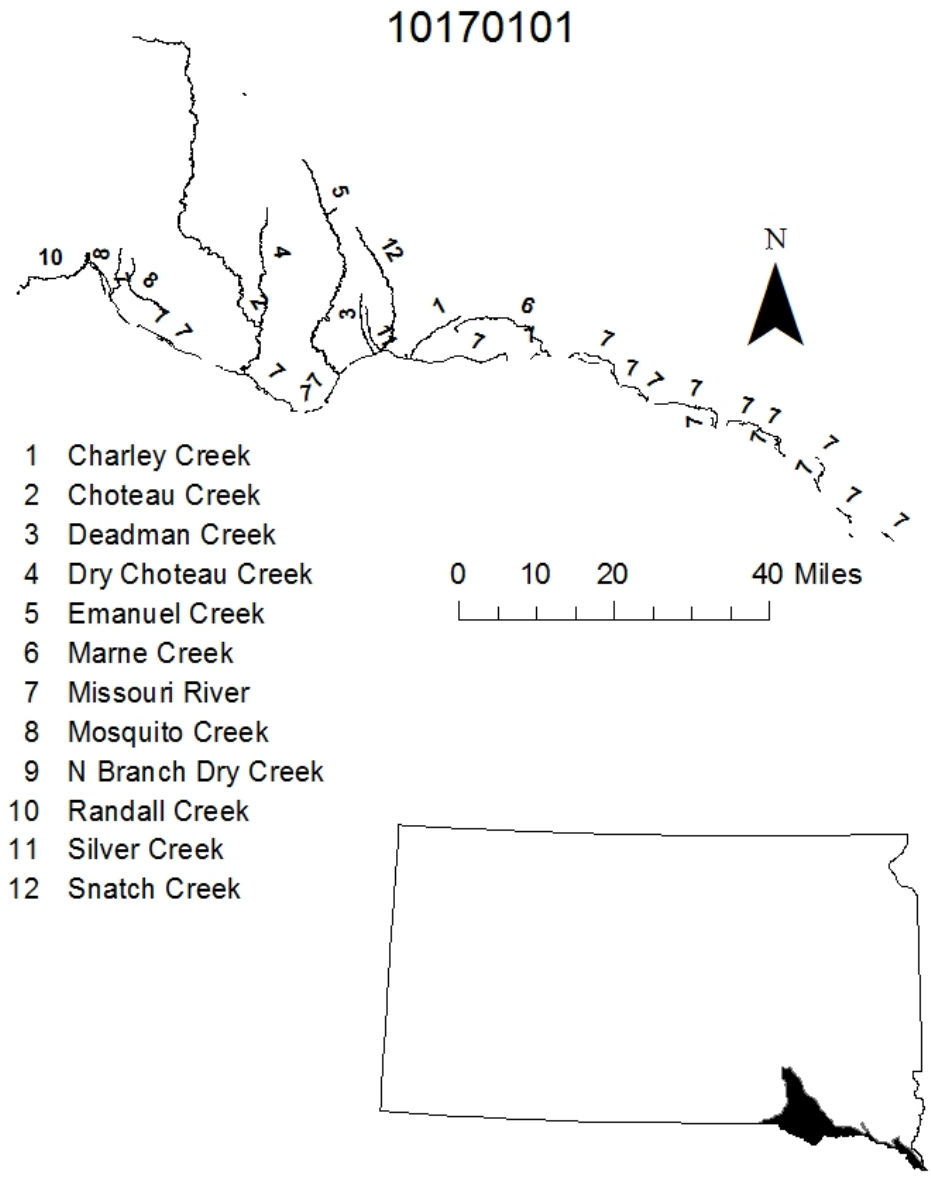

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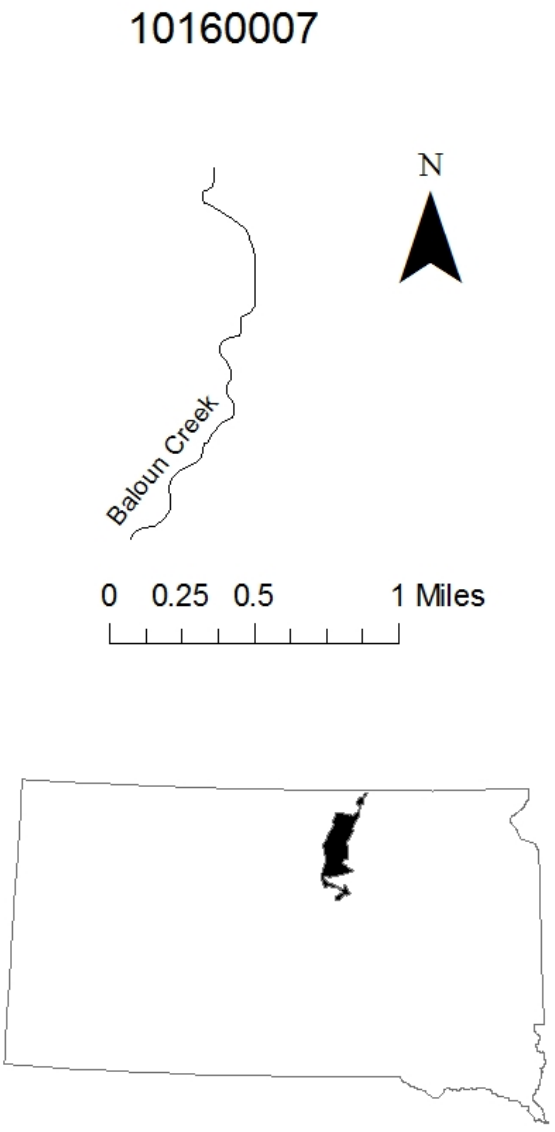

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10140105

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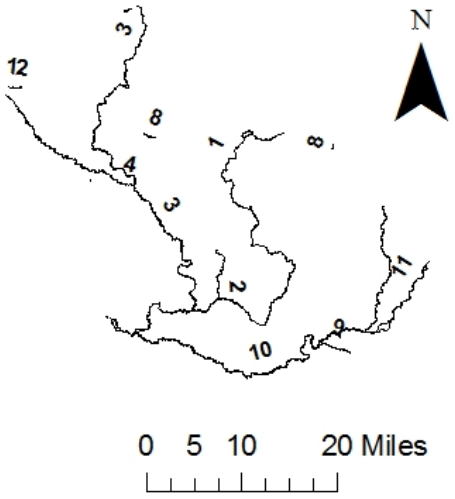
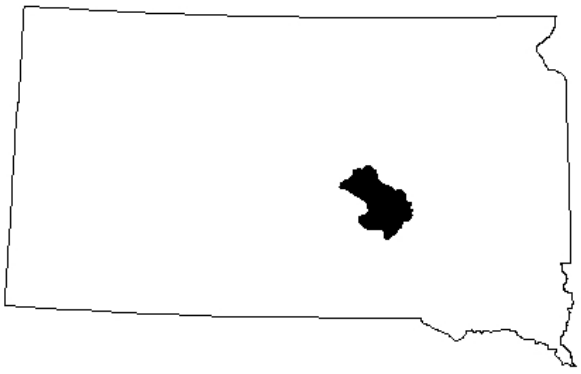
2 Dry Run
3 Elm Creek
4 Elm Creek, West Fork
5 Little Elm Creek
6 Missouri River
7 South Medicine Creek
8 Sand Creek
9 Sayles Creek
10 Smith Creek
11 Smith Creek, East Fork
12 Elm Creek, West Fork





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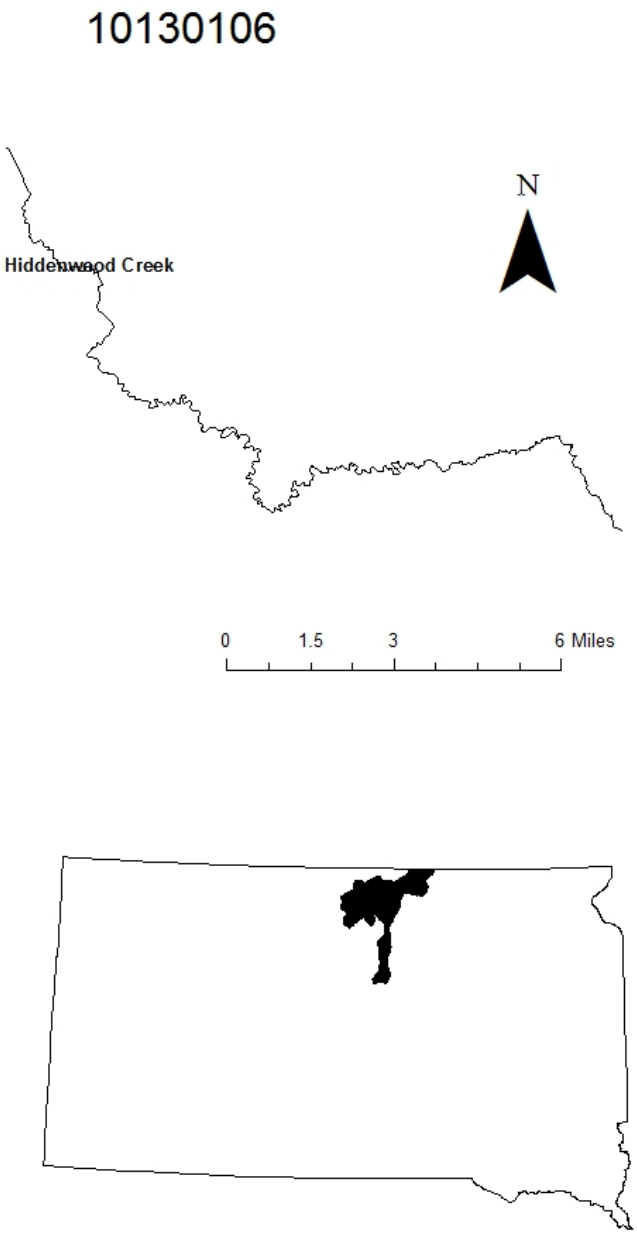

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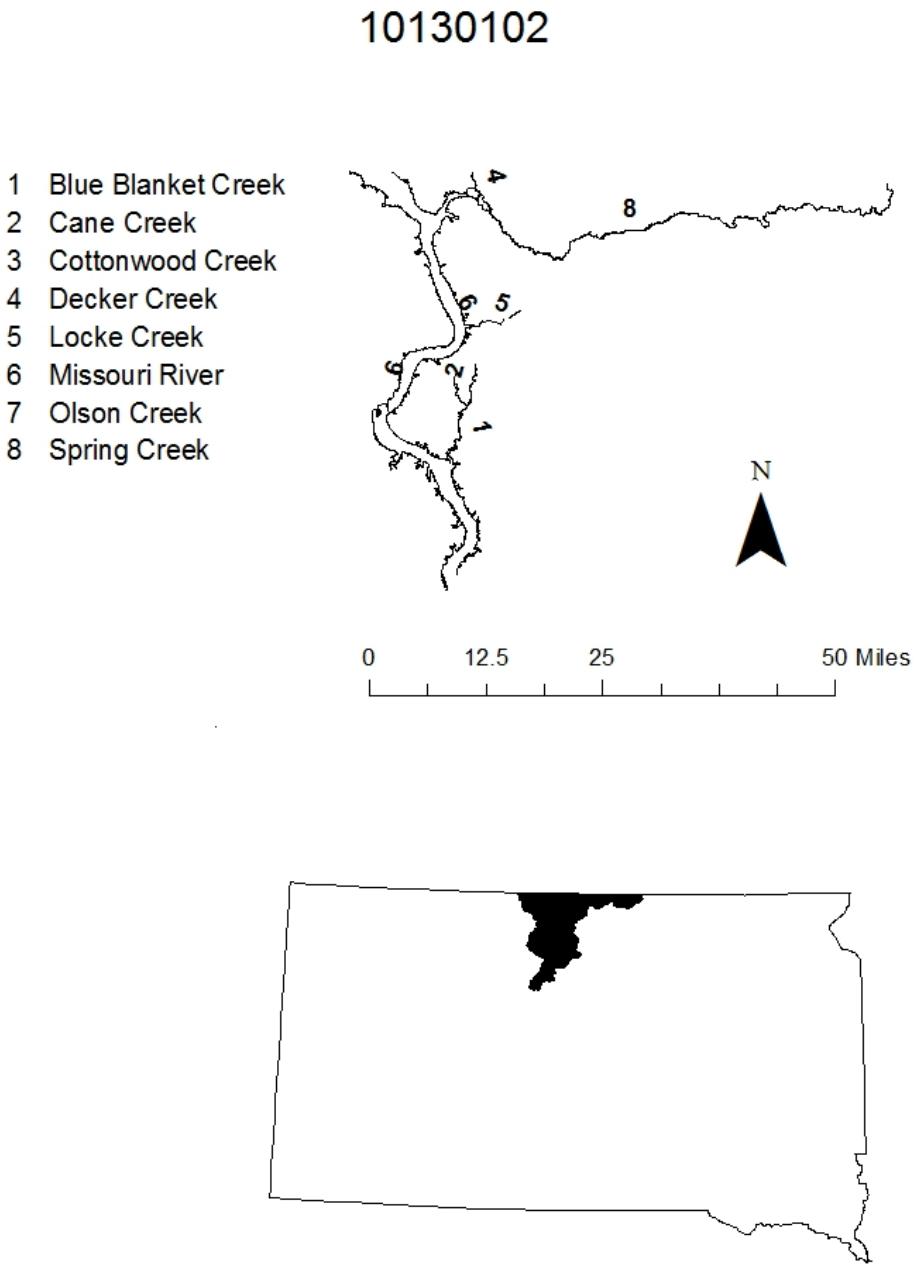

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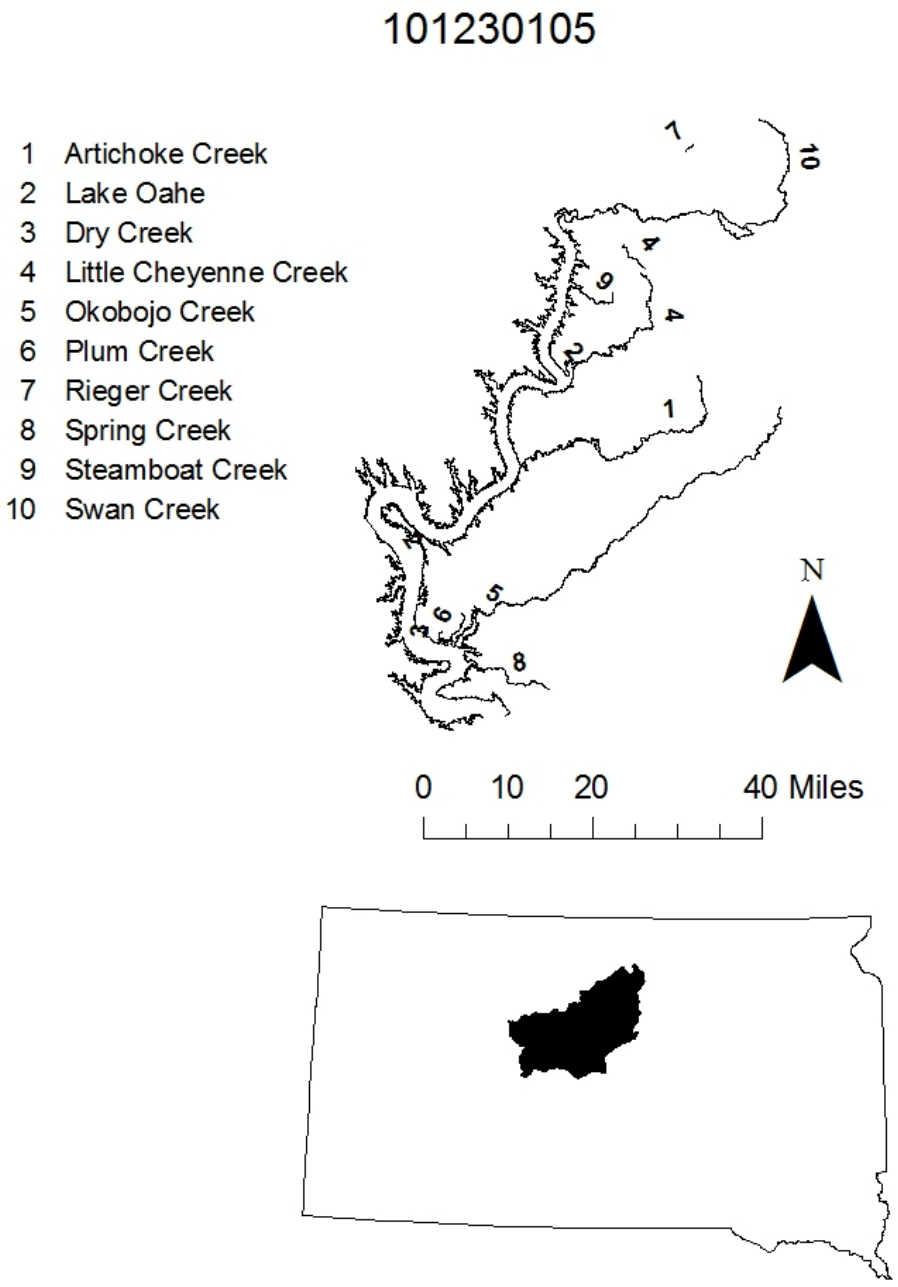

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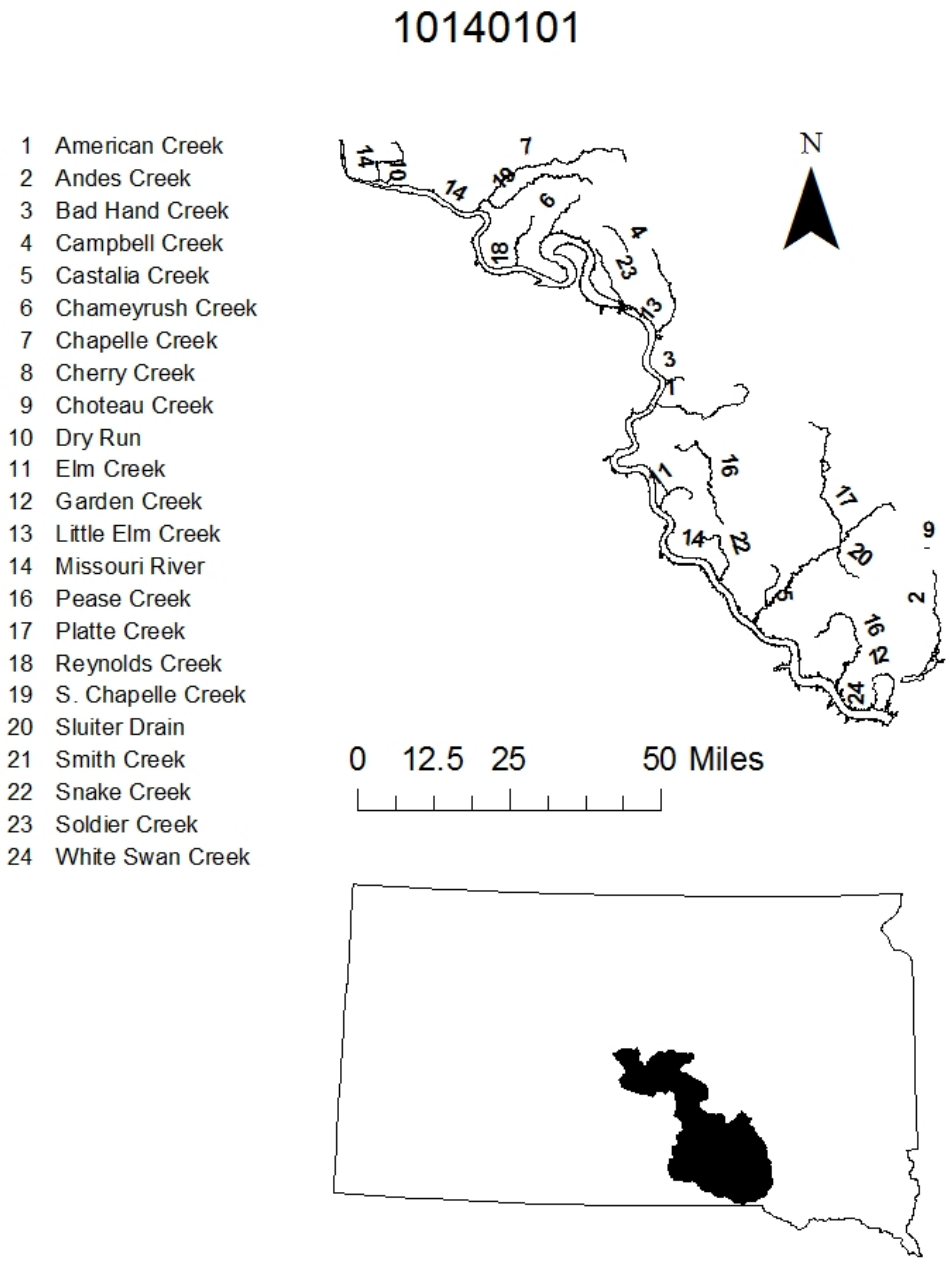

008402

Western Prairie Fringed Orchid Recovery Plan

(Platanthera praeclara)

Department of the Interior
United States Fish & Wildlife Service

008403

PLATANTHERA PRAECLARA (WESTERN PRAIRIE FRINGED ORCHID)

RECOVERY PLAN

Prepared in consultation with
THE WESTERN PRAIRIE FRINGED ORCHID RECOVERY TEAM

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for
Region 3
U.S. Fish and Wildlife Service
Ft. Snelling, Minnesota

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: 9/30/96

DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the Service. The inclusion of citations of both published and unpublished work in this plan does not reflect an endorsement of the methods or results by any individuals or agencies involved in the plan formulation. Such citations are included to provide the reader with the complete range of information available for the species at the time of release of this plan.

Recovery plans represent the official position of the Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature Citations for this plan should read as follows:

U.S. Fish and Wildlife Service. 1996. *Platanthera praeclara* (western prairie fringed orchid) recovery plan. U.S. Fish and Wildlife Service, Ft. Snelling, Minnesota. vi + 101 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814

301/492-6403 or 1-800/582-3421

The fee varies for the Plan depending on the number of pages of the Plan.

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EXECUTIVE SUMMARY

Current Status: *Platanthera praeclara* (western prairie fringed orchid), classified as threatened under the Endangered Species Act of 1973, as amended, is a terrestrial orchid currently known to occur at 175 sites in 8 ecoregions, including 41 counties of 6 states and 1 population complex in Manitoba. Approximately 90 percent of known western prairie fringed orchids in the United States occur in the Red River Valley of North Dakota and Minnesota (ecoregion 251A). Populations in the southern portion of the range account for a mere 3 percent of known plants. The species is apparently absent from both Oklahoma and South Dakota. Table 3 summarizes population sizes, ownership, protection status, and management. This table reflects peak numbers of plants recorded at each site between 1970 and 1994.

Habitat Requirements and Limiting Factors: Preferred habitat is unplowed, calcareous prairies and sedge meadows; plants have also been observed in successional communities such as borrow pits, old fields, and roadside ditches. The major historical cause of the species' decline was conversion of habitat to cropland. Hydrologic changes that draw down or contaminate the water table may also adversely affect the species. Other land management practices such as burning, grazing, and mowing may affect the species depending on their timing, frequency and intensity. However, some disturbance may be important for establishment.

Recovery Objective: Delist.

Recovery Criteria: *Platanthera praeclara* will be considered for delisting when sites that include occupied habitat harboring 90 percent of plants in each ecoregion are protected at protection codes 4 through 9 (public ownership or higher level of protection), and managed in accordance with a Service-approved management plan or guidelines. This plan must assure implementation of management practices that provide the range and spatial distribution of successional and hydrologic regimes required to maintain the species and its pollinators in self-sustaining, naturally occurring populations, and must remain in effect following delisting.

Implementation of these criteria is further clarified in the Strategy of Recovery section at the end of the introduction.

Actions Needed:

1. Maintain habitat of known populations as native prairie.
2. Provide the highest level of state legal protection appropriate for all populations.
3. Develop and implement habitat management plans that sustain and enhance *P. praeclara* populations.
4. Conduct appropriate research and monitoring.
5. Identify and search potential habitat.
6. Disseminate information about the species to a variety of audiences.

Cost of Recovery (000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
1996	300	3	60	100	30	5	498
1997	300	5	60	100	30	5	500
1998	300	5	60	100	30	5	500
1999	300	5	60	100	30	5	500
2000	0	5	60	100	20	5	190
2001	0	5	60	80	20	0	165
2002	0	0	60	80	20	0	160
2003	0	0	60	80	10	0	150
2004	0	0	60	80	10	0	150
2005	0	0	60	80	10	0	150
Total	1,200	28	600	900	210	25	2,963

Date of Recovery: If needed recovery actions are implemented and recovery criteria have been met, the species could be delisted by the year 2005.

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I. INTRODUCTION

A. Description

Platanthera praeclara Sheviak and Bowles (western prairie fringed orchid) is a terrestrial member of the Orchidaceae (orchid family). The species was proposed as a threatened species under the Endangered Species Act of 1973, as amended (Act), by the U.S. Fish and Wildlife Service (Service) (USFWS 1988) and listed as such on September 28, 1989 (USFWS 1989). *Platanthera*, included in the genus *Habenaria* by some taxonomists, comprises approximately 200 species of temperate and tropical North Africa, North America, Central America, and Eurasia (Airy Shaw 1973, Luer 1975). There are 24 species, 36 taxa, and 5 named hybrids of *Platanthera* in North America, north of Mexico (Luer 1975). *Platanthera praeclara* was described in 1986 from material collected by M.L. Bowles on the Sheyenne National Grassland in Ransom County, North Dakota (Sheviak and Bowles 1986). Previously, the species was included in a broader taxonomic concept of *P. leucophaea*.

Platanthera praeclara, a smooth, erect, perennial herb grows to 1.2 meters (m) [4 feet (ft)] tall (Figure 1). Plants have two to five fairly thick, elongate, hairless leaves each. The open, spike-like flowering stalk bears up to 24 showy, 2.5 centimeters (cm) [1-inch (in)] wide, white flowers. The lower petal of each flower is deeply 3-lobed and fringed, hence the common name. The seedpods, which contain many tiny seeds, are about 2.5 cm (1 in) long and tapered on both ends (Sheviak and Bowles 1986).

Described in technical terms (Sheviak and Bowles 1986), *P. praeclara* is a erect, stout, herbaceous perennial, usually 30 to 85 cm (12 to 34 in) tall, sometimes ranging from 20 to 120 cm (8 to 47 in) tall. The plant typically has numerous coarse, fleshy roots arising from a fleshy tuber. Each plant usually has a single, glabrous, unbranched, and barely angled stem bearing two to five oblong-elliptic to lanceolate, keeled, glabrous leaves. Leaves are usually 7 to 15 cm (3 to 5.9 in), sometimes up to 26 cm (10.2 in), long and 1 to 4 cm (0.4 to 1.6 in), sometimes up to 5 cm (2 in) wide.

The inflorescence, a showy raceme of 5 to 25 flowers, is 5 to 22 cm (2 to 8.7 in) long, 4 to 7 cm (2 to 3 in), sometimes up to 10 cm (4 in) in diameter, with lanceolate, acuminate bracts 1.5 to 4 cm (0.6 to 1.6 in) long and 0.4 to 0.7 cm (0.2 to 0.3 in) wide. The flowers are creamy white to white or rarely greenish white and have a perianth which is directed forward and forms a hood over the column. The dorsal sepal is ovate to suborbiculate, concave, 9 to 13 millimeters (mm) (0.4 to 0.5 in) long, and 5 to 8 mm (0.2 to 0.3 in) wide. The lateral sepals are obliquely-obovate, asymmetrical, 7 to 14 mm (0.3 to 0.6 in) long, and 5 to 10 mm (0.2 to 0.4 in) wide. The lateral petals are cuneate to flabelliform, rounded to truncate, 9 to 16.5 mm (0.4 to 0.6 in) long, and 6.5 to 13.5 mm (0.3 to 0.5 in) wide, with lacerate distal margins. The lip (lower petal) is deeply 3-lobed, sometimes as short as 1.7 cm (0.7 in) long, but usually 2 to 3.2 cm (0.8 to 1.3 in) long, 2 to 3.9 cm (0.8 to 1.5 in) wide, fringed, and bears a slender, arcuate, clavate, 4 to 5.5 cm (1.6 to 2.2 in) long, sometimes as short as 2 cm (0.8 in) long, spur. The ellipsoid capsule is 2 to 2.5 cm (0.8

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to 1.0 in) long and 4 to 6 mm (about 0.2 in) in diameter and releases minute seeds through slits in the mature seedpods.

Throughout its range, flowering specimens of *P. praeclara* are most likely to be confused with *P. leucophaea* (eastern prairie fringed orchid) or with *P. lacera* (ragged fringed orchid) (Table 1). All three species inhabit tallgrass prairie communities in at least a portion of their ranges.

Platanthera leucophaea and *P. praeclara*, a species pair similar in gross morphology, can be distinguished by flower color, fragrance, and size; column structure; petal shape; and sepal width. The lateral lobes of the lip of *P. praeclara* are often, but not always, narrower than those of *P. leucophaea*. The basic distinguishing characteristics of *P. praeclara* are its slightly larger flowers and less elongated inflorescence. In addition, there are other differences in more technical characteristics (Sheviak and Bowles 1986), including a significant difference in anther morphology. *Platanthera praeclara* has divergent anther sacs with viscidia widely spaced to place pollinia on the compound eyes of moths, while in *P. leucophaea* (and the similar, but less closely-related *P. lacera*), anther sacs are parallel with viscidia in position to attach to the tongue of moths.

Although a preliminary examination of genetic variation between *P. praeclara* and *P. leucophaea* did not allow Pleasants and Klier (1995) to distinguish the two species by examining allozymes, the positions of the pollinaria and stigmata on the two species preclude cross pollination (Sheviak and Bowles 1986).

Platanthera praeclara is known to occur only west of the Mississippi River, whereas *P. leucophaea* occurs both east and west of the Mississippi. *Platanthera leucophaea* populations west of the Mississippi River include the historical type locality in Oklahoma (Sheviak and Bowles 1986), two historical and two extant populations in Iowa (Roosa *et al.* 1989), six suggested historical populations in eastern Missouri (Morgan 1980), and one historical population in eastern Nebraska (Sheviak and Bowles 1986). Despite the fact that *P. leucophaea* occurs west of the Mississippi River, there are no known locations where the two species coexist.

Platanthera praeclara and *P. lacera* both occur in southeastern Kansas, southern Missouri, northern Minnesota (Luer 1975), and southeastern Manitoba (White and Johnson 1980). The two species inhabit physiognomically similar habitats, but there are no reports of the two species co-occurring at the same site. *Platanthera lacera* is distinguished by its more dense inflorescence, which bear more numerous, smaller, greenish white flowers (Great Plains Flora Association 1986). Bowles and Duxbury (1986) suggest the species usually grows in soils more acidic than the soils of *P. praeclara* (Table 1).

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B. Distribution

Published accounts and herbarium records suggest *P. praeclara* was widespread and perhaps locally common prior to European settlement (Bowles and Duxbury 1986). Historically, Brownell (1984) and Lobeck (1957) suggest western prairie fringed orchid was distributed throughout much of the western Central Lowlands and eastern Great Plains physiographic provinces of the central United States and Interior Plains in extreme south-central Canada. Historical observations or collections (last observed prior to 1970 and/or confirmed destroyed) are known from 81 counties in 8 states. Comparison of the historical and extant ranges shows the species apparently has been lost from South Dakota and Oklahoma, with significant reductions in counties of occurrence in Iowa, southeastern Kansas, Missouri, and eastern Nebraska. A single collection reported from Wyoming (Bowles 1983, Sheviak and Bowles 1986) is of dubious origin (Bjugstad and Fortune 1989) and is excluded from the following discussions.

Historically known locations are summarized in Table 2 and extant population in Table 3. Comparison of these tables reveals that, although the species is no longer known to occur in nearly 75 percent of counties where it was historically documented, populations have been found in an additional 28 counties since 1970. Recent discovery of the orchid in these counties is probably not the result of expansion of the species range, but of increased interest in the species arising from its listing as a federally-threatened species. Because intensive searches have concentrated first in historic locations, it is less likely new populations will be discovered in counties from which it has been lost.

Two phases of decline are hypothesized to have occurred: The first occurred in the latter half of the nineteenth century when there was rapid conversion of prairie to agricultural use and the second, which continues today, as hay meadows and pasture are converted to cultivation, (Bowles and Duxbury 1986).

Extant populations of *P. praeclara* reportedly occur in 41 counties in 6 states and 8 ecoregions (Figures 2 and 3). County distribution is as follows: Iowa (15 counties), Kansas (7 counties), Minnesota (9 counties), Missouri (3 counties), Nebraska (5 counties), North Dakota (2 counties), and Manitoba, Canada. Status surveys have been conducted, and information about the species summarized for the entire range (Bowles 1983), the Great Plains (Bowles and Duxbury 1986), central Great Plains (Freeman and Brooks 1989), Iowa (Watson 1983, 1994), Kansas (Magrath 1972), Minnesota (Sather 1991, Smith 1981), Missouri (Morgan 1980), Oklahoma (Watson 1989), Sheyenne National Grassland (Bjugstad and Fortune 1989, Hansen *et al.* 1994, Sieg and Bjugstad 1994, Wolken 1995, Sieg and King 1995), and Canada (Brownell 1984, Collicutt 1992, Davis 1995).

Table 3 summarizes the following information about each known extant population of *P. praeclara*: county, site name, ecoregion, highest number of flowering plants recorded between 1970 and 1994, dates of first and last observations (with population size in parentheses if known), ownership, protection status, present management, and monitoring status. The state-by-state

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distribution of populations among ecoregions, management, and ownership are displayed in Figures 3, 4, and 5, respectively.

Three conceptual metapopulations, each with several populations totaling 3,000 or more plants, are suggested for the northern part of the range: the Pembina Trail prairie complex of Minnesota (Sather 1991), the Sheyenne Delta (North Dakota), and Vita Prairies (Manitoba, Canada). All three metapopulations lie in ecoregion 251A, the Red River Valley Section of the Prairie Parkland Province (Bailey *et al* 1994). These metapopulations are dynamic groupings of populations within which it is very likely that cross-pollination occurs. Although there is a reasonable probability of independent local population extinctions, independent colonizations may also occur, allowing the metapopulation to persist. In addition to these conceptual metapopulations, there are 3 population complexes in which several populations lie within a 5-6 square mile area and total between 100 and 1,000 plants. These populations are located in ecoregion 251A in Kittson and Clay Counties, Minnesota, and in ecoregion 332C in Cherry County, Nebraska (Bray and Wilson 1993, Nebraska Game and Parks Commission 1995). The remaining populations are either isolated, small or both. No population in Kansas or Missouri is known to contain more than 50 individuals.

C. Habitat

1. Ecoregions and Soils

Bailey *et al.* (1994) produced a map of the ecological provinces and province sections of the United States based on the U.S. Forest Service National Hierarchical Framework (ECOMAP 1993). These provinces and sections are frequently referred to as "ecoregions; provinces are identified by a 3-number descriptor and sections are identified by a 3-number descriptor with capitol letter suffix. Provinces are characterized by geologic, edaphic, aquatic, and vegetative variables; sections are characterized by regional climate, geomorphic process, stratigraphy, geologic origin, topography, drainage networks, and potential natural vegetation.

Platanthera *praeclara* is a perennial orchid of the North American tallgrass prairie and is found most often on unplowed, calcareous prairies and sedge meadows. Its occurrence has also been suggested at disturbed sites in successional communities, such as borrow pits, old fields, and roadside ditches (Freeman and Brooks 1989, Minnesota Department of Natural Resources 1979 to present, Nebraska Games and Parks Commission 1987 to present).

Surveys suggest the largest known populations of *P. praeclara* occur in ecoregion 251A, the Red River Valley Section of the Prairie Parkland Province (Bailey *et al* 1994) in eastern North Dakota (North Dakota Parks and Recreation Department 1995, Hansen *et al.* 1994), northwest Minnesota (Minnesota Department of Natural Resources 1995), and southeastern Manitoba (Catling and Brownell 1987, Collicutt 1992, Davis 1995) (Figures 2 and 3). In North Dakota, *P. praeclara* most frequently occurs in the sedge meadow community on the Glacial Sheyenne Delta (Bjugstad and Fortune 1989) and also in the tallgrass prairie community classified as Midland

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Grassland habitat type (Manske and Barker 1988). This delta is a periglacial feature of Wisconsinan age formed when meltwater from the glacial Sheyenne River emptied into glacial Lake Agassiz, depositing clay, gravel, and sand. Soils of the area are Calciaquolls (calcium rich wet prairie soils), Haploquolls (wet prairie soils with minimum horizon development), and Haploboralls (cool prairie soils with minimum horizon development) (USDA 1975). On the Sheyenne National Grassland, soils supporting orchids include not only Mollisols (mostly Endoaquolls and Haploborolls), but also, suggests Wolken (1995), Entisols and a few Inceptisols. A nearly impervious layer of lake sediments below the delta formation results in a perched water table in the area (Bjugstad and Fortune 1989).

In Polk County, Minnesota, most populations and subpopulations in the Pembina Trail prairie complex lie on a lacustrine plain between two well developed beachlines of Glacial Lake Agassiz. A detailed soil survey of the county has not been completed, but general soils maps of the area show *P. praeclara* populations are associated with poorly drained to moderately well-drained, nearly level to gently sloping soils formed on loamy and clayey glacial till (University of Minnesota 1980). A preliminary soil survey of the Pembina Trail Preserve indicates the greatest concentrations of the species occur on nearly level Haploquolls (wet soils with minimum horizon development) (USDA 1974).

Farther north, in Kittson County, Minnesota, the beach ridges of Glacial Lake Agassiz are broken into discontinuous remnants with less clearly defined interbeach areas. The northernmost United States population occurs on sandy over loamy, poorly drained dark soils in an undifferentiated complex of Haplaquents (azonal wet soils with minimum horizon development) and Calciaquolls (calcium rich wet soils) in the interbeach area (USDA 1979).

In Manitoba, the species occurs in a lake terrace area where the nearly indistinguishable beach ridges are replaced by reworked till with coarse boulder layers. The complex soils of this region developed when the ice sheet of the last glaciation formed the eastern boundary of Lake Agassiz. Collicutt (1992) and Ehrlich *et al.* (1953) suggest *P. praeclara* populations occur in wet prairie to meadow vegetation developed on poorly drained grey wooded soils (Alfisols) with a thin sandy mantle overlying stony calcareous reworked till.

Populations in glaciated Iowa (Iowa Department of Natural Resources 1995), southwestern Minnesota (Minnesota Department of Natural Resources 1995) and northeast Nebraska (Nebraska Game and Parks Commission 1995) occur in ecoregion 251B, the North Central Glaciated Plains Section of the Prairie Parkland Province. Those in northeastern Kansas, northwestern Missouri, eastern Nebraska and southern Iowa occur in ecoregion 251C, the Central Dissected Till Plains Section of the Prairie Parkland Province. Populations in southeastern Minnesota and northeastern Iowa occur in ecoregion 222M, the Minnesota and Northeast Iowa Morainal Oak Savannah Section of the Eastern Broadleaf Forest Province (Bailey *et al* 1994). The suggested habitat in these areas are wet-mesic to mesic tallgrass prairie on Kansan- or Wisconsin-age drift (Freeman and Brooks 1989). Post-glacial erosion has removed the drift in many areas, exposing Pennsylvanian to Cretaceous age sediments. The soils in these areas are

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usually Udolls or Udic Ustolls (humid to intermittently dry mollisols, or prairie soils) on gentle to moderate slopes (USDA 1975).

Populations in eastern Kansas (Kansas Department of Wildlife and Parks 1995) south of the Kansas River occur in ecoregion 251E, the Osage Plains Section of the Prairie Parkland Province (Bailey *et al* 1994). In this area, *P. praeclara* is found in mesic to wet-mesic upland prairies on unglaciated, level to hilly, Pennsylvanian-age sediments covered with a thin, discontinuous mantle of loess residuum. Freeman and Brooks (1989) suggest the species also occurred historically on wet-mesic prairies along the floodplains of several major rivers.

In north-central Nebraska, *P. praeclara* occurs in ecoregion 332C, the Great Plains Steppe Province, Nebraska Sandhills Section (Bailey *et al* 1994, Nebraska Game and Parks Commission 1995). The sandhills are wind-borne dunes of late Pleistocene age (Flint 1971). Soils in the Nebraska Sand Hills are Ustipsamments (poorly developed sandy soils of warm climates) that tend to be slightly acidic to circumneutral and on gentle or moderate slopes (USDA 1975). Plants typically grow on tallgrass prairies or sedge meadows in swales among the dunes. In eastern Nebraska, the species also occurs in ecoregion 251G, the Central Loess Plains Section of the Prairie Parkland Province and ecoregion 332E, South Central Great Plains Section of the Great Plains Steppe Province (Bailey *et al* 1994). In this area of the state, the orchid's habitat is on wet-mesic prairies and sedge meadows along the floodplain of the Platte River. Many of these habitats are similar in that they are subirrigated by near-surface groundwater, which provides a reliable source of water (Nagel and Kolstad 1987, Tolstead 1942).

2. Associated Species

Platanthera praeclara occurs in several kinds of fire- and grazing-adapted communities dominated by species of Poaceae (grass family). Table 4 generalizes the communities within which the species is found for each state and province of occurrence. Table 5 summarizes associated species from a variety of sites for which data are available. Data are derived from several types of sources, including quantitative data from orchid habitat and species lists for entire tracts. Because the latter data are from a wider area, the degree to which they reflect the microhabitats in which *P. praeclara* occurs is unknown.

Tallgrass prairies within which the orchid occurs are usually dominated by *Andropogon gerardii* (big bluestem), *A. scoparius* (little bluestem), and *Sorghastrum nutans* (Indiangrass), with *Deschampsia caespitosa* (tufted hairgrass) and *Panicum virgatum* (switchgrass) common associates in wetter sites. These prairies generally support a great variety of annual and perennial forbs and grasses with few shrubs unless fire or grazing is suppressed. *Platanthera praeclara* generally occurs within the wetter facies of such prairies or in associated sedge meadows.

Sedge meadows occur in seasonally hydric to wet-mesic conditions and are dominated by perennial taxa of the Cyperaceae (sedge family), especially *Carex* spp. (sedges) and *Eleocharis* spp. (spikerushes). A variety of annual and perennial grasses and forbs also occurs in this

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community type, with shrubs becoming increasingly prevalent northward. For example, *Poa pratensis, Carex lanuginosa, Juncus balticus, Salix exigua,* and *Salix bebbiana* were the dominant species in 16 swales supporting the species on the Sheyenne National Grasslands (Sieg and Bjugstad 1994). However, in this area orchid density was most highly correlated with canopy cover of *Calamagrostis stricta* (Sieg and King 1995). Wolken (1995) compared 19 swales that supported orchids with 19 swales devoid of orchids on the Sheyenne National Grassland and suggested the plant canopy cover of baltic *Juncus balticus, Stachys palustris*, and *Carex* spp. was higher in orchid swales than in swales without orchids.

D. Biology

Root systems of the genus *Platanthera*, including the herbaceous perennial *P. praeclara*, are fusiform tubers that regenerate during the growing season by forming a new tuber and a perennating bud, which gives rise to vegetative shoots the following season. This is the major mode of perpetuation of established populations. Various investigators suggest these plants may, infrequently, form multiple buds and tubers that may become isolated from the parent plant (Bowles 1983, Bowles and Duxbury 1986, Currah *et al.* 1990). Sieg and King (1995) documented the presence of double and triple ramets arising from individual plants on the Sheyenne National Grassland. Wolken (1995) verified the occurrence of multiple ramets and tubers from a single plant by excavation. Vegetative shoots develop from a perennating bud and emerge from the soil in the late spring after a period of soil warming, which usually occurs from mid-April in the South to late May in the North (Pleasants 1995a). Two months of vegetative growth may pass before an inflorescence will fully develop on a flowering plant. Studies suggest it is also common for *P. praeclara* to remain vegetative throughout the entire growing season (Sieg and King 1995, Sather and Smith 1994). Plants that remain vegetative throughout the growing season are shorter and usually have one to three leaves (Sieg and King 1995).

Researchers (Bowles 1983, Bowles and Duxbury 1986) have suggested sexual reproduction is the principal means of recruitment of new individuals into populations. Bowles (1983) believes formation of floral primordia in *P. praeclara* is initiated in the perennating bud the season prior to anthesis, as in *P. leucophaea*. Research by Bowles (1983) and Bowles and Duxbury (1986) suggests blooming in *P. praeclara* is stimulated by burning. Circumstantial evidence suggests flowering at the Platte River Trust's Mormon Island Crane Meadows near Grand Island, Nebraska, responds to high flows and concomitant soil saturation along the Platte River (Platte River Trust 1995). Density of flowering orchids in 1993 on the Sheyenne National Grassland was positively correlated with the surface soil moisture both that year and the previous year (Sieg and King 1995). Pleasants (1995a) also found flowering in a particular year appears to be stimulated by above average precipitation the previous year. Both *P. leucophaea* and *P. praeclara* produce indeterminate inflorescence with showy flowers. Plants bloom from mid-June in the southern portion of the range to late July in the northern portion. Individual flowers last up to 10 days, and inflorescence produce flowers for up to 3 weeks.

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Pollination is required for seed production in *P. praeclara*. Pleasants (1994) suggested pollinator activity levels, as measured by pollinia removal rates, and fruit set were correlated over three years in two study areas. Pleasants and Moe (1993) found hand-pollinated plants to be self fertile. The relative proportion of selfed and outcrossed progeny within any given population has not been investigated. Both *P. leucophaea* and *P. praeclara* have evolved outcrossing pollination systems (Sheviak and Bowles 1986). The white flowers lack nectar guides, bear long nectariferous spurs, and are fragrant at night, a suite of features typical of sphingophyllous (sphinx moth-pollinated) plants. Sheviak and Bowles (1986) suggest the column of *P. praeclara* is adapted to deposit pollinia on the compound eyes of appropriate pollinators. Using a limited number of museum specimens, Sheviak and Bowles (1986) identified four common prairie hawkmoths as potential pollinators of *P. praeclara*: *Eumorpha achemon*, *Hyles lineata*, *Sphinx drupiferatum*, and *S. kalmiae*. Pleasants and Moe (1993) identified three additional potential pollinators: *Catacola* sp., *Ceratomia undulosa*, and *Hyles galli*. Efforts to identify putative pollinators in 1990 at Tarkio Prairie in Missouri were unsuccessful because, as suggested by Ashley (1990) plants failed to bloom. The most definitive data for pollen vectors of *P. praeclara* are from the Sheyenne National Grasslands, where Cuthrell and Rider (1993) suggest individuals of *Eumorpha achemon* and *Sphinx drupiferatum* carried pollinia in 1993 and 1992, respectively. Hawkmoths are capable of flying great distances, for example, hawkmoth species considered strictly southern in distribution are frequently collected in more northerly latitudes. At present, pollinator densities are unknown and the ratio of local and in-migrant pollinators at any given site remains unexamined. It is also important to note the dependence of the orchid on hawkmoths is not reciprocal. Although the orchid depends on hawkmoths for pollination, adult hawkmoths can apparently feed from a number of non-orchid nectar sources, thus having the ability to sustain their populations before and after orchid anthesis, or during years of low orchid flowering (Cuthrell, personal communication). It is not known at the present time whether these alternative nectar sources are all native plants or whether the moths have also adapted to use introduced species.

Bowles and Duxbury (1986) suggest seeds mature on the plant and are released in early fall, the capsules opening at the onset of dormancy. A single capsule may produce thousands of seeds. Therefore, under ideal circumstances for germination and survivorship, the reproductive potential of a small population could be very large. Seeds are wind-dispersed and may also be adapted for dissemination through the soil profile by water (Bowles 1983). Orchid seeds are extremely small, and each bears a minute, morphologically undifferentiated embryo that often consists of only a few cells (Cronquist 1981). Orchid seeds contain very limited food reserves and exhibit limited development (Harley and Smith 1983). Continued growth of the seedling in natural conditions requires association with a compatible soil-inhabiting mycorrhizal fungus, as suggested by Bowles and Duxbury (1986), Cronquist (1981), and Currah *et al.* (1990). After infection with this symbiont fungus, orchids may persist in an underground saprophytic stage until or beyond the second year before the first green foliage leaves appear (Harley 1969). Seedling establishment may also be linked to the availability of suitable microhabitats, edaphic factors controlling soil mycorrhizae, and interspecific competition.

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Orchid ecology is probably closely linked with edaphic factors controlling mycorrhizal fungi (Sheviak 1974). Bowles (1983) and Bowles and Duxbury (1986) suggest the formation of a symbiotic mycorrhizal association between the seedling and soil fungus probably is required for *P. praeclara* seedling establishment and is believed to continue as the plant matures. It has been hypothesized that annual tuber regeneration requires reinfection by mycorrhizae, dependent on appropriate ecological conditions for the mycorrhizae (Sheviak 1974). A counter-hypothesis suggests, that although mycorrhizae are necessary for germination, they may be killed by the plants as they mature (From 1995). A number of endophytic fungi have been isolated from roots of species of *Platanthera* (Currah *et al.* 1990), including members of the genus *Rhizoctonia* (Bjugstad-Porter 1993), the newly-described species *Ceratorhiza pernacatena* (Zelmer and Currah 1994), and *Epulorhiza* spp. (Zelmer 1994).

Reproductive success, survivorship, and mortality may be limited at several stages in the life cycle of *P. praeclara*. Although the orchid is reportedly long-lived (Sheviak and Bowles 1986), more recent published and unpublished data from demographic studies from various parts of the range suggest longevity varies geographically depending on soil moisture and other factors (Sieg and Bjugstad 1994, Sather and Smith 1994, Johnson 1994, Pleasants 1995b, Sieg and King 1995, Fritz personal communication 1995). On the Sheyenne National Grassland, published demographic data indicate the orchid could have a half life as short as one to three years (Sieg and King 1995). Most plants observed over a 7-year period that included both droughty conditions and flooding in this study area were present aboveground less than three years, and once absent, plants rarely reappeared (Sieg and King 1995). Unpublished data from Minnesota also suggests a high attrition rate, but that individual plants absent in a given year may reappear aboveground in subsequent years (Sather and Smith 1994). Although a small number of orchids on the Sheyenne National Grassland appeared aboveground every year for eight years, a predictable pattern in life states was not apparent. Sieg and King (1995) noted flowering plants can flower the following year, can reappear as vegetative plants, or be absent. Unpublished data from Minnesota (Sather and Smith 1994) suggest individual orchids in this study area can reappear aboveground for equally long periods of time and display a similar lack of predictable pattern in life state from year to year.

Habitat management, such as burning, grazing, or mowing, could have a positive or negative effect on recruitment and survivorship, depending on its frequency, intensity, and timing. Controlled studies of management are logistically difficult and require collection of data over a period of years. Preliminary studies have been restricted to particular populations, their methods are far from comparable, and their results to date are less conclusive than might be desired by those actively involved in management.

It has been suggested that flowering may be suppressed by litter accumulation and stimulated by fire (Bowles 1983, Bowles and Duxbury 1986). The effect of fire on flowering is probably influenced by intensity and timing of the burn and weather conditions both at the time of the burn and the time of flowering. In studies of individual plants subjected to controlled burns at Sheeder Prairie, Iowa, in 1993 and 1994, flowering probability did not differ between burned and

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unburned plants in either year, but survivorship of individual plants burned in 1993 was significantly higher than that of control plants over the period 1992-1994, suggesting short-term survivorship under these experimental conditions may have been enhanced by fire. Preliminary data from this study indicate a greater portion of plants disappeared on unburned plots than on plots burned two years previously (Pleasants 1995a). In a small-scale study in the Sheyenne National Grasslands, prescribed burning of plots in the fall did not significantly affect orchid numbers, heights, number of leaves, phenology, and condition the following year compared to paired plots that were not burned in the fall (Bjugstad-Porter 1993). Because of the species' apparent variability in response to environmental factors, caution must be exhibited in extrapolating the results of these studies until they have been replicated and similar research has taken place in other populations.

In an effort to assess the effects of management on a broader scale, data collected on the Sheyenne National Grassland between 1987 and 1994 have not documented any consistent, significant differences in orchid densities or flowering rates among areas with five ambient management regimes (Sieg and King 1995). These management regimes included livestock grazing with and without spring burning, and no grazing with and without burning. As is the case with all studies conducted in only a single part of the species' range, these results need corroboration at additional sites before they can be extrapolated to populations across the species' range.

Present management of extant sites is presented in Table 3, and is illustrated in Figures 4 and 5, which show the proportion of plants in each predominant management within ecoregions and within states, respectively. The best management for this species is likely to be that which best maintains the quality of the grassland and prairie habitats. Additional experimentally-designed and replicated research is needed to document the influence of various management techniques on the orchid in all parts of the species' range.

E. Threats and Limiting Factors

Platanthera praeclara has been and continues to be jeopardized by both natural and human-caused threats. The Endangered Species Act (Act) requires the Service to consider five specified factors in making its listing decisions. The final rule listing *P. leucophaea and P. praeclara* addressed those five factors as quoted below (USFWS 1989):

1. The present or threatened destruction, modification, or curtailment of its habitat or range.

"The prairie fringed orchids [eastern and western species] have declined significantly throughout their ranges due to conversion of most of their habitats to cropland, overgrazing, intensive hay mowing, drainage, and for fire protection; these and related threats continue. . . . Over 35 percent of the known populations of *Platanthera praeclara* occur in hay meadows; these plants seldom are seen, and populations apparently are small. Bowles (1983) and Bowles and Duxbury (1986) suggest hay mowing annually removes seed capsules and plant biomass before natural seed

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dispersal can occur. This prevents recruitment of seedlings into populations and probably weakens adult plants, resulting in gradual population decline through attrition. Changing land use also threatens hay meadow populations. At least four Kansas hay meadows known to support *Platanthera praeclara* populations have been converted to cultivated cropland since their discovery in the 1970s, while one Oklahoma hay meadow now is threatened with subdivision (Bowles and Duxbury 1986). The use of herbicides, especially on highway and railroad rights-of-way, continues to threaten these species in a number of instances. . ."

2. Overutilization for commercial, recreational, scientific, or educational purposes.

"Native terrestrial orchids rarely are grown from seed; adult plants are often sought for scientific and commercial purposes, or for private gardens. Smaller populations of the prairie fringed orchids would be adversely affected by collecting. . . . However, because of the recent description of *Platanthera praeclara* (western prairie fringed orchid) and its usually small populations, over-collecting may also become a serious problem for this species. At least one instance of removal of a western prairie fringed orchid plant for commercial purposes has taken place in Minnesota."

3. Disease or predation.

"No diseases are known to be adversely affecting either prairie fringed orchid species. All inflorescence were removed from one Minnesota population of *Platanthera praeclara* by an unknown herbivore, but the long term impact remains unknown. Conehead grasshoppers (Orthoptera: *Neoconocephalus*) occasionally are observed eating the flowers or fruits of these orchids. However, the major predator is man through use of this orchid's community for pasture or hay. Long term overgrazing or haying apparently leads to population decline because plants either are harvested or are not allowed to complete their life cycles."

4. The inadequacy of existing regulatory mechanisms.

"The prairie fringed orchids [eastern and western species] are formally or officially listed as endangered, threatened, or rare in 10 states (IA, IL, ME, MI, MN, MO, NE, ND, OH, WI) throughout their range. However, only a few states where these species are extant offer protection to listed plants beyond that afforded by their presence on public lands. State laws of Illinois, Iowa, Minnesota, Michigan, and Missouri prohibit the removal and sale of listed plants. Although *Platanthera leucophaea* and *P. praeclara* are offered various forms of recognition or protection under state laws, the Endangered Species Act offers possibilities for protection through section 6 by cooperation between States and the Service, and cooperation with other Federal agencies through section 7 (interagency cooperation) requirements. The plants are considered rare in Canada, but are not afforded any official designation or protection."

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5. Other natural or manmade factors affecting its continued existence.

"Pollination of the prairie fringed orchids is required for seed set, and is accomplished only by hawkmoths (Sphingidae). As a result, long-term population survival requires maintenance of hawkmoths. Any threat to these insects (such as the use of insecticides) or their habitats and food plants, is a threat to survival of prairie fringed orchids. . ."

The Western Prairie Fringed Orchid Recovery Team recognizes the conversion of *P. praeclara* habitat to cropland as the single most detrimental threat to the species. Although approximately 50 percent of Canadian plants are protected (Davis 1995) and 60 percent of sites in the two northern metapopulations are owned by public agencies or private conservation groups (Minnesota Department of Natural Resources 1995, North Dakota Parks and Recreation Department 1995), conversion of habitat to cropland continues as the single most detrimental threat in the southern portion of the species' range, where the majority of isolated, small populations remain unprotected (Iowa Department of Natural Resources 1995, Kansas Department of Wildlife and Parks 1995, Nebraska Game and Parks Commission 1995, Missouri Department of Conservation 1995). Figure 5 illustrates ownership patterns in each of the states. This figure reveals the majority of plants are in public or private conservation ownerships that allow for implementation of appropriate management techniques.

Within ecoregion 251A, an ecoregion where the majority of populations are relatively large and habitat relatively unfragmented, the threat of habitat conversion has increased since the species was listed because cultivation of newly developed potato varieties requiring new ground is rapidly expanding in the Sheyenne delta. Despite this, the major challenge for conservation of the orchid in this ecoregion is the determination and implementation of appropriate management techniques for the 60 percent of orchids presently assured protection from the plow. As can be seen from Figure 4, predominant management techniques vary with state. Whereas the majority of Minnesota orchids are managed with fire, the majority of North Dakota orchids are *under the influence* of grazing. The practices of burning, grazing, and mowing may have either positive or detrimental impacts on orchid populations depending on the frequency, intensity, and timing of these treatments. The most appropriate management may vary from one physiographic region to another. However, at present there are no available data to determine an appropriate balance of management activities across the range or within states or physiographic regions.

Because data from throughout the range indicated a decrease in flowering and an increase in mortality during the extreme drought of the late 1980s, it is more certain that hydrologic alterations that draw down the local water table near the root zone of the orchid have the potential of serious adverse impacts. This threat probably varies from site to site, depending on local climate, groundwater hydrology, and soil characteristics.

Among the biological threats not fully discussed in the listing package are potential changes in community composition resulting from invasion by natural succession and/or noxious species. Of these threats, competition for space, light, water, and nutrients by the naturalized, introduced

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Euphorbia esula (leafy spurge) and *Carduus nutans* (musk thistle) are probably the most severe current threat to *P. praeclara*. Studies suggest leafy spurge is a highly invasive, deeply rooted, persistent weed species known from orchid sites in North Dakota (Sieg and Bjugstad 1994) and Minnesota (Winter 1994) and has the potential of outcompeting native vegetation. The direct effect of competition with these and other weed species is exacerbated by the potential threat of control measures. In the absence of toxicity studies on *P. praeclara* or its pollinators, the potential impact of commonly used pesticides remains unknown. Musk thistle is frequently found on prairie hay meadows in eastern Kansas, but it is a serious problem at only one orchid site.

Various investigators suggest damage to plants is due not only to conehead grasshoppers (Bowles and Duxbury 1986) and unknown herbivores (Smith 1981) mentioned in the Service's final listing rule, but also to moose (Smith and Sather, personal observation), deer (Pleasants 1994), cattle (Freeman and Brooks 1989), unknown insects (Freeman and Brooks 1989), the weevil *Stethobaris commixta* (Sieg and O'Brien 1993), and two species of Tortricidae (leaf roller moths): *Sparganothis xanthoides* and *S. sulfureana* (Cuthrell and Rider 1993). Preliminary data on the impact of angora goats on the Sheyenne National Grassland introduced as a biological control for leafy spurge indicate both non-flowering orchids (19 percent) and flowering orchids (100 percent) were damaged when goats were herded three times through the area. However, Wolken (1994) suggests plants in plots protected from goats were not unscathed -- 16 percent of 61 non-flowering control orchids and 13 percent of 22 budding orchids in these plots sustained insect damage.

F. Conservation Measures

Several conservation and recovery activities for western prairie fringed orchid began before the species was listed under the Act, other activities followed listing, but prior to approval of this plan.

Federal action to protect *P. praeclara* was initiated under section 12 of the Act which directed the Secretary of the Smithsonian Institution to draft a list of plants considered to be endangered, threatened, or extirpated. This report was presented to Congress on January 9, 1975, and designated House Document No. 94-51 (Smithsonian Institution 1975). It included the then undescribed *P. praeclara* under the name *H. leucophaea* and recommended its listing as threatened. On July 1, 1975, the Service published notice of acceptance of the Smithsonian report as a petition under the Act and of its intent to review the status of the included taxa (USFWS 1975). Based on comments and data assembled in response to House Document No. 94-51 and its 1975 notice, the Service published a proposed rule on June 16, 1976, including roughly 1,700 vascular plant species, but not including *H. leucophaea* (USFWS 1976). Portions of the 1976 proposal that were not finalized were withdrawn on December 10, 1979 (USFWS 1979). A new notice of review was issued on December 15, 1980 (USFWS 1980), which included *P. leucophaea* as a category 1 candidate for listing [Category 1 candidate status denoted a species found by the Service to warrant publication of a proposed listing rule under the Endangered Species Act, but for which the Service had not yet listed. Today, such species are referred to

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simply as candidates, with no numerical categorization.]. Notices issued November 28, 1983 (USFWS 1983), and September 27, 1985 (USFWS 1985), changed the species' status to category 2, a candidate category formerly designating species for which the Service needed further biological data before deciding whether to publish a proposed rule to list the species. On October 11, 1988, the Service issued a proposed rule to determine both *P. leucophaea* and *P. praeclara* as threatened species (USFWS 1988). The final rule listing *P. praeclara* as threatened under the Act, was issued on September 28, 1989 (USFWS 1989), and became effective October 30, 1989.

Conservation measures provided to *P. praeclara* as a threatened species under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in conservation actions by Federal, state, and private agencies, groups, and individuals. The Act provides for, but does not require, land acquisition and cooperation with the States; it requires recovery actions be carried out for all listed species. The protection required of Federal agencies and the prohibition against certain activities involving listed plants are discussed, in part, below.

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to species proposed or listed as endangered or threatened and with respect to their critical habitat, if any is designated. Regulations implementing interagency cooperation under section 7 of the Act are codified at 50 CFR Part 402. Section 7(a)(2) requires Federal agencies to insure the activities they authorize, fund, or implement are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service. *Platanthera praeclara* was listed as a threatened species without critical habitat designation. Where the species occurs on land administered by a Federal agency, or for actions requiring Federal permit (regardless of land ownership), or when Federal funding is used, section 7(a) of the Act must be followed.

The Act and its implementing regulations found at 50 CFR 17.71 and 17.72 set forth general prohibitions and exceptions that apply to all threatened plant species not covered by a special rule. No special rule has been published for *P. praeclara*. The prohibitions of section 9(a)(2) of the Act, implemented by 50 CFR 17.76, apply to this species. These prohibitions, in part, make it illegal, with respect to any endangered or threatened plant subject thereto, for any person subject to the jurisdiction of the United States to import or export; transport in interstate or foreign commerce in the course of a commercial activity; sell or offer for sale this species in interstate or foreign commerce; or to remove and reduce to possession this species from areas under Federal jurisdiction; maliciously damage or destroy this species on any area under Federal jurisdiction; or remove, cut, dig up, damage, or destroy this species on any other area in knowing violation of any State law or regulation or in the course of any violation of a State criminal trespass law. "Plant" means any member of the plant kingdom, including seeds, roots, and other parts thereof. Because *P. praeclara* is a threatened plant species, seeds from cultivated specimens are exempt from these prohibitions provided a statement of "cultivated origin" appears on their containers. Certain exceptions apply to agents of the Service and state conservation agencies. Any occurrence of *P.*

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praeclara on Federal land is protected by section 9(a)(2) of the Act. Any occurrence which is adversely affected as a result of violation of the State laws indicated above is also protected by the Act.

The Act and 50 CFR 17.72 also provide for the issuance of permits to carry out otherwise prohibited activities involving threatened species under certain circumstances. Such permits are available for scientific purposes or to enhance propagation or survival of the species. It is anticipated that few trade permits would be sought or issued for this species because it is not common in cultivation or in the wild. Requests for copies of the regulations on plants and inquiries regarding them may be addressed to the Permits Coordinator, Division of Endangered Species, U.S. Fish and Wildlife Service, 1 Federal Drive, Fort Snelling, Minnesota 55111-4056 (Telephone: 612/725-3536, Fax: 612/725-3526).

Protections and considerations, provided by laws and authorities other than the Act, became applicable to the western prairie fringed orchid with its listing under the Act. Examples are discussed below.

The Federal Native Plant Conservation Memorandum of Understanding, concluded in 1994, established and described a Federal Native Plant Conservation Committee composed of the Bureau of Land Management, National Biological Survey (now National Biological Service), National Park Service, Agricultural Research Service, Soil Conservation Service (now Natural Resource Conservation Service), and Fish and Wildlife Service. The purpose of the Committee is to identify priority conservation needs for native plants and their habitats and coordinate implementation of programs for addressing those needs.

Also in 1994, a memorandum of understanding was signed by the U.S. Forest Service, Department of Defense, U.S. Army Corps of Engineers, National Marine Fisheries Service, Bureau of Land Management, Bureau of Mines, Bureau of Reclamation, Minerals Management Service, National Park Service, U.S. Coast Guard, Federal Aviation Administration, Federal Highway Administration, Environmental Protection Agency, and Fish and Wildlife Service. The Memorandum establishes a general framework for cooperation and participation among the signatory agencies in the exercise of their responsibilities under the Act. More specifically, the goals of the memorandum are to (1) conserve species federally listed under the Act, (2) use existing Federal authorities and programs to further the purposes of the Act, and (3) improve efficiency and effectiveness of the interagency consultations conducted pursuant to section 7(a)(2) of the Act.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (TIAS 8249, 50 CFR Part 23) prohibits the following actions involving species listed under CITES: Import; export; re-export; or possession of individuals of species which have been illegally imported, export, or re-exported. The United States and many other countries are parties to CITES, and *P. praeclara* is protected under the treaty.

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Individual Federal agencies develop their own policies for listed species. For example, rules for protection of listed plants in the National Forests are in the Forest Service Manual Title 2600--Wildlife, Fish, and Sensitive Plant Habitat Management, Chapter 2670--Threatened, Endangered and Sensitive Plants and Animals. The Forest Service must abide by the Act and the National Environmental Protection Act in managing the lands it is responsible for. The National Forest Management Act of 1976 mandates a Management Plan be written for each National Forest. The Custer National Forest Management Plan (USFS 1986) includes management actions to be performed for endangered, threatened, and special concern plants. In addition, management guidelines specific for *P. praeclara* on the Sheyenne National Grassland have been developed (USFS 1993). These guidelines are considered important and necessary for recovery of the orchid. They will (1) help implement management direction found in the Custer National Forest Management Plan and the Western Prairie Fringed Orchid Recovery Plan, (2) provide a broad umbrella under which management activities will occur that will not adversely impact the orchid, (3) provide a framework for implementing a realistic orchid monitoring program specific to the Sheyenne National Grasslands, and (4) provide a basis for setting priorities for allotment management plan revisions.

The Service prepared, under section 7 of the Act, a biological opinion on the Forest Service's management guidelines (USFWS 1994). The biological opinion concluded "management of the Sheyenne National Grasslands by means of the western prairie fringed orchid management guidelines is not likely to jeopardize the continued existence of the orchid. This opinion is based in part upon the recorded increased number of orchids during the 1993 growing season and provisions of the guidelines that allow for specific metapopulation management in core areas and the Forest Service's commitment to continue monitoring orchid response on grassland management activities. Should monitoring determine a decline in orchid numbers, the Forest Service will amend the guidelines and reinitiate section 7 consultation. Also, management practices not addressed in these guidelines will undergo section 7 consultation on a case-by-case basis."

Many tracts containing *P. praeclara* have Federal or state legal protection (Appendix B). Other occurrences have management plans or protection strategies in place. Some occurrences have little protection. Protection status of each population of *P. praeclara* is included in Table 3.

Four state natural resource agencies presently contribute to the conservation of the species. Three states officially list *P. praeclara* as endangered and Iowa lists it as threatened. Iowa endangered species law prohibits the possession, transport, or sale of listed plants. The Kansas Nongame and Endangered Species Conservation Act does not provide protection for native plant species. Minnesota endangered species law prohibits taking and sale of protected species without a permit except through actions necessary for agriculture or accidental taking. Missouri endangered species law prohibits the export or sale of listed plants without permit and taking without the permission of the property owner. Current legal protection status is summarized by state and Canadian province in Table 6.

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In addition to legal protections, the Service has for several years contributed endangered species funding to state agencies' and others' surveys, monitoring, and management and genetic studies for the conservation of western prairie fringed orchid. Citizen volunteers provide invaluable assistance to some of the survey and monitoring efforts. The Minnesota State Department of Agriculture has a landowner contact program wherein owners of lands with listed plants are alerted to the presence of the plants on their land and are offered voluntary, custom tailored pesticide management plans to protect the orchids and other listed plants. Many landowners in Minnesota have adopted the voluntary plans and western prairie fringed orchid is a significant beneficiary.

G. Strategy of Recovery

The recovery strategy for *P. praeclara* focuses on assuring protection of the habitat of remaining populations from conversion to agricultural use; assuring that the frequency, intensity, and timing of management practices are appropriate for the enhancement and maintenance of *P. praeclara* populations; and providing the highest level of legal protection appropriate for all populations. Decisions related to habitat management and protection are to be made based on the best current scientific information of the biology of the species and monitoring data. The highest priority recovery tasks for *P. praeclara* are those that have a direct impact on the plants themselves: maintaining the habitat of known populations as native prairie and providing the highest level of protection appropriate for all populations. Because the major historic cause of decline of populations of this species throughout its range is conversion of native tallgrass prairie to intensive agricultural use, maintenance of native prairie is the highest priority recovery action.

In addition to sites already in public ownership or protective management, fulfillment of the recovery goal in certain ecoregions will require bringing additional sites into protective management. Necessary actions are spelled out on an ecoregion by ecoregion basis in the stepdown outline and narrative. The objective is protection from the plow and other direct physical destruction, from pesticide impacts on the plant and its pollinators, and from hydrologic alterations.

Because mechanisms for protection differ from state to state and change over time, the plan does not spell out specific conservation tools or protection levels on a population by population basis. It is becoming increasingly clear that conservation tools other than fee acquisition by public agencies can provide effective protection for endangered resources where these measures guarantee perpetual protection and ensure appropriate management (protection levels 4 and 5) (The Nature Conservancy 1996). Effective protection means a population is permanently safe from conversion from grassland into any other use and is subject to a management plan approved by the Service and implemented through at least three management cycles. In practice, the majority of sites listed at protection levels 4 and above in Table 3 have been protected from habitat conversion, but still require preparation and implementation of a management plan or guidelines. Protection levels designated in this plan are those effective on the date of release of the plan. They reflect the ownerships and management measures in effect on that date. The

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present distribution of ownerships within ecoregions and within states is illustrated in Figures 6 and 7, respectively. The distribution of predominant management regimes within ecoregions and states is illustrated in Figures 4 and 5, respectively. The protection level listed for any population is not absolute and permanent, but may shift up or down in the event that either the population's ownership or management status changes. The final judgement about whether protection fulfills the recovery goal lies with the Service in consultation with other agencies and experts. This judgement will be based on the permanence and effectiveness of protection and management.

Examples of activities that contribute to effective protection include, but are not limited to: pesticide protection programs administered by state Departments of Agriculture, landowner agreements, conservation easements, dedication of State Nature Preserves, and acquisition by conservation organizations or public agencies with operational management guidelines. The mix of conservation tools, lead agencies or conservation groups, and specific sites brought into protective management is entirely dependent on the engagement of willing landowners. For this reason no effort has been made to match specific actions and agencies or organizations with particular sites. The Recovery Goal can be best met by bringing into protective management the largest unprotected populations listed in Table 3 in each ecoregion where additional protective management is needed to meet the recovery criteria. However, in the event some of these sites cannot be brought into protective management, the strategy for recovery allows for site substitutions within the ecoregion.

Assuring compliance with existing legal protection for the species and development of additional state protective measures will help prevent further loss of populations. These tasks, the basis of the long-term conservation of the species, can be implemented through cooperation of involved parties and thorough analysis of all factors relating to the species' biology.

Additional recovery tasks include species biology and management regime research, population monitoring, development and implementation of appropriate management regimes, and development and distribution of educational materials about the species. Despite the large numbers of plants in actively managed protective ownership in ecoregions 251A, many sites in public ownership still need to have management guidelines either prepared or implemented. Protection will not be considered adequate for recovery until management guidelines have been fully implemented for three management cycles (depending on the site-by-site management specifications). For example, if guidelines call for a 3-year frequency of prescribed fire, the guidelines would not be fully implemented until the third prescribed burn had taken place. In the case of public lands or conservation easements the agency with management authority over the site is responsible for implementation of guidelines, but these guidelines must be approved by the Service in order to qualify a site as "recovered."

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II. RECOVERY

A. Recovery Plan Objective: Delisting.

B. Recovery Criteria: *Platanthera praeclara* will be considered for delisting when sites that include occupied habitat harboring 90 percent of plants in each ecoregion are protected at protection levels 4 through 9 (The Nature Conservancy 1996) and managed in accordance with a Service-approved management plan or guidelines. This plan must assure implementation of management practices that provide the range and spatial distribution of successional and hydrologic regimes required to maintain the species and its pollinators in self-sustaining, naturally occurring populations, and must remain in effect following delisting. Implementation of these criteria is further clarified in the strategy of recovery section above and in the recovery narrative below.

C. Stepdown Outline

Service guidelines classify recovery actions into three priority classes. Priority 1 tasks must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future. Because *P. praeclara* is listed as threatened and a high proportion of all plants are presently in protective ownership, none of the recovery tasks identified below are Priority 1. Priority 2 tasks must be taken to prevent significant decline in species population/habitat quality, or some other significant negative impact short of extinction. Most recovery actions specified in this plan qualify as priority 2 actions. Actions are listed below in order of their priority for the perpetuation of the species, beginning with those that have the most direct affect on the species and proceeding to those with an indirect affect. Priority 3 actions are other actions necessary to meet the recovery objective. Although a high level of public knowledge about the orchid may not be necessary to prevent significant declines in the species populations or habitat quality, a higher level of public interest in the species will facilitate implementation of Priority 2 actions. Public education and information is therefore deemed necessary to meet the recovery objective and is considered a Priority 3 action.

1. Maintain habitat of known populations as native prairie.

    11. Prevent agricultural conversion of native prairie habitat.

        111. Within ecoregion 251A, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites collectively harboring a total of 626 or more plants.

        112. Within ecoregion 251B, maintain protective management of all sites presently owned by public agencies or conservation organizations and

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secure protective management at privately-owned sites collectively harboring a total of 12 or more additional plants.

113. Within ecoregion 251C, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites harboring an additional 245 plants.

114. Within ecoregion 251E, secure protective management at both privately-owned sites to reach the recovery criteria.

115. Within ecoregion 251G, maintain protective management of sites.

116. Within ecoregion 222M, enhance populations presently in the ownership of public agencies and/or conservation organizations.

117. Within ecoregion 332C, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites harboring an additional 26 plants.

118. Within ecoregion 332E, maintain protective management and hydrology of the remaining site.

2. Provide the highest level of legal protection appropriate for all populations.

21. Insure compliance with all laws and regulations protecting *P. praeclara*.

22. Develop and implement new laws for the protection of *P. praeclara* in those states not now offering statutory protection.

3. Develop and implement habitat management plans that sustain and enhance *P. praeclara* populations.

31. Develop or maintain appropriate burning regimes.

32. Develop or maintain appropriate grazing regimes.

33. Develop or maintain appropriate mowing regimes.

34. Develop or maintain appropriate noxious weed control practices.

35. Develop and implement pesticide management plans.

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36. Develop and implement hydrologic guidelines.

37. Use direct seeding, artificial pollination, and/or artificial propagation, as appropriate in ecoregions 222M and 251E.

4. Conduct appropriate research and monitoring.

41. Conduct necessary research.

411. Experimentally determine appropriate management practices to maintain and enhance populations of *P. praeclara*.

4111. Determine appropriate fire regimes.

4112. Determine appropriate grazing regimes.

4113. Determine appropriate mowing regimes.

4114. Determine appropriate methods of noxious weed control.

4115. Determine effects of pesticides on plants.

42. Determine parameters required to maintain viable self-sustaining populations.

421. Conduct research to determine physical limiting factors.

4211. Determine the role of soil disturbance.

4212. Determine the role of groundwater hydrology.

422. Conduct research on reproductive biology.

4221. Identify principal pollinator(s) and their biology.

4222. Develop propagation methods.

4223. Determine the importance of vegetative reproduction and the mycotrophic state.

423. Conduct research on species synecology.

4231. Determine the role of competitors.

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424. Conduct a population viability analysis for the species.

43. Monitor populations.

431. Monitor status and trends of all populations.

432. Conduct demographic monitoring.

433. Establish consistent monitoring criteria.

5. Identify and search potential habitat.

51. Search historical sites.

52. Identify and search potential new sites.

6. Disseminate information to a variety of audiences.

61. Develop modular educational materials for the public.

62. Distribute educational modules to appropriate audiences.

63. Conduct education and training programs.

64. Assure publication of research results.

65. Identify a central repository for information about *P. praeclara*.

66. Provide opportunities for local members of the public, to become actively involved in recovery efforts.

D. Narrative

1. Maintain habitat of known populations as native prairie.

Bowles and Duxbury (1986) suggest the major cause of decline in *P. praeclara* populations throughout the range is conversion of native tallgrass prairie to intensive agricultural cropland. Maintain habitat of known populations as native prairie through a variety of conservation tools, including, but not limited to, protection and appropriate management of populations on public land, as well as voluntary acquisition, easements, registry agreements, and tax exemption programs to assure protection and appropriate management on private lands. Wherever possible, assure sites are sufficiently large to allow plant community succession to occur and *P. praeclara* populations to move and make use of suitable microhabitats. Where sites are too small to permit

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natural succession to occur, manage communities to maintain the species' specific microhabitat requirements.

11. Prevent agricultural conversion of native prairie habitat.

Where there are willing sellers, bring into protective public or private ownership and appropriate management the populations needed to satisfy recovery within each ecoregion. Recovery can be most easily reached by protection of those populations noted with an asterisk following the current protection status in Table 3. However, within any given ecoregion, the recovery criteria can be met by substitution of any combination of sites that collectively protect the target number of plants listed below. Substitutions may include both privately and publicly owned equivalent sites discovered after final approval of this plan. The actions listed below are needed in addition to preparation and implementation of management guidelines at all sites presently owned by public agencies and/or conservation organizations.

111. Within ecoregion 251A, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites collectively harboring a total of 626 or more plants.

112. Within ecoregion 251B, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites collectively harboring a total of 12 or more additional plants. This criterion can be met by protecting any one of the three largest remaining unprotected Iowa populations.

113. Within ecoregion 251C, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites harboring an additional 245 plants.

114. Within ecoregion 251E, secure protective management at both privately-owned sites to reach the recovery criteria.

115. Within ecoregion 251G, maintain protective management of all sites presently owned by public agencies or conservation organizations.

Protective management of privately-owned sites will not be necessary if management guidelines are prepared and implemented at all sites presently owned by public agencies or conservation organizations.

116. Within ecoregion 222M, enhance populations presently in the ownership of public agencies and/or conservation organizations.

There are no known privately-owned sites of sufficient size to contribute to the recovery criteria.

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117. Within ecoregion 332C, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites harboring an additional 26 plants.

118. Within ecoregion 332E, where the sole population is in the ownership of a single conservation organization, maintain protective management, including maintenance of appropriate hydrologic regime.

2. Provide the highest level of legal protection appropriate for all populations.

21. Insure compliance with all laws and regulations protecting *P. praeclara*.

22. Develop and implement new laws for the protection of *P. praeclara* in those states not now offering statutory protection.

3. Develop and implement habitat management plans that sustain and enhance *P. praeclara* populations.

Use a prudent conservation strategy to focus on maintaining or restoring the composition, function, and structure of the ecosystem on which *P. praeclara* depends, even though specific autecological and synecological information is lacking for the species. Develop management practices that duplicate the natural processes of the tallgrass prairie ecosystem, which evolved with frequent natural disturbances, including fire and ungulate grazing. Maintain open grassland habitats by developing, implementing, and reviewing management practices regularly and refining them as relevant research results become available.

For each population of *P. praeclara*, conduct a field assessment to identify existing or potential threats and to determine if existing management practices provide ecological conditions appropriate for maintenance of the population. Based on these assessments, develop and implement management plans for all populations owned by public agencies or private conservation organizations in all ecoregions. These plans should include specific management regimes required for maintenance and enhancement of populations and associated habitat.

31. Develop or maintain appropriate burning regimes.

Perform prescribed burns as appropriate, modifying burn prescriptions as necessary to maintain and enhance *P. praeclara* populations when results of research become available.

32. Develop or maintain appropriate grazing regimes.

Modify grazing regimes if necessary to maintain and enhance *P. praeclara* populations when results of research become available.

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33. Develop or maintain appropriate mowing regimes.

Modify mowing regimes if necessary to maintain and enhance *P. praeclara* populations when results of research become available.

34. Develop or maintain appropriate noxious weed control practices.

Use methods of noxious weed control that are least likely to have adverse effects on *P. praeclara* populations. Modify methods as results of research become available. Control noxious weeds with non-chemical methods whenever possible.

35. Develop and implement pesticide management plans.

If herbicides are required, use them as part of an integrated pest management plan. Use only chemicals and application methods which have been proven to have the least adverse effects according to the best available research results relevant to *P. praeclara* populations. Regularly review and update control methods in response to the results of toxicity tests (Task 4115).

36. Develop and implement hydrologic guidelines.

Develop appropriate aquifer management guidelines based on groundwater hydrology research (Task 4212) that demonstrates the relationship of local hydrologic regimes and soil characteristics to the survival and enhancement of *P. praeclara* populations.

37. Use artificial pollination, direct seeding, and/or artificial propagation, as appropriate, in ecoregions 222M and 251E.

Populations within these ecoregions are small, isolated, and appear to be declining. Extant populations need to be enhanced to achieve the Recovery criteria in these ecoregions. Although pollination rates are not presently known, it is reasonable to assume that enhancing pollination is a good first step toward increasing population sizes. It is important that accompanying management practices in these populations are timed to allow fruit set to occur.

4. Conduct appropriate research and monitoring.

Conduct research to determine experimentally the most appropriate management practices to maintain and enhance *P. praeclara* populations, to determine limiting factors, and to better understand the species' life history and synecology. Conduct long-term monitoring to determine the status of populations, to measure progress towards recovery, and to obtain life history data. Wherever and whenever experimental research is conducted, dedicated research areas are needed to assure adequate controls and replications.

41. Conduct necessary research.

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411. Experimentally determine appropriate management practices to maintain and enhance populations of *P. praeclara*.

4111. Determine appropriate fire regimes.

Conduct experimental research to determine the effect of various prescribed fire regimes on *P. praeclara* and to compare these effects with other potential management practices that may affect populations of the species.

4112. Determine appropriate grazing regimes.

Conduct experimental research to determine the effect of a variety of various grazing regimes on *P. praeclara* and to compare these effects with other potential management practices that may affect populations of the species.

4113. Determine appropriate mowing regimes.

Conduct experimental research to determine the effect of various mowing regimes on *P. praeclara* and to compare these effects with other potential management practices that may affect populations of the species.

4114. Determine appropriate methods of noxious weed control.

Determine which noxious weed species require control and appropriate methods and frequency of control. Conduct experimental research to determine if effective methods of noxious weed control can replace or supplement pesticide use in sensitive areas while maintaining populations of the species.

4115. Determine effects of pesticides on plants.

Conduct toxicity tests to determine susceptibility of *P. praeclara* to the entire range of agricultural chemicals to which the species may be subjected. Initially focus these tests on those pesticides that currently are most widely used in and adjoining the species' habitat.

42. Determine parameters required to maintain viable self-sustaining populations.

421. Conduct research to determine physical limiting factors.

4211. Determine the role of soil disturbance in *P. praeclara* recruitment and maintenance of early successional communities.

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4212. Determine the role of groundwater hydrology.

Determine at a local level the interactive role of groundwater hydrology and soil characteristics as factors limiting the establishment, flowering, and persistence of *P. praeclara* populations.

422. Conduct research on reproductive biology.

4221. Identify principal pollinator(s) and their biology as it relates to *P. praeclara*.

Include in this research effectiveness of pollination, pollinator behavior, alternative nectar sources, flight range, and role of pollinator availability as a limiting factor for *P. praeclara*. Attention should particularly be paid to pollinator success in large metapopulations versus small, isolated populations.

4222. Develop propagation methods.

In developing propagation methods, include direct seeding and artificial propagation. Use these methods when needed to develop captive populations for research purposes (such as Task 4115) or in the event reintroduction is needed.

4223. Determine the importance of vegetative reproduction and the mycotrophic state.

Determine the importance of vegetative reproduction (yearly regeneration of photosynthetic plants) and of the mycotrophic state (persistence as an underground plant dependent on mycorrhizal associates) in maintaining *P. praeclara* populations. Presently-available data suggest these factors may vary in importance in different parts of the range.

423. Conduct research on species synecology.

4231. Determine the role of competitors.

Conduct research to determine how plant species other than noxious weeds compete with *P. praeclara*.

424. Conduct a population viability analysis for the species.

Use data from research conducted in Tasks 421 through 424 to develop a population viability model for *P. praeclara*. Use the population viability model as a tool to guide management and restoration decisions by simulating potential effects of management regimes and environmental perturbations on populations of given sizes under given conditions.

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43. Monitor populations.

Monitor population trends to provide the basis for assessing the status of individual populations or effects of management treatments through time. Develop a plan for monitoring the status of individual populations through time for all *P. praeclara* populations.

431. Monitor status and trends of all populations on a regular basis.

Visit all known *P. praeclara* populations at 3-year intervals and monitor overall status of the populations (presence/absence, estimate of number of flowering individuals, comments on management, and other relevant factors). Visit populations not observed in the regular year of monitoring the following year.

432. Conduct demographic monitoring at selected sites.

Long term demographic monitoring is the only method of assessing recruitment, mortality, and changes in population structure. Establish or expand monitoring programs, as needed.

433. Establish consistent monitoring criteria.

Consistently record a minimum set of variables at each demographic monitoring site.

5. Identify and search potential habitat.

Search suitable habitats for new populations of *P. praeclara* throughout its range.

51. Search historical sites where *P. praeclara* has been found and habitat is still present.

In locations where *P. praeclara* is known to have occurred historically, but populations currently are not known, the species may still be present in a natural seed bank which is dormant during drought or in small numbers that are difficult to locate. Survey these sites at 3- to 5-year intervals to determine if populations are present. Historical sites where *P. praeclara* has been found are identified by State in Table 2. This task is especially important in those ecoregions where there are few populations and these populations are small.

52. Identify and search potential new sites.

Identify prairies believed to provide suitable habitat requirements for *P. praeclara* and search them for new populations. Sites with suitable habitat that have been identified to date are listed by State in Appendix A. Continue to examine references from amateur and professional botanists, botanical literature, and herbarium records for identification of additional sites. Location of additional sites may assist recovery efforts by increasing the pool of potential substitution sites for protective management.

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6. Disseminate information to a variety of audiences.

Public awareness of *P. praeclara* and its role in grassland ecosystems is low. Therefore, give the same priority to public education concerning the species as to other recovery tasks, such as enforcement of protective regulations, population management, and preservation of natural habitats.

61. Develop modular educational materials for the public.

Include topics such as history of the species within the region or state, management practices that maintain habitat quality, practices that contributed to the species' decline, species biology and identification, and steps being taken to recover the species.

62. Distribute educational modules to appropriate audiences.

Appropriate audiences for educational modules might include land management agencies, private landowners, and others whose actions may affect the recovery of *P. praeclara*.

63. Conduct education and training programs.

In addition to printed materials, conduct interactive educational programs, field trips, and training workshops as needed. These programs will generate public interest in *P. praeclara* and will help assure that managing agencies, private landowners, and others whose activities may affect the species are aware of its current status and of specific actions required to maintain and enhance populations.

64. Assure publication of research results.

Publish research results in a timely fashion to ensure management prescriptions can be based on the best available scientific data. Encourage researchers to publish or make available their research results.

65. Identify a central repository for information about *P. praeclara*.

A central repository is needed to act as a clearinghouse for information and help avoid redundancy of efforts and expenditures.

66. Provide opportunities for local members of the public to become actively involved in recovery efforts. Involvement of local citizens and private landowners is especially crucial in those instances where conservation tools, other than fee acquisition, are being used to secure protective management.

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SUMMARY:

Recovery of *P. praeclara* is dependent on a mix of legal protection, maintenance of habitat as native grassland through a variety of protection mechanisms, appropriate management, monitoring and research. Public appreciation of the plant and involvement in recovery is essential to the success of its recovery.

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III. IMPLEMENTATION SCHEDULE

The following Implementation Schedule outlines actions and estimated costs for the recovery program. It is a guide for meeting the objective discussed in Part II of this Plan. This schedule indicates task priorities, task numbers, task descriptions, duration of tasks, responsible agencies, and estimated costs. These actions, when accomplished, should lead to the recovery of the species and protect its essential habitat. The estimated funding needs for all parties anticipated to be involved in recovery are identified and, therefore, Part III reflects the total estimated costs for the 10-year recovery program for this species. The estimated recovery costs for the 10-year program are $2,963,000. If delisting occurs, a minimum of five years of monitoring is required by the Act to assess the adequacy of recovery actions and determine if there will be cause to consider relisting. Because of special concerns with the biology of *Platanthera praeclara*, a minimum of 10 years of monitoring is necessary for this species.

Priorities in the first column of the following implementation schedule are assigned as follows:

Priority 1: An action that ***must*** be taken to prevent extinction or to prevent the species from declining irreversibly in the ***foreseeable*** future.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to meet the recovery objectives.

008448

Implementation Schedule for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	111	Within ecoregion 251A, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites collectively harboring a total of at least 626 plants. This criterion can be met by protecting any of several different combinations of MN and ND populations.	Ongoing	3, 6	TE	MN, ND, USFS, TNC, NRCS, FWS	See note	See note	See note	See note	Overall cost for tasks 111 through 117 is indeterminable, but exceeds $1,200,000 rangewide.
2	112	In ecoregion 251B, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites collectively harboring a total of 12 or more additional plants. This criterion can be met by protecting any one of the 3 largest remaining unprotected IA populations.	Ongoing	3, 6	TE	IA, MN, TNC, NRCS, FWS	"	"	"	"	"

[1] A key to abbreviations is at the end of this table.

008449

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	113	Within ecoregion 251C, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites harboring an additional 245 plants. This criterion can only be met by protecting the three largest remaining unprotected IA populations and the largest remaining unprotected NE population.	Ongoing	3, 6	TE	IA, KS, MO, NE, TNC, NRCS, FWS	See note	See note	See note	See note	Overall cost for tasks 111 through 117 is indeterminable, but exceeds $1,200,000 rangewide.
2	114	Within ecoregion 251E, secure protective management at the largest remaining unprotected KS population.	Ongoing	6	RE, RW, TE	KS, TNC, NRCS, FWS	"	"	"	"	"
2	115	Within ecoregion 251G, maintain protective management of all sites presently owned by public agencies or conservation organizations.	Ongoing	6	RE, RW, TE	NE, TNC, NRCS, FWS	"	"	"	"	"

[1] A key to abbreviations is at the end of this table.

008450

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	116	Within ecoregion 222M, enhance populations presently in the ownership of public agencies and/or conservation organizations.	Ongoing	3	RE, RW, TE	MN, IA, TNC, NRCS, FWS	See note	See note	See note	See note	Overall cost for tasks 111 through 117 is indeterminable, but exceeds $1,200,000 rangewide.
2	117	Within ecoregion 332C, maintain protective management of all sites presently owned by public agencies or conservation organizations and secure protective management at privately-owned sites harboring an additional 26 plants. This criterion can be met by protecting any combination of the largest three remaining unprotected NE populations.	Ongoing	6	RE, RW, TE	NE, TNC, NRCS, FWS	"	"	"	"	"

[1] A key to abbreviations is at the end of this table.

008451

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	118	Within ecoregion 332E, where the sole population is in the ownership of a single conservation organization, maintain protective management, including maintenance of appropriate hydrologic regime.	Ongoing	6	RE, RW, TE	NE, TNC, NRCS, ICF, FWS, WY	See note	See note	See note	See note	Overall cost for tasks 111 through 117 is indeterminable, but exceeds $1,200,000 rangewide.
2	21	Insure compliance with all laws and regulations protecting P. praeclara.	Ongoing	3, 6	LE TE	States (DAg, DNR, DOT), USDOT, EPA, USFS,	--	--	--	--	Conducted with existing funds.
2	22	Develop and implement new laws for the protection of P. praeclara in those states not now offering statutory protection.	2	3, 6	TE	TNC, States (DNR)	3	5	5	15	
2	31	Develop or maintain appropriate burning regimes.	Ongoing	3, 6	TE	Counties, Owners, State (DAg, DNR), TNC, USFS	10	10	10	70	

[1] A key to abbreviations is at the end of this table.

008452

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	32	Develop or maintain appropriate grazing regime.	Ongoing	3, 6	TE	USFS, USDA, Owners, States, ICF, FWS	5	5	5	30	Assumes some income to offset costs.
2	33	Develop or maintain appropriate mowing regime.	Ongoing	3, 6	TE	Owners, States, SVGA, USFS, TNC, Univ., FWS	5	5	5	40	Assumes some income to offset costs.
2	34	Develop and maintain appropriate noxious weed control practices.	Ongoing	3, 6	TE	Counties,APHIS, NRCS, Owners, States, TNC, USDA	10	10	10	60	
2	35	Develop and implement pesticide management plans.	Ongoing	3, 6	TE	Owners, States, SVGA, TNC, USDA, EPA, USFS, NPS	10	10	10	70	
2	36	Develop and implement hydrologic guidelines.	Ongoing	3, 6	TE	States, Counties,USFS, USGS	10	10	10	105	
2	37	Use direct seeding, artificial pollination, and/or artificial propagation, as appropriate in ecoregions 222M and 251E.	2	6	TE	IA, KS, FWS, TNC	10	10	10	45	

[1] A key to abbreviations is at the end of this table.

008453

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	4111	Determine appropriate fire regimes.	Ongoing	3, 6	TE	States (esp. MN), (DNR, DAg), TNC, Univ., USFS	5	5	5	90	$40,000/yr. for 10 years.
2	4112	Determine appropriate grazing regimes.	10	3, 6	TE	ARS, States (esp. MN, ND), (DAg, DNR), Univ., USFS, USDA, USFS	15	15	15	90	$40,000/yr. for 10 years.
2	4113	Determine appropriate mowing regimes.	10	3, 6	TE	States (esp. ND, NE), (DAg, DNR), Univ., USDA, USFS	5	5	5	20	$40,000/yr. for 10 years.
2	4114	Determine appropriate methods of noxious weed control on plants.	2	3, 6	TE	APHIS, ARS, EPA, USFS, States, Univ.	5	5	5	10	

[1] A key to abbreviations is at the end of this table.

008454

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	4115	Determine effects of pesticides on plants.	2	3, 6	TE	APHIS, ARS, Chem. indus., States, (DAg), Univ., EPA, USFS	5	5	5	50	
2	4211	Determine the role of soil disturbance.	2	3, 6	TE	States (DAg, DNR), Univ., USDA, USFS	--	--	--	5	Mainly concurrent with other research.
2	4212	Determine the role of groundwater hydrology.	5	3, 6	TE	State (GS), Univ., USFS, USGS	20	20	20	40	
2	4221	Identify principal pollinator(s) and their biology.	4	3, 6	TE	States (DNR), TNC, Univ., USFS	15	15	15	40	
2	4222	Develop propagation methods.	2	3, 6	TE	CPC, IUCN, Univ., Orchid soc.	5	5	5	0	

[1] A key to abbreviations is at the end of this table.

008455

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
2	4223	Determine the importance of vegetative reproduction and the mycotrophic state.	2	3, 6	TE	Res., States (DNR), Univ., USFS	--	--	--	--	Accomplished through task 432.
2	431	Monitor status and trends of all populations.	To and beyond recovery	3	TE	States (DAg, DNR), TNC, USFS	6	6	6	85	
2	432	Conduct demographic monitoring.	To and beyond recovery	3	TE	States (DNR), TNC, USFS	15	15	15	140	
2	433	Establish consistent monitoring criteria.	1	3, 6	TE	Recov. Team, States, TNC, Univ., USFS, NPS	2	2	2	--	
3	423	Determine role of competitors.	6	3, 6	TE	States, Univ., USFS	2	2	2	10	In conjunction with other research.
3	424	Conduct a population viability analysis for the species.	1	3, 6	TE	CBSG, Res., Univ., USFS	--	--	--	20	

[1] A key to abbreviations is at the end of this table.

008456

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
3	51	Search historical sites.	6	3, 6	TE	States, TNC, USFS, NRCS, FWS	5	5	5	10	
3	52	Identify and search potential new sites.	6	3, 6	TE	States, TNC, USFS, NRCS, FWS	5	5	5	10	
3	61	Develop modular educational materials for the public.	3	3, 6	RW TE	States (DAg, DNR, DOE, Ext. Serv.) EPA USFS	35	35	35	7	
3	62	Distribute educational modules to appropriate audiences.	3	3, 6	TE	States USDA, EPA, Ext. Svc., USFS	--	--	5	--	Cost of printing existing materials.
3	63	Conduct education and training programs.	Ongoing	3, 6	TE	States, Univ., Ext. Svc., USDA, EPA, TNC, FWS	3	3	--	--	
3	64	Assure publication of research results.	Ongoing	3, 6	TE	USFS, States, Univ., TNC	--	--	--	--	In conjunction with other research.

[1] A key to abbreviations is at the end of this table.

008457

Implementation Schedule (continued)
for *Platanthera praeclara* (western prairie fringed orchid) Recovery Plan.

PRIORITY NUMBER	TASK NUMBER	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($000)				NOTES
				USFWS		Other[1]	FY97	FY98	FY99	FY2000-2005	
				Region	Program						
3	65	Identify a central repository for information about P. praeclara.	Ongoing	3, 6	TE	Recov. Team, States, Univ., TNC, USFS, ICF	--	--	--	--	Conducted with existing funds.
3	66	Provide opportunities for local members of the public to be actively involved in recovery actions.	Ongoing	3, 6	TE	2	2	--	--	--	

1 A key to abbreviations is at the end of this table.

008458

Implementation Schedule abbreviations:

APHIS	Animal & Plant Health Inspection Service
ARS	Agricultural Research Stations
Chem. ind.	Chemical industry
CPC	Center for Plant Conservation
DAg	State Department of Agriculture
"	Ditto
DOT	State Departments of Transportation
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish & Wildlife Service
GS	State geological survey
IA	Iowa State agencies
ICF	Intl. Crane Foundation (headquarters at Baraboo, WI)
IUCN	Intl. Union for the Conservation of Nature
KS	Kansas State agencies
MN	Minnesota State agencies
MO	Missouri State agencies
NE	Nebraska State agencies
ND	North Dakota State agencies
NPS	National Park Service
NRCS	Natural Resources Conservation Service (formerly U.S. Soil Conservation Service)
Orchid soc.	Orchid & native plant societies
Owners	Private owners of plant sites
Res.	Any private, academic, or agency research entity
States	State agencies
SVGA	Sheyenne Valley Grazing Association
TE	Threatened and Endangered Species Program of FWS
TNC	The Nature Conservancy
Univ.	Universities
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USGS	U.S. Geological Service

008459

IV. TABLES

Table 1

Characteristics separating *Platanthera lacera*, *Platanthera leucophaea*, and *Platanthera praeclara*.[1]

CHARACTERISTIC	PLATANTHERA LACERA	PLATANTHERA LEUCOPHAEA	PLATANTHERA PRAECLARA
BLOOMING TIME	mid-June to August	June, July, rarely August	June, July, rarely August
COLUMN	--	rounded	somewhat angled
FLOWER COLOR	green, yellow-green, or cream	pure white lip & petals, green sepals & claws	creamy white lip & petals, greenish-white sepals
HABITAT	#sterile acid-soil	mesic to wet calcareous prairie; marshes, fens, & bogs	mesic to wet calcareous prairies
LIP	0.5-1.9 cm wide	1.5-2.5 cm wide	3.0 cm wide (mean)
LIP FRINGE	cut nearly to base	cut 1/3-1/2 length of lip segments	cut 1/3-1/2 length of lip segments
PETALS	linear to spatulate, 5-7 mm long, 2 mm wide	obovate (wedge-shaped) 9.6 mm long (mean), 5.8 mm wide (mean)	nearly triangular (fan-shaped) 13.1 mm long (mean), 9.5 mm wide (mean)
PLANT	sparse to stout, 20-80 cm tall	stout, 20-100 cm tall	stout, 38-85 cm tall
RACEME	rather dense; 15- to 60-flowered, 5-25 cm long, 2.0-4.5 cm wide	elongate; 12- to 30-flowered 12.8 cm long (mean)	short; 8- to 16-flowered (usually <20), 5-15 cm long, 5-9 cm wide
POLLINIA	--	closely spaced	divergent
RANGE	Newfoundland & Nova Scotia to Manitoba & MN, south to GA, AL, MS, AR, TX, MO	mostly east of Mississippi River: IA, KS, MN, MO, NE, ND, OK, Manitoba	west of Mississippi River: IL, ME, MI, OH, VA, WI, Ontario
SEPALS - LATERAL	4-6 mm long, 3 mm wide	8.1 mm long (mean), 5.0 mm wide (mean)	12.0 mm long (mean), 8.3 mm wide (mean)
SPUR	1.1-1.7 cm long	2.0-3.5 cm long	3.5-5.3 cm long
VISCIDIA	--	essentially parallel	somewhat forward

[1]Information from Case 1987, Sheviak and Bowles 1986, and Smith 1993.

008460

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
IOWA				
Adair	Greenfield	1891	1892: July 4	Status unknown; reported by Iowa Natural Heritage Program 1990.
Benton	Shellsburg	1918: July 8	1918: July 8	Status unknown.
Black Hawk	Cedar Falls	1894	1894	Status unknown.
Buena Vista	Marathon	1921: August 2	1921: August 2	Status unknown.
Cedar	unknown	undated	undated	Status unknown; reported in Roosa et al. 1989.
Chickasaw	Chickasaw Depot	1925: June 25	1926: June 25	Status unknown.
Clayton	Edgewood	1932: August 19	1932: August 19	Status unknown.
Decatur	Decatur	1898	1905: July 4	Status unknown.
Dickinson	Caylor Prairie State Preserve Wahpeton	1952: July 28 1943	1953: July 14 1945: July 15	Status unknown; site has not been searched systematically (Loeschke, unpub.) Status unknown.
Emmet	Armstrong Estherville Superior Wallingford 1 Wallingford 2	1892: August 1952: July 24 1949: July 14 1954: July 16 1944: July 4	1892: August 1952: July 24 1949: July 14 1954: July 16 1944: July 4	Status unknown. Status unknown. Status unknown. Status unknown. Status unknown.
Fayette	Fayette	undated	undated	Status unknown; not known if the same as West Union Prairie.
Grundy	Grundy	1903: July	1903: July	Status unknown.
Guthrie	Beaver	1952: June 21	1952: June 21	Status unknown.
Hamilton	Ellsworth	1940: June 1	1940: June 1	Status unknown.
Hancock	Lake Edwards	1896: July 20	1896: July 20	Status unknown.
Ida	Battle Creek	1945: June 24	1945: June 24	Status unknown.
Iowa	Homestead South Tama	1950: June 28 1903: July 4	1950: June 28 1903: July 4	Status unknown. Status unknown.

008461

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
Johnson	Iowa City	1903	1903	Status unknown.
Linn	Coggon	1928: July 18	1928: July 18	Status unknown.
	Linn	1921: July 2	1921: July 2	Status unknown.
	Mound Farm	1939: June 26	1939: June 26	Status unknown.
Muscatine	unknown	undated	undated	Status unknown; reported in Roosa et al. 1989.
Palo Alto	Crippen Siding	1943: July 27	1943: July 27	Status unknown.
Pottawat-tamie	unknown	undated	undated	Status unknown; reported in Roosa et al. 1989.
Poweshiek	Poweshiek	1884: July 8	1884: July 8	Status unknown.
Scott	unknown	undated	undated	Status unknown; reported in Roosa et al. 1989.
Story	Ames	1907	1907	Status unknown.
	Story City	1891: July 7	1891: July 7	Status unknown.
Tama	Tama	1908: June 19	1908: June 19	Status unknown.
Union	Douglas	1952: June 30	1952: June 30	Status unknown.
Webster	Oakdale	1904: July 29	1904: July 29	Status unknown.
	Otho	1903	1904: July 28	Status unknown.
	Webster	1904: July 19	1904: July 19	Status unknown.
Winneshiek	Decorah	1881: June 26	1881: June 26	Status unknown.
	Fort Atkinson	1903: August 11	1903: August 11	Status unknown.
	Lincoln	1933: August 10	1933: August 10	Status unknown.
Wright	Eagle Grove	1902: July 9	1902: July 9	Status unknown.

008462

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
KANSAS				
Anderson	Wesphalia Prairie	1969: June 23	1969: June 23	Status unknown; reported in Bowles & Duxbury 1986; repeated unsuccessful survey (Freeman & Brooks 1989).
Atchison	unnamed	1866: July	1866: July	Status unknown; reported in Bowles & Duxbury 1986.
Coffey	Waverly Prairie	1969: June 23	1969: June 23	Prairie destroyed; converted to cropland (Freeman & Brooks 1989).
Crawford	Frisco Tree Farm	1950: June 24	1950: June 24	Population assumed destroyed; site of former tree farm, now used for agriculture (Bowles & Duxbury 1986).
Douglas	Elkins Prairie Wakarusa Valley Prairie Lawrence	1969: June 18 1941: June 15 undated	1983 1941: June 15 undated	Prairie destroyed; plowed in 1990. Prairie destroyed; converted to cropland (Freeman & Brooks 1989). Status unknown; reported in Bowles & Duxbury 1986; 3 vouchers listed from county without dates.
Jefferson	Dean's Prairie	1969: June 23	1969: June 23	Status unknown; reported in Bowles & Duxbury 1986; surveyed in 1989, but no plants observed (Freeman & Brooks 1989).
Johnson	Olathe Prairie	1970: June 17	1970: June 17	Prairie destroyed; converted to cropland (Freeman & Brooks 1989).
Leavenworth	Lansing Prairie	1969: June 23	1969: June 23	Prairie destroyed; converted to cropland (Freeman & Brooks 1989).
Lyon	Reading	1909: June 24	1909: June 24	Status unknown; reported in Bowles & Duxbury 1986.
Neosho	unnamed	undated	undated	Status unknown; reported in Correll 1950.
Pottawat-tamie	near Onaga	1904: June	1904: June	Status unknown; reported in Bowles & Duxbury 1986.
Riley	unnamed	1896: June	1896: June	Status unknown; reported in Bowles & Duxbury 1986.
Shawnee	Topeka	1879: May 5	1879: May 5	Status unknown; reported in Bowles & Duxbury 1986.
Unknown	Manniouth Westport, Arkansas [Territory?]	1878: June 14 undated	1878: June 14 undated	Status unknown; reported in Bowles & Duxbury 1986. Status unknown; reported in Bowles & Duxbury 1986; possible location in Sheviak 1987.

008463

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
MINNESOTA				
Douglas	Alexandria	1878: July	1878: July	Status unknown; general area searched but no plants found (W. Smith, unpub).
Freeborn	10 mi east of Albert Lea	1939: July	1939: July	Status unknown; searched 1980,1981, but no plants found (W. Smith, unpub).
Goodhue	Cannon Falls	1881: August	1881: August	Status unknown; label information too general to relocate.
Hennepin	Fort Snelling	1909: July 19	1909: July 19	Status unknown; label information too general to relocate.
Houston	Railroad along Crooked Creek	1899: July 7	1899: July 7	Status unknown; label information too general to relocate.
Kandiyohi	Spicer	1892: August	1892: August	Status unknown; label information too general to relocate.
Nicollet	Swan Lake	1878	1893: July	Status unknown; label information too general to relocate.
Nicollet	unnamed	1878	1883	Status unknown; label information too general to relocate.
Nobles	Worthington	undated	undated	Status unknown; label information too general to relocate.

008464

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
MISSOURI				
Clinton	unnamed	undated	undated	Listed in Steyermark 1963, but specimen evidence is lacking.
Greene	unnamed	undated	undated	Listed in Steyermark 1963, but specimen evidence is lacking.
Jackson	Grain Valley	1895: July 4	1898: July 11	Reported extirpated in Morgan 1980.
Jasper	unnamed	????: June 15	????: June 15	Status unknown; recent searches, no plants found (T. Smith, MO DOC, 1995 pers. comm. to N. Sather).
Johnson	Near Warrensburg	1926: June 20	1926: June 20	Reported extirpated in Morgan 1980.
Lawrence	3.5 mi northeast of Aurora	1952: June 10	1952: June 10	Reported extirpated in Morgan 1980.
Newton	unnamed	undated	undated	Listed in Steyermark 1963, but specimen evidence is lacking.
Stone	unnamed	undated	undated	Status unknown; reported in Thurman and Hickey 1989.
Vernon	unnamed	1873: July 25	1873: July 25	Status unknown; reported in Morgan 1980.

008465

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
NEBRASKA				
Antelope	Neligh	1887: July 1	1887: July 1	Status unknown; reported in Bowles & Duxbury 1986.
Brown	Long Pine	1893: July 8	1893: July 8	Status unknown; reported in Bowles & Duxbury 1986.
Cass	near Plattsmouth	1890	1890	Status unknown; reported in Bowles & Duxbury 1986.
Cherry	Dewey Lake	1912: July 6	1912: July 6	Status unknown; reported in Bowles & Duxbury 1986, Freeman & Brooks 1989; several searches of general area have failed to relocate plants.
	Kennedy	1889: July 11	1889: July 11	Status unknown; reported in Bowles & Duxbury 1986.
	Lone Tree Lake, Kennedy	1928: July 28	1928: July 28	Status unknown; reported in Bowles & Duxbury 1986.
	Oasis	1912: July 13	1912: July 13	Status unknown; reported in Bowles & Duxbury 1986; search 1985, none found.
	Pullman	1892: July 20	1892: July 20	Status unknown; reported in Bowles & Duxbury 1986, Freeman & Brooks 1989.
				Status unknown; reported in Bowles & Duxbury, Freeman & Brooks 1989.
Dodge	Union Pacific Railroad Prairie	1903: June 26	1903: June 26	Presumed extirpated prairie highly degraded (Bowles & Duxbury 1986, Freeman & Brooks 1989).
Grant	Whitman	1913: July 2	1913: July 2	Status unknown; reported in Bowles & Duxbury 1986, Freeman & Brooks 1989.
Greeley	Chalk Mine Wayside at Scotia	1974-1979	1974-1979	Status unknown; reported in Bowles & Duxbury 1986, Freeman & Brooks 1989.
Jefferson	Diller	1885: July 13	1885: July 13	Status unknown; reported in Bowles & Duxbury 1986.
Kearney	Newark	1891: June 30	1891: June 30	Status unknown; reported in Bowles & Duxbury 1986.
	Platte River	1891: June 15	1891: June 15	Status unknown; reported in Bowles & Duxbury 1986.
Lancaster	Lincoln area	1873: June 18	1927: June 27	Status unknown; reported in Bowles & Duxbury 1986; includes 5 collections from the general vicinity of Lincoln made over a 50-year period.
Otoe	near Bennett	1894: July 1	1894: July 1	Status unknown; reported in Bowles & Duxbury 1986.
	Nebraska City area	1900: June	1900: July 27	Status unknown; reported in Bowles & Duxbury 1986; includes 2 specimens from the vicinity of Nebraska City.
Pierce	Plainview	1907: July	1907: July	Status unknown; reported in Bowles & Duxbury 1986.
Sarpy	near Bellevue	1884: July 6	1884: July 6	Status unknown; reported in Bowles & Duxbury 1986.

008466

Table 2

Historical reports of *Platanthera praeclara (last observed prior to 1970 and/or confirmed destroyed).*

COUNTY	SITE NAME	DATE OF FIRST OBSERVATION	DATE OF LAST OBSERVATION	STATUS AND COMMENTS
Washington	Rathgen Prairie	undated	undated	Status unknown; reported in Bowles & Duxbury 1986; area invaded by shrubs.
Unknown	Greely Center	1889: July 4	1889: July 4	Status unknown; reported in Bowles & Duxbury 1986.
	Iron Mountain	1889: June 21	1889: June 21	Status unknown; reported in Bowles & Duxbury 1986.
NORTH DAKOTA				
Cass	unnamed	1929: July 4	1929: July 4	Status unknown; reported in Bowles & Duxbury 1986, specimen may have been collected in Richland County.
Ransom	13 mi west and 8 mi south of McLeod	1953: July 15	1953: July 15	Status unknown; reported in Bowles & Duxbury 1986; area searched 1983, but no plants found.
Richland	Section 22 Prairie	1908: August 6	1908: August 6	Prairie destroyed; converted to cropland (Bowles & Duxbury 1986).
	Waldron	1890: July 19	1890: July 19	Status unknown; reported in Bowles & Duxbury 1986.
OKLAHOMA				
Craig	White Oak Prairie	1975: June 21	1975: June 21	Status unknown; surveyed several years, no plants observed
Rogers	Foyil Prairie	1975: June 21	1975: June 21	Status unknown; surveyed several years, no plants observed
SOUTH DAKOTA				
Brookings	Brookings	1892	1892	Status unknown; reported in Bowles & Duxbury 1986.
Minnehaha	Near Brandon	1916: July 14	1916: July 14	Status unknown; reported in Bowles & Duxbury 1986.
WYOMING				
unknown	Platte Bottom	undated	undated	Status unknown; reported in Bowles & Duxbury 1986 (now assumed spurious).

The majority of old collections were collected under the name P. leucophaea, but have been subsequently determined to be P. praeclara.

008467

Table 3.

Extant populations of Platanthera praeclara (1st observed or reconfirmed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
Iowa	Adair	Woodside Prairie	71	1	251C	private	1967	1979	Burned	
Iowa	Bremer	Brayton Prairie	1	1	222M	private	1973	1994(0)	Burned	Periodic census
Iowa	Bremer	Ray Prairie	1	1	222M	private	1982	1982	Hayed	Periodic census
Iowa	Buena Vista	Lew Morris Prairie	11	1	251B	private	1993	1994(3)	Hayed	Periodic census
Iowa	Cherokee	Steele Prairie State Preserve	141	9	251B	IA DNR	1985	1989	Burned	Periodic census
Iowa	Clay	Kirchner Prairie	27	1	251B	private	1982	1994(5)	Hayed	Periodic census
Iowa	Crawford	Welch Prairie	2	1	251C	private	1993	1994(2)	Grazed	
Iowa	Dickinson	Bergman Becker Prairie	18	1	251B	private	1983	1994(0)	Hayed	Periodic census
Iowa	Emmet	Anderson Prairie State Preserve	1	9	251B	IA DNR	1983(1)	1994(0)	Burned	
Iowa	Emmet	Superior Railroad Prairie	5	1	251B	Railroad	1994(5)	1994(5)	Unknown	
Iowa	Emmet	Estherville Railroad Prairie	3	1	251B	Railroad	1994(3)	1994(3)	None	
Iowa	Fayette	Potratz Ditch	1	1	222M	ROW	1992	1992(1)	None	Periodic census
Iowa	Fayette	West Union Prairie	23	9	222M	private	1991(23)	1991(23)	None	
Iowa	Guthrie	Sheeder Prairie State Preserve	282	9	251C	IA DNR	1974	1987	Burned	
Iowa	Guthrie	Rosehill Cemetery	1	0	251C	ROW	1993	1994(1)	None	
Iowa	Howard	Hayden Prairie State Preserve	27	9	222M	IA DNR	1981	1994(1)	Burned	
Iowa	Howard	Crossman Prairie State Preserve	11	9	222M	TNC	1982	1994(3)	Burned	
Iowa	Kossuth	Bernau Prairie	1	1	251B	private	1986	1986	Hayed	
Iowa	Mills	Wearin Prairie	2	1	251C	private	1993	1994(1)	Hayed	
Iowa	Mills	Burgoin Prairie	1	1	251C	private	1993	1994(1)	Unknown	
Iowa	Mills	Mills County #3	100	0	251C	private	1995	1995	Hayed	
Iowa	Pocahontas	Kalsow Prairie State Preserve	13	9	251B	IA DNR	1954	1994(13)	Burned	
Iowa	Taylor	Powell Prairie	55	1	251C	private	1994(55)	1994(55)	Hayed	
Kansas	Douglas	Colyer Prairie	10	0	251C	private	1991	1993	Hayed	
Kansas	Franklin	Fowler Hill Prairie	1	0	251E	private	1970	1970	Hayed	

008468

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
Kansas	Jackson	Hoyt Prairie	1	0	251C	private	1970	1970	Hayed	Demographic
Kansas	Jefferson	Rockefeller Prairie	30	8	251C	KS	1969	1994	Burned	Periodic census
Kansas	Leavenworth	High Prairie	1	0	251C	private	1986	1986	Hayed	Demographic
Kansas	Osage	Osage Prairie	14	2	251E	private	1986	1991	Hayed	Periodic census
Kansas	Shawnee	Shawnee Heights Prairie	1	0	251C	private	1970	1970	Hayed	Demographic
Minnesota	Clay	Bicentennial Prairie	25	9	251A	County	1979(25)	1994(6)	Burned	Periodic census
Minnesota	Clay	Bluestem Prairie	6	8	251A	TNC	1992(6)	1994(3)	Burned	Demographic
Minnesota	Clay	Bluestem Prairie	48	8	251A	TNC	1987(7)	1994(48)	Burned	Demographic
Minnesota	Clay	Bluestem Prairie	86	6	251A	MN DNR	1991(18)	1994(45)	Burned	Demographic
Minnesota	Clay	Ulen WMA	55	6	251A	MN DNR	1986(38?)	1994(55)	Unknown	
Minnesota	Clay	Riverton 11	1	1	251A	MSU	1992(1)	1994(0)	Burned	Demographic
Minnesota	Clay	Elkton 1	1	0	251A	private	1994(1)	1994(1)	Hayed	Periodic census
Minnesota	Clay	Riverton 15	8	1	251A	private	1993(8)	1994(5)	Unknown	
Minnesota	Clay	Ulen WMA	3	0	251A	ROW	1990(3)	1994(0)	None	Periodic census
Minnesota	Dodge	Sargeant	1	6	222M	MN DNR	1982(1)	1992(0)	Burned	
Minnesota	Kittson	Lake Bronson Parkland	7	6	251A	MN DNR	1992(7)	1992(0)	None	Periodic census
Minnesota	Kittson	Lake Bronson Parkland SNA	159	9	251A	MN DNR	1991(300)	1994(159)	None	Demographic
Minnesota	Kittson	Lake Bronson Parkland	300	1	251A	private	1991(300?)	1992(300)	Grazed	
Minnesota	Mower	Leroy/Rose CRK ROW NHR	38	6	222M	MN DNR	1980(34)	1991(0)	Burned	
Minnesota	Norman	Agsco Dunes SNA	1	9	251A	MN DNR	1980(34)	1991(0)	Burned	
Minnesota	Norman	Dalby WMA	102	6	251A	MN DNR	1994(4)	1995	Unknown	Periodic census
Minnesota	Norman	Syre WMA	30	6	251A	MN DNR	1994(30)	1994(30)	Unknown	
Minnesota	Norman	Flaming	1	1	251A	ROW	1975(1)	1991(0)	None	
Minnesota	Norman	Strand	5	1	251A	ROW	1975(3)	1994(5)	None	Periodic census
Minnesota	Norman	Rockwell 11	13	0	251A	private	1995	1995	None	
Minnesota	Pennington	Goose Lake Prairies	100	6	251A	MN Trust	1993(83)	1994(?)	None	Demographic
Minnesota	Pennington	Goose Lake Prairies	8	0	251A	private	1992(8)	1992(8)	Grazed	

008469

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
Minnesota	Pennington	Goose Lake Prairies	71	0	251A	private	1992(71)	1994(?)	Grazed	Periodic census
Minnesota	Pipestone	Pipestone Natl. Monument	37	6	251B	US NPS	1980(2)	1994(9)	Unknown	Periodic census
Minnesota	Pipestone	Pipestone Natl. Monument	1	6	251B	US NPS	1984(1)	unknown	Unknown	Periodic census
Minnesota	Polk	Pembina Trail	300	9	251A	TNC	1990(50)	1994(1001)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	1381	9	251A	TNC	1990(135)	1994(1381)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	1	9	251A	TNC	unknown	unknown	Burned	Periodic census
Minnesota	Polk	Pembina Trail	13	9	251A	TNC	1990(1)	1994(13)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	43	9	251A	TNC	1982(43)	unknown	Burned	
Minnesota	Polk	Pembina Trail	75	9	251A	TNC	1984(75)	1991(2)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	4792	9	251A	TNC	1976	1990(4792)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	326	9	251A	TNC	unknown	1994(326)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	79	9	251A	TNC	1990(5)	1994(79)	Burned	
Minnesota	Polk	Burnham WMA	1	6	251A	MN DNR	1991(1)	1991(1)	Burned	Demo-graphic census
Minnesota	Polk	Burnham WMA	78	6	251A	MN DNR	1971(1?)	1990(78)	Burned	Periodic census
Minnesota	Polk	Burnham WMA	15	6	251A	MN DNR	1990(15)	1990(15)	Burned	Periodic census
Minnesota	Polk	Dugdale WMA	14	6	251A	MN DNR	1991(14)	1991(14)	Burned	Periodic census
Minnesota	Polk	Dugdale WMA	5	6	251A	MN DNR	1993(5)	1993(5)	Burned	
Minnesota	Polk	Dugdale WMA	15	6	251A	MN DNR	1993(15)	1993(15)	Burned	Periodic census
Minnesota	Polk	Foxboro Prairie SNA	20	9	251A	MN DNR	1983(20)	1990(9)	Burned	
Minnesota	Polk	Godfrey WMA	100	6	251A	MN DNR	1993(100)	1993(100)	Burned	Periodic census
Minnesota	Polk	Pembina Trail	104	9	251A	MN DNR	1976(1)	1994(104)	Burned	
Minnesota	Polk	Tympanuchus Prairie	8	9	251A	MN DNR	1979(1)	1994(8)	Burned	Periodic census

008470

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
Minnesota	Polk	Tympanuchus Prairie	2	9	251A	MN DNR	1979(2)	1993(0)	Burned	
Minnesota	Polk	Godfrey Prairie	5	0	251A	private	1993(5)	unknown	Grazed	Periodic census
Minnesota	Polk	Grove Park 20	111	1	251A	private	1993(1)	1994(111)	None	
Minnesota	Polk	Marcoux	15	0	251A	ROW	1991(15)	1993	None	Periodic census
Minnesota	Polk	Marcoux	50	0	251A	ROW	1991(20)	unknown	None	
Minnesota	Polk	Marcoux Corners Prairie	12	0	251A	ROW	1993(12)	1993(12)	None	
Minnesota	Polk	Onstad 26	370	1	251A	private	1976(370)	1991(44)	Hayed	Periodic census
Minnesota	Polk	Onstad 3	237	1	251A	private	1991(115)	unknown	Hayed	Periodic census
Minnesota	Polk	Onstad 3	106	1	251A	private	1990(2)	1991(24)	Grazed	
Minnesota	Polk	Tilden 20	2	0	251A	private	1990(2)	1993(1)	None	
Minnesota	Polk	Benoit Station	130	1	251A	ROW	1990(34)	1993(130)	None	Periodic census
Minnesota	Polk	Marcoux	1	0	251A	ROW	1990(1)	1991(0)	None	Periodic census
Minnesota	Polk	Marcoux Corners Prairie	12	0	251A	ROW	1993(12)	unknown	None	Periodic census
Minnesota	Rock	Blue Mounds State Park	275	6	251B	MN DNR	unknown	unknown	Burned	Periodic census

008471

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
Missouri	Atchison	Tarkio Prairie NA	17	8	251C	MO DOC	unknown	unknown	Hayed/ burned	Periodic census
Missouri	Harrison	Helton Prairie Natural Area	15	9	251C	MO DOC	unknown	1994(15)	Burned	Periodic census
Missouri	Holt	Little Tark Prairie	5	0	251C	private	unknown	unknown	Hayed	
Nebraska	Cherry	Valentine NWR	77	6	332C	USFWS	1990	1995	Grazed	Periodic census
Nebraska	Cherry	Valentine NWR	123	6	332C	USFWS	1994	1995	Grazed	Periodic census
Nebraska	Cherry	Valentine NWR	2	6	332C	USFWS	1979	1995	Grazed	
Nebraska	Cherry	Road Side Park	2	0	332C	private	1993	1993	Grazed	Periodic census
Nebraska	Cherry	CNW-Arabia	22	0	332C	private	1985	1994	Hayed	
Nebraska	Cherry	Watts Lake	21	0	332C	private	1993	1994	Hayed	
Nebraska	Cherry	Duck lake	6	0	332C	private	1986	1994	Hayed	Periodic census
Nebraska	Hall	Mormon Island Crane Meadows	50	8	332E	ICF	1978	1995 (5)	Burned	Periodic census
Nebraska	Lancaster	Nine Mile Prairie	176	8	251G	NE	1984	1995 (0)	Burned	Demographic
Nebraska	Lancaster	Lancaster #2	2	0	251G	private	1994	1994	Hayed	
Nebraska	Otoe	Dicken Prairie	12	0	251G	private	1995	1995	Hayed	
Nebraska	Sarpy	Krebs Prairie	60	2	251C	private	1993	1994(9)	Hayed	Periodic census
Nebraska	Seward	Twin Lakes WMA	50	8	251G	NE Game & Parks	1982	1994	Burned	

008472

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
N. Dakota	Ransom	North S Allotment	73	6	251A	USFS	1985	1993	Grazed	Periodic census
N. Dakota	Ransom	Venlo Allotment	364	6	251A	USFS	1982	1994	Grazed	Periodic census
N. Dakota	Ransom	Berg Allotment	232	6	251A	USFS	1982	1994	Grazed	Periodic census
N. Dakota	Ransom	McLeod Allotment	137	6	251A	USFS	1981	1994	Grazed	Periodic census
N. Dakota	Ransom	A Annex Allotment	1140	6	251A	USFS	1982	1994	Grazed	Demo-graphic census
N. Dakota	Ransom	Bjugstad Allotment	328	6	251A	USFS	1982	1994	Grazed	Demo-graphic census
N. Dakota	Ransom	Brown Allotment	24	6	251A	USFS	1984	1994	Grazed	Periodic census
N. Dakota	Ransom	Braaten Allotment	43	6	251A	USFS	1984	1994	Grazed	Periodic census
N. Dakota	Ransom	Sagvold Allotment	526	6	251A	USFS	1982	1994	Grazed	Periodic census
N. Dakota	Ransom	Olerud Allotment	561	6	251A	USFS	1979	1994	Grazed	Demo-graphic census
N. Dakota	Ransom	Hanson Allotment	54	6	251A	USFS	1984	1994	Grazed	
N. Dakota	Ransom	Griggs Allotment	7	6	251A	USFS	1984	1994	Grazed	Periodic census
N. Dakota	Ransom	S Brown	11	6	251A	USFS	1993	1993	Grazed	Periodic census
N. Dakota	Ransom	North Durler Allotment	347	6	251A	USFS	1982	1991	Grazed	Periodic census
N. Dakota	Ransom	South S East Allotment	27	6	251A	USFS	1982	1993	Grazed	Periodic census
N. Dakota	Ransom	Owego Allotment	73	6	251A	USFS	1982	1990	Grazed	Periodic census
N. Dakota	Ransom	LX Allotment	167	6	251A	USFS	1982	1994	Grazed	Periodic census
N. Dakota	Ransom	Penberty Allotment	185	6	251A	USFS	1982	1994	Grazed	Demo-graphic census
N. Dakota	Ransom	Wall Allotment	436	6	251A	USFS	1979	1994	Grazed	Periodic census

008473

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
N. Dakota	Ransom	Code 6, pasture	5	0	251A	private	1992	1993	Grazed	Periodic census
N. Dakota	Ransom	Code 5, prairie	7	0	251A	private	1982	1987	Grazed	Periodic census
N. Dakota	Ransom	Code 22	4	0	251A	private	unknown	unknown	Grazed	Periodic census
N. Dakota	Ransom	Hakanson Allotment	9	6	251A	USFS	1987	1993	Grazed	Periodic census
N. Dakota	Ransom	Milton Sr. Allotment	56	6	251A	USFS	1982	1994	Grazed	Periodic census
N. Dakota	Ransom	South Durler Allotment	51	6	251A	USFS	1976	1993	Grazed	Periodic census
N. Dakota	Ransom	Northrop Allotment	53	6	251A	USFS	1984	1994	Grazed	Periodic census
N. Dakota	Ransom	Code 3, pasture	27	0	251A	private	1991	1994	Grazed	Periodic census
N. Dakota	Ransom	East S	12	6	251A	USFS	1993	1993	Grazed	Periodic census
N. Dakota	Ransom	Code 1, pasture	36	0	251A	private	1984	1993	Grazed	Periodic census
N. Dakota	Ransom	J Allotment	7	6	251A	USFS	1981	1994	Grazed	Periodic census
N. Dakota	Ransom	Code 25	3	0	251A	private	unknown	unknown	Grazed	Periodic census
N. Dakota	Ransom	Code 2, dunes	26	0	251A	private	1991	1994	Grazed	Periodic census
N. Dakota	Ransom	Code 15, pasture	25	0	251A	private	1982	1984	Grazed/ hayed	
N. Dakota	Ransom	Code 8	2	0	251A	private	1982	1984	Grazed/ hayed	
N. Dakota	Ransom	Code 7, ditch	2	0	251A	unknown	1992	1992	Hayed	Periodic census
N. Dakota	Ransom	Highway 27B Ditch	34	0	251A	unknown	1993	1993	Hayed	
N. Dakota	Ransom	Code 24, ditch	75	0	251A	unknown	unknown	unknown	Hayed	Periodic census
N. Dakota	Ransom	Code 14, ditch	3	0	251A	unknown	1982	1984	Hayed	Periodic census
N. Dakota	Ransom	Code 4, prairie ditch	3	0	251A	unknown	1992	1993	Hayed	Periodic census
N. Dakota	Ransom	Code 13, ditch	18	0	251A	unknown	1987	1993	Hayed	

008474

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
N. Dakota	Ransom	Highway 53B Ditch	46	0	251A	unknown	1992	1994	Hayed	Periodic census
N. Dakota	Ransom	Code 11, ditch	5	0	251A	unknown	1991	1993	Hayed	
N. Dakota	Ransom	Code 10, ditch	1	0	251A	unknown	1992	1992	Hayed	Periodic census
N. Dakota	Ransom	Highway 53C Ditch	17	0	251A	unknown	1993	1993	Hayed	Periodic census
N. Dakota	Ransom	Highway 27A Ditch	44	0	251A	unknown	1987	1987	Hayed	
N. Dakota	Ransom	Highway 53A Ditch	10	0	251A	unknown	1990	1994	Hayed	
N. Dakota	Ransom	Code 19, prairie	4	0	251A	private	unknown	unknown	Hayed	
N. Dakota	Ransom	Code 21, meadow	1	0	251A	private	unknown	unknown	Hayed	Periodic census
N. Dakota	Ransom	Code 20	35	0	251A	private	unknown	unknown	Hayed	
N. Dakota	Ransom	Code 12, prairie	2	0	251A	private	1991	1992	Hayed	Periodic census
N. Dakota	Ransom	Code 17, prairie ditch	28	0	251A	unknown	1992	1992	Unknown	Periodic census
N. Dakota	Ransom	Railroad ROW	100	0	251A	private	unknown	unknown	Unknown	
N. Dakota	Ransom	Code 9	17	0	251A	private	1984	1984	Unknown	Periodic census
N. Dakota	Ransom	Code 26	1	0	251A	private	unknown	unknown	Unknown	Periodic census
N. Dakota	Ransom	Code 18, prairie	23	0	251A	private	1984	1984	Unknown	Demographic
N. Dakota	Ransom	Code 23, prairie	2	0	251A	private	unknown	unknown	Unknown	Periodic census
N. Dakota	Ransom	Code 16	13	0	251A	private	1984	1984	Unknown	Periodic census
N. Dakota	Richland	R Allotment	74	6	251A	USFS	1984	1984	Grazed	Periodic census
N. Dakota	Richland	Code 27	5	0	251A	private	unknown	unknown	Grazed	Demographic
N. Dakota	Richland	Jordheim	40	6	251A	USFS	1987	1987	Grazed	Periodic census
N. Dakota	Richland	Code 35, road ditch	1	0	251A	unknown	unknown	unknown	Grazed	Periodic census
N. Dakota	Richland	Code 32, pasture	3	0	251A	private	unknown	unknown	Grazed	Periodic census
N. Dakota	Richland	King Allotment	1	6	251A	USFS	1991	1991	Grazed	Periodic census
N. Dakota	Richland	Code 29, prairie	8	0	251A	private	unknown	unknown	Grazed	Demographic

008475

Table 3.

Extant populations of Platanthera praeclara (reconfirmed or 1st observed after 1970).

STATE	COUNTY	SITE NAME	POP. SIZE[1]	PROTECTION LEVEL[2]	ECO REGION[3]	OWNERSHIP	1ST SEEN	LAST SEEN	PRE-DOMINANT MANAGEMENT	MONITORING
N. Dakota	Richland	Code 33, pasture	9	0	251A	private	unknown	unknown	Grazed/ hayed	Periodic census
N. Dakota	Richland	Code 30, ditch	3	0	251A	unknown	unknown	unknown	Hayed	Periodic census
N. Dakota	Richland	Code 31, ditch	1	0	251A	unknown	unknown	unknown	Hayed	Periodic census
N. Dakota	Richland	Code 36, haymeadow	7	0	251A	private	unknown	unknown	Hayed	Periodic census
N. Dakota	Richland	Highway 1B Ditch	14	0	251A	unknown	unknown	unknown	None	Periodic census
N. Dakota	Richland	Code 34, pasture ditch	1	0	251A	unknown	unknown	unknown	Unknown	Periodic census
N. Dakota	Richland	Code 28, ditch	10	0	251A	unknown	unknown	unknown	Unknown	Periodic census
TOTAL KNOWN FLOWERING PLANTS IN RANGE			15172							
TOTAL NUMBER OF KNOWN POPULATIONS			175							

008476

Table 3.

Extant populations of *Platanthera praeclara* (reconfirmed or 1st observed after 1970).

[1] Maximum number of flowering plants documented at the site.

[2] Protection status of The Nature Conservancy 1996.

[3] Ecoregions of Bailey *et al.* (1994)

The Nature Conservancy's 10 levels of protection:

0	No protection
1	Notification -- Landowner or site manager notified of the species presence
2	Voluntary protection provided by landowner or site manager
3	Bequest - Will, right of first refusal, or other landowner/agency committment
4	Lease, license, or management agreement
5	Undivided or remainder interest conveyed to a conservation entity
6	Public land designation
7	Conservation easement
8	Fee title or beneficial interest with management control
9	Dedication

008477

Table 4.

Habitat type of Platanthera praeclara in each state and province of occurrence.

STATE/PROVINCE	HABITAT TYPE
UNITED STATES	
IOWA	wet-mesic to mesic tallgrass prairie
KANSAS -- eastern	mesic to wet-mesic upland prairies
-- northeastern	wet-mesic to mesic tallgrass prairie
MINNESOTA -- southern	wet-mesic to mesic tallgrass prairie
-- central	interbeach lacustrine plain
-- northern	discontinuous interbeach areas
MISSOURI -- western sect., glaciated plains natural div.	mesic prairie
-- Grand River sect., glaciated plains natural div.	mesic prairie
NEBRASKA	tallgrass prairies or sedge meadows in swales among eolian dune sands
NORTH DAKOTA	sedge meadow and tallgrass prairie
OKLAHOMA (extirpated)	mesic to wet-mesic upland prairies
SOUTH DAKOTA (extirpated)	wet-mesic to mesic tallgrass prairie
CANADA	
MANITOBA	wet prairie to meadow

008478

Table 5. Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Achillea millefolium	common yarrow	X[6]					X			X		X	
Agalinis tenuifolia	slender false foxglove												
Agoseris glauca	prairie dandelion											X	
Agropyron caninum var. majus	cutting wheatgrass												
Agrostis stolonifera	spreading bentgrass			X					X			X	X
Alisma triviale	water plantain												X
Allium canadense	wild onion						X						
Allium stellatum	wild onion						X		X				
Amaranthus rudis	water-hemp												X
Ambrosia artemisiifolia	common ragweed			X			X						
Ambrosia psilostachya	western ragweed					X							
Ammania robusta	toothcup												X
Amorpha canescens	leadplant	X				X	X	X					
Amorpha fruticosa	false indigo												X
Amorpha nana	fragrant false indigo									X			
Andropogon gerardii	big bluestem	X				X	X	X	X	X	X	X	
Andropogon scoparius	little bluestem	X				X			X				
Anemone canadensis	meadow anemone					X			X	X	X		

Sites:
A. Glaciated KS, NE.
B. Unglaciated eastern KS.
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D. Valentine National Wildlife Refuge, NE.
E. Sheyenne National Grassland, ND.
F. Blue Mounds, MN.
G. Mower County, MN.
H. Pembina Trail, MN.
I. Pennington County,MN.
J. Kittson County, MN.
K. Vita, Manitoba, Canada.
L. Nine Mile Prairie, NE.

008479

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Antennaria neglecta	pussytoes					X						X	
Apocynum cannabinum	Indian hemp							X	X	X			X
Artemisia ludoviciana	white sage					X							
Asclepias incarnata	swamp milkweed				X				X				X
Asclepias speciosa	showy milkweed								X				
Asclepias sullivantii	prairie milkweed		X										
Asclepias tuberosa	butterfly-weed	X											
Asclepias verticillata	whorled milkweed	X											
Asclepias viridiflora	green milkweed		X										
Asclepias viridis	green-flowered milkweed		X										
Aster ericoides	heath aster	X				X	X		X	X		X	
Aster junciformis	rush aster								X				
Aster laevis	smooth aster	X					X						
Aster novae-angliae	New England aster							X	X	X			
Aster oblongifolius	aromatic aster						X			X			
Aster oolentangiensis	azure aster							X					
Aster sericeus	silky aster						X						
Aster simplex	panicled aster					X			X	X	X	X	

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I. Pennington County,MN.
J. Kittson County, MN.
K. Vita, Manitoba, Canada.
L. Nine Mile Prairie, NE.

008480

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Aster umbellatus	flat-top aster							X	X		X		
Baptisia australis	blue wild indigo		X										
Baptisia bracteata var. glabrescens	plains wild indigo		X					X					
Baptisia lactea	white wild indigo							X					
Betula pumila	dwarf birch								X		X	X	
Bidens cernua	nodding beggar-ticks												X
Bidens frondosa	beggar-ticks												X
Bidens vulgata	tall beggar-ticks												X
Bouteloua curtipendula	side-oats grama	X				X	X						
Bromus ciliatus	Canada brome grass								X				
Bromus inermis	awnless brome grass	X											
Bromus japonicus	Japanese chess	X											
Calamagrostis canadensis	bluejoint grass				X						X		
Calamagrostis stricta	narrow-spike small-reedgrass					X			X	X			
Campanula aparinoides	marsh bell-flower				X				X		X		
Carex amphibola var. turgida	sedge												X
Carex aquatilis	sedge			X									

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G. Mower County, MN.
H. Pembina Trail, MN.
I. Pennington County,MN.
J. Kittson County, MN.
K. Vita, Manitoba, Canada.
L. Nine Mile Prairie, NE.

008481

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Carex aurea	sedge											X	
Carex bicknellii	sedge						X						X
Carex brevior	sedge	X		X		X							
Carex buxbaumii	sedge								X	X	X	X	
Carex crawei	sedge											X	
Carex granularis	sedge					X							
Carex gravida	sedge												X
Carex hallii	Hall's sedge								X				
Carex heliophila	sedge					X							
Carex hystericina	sedge												X
Carex laeviconica	sedge												X
Carex lanuginosa	sedge				X	X				X			X
Carex praegracilis	sedge								X	X			
Carex sartwellii	sedge										X		
Carex scirpiformis	sedge								X				
Carex scoparia	sedge			X				X					
Carex stipata	sedge												X
Carex stricta	sedge												X

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008482

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Carex tetanica	sedge								X	X	X		
Carex viridula	sedge											X	
Carex vulpinoidea	fox sedge			X									X
Cirsium flodmanii	Flodman's thistle												X
Cicuta maculata	water hemlock								X	X	X	X	X
Cirsium muticum	swamp thistle								X				
Coreopsis palmata	prairie coreopsis						X						
Cornus drummondii	rough-leaved dogwood	X											
Cornus stolonifera	red osier dogwood									X		X	
Cyperus odoratus	fragrant sedge												X
Cyperus strigosus	umbrella sedge							X					
Cypripedium candidum	small white ladyslipper								X				X
Dalea candida	white prairie clover	X						X					
Dalea purpurea	purple prairie clover	X						X		X	X	X	
Delphinium virescens	prairie larkspur	X											
Deschampsia cespitosa	tufted hairgrass								X	X	X	X	
Desmodium illinoense	Illinois tick-trefoil	X											

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H. Pembina Trail, MN.
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008483

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Dichanthelium acuminatum var. acuminatum	panic grass						X		X			X	
Dicanthelium wilcoxianum	Wilcox dicanthelium					X							
Echinacea angustifolia	purple coneflower	X					X						
Echinochloa crusgalli	barnyard grass												X
Echinochloa muricata var. microstachya	barnyard grass												X
Echinodorus rostratus	burhead												X
Eclipta prostrata	yerba-de-tajo												X
Eleocharis elliptica var. compressa	spikerush			X		X			X	X	X		
Eleocharis erythropoda	spikerush			X									X
Eleocharis macrostachya	spikerush			X									X
Epilobium coloratum	willow-herb												X
Equisetum arvense	field horsetail												X
Equisetum hyemale	tall scouring-rush												X
Equisetum laevigatum	scouring-rush				X	X			X	X			
Erechtites hieracifolia	fireweed												X
Erigeron strigosus	daisy-fleabane	X					X						

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Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Eryngium yuccifolium	rattlesnake master							X					
Eupatorium perfoliatum	boneset												X
Euthamia graminifolia	grass-leaved goldenrod					X			X	X	X	X	
Fragaria virginiana	wild strawberry					X		X	X	X	X	X	
Galium aparine	goosegrass										X		
Galium boreale	northern bedstraw								X	X	X		
Gentiana alba	pale gentian							X					
Gentiana andrewsii	closed gentian										X		
Gentiana puberulenta	downy gentian	X					X						
Gentianopsis crinita	fringed gentian								X				
Geum triflorum	prairie avens								X				
Glyceria striata	manna grass								X				X
Glycyrrhiza lepidota	wild licorice				X	X							
Habenaria leucophaea	prairie fringed orchid												X
Helenium autumnale	autumn sneezeweed					X			X	X			
Helianthus maximilianii	Maximilian's sunflower								X	X			
Helianthus mollis	downy sunflower		X										
Helianthus nuttallii	Nuttall's sunflower				X								

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008485

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Helianthus occidentalis	western sunflower						X						
Helianthus rigidus	prairie sunflower	X							X	X			
Heliopsis helianthoides	false sunflower						X						
Heuchera richardsonii	prairie alumroot						X						
Hieracium longipilum	hairy hawkweed		X										
Hypoxis hirsuta	yellow stargrass											X	
Juncus alpinus	rush								X			X	
Juncus balticus	rush			X		X			X	X			
Juncus dudleyi	rush			X									X
Juncus interior	rush	X		X									X
Juncus longistylis	rush								X			X	
Juncus nodosus	rush								X				
Juncus torreyi	rush	X		X									X
Koeleria cristata	June grass	X					X						
Kuhnia eupatorioides	false boneset												
Lathyrus palustris	marsh vetchling								X	X	X		
Leersia oryzoides	rice cut-grass												X
Leersia virginica	white-grass												X

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Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Leptochloa fascicularis	bearded sprangle-top grass												X
Lespedeza capitata	round-headed bushclover							X					
Liatris ligulistylis	blazing-star								X				
Liatris punctata	blazing-star	X											
Liatris pycnostachya	blazing-star		X						X				
Lilium philadelphicum	wood lily								X				
Linum sulcatum	flax	X											
Lippia lanceolata	northern fog fruit												X
Lithospermum canescens	hoary puccoon						X						
Lithospermum incisum	narrow-leaved puccoon	X											
Lobelia kalmii	Kalm's lobelia	X							X			X	
Lobelia siphilitica	big blue lobelia												X
Lobelia spicata	spiked lobelia	X		X					X				
Lycopus americanus	common water horehound								X	X	X	X	X
Lysimachia ciliata	fringed loosestrife			X									X
Lysimachia quadriflora	loosestrife								X	X	X	X	
Lythrum alatum	loosestrife												X
Mentha arvensis	field mint			X							X		X

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008487

Table 5 (continued). Associated plant taxa occurring at selected extant *Platanthera praeclara* sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Mimulus ringens	monkey flower												X
Muhlembergia glomerata	muhly grass								X				
Muhlenbergia richardsonis	muhly grass								X	X	X	X	
Oenothera parviflora	evening primrose						X						
Panicum dichotomiflorum	fall panic grass												X
Panicum virgatum	switchgrass	X				X			X	X			
Parnassia glauca	grass-of-parnassus								X				
Parthenium integrifolium	American feverfew							X					
Pedicularis lanceolata	swamp wood betony								X	X		X	
Penthorum sedoides	ditch stonecrop												X
Phalaris arundinacea	reed canary grass										X		X
Phlox pilosa	downy phlox						X						
Poa compressa	Canada bluegrass	X					X						
Poa pratensis	Kentucky bluegrass	X		X		X	X		X	X			
Polygonum amphibium	water smartweed					X							X
Polygonum punctatum	dotted water smartweed												X
Populus tremuloides	quaking aspen									X			
Potentilla anserina	silver-weed								X		X	X	

Sites:
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J. Kittson County, MN.
K. Vita, Manitoba, Canada.
L. Nine Mile Prairie, NE.

008488

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Potentilla arguta	tall cinquefoil				X								
Potentilla fruticosa	shrubby cinquefoil								X		X	X	
Potentilla norvegica	rough cinquefoil												X
Potentilla rivalis	brook cinquefoil												X
Potentilla simplex	old-field cinquefoil		X										
Prenanthes aspera	rattlesnake root						X						
Prenanthes racemosa	glaucous rattle-snake root							X					
Prunella vulgaris	heal-all								X			X	
Prunus besseyi	sand cherry										X		
Psoralea tenuiflora	scurf-pea	X											
Pycnanthemum tenuifolium	slender mountain mint		X										
Pycnanthemum virginianum	common mountain mint								X	X			
Ranunculus scleratus	cursed crowfoot												X
Rhus glabra	smooth sumac	X											
Rorippa palustris	bog yellow grass												X
Rosa woodsii	wild rose								X	X			
Rudbeckia hirta	black-eyed Susan	X							X			X	
Rumex altissimus	pale dock												X

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L. Nine Mile Prairie, NE.

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Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Rumex crispus	curly dock												X
Sagittaria brevirostra	arrowhead												X
Sagittaria calycina	arrowhead												X
Salix bebbiana	Bebb's willow					X			X		X		
Salix discolor	pussy willow								X	X	X		
Salix exigua var. interior	sandbar willow					X			X				X
Salix eriocephala	diamond willow												X
Salix petiolaris	meadow willow								X	X	X		
Salvia azurea	blue sage		X										
Scirpus americanus	three-square			X	X								X
Scirpus atrovirens	green bulrush												X
Scirpus pallidus	dark green bulrush												X
Scirpus validus	soft-stem bulrush												X
Scutellaria galericulata	marsh skullcap									X			
Scutellaria lateriflora	side-flowering skullcap												X
Scutellaria parvula	small skullcap	X											
Senecio aureus	golden ragwort										X		
Senecio pauperculus	northern ragwort								X				

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008490

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Senecio plattensis	prairie grounsel	X										X	
Senecio pseudaureus	western golden ragwort								X	X			
Silphium integrifolium	rosinweed	X											
Silphium laciniatum	compass-plant	X					X						
Sisyrinchium angustifolium	blue-eyed grass				X								
Sisyrinchium campestre	blue-eyed grass	X								X			
Solidago canadensis	tall goldenrod	X		X		X			X	X			
Solidago gigantea	giant goldenrod								X				
Solidago missouriensis	Missouri goldenrod	X				X	X			X			
Solidago nemoralis	grey goldenrod								X				
Solidago ptarmicoides	white goldenrod								X			X	
Solidago riddellii	Riddell's goldenrod								X		X		
Solidago rigida	rigid goldenrod						X	X	X	X		X	
Solidago speciosa	showy goldenrod							X					
Sonchus arvensis	field sowthistle									X			
Sorghastrum nutans	Indian grass	X				X	X		X				
Spartina pectinata	cord grass			X		X			X	X	X	X	
Sphenopholis obtusata	wedge grass				X				X				

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008491

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Spiraea alba	white spiraea								X	X	X		
Spiranthes cernua	nodding ladies'-tresses							X					
Sporobolus heterolepis	prairie dropseed	X	X				X			X		X	
Stachys palustris	woundwort					X			X		X		X
Stipa spartea	porcupine grass						X						
Thalictrum dasycarpum	purple meadow-rue								X				
Thelypteris palustris	marsh fern				X								
Tofieldia glutinosa	false asphodel								X				
Tradescantia bracteata	prairie spiderwort	X											
Triglochin maritima	arrow-grass				X					X			
Triodanis perfoliata	Venus' looking-glass	X											
Typha angustifolia	narrow-leaved cattail												X
Typha latifolia	broad-leaved cattail												X
Urtica dioica	stinging nettle												X
Valerianella radiata	corn salad		X										
Verbena hastata	blue vervain						X						
Vernonia sp.	ironweed			X									
Veronicastrum virginicum	Culver's-root								X	X			

Sites:
A. Glaciated KS, NE.
B. Unglaciated eastern KS.
C. Mormon Island, NE.
D. Valentine National Wildlife Refuge, NE.
E. Sheyenne National Grassland, ND.
F. Blue Mounds, MN.
G. Mower County, MN.
H. Pembina Trail, MN.
I. Pennington County, MN.
J. Kittson County, MN.
K. Vita, Manitoba, Canada.
L. Nine Mile Prairie, NE.

008492

Table 5 (continued). Associated plant taxa occurring at selected extant Platanthera praeclara sites.

PLANT TAXA		SITES (See bottom of page for site names and end of table for notes.)											
SCIENTIFIC NAME	COMMON NAME	A[1,2]	B[2]	C[3]	D[3]	E[4,5,7,6]	F[8]	G[8]	H[8]	I[8]	J[8]	K[8,9,10]	L[11]
Viola nephrophylla	northern blue violet								X		X		
Viola pedatifida	prairie violet	X					X						
Zigadenus elegans	white camas								X			X	
Zizia aptera	heart-leaf meadow-parsnip						X			X			
Zizia aurea	golden alexanders								X		X		

1 Sheviak and Bowles 1986
2 Freeman and Brooks 1987
3 Nebraska Game and Parks Commission, Natural Heritage Program 1995
4 Manske 1980
5 Sieg and Bjugstad 1994
6 Wolken 1995
7 Sieg and King in press
8 Minnesota Department of Natural Resources 1979
9 Brownel 1984
10 Collicutt 1992
11 Kaul and Rolfsmeier 1987

Sites:
A. Glaciated KS, NE.
B. Unglaciated eastern KS.
C. Mormon Island, NE.
D. Valentine National Wildlife Refuge, NE.
E. Sheyenne National Grassland, ND.
F. Blue Mounds, MN.
G. Mower County, MN.
H. Pembina Trail, MN.
I. Pennington County,MN.
J. Kittson County, MN.
K. Vita, Manitoba, Canada.
L. Nine Mile Prairie, NE.

008493

Table 6. State and provincial protection status of Platanthera praeclara.

STATE/ PROVINCE	PROTECTION STATUS	COMMENTS
		UNITED STATES
IOWA	Listed threatened	Reclassified from Endangered to Threatened in 1994. These two classifications receive equal protection under Iowa law. (John Pearson, Iowa Department of Natural Resources, personal communication (pers. comm. 1994)
KANSAS	Not protected	Listed as rare (McGregor 1977) as Platanthera leucophaea. The Kansas Nongame and Endangered Species Conservation Act does not provide protection for plants.
MINNESOTA	Listed endangered	Listed in Coffin and Pfannmuller (1988). Protected by the Minnesota Endangered Species Act.
MISSOURI	Listed endangered	Listed and protected under the Missouri Endangered Species Act.
NEBRASKA	Listed threatened	Listed as a rare native vascular plant by the Committee on Endangered and Threatened Plant Species of Nebraska (Michael Fritz, Nebraska Game and Parks Commission, pers. comm. 1989). Protected by the Nebraska Endangered Species Law.
NORTH DAKOTA	Not protected	North Dakota has no native plant protection law, but most individuals of P. praeclara are subject to U.S. Forest Service guidelines for the species (Charles Umbanhower, North Dakota Parks and Recreation Board, pers. comm. 1992).
OKLAHOMA	Not protected	Oklahoma has no plant protection law. The State Heritage Program lists the species as historical.
SOUTH DAKOTA	Not protected	South Dakota has a native plant protection law, but it lists no plants. The species is listed as historically known from South Dakota (Houtcooper et al. 1985) as P. leucophaea.
		CANADA
MANITOBA	Listed endangered	Proposed for protected status.

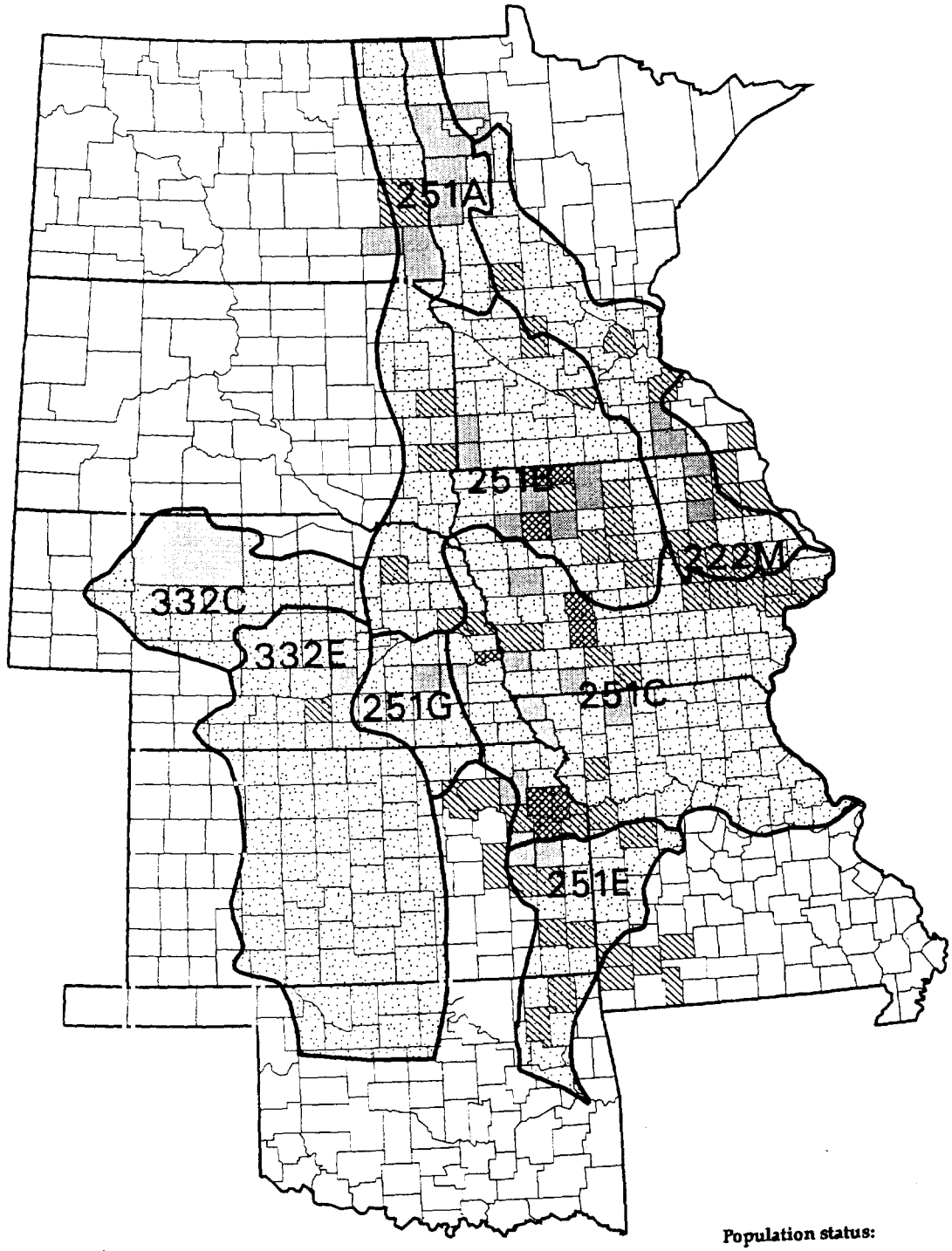
008494

V. FIGURES

Figure 1. Illustration of *Platanthera praeclara* Sheviak and Bowles. Copyright, Marlin Bowles.

008495

Figure 2. Present and historical distribution of *Plantanthera praeclara*. Data from state Natural Heritage Program databases. Ecoregions follow Bailey 1994.



Bailey Ecoregions

222 Eastern Broadleaf Forest Province
M. MN and northeast IA morainal oak savannah section

332 Great Plains Steppe Province
C. NE Sandhills section
E. South-central Great Plains section

251 Prairie Parkland Province
A. Red River Valley section
B. North central glaciated plains section
C. Central dissected till plains section
E. Osage Plains section
G. Central loess section

Population status:

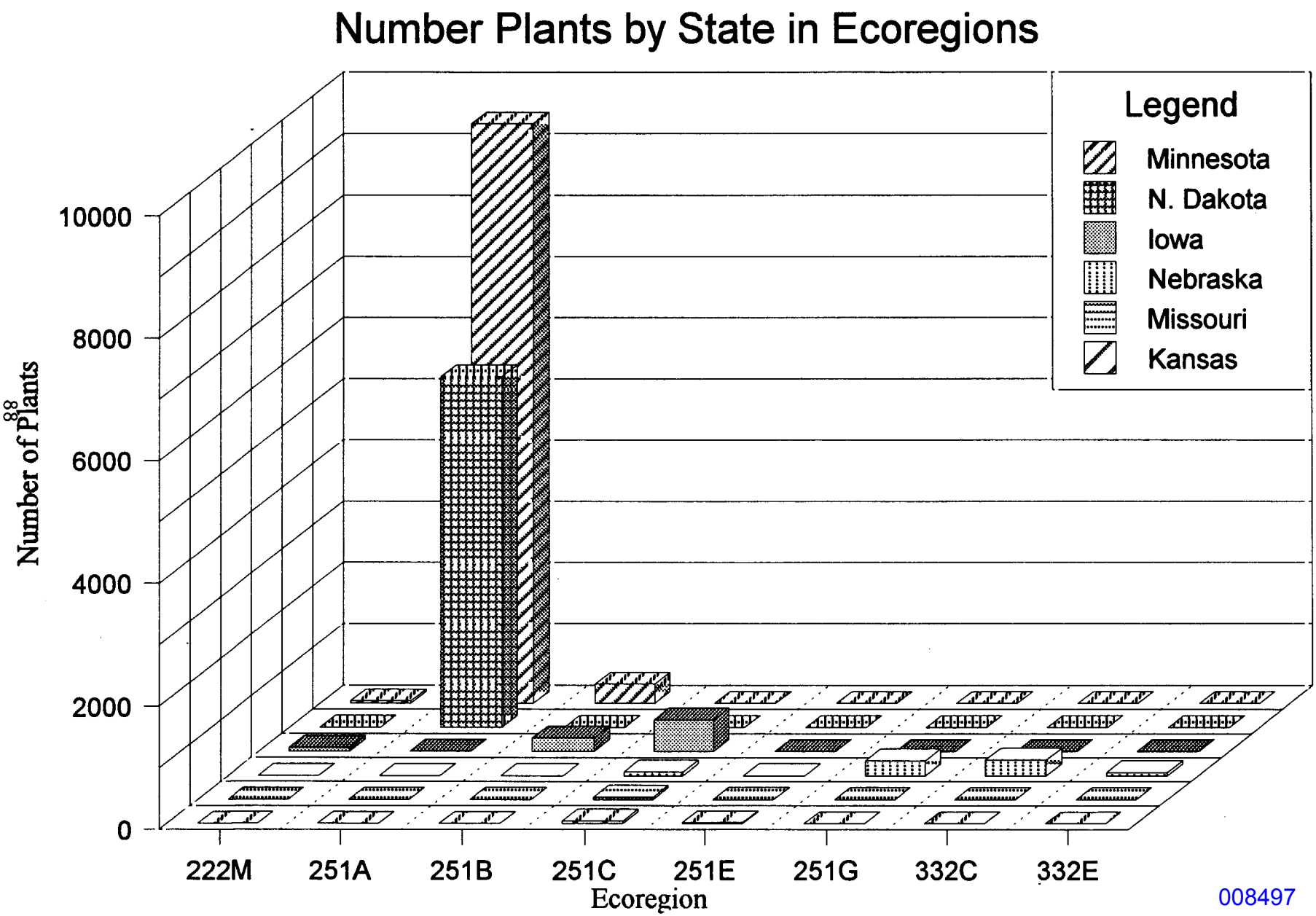
Historic: (pre-1970 or known extirpated)

Extant: (seen or verified since 1970)

Historic and extant: (seen since 1970, and also known from historic records)

008496

Figure 3. Platanthera praeclara



008497

Figure 4. Platanthera praeclara

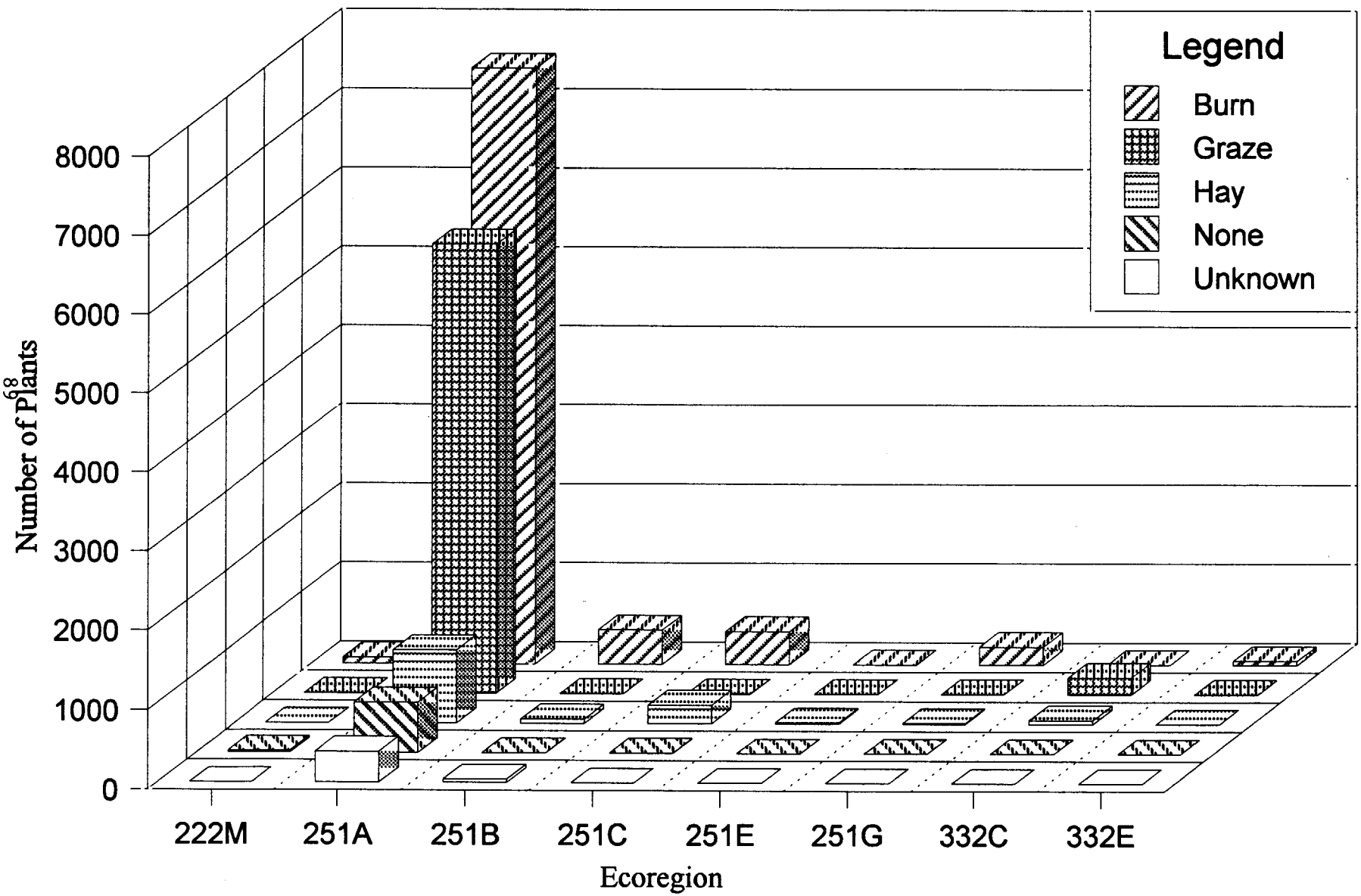
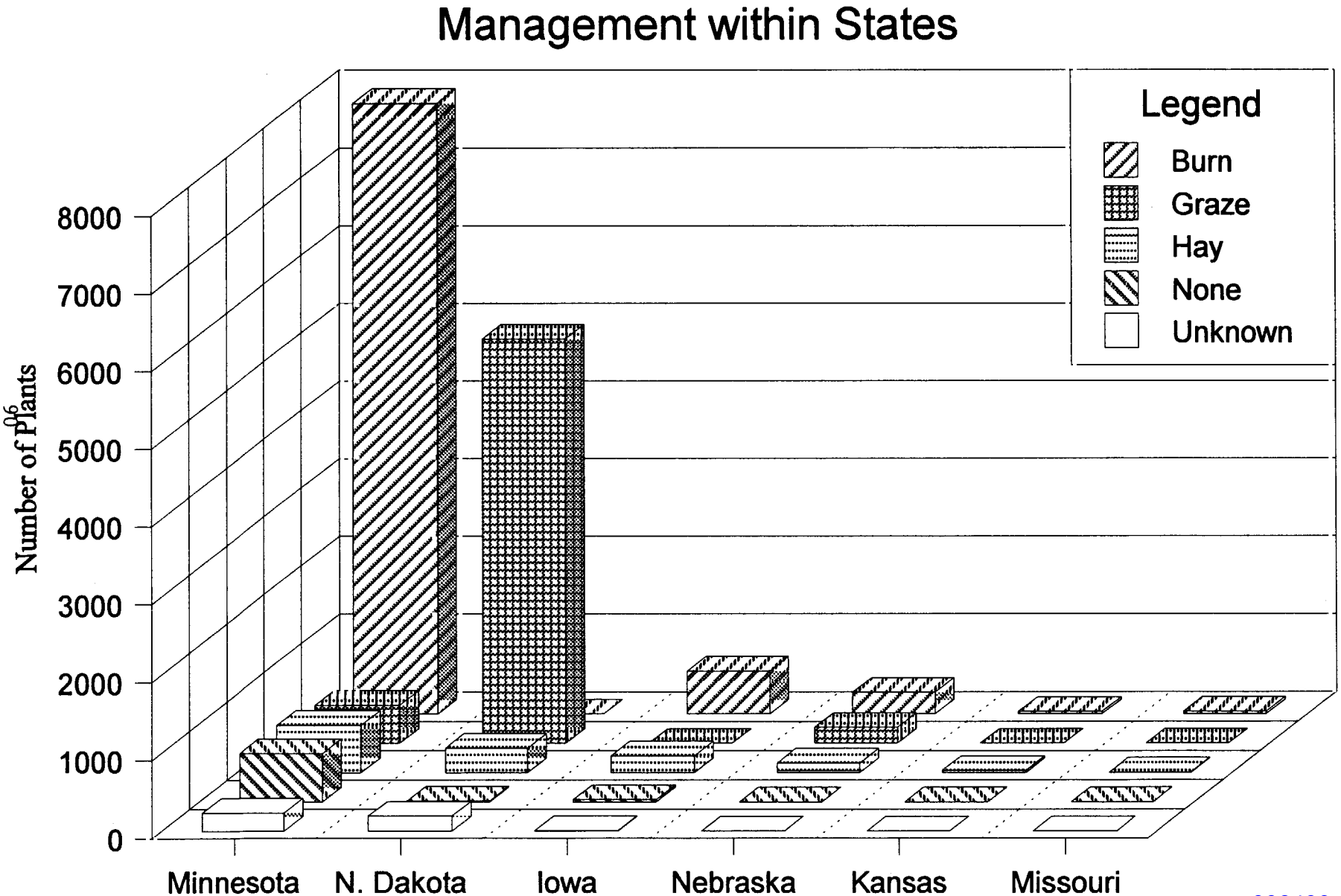
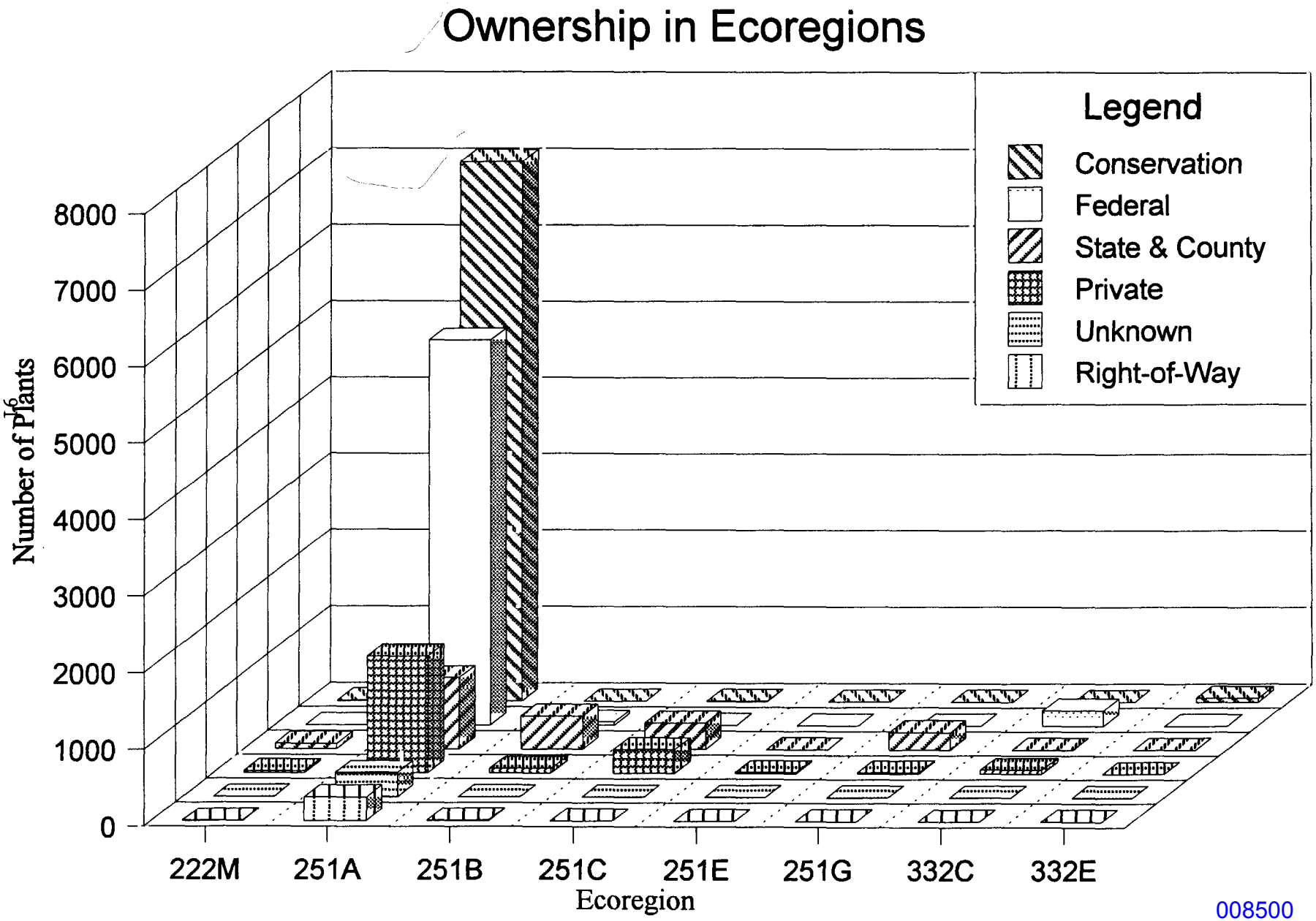


Figure 5. Platanthera praeclara



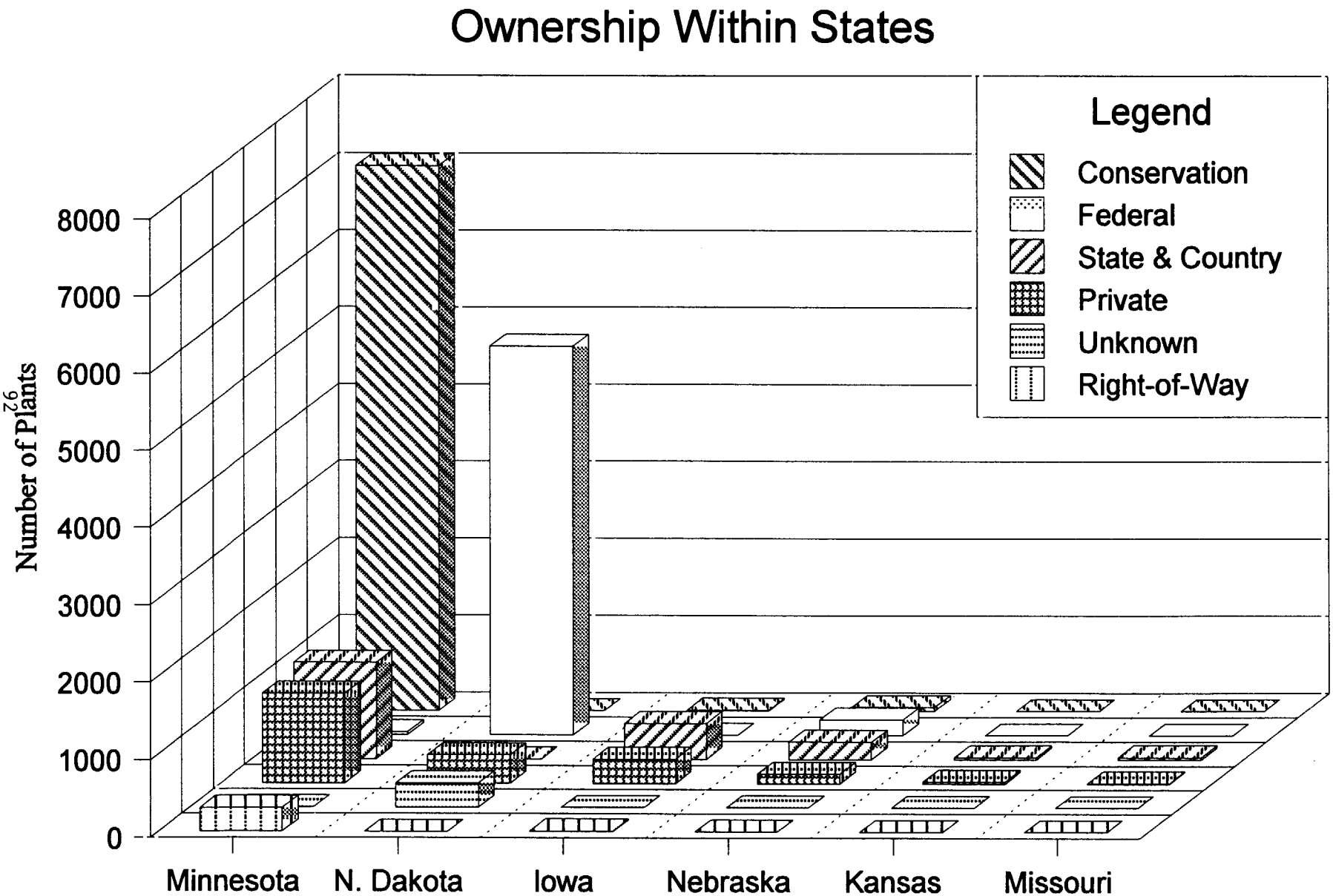
008499

Figure 6. Platanthera praeclara



008500

Figure 7.Platanthera praeclara



APPENDIX A.

PRIORITY SEARCH SITES AND POTENTIAL HABITATS OF *PLATANTHERA PRAECLARA*.

UNITED STATES

IOWA

Prairie remnants and rights-of way in northwest counties.

KANSAS

Priority survey efforts should focus on the following counties where extant populations are located and most of the post-1960 observations were made:

Anderson	Franklin	Johnson	Miami
Coffey	Jackson	Leavenworth	Osage
Douglas	Jefferson	Linn	Shawnee

Survey work also is needed in the mesic and wet-mesic prairies in the Glaciated Region and Osage Cuestas of eastern Kansas.

MINNESOTA

Rights-of-way and privately-owned prairie remnants within the following counties:

Clay	Houston	Marshall	Pennington
Douglas	Kandiyohni	Mower	Pipestone
Fillmore	Kittson	Nicollet	Polk
Freeborn	Lyons	Nobles	Red Lake
Hennepin	Mahnomen	Norman	Rock

MISSOURI

Atchison County, Tarkio Prairie Natural History Area (T66N, R38W, Section 28, Blanchard Quadrangle): There is high probability of occurrence here, with 17 plants located in 1985, but none in 1989 and 1990.

Holt County, Little Tark Prairie (T62N, R39W, Section 8, Craig Quadrangle): There is moderate probability of occurrence here with five plants seen in 1985. Some herbicide use has been documented at this unprotected site. No orchids were located in 1989 and 1990.

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APPENDIX A (continued). PRIORITY SEARCH SITES AND POTENTIAL HABITATS OF *PLATANTHERA PRAECLARA*.

The following sites need additional survey work because they contain suitable habitat in counties with historical occurrences. There is a good chance that at least one site contains *Platanthera praeclara* populations, but the probability for any one site to contain orchids is low.

Quadrangle	Legal Description	Quadrangle	Legal Description
Lawrence County			
Aurora	(T26N, R25W, Section 10, E½NW¼NE¼)	Stotts City	(T28N, R27W, Section 29)
Chesapeake	(T28N, R26W, Section 36, NW¼SW¼)	Stotts City	(T28N, R27W, Section 29, E½)
Newton County			
Fidelity	(T27N, R31W, Section 20, SE¼SE¼)	Joplin East	(T27N, R32W, Section 36)
Fidelity	(T27N, R31W, Section 28, N½SW¼)	Joplin East	(T27N, R32W, Section 26, N½NW¼NW¼)
Vernon County			
Bronaugh	(T34N, R32W, Section 27, NW¼SE¼)	Horton	(T37N, R31W, Section 31/32, S½)
Deerfield	(T35N, R33W, Section 10, NE¼NE¼)	Nevada	(T35N, R31W, Section 33, SE¼SE¼)
Horton	(T36N, R30W, Section 6, NW¼NW¼)	Richards	(T36N, R33W, Section 6, SW¼SW¼)
Horton	(T36N, R31W, Section 6, NE¼NE¼)	Sprague	(T37N, R32W, Section 1, N½NE¼)
Harris County			
Mount Moria	(T63N, R26W, Section 16, W½E½SW¼)		
Holt County			
Craig	(T62N, R39W, Section 19/20/29)	Craig	(T62N, R39W, Section 29, NWS¼)
Jasper County			
Jasper	(T29N, R31W, Section 15, S½SW¼)	Webb City	(T28N, R32W, Section 15, S½SW¼)
Joplin East	(T27N, R32W, Section 15		

008503

APPENDIX A (continued). PRIORITY SEARCH SITES AND POTENTIAL HABITATS OF *PLATANTHERA PRAECLARA*.

NEBRASKA

Valentine National Wildlife Refuge and adjacent sandhill habitats in Cherry County, where four extant populations exist and others are likely to occur.

Elkhorn River floodplain from Bassett, northeast to Valley, northeast in the following counties:

Antelope	Douglas	Madison	Stanton
Cuming	Holt	Rock	Washington
Dodge			

There are numerous historical records from this area and much suitable habitat remaining in the form of mesic to wet hay meadows.

Platte River floodplain from Kearney, Nebraska, to Omaha, Nebraska, in the following counties:

Colfax/Butler	Douglas	Hamilton	Merrick
Dodge/Saunders	Hall	Kearney/Buffalo	Polk

There is one extant population near Grand Island and several historical records for the area.

Sizeable areas with numerous tracts of suitable habitat and scattered historical records in other areas of the sandhills and along the floodplains of the Cedar, Calamus, and Loup Rivers.

NORTH DAKOTA

Suitable habitats within the Glacial Lake Dakota Delta in southern Sargent County.

Suitable habitats within the Sheyenne Delta geologic formation in the following counties:

Ransom	Richland	Sargent

The Sheyenne National Grassland is within the Sheyenne Delta.

Historic Lake Agassiz beachline where suitable habitat exists in the following counties:

Cass	Ransom	Sargent	Trail	Pembina
Grand Forks	Richland	Steele	Walsh	

008504

APPENDIX A (continued). PRIORITY SEARCH SITES AND POTENTIAL HABITATS OF *PLATANTHERA PRAECLARA*.

OKLAHOMA

White Oak Prairie in Craig County and Foyil Prairie in Rogers County are sites where *P. praeclara* was located by Dr. Lawrence Magrath in 1975. No reoccurrence has been documented following surveys of these sites in 1978, 1983, 1985, and 1988 to 1990.

Areas of potential habitat identified as needing additional survey work in the following northeastern counties:

Craig	Muskogee	Pawnee	Wagner
Delaware	Nowata	Payne	Washington
LeFlore	Osage	Rogers	
Mayes	Ottawa	Tulsa	

SOUTH DAKOTA

Roberts County: Red River Valley.

The eastern edge of the Prairie Coteau in the State's east-central and southeastern counties.

The Heckla Sandhills in parts of the following counties:

Brown	Marshall

CANADA

MANITOBA

All aspen parkland sedge meadows and wet mesic prairies in the Gardenton-Vita area.

008505

APPENDIX B.

PRINCIPLE FEDERAL AND STATE LAWS OF CURRENT OR POTENTIAL APPLICABILITY TO THE PROTECTION OF *PLATANTHERA PRAECLARA* AND ITS HABITAT.

International Treaty

Convention on International Trade in Endangered Species of Wild Fauna and Flora. 27 U.S.T. 108. (CITES)

Established a system of import/export regulations to prevent the over-exploitation of plants and animals listed in the Convention.

Federal (United States) Laws

United States. Endangered Species Act of 1973 (PL 93-205, 81 Stat.884, Dec. 28,1973; current version at 16 U.S.C. 1531-1543). As amended.

Administered by the U.S. Fish and Wildlife Service. *Platanthera praeclara* is listed as a threatened species under the Act.

United States. Federal Environmental Pesticide Control Act of 1972. 7 USC 136 to 136y, P.L. 92-516, October 21, 1972, 86 Stat. 973). As amended.

This was originally the Federal Insecticide, Fungicide, and Rodenticide Act. Administered by the U.S. Environmental Protection Agency (EPA). The EPA must register pesticides before they may be used, and the EPA must comply with the Endangered Species Act and insure that no listed species is put in jeopardy of extinction by the registration.

United States. International Environment Protection Act of 1983. 22 USC 3151q; 97 Stat. 1045.

Authorizes, among other provisions, the President to assist other countries in wildlife and plant protection efforts to preserve biological diversity; authorizes exchange of U.S. and other countries' scientists and other experts in environmental science and management.

United States. National Environmental Policy Act of 1969. P.L. 91-190, 42 USC 4321 to 4347, January 1, 1970, 83 Stat. 853. As amended.

Requires all Federal agencies prepare environmental impact statements for "every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment." Species protected by the Endangered Species Act must be considered.

United States. National Wildlife Refuge System Administration Act of 1966. 16 USC 668dd to 668ee.

Provides guidelines and directives for administration and management of all areas in the National Wildlife Refuge system.

008506

United States. Tax Deductions for Conservation Easements. 26 USC 170.
Defines the deductibility of contributions of conservation easements.

State Laws

Iowa

Administrative Code, Chapter 19, Section 290-19.1. (November 21, 1984, and updated periodically).

Lists protected animals and plants.

Management and Protection of Endangered Plants and Wildlife. Iowa Code Ann., Title V. Chapter 109A, Sections 109A.1 to 109A.10. 1975.

Authorizes the State Conservation Commission to list rare species and establish conservation programs, including land acquisition. Prohibits taking, possession, transport, or sale of listed plants. *Platanthera praeclara* is listed as endangered in Iowa.

State Preserves Act. 1965, amended 1987 to include technical updates.

Authorizes the Natural Resources Commission to dedicate natural areas as State Preserves. Proceeds from the State lottery may be used for acquisition.

Kansas

Natural and Scientific Areas Law. 1985. Kansas Stats. Ann., Sections 74-6607 to 74-6609.

Creates a Natural and Scientific Areas Board as part of the State Biological Survey to adopt rules for creating preserves and creates and administers policies in the reserve system. There is no endangered plant law in Kansas.

Minnesota

Conservation of Certain Wildflowers (1935), Minn. Stats. Ann., Agriculture, Sections 17.23 to 17.34.

Prohibits sale of selected plants gathered from the State without a permit and without the written permission of the landowner. This is administered by the Department of Agriculture, and all orchids are included under the law's protection.

Protection of Threatened and Endangered Species, Minn. Stats. Ann., Section 97.488 (amended 1981).

Prohibits take or sale of protected species without permit except through actions necessary for agriculture or accidental taking. *Platanthera praeclara* is listed as endangered in Minnesota.

008507

Regulations for the Issuance of Special Permits for the Taking, Possession, Importation, Transportation, Purchase, Sale, and Disposal of Endangered and Threatened Species of Plants, Animals and Insects. Commissioner's Order No. 2204, June 1985. Department of Natural Resources. Permits are available for scientific and educational purposes.

Missouri

Endangered Species Act. Amended 1986. Revised Stats. of Missouri Sections 252.240.

Prohibits export or sale of listed plants without a permit and prohibits taking without the permission of the property owner. *Platanthera praeclara* is listed as endangered in Missouri.

Regulations. Rules of the Conservation Commission (issued January 1, 1987), Sections 3 CSR 10-4.111 and 252.240 (appendix).

Prohibits export or sale of protected species.

Nebraska

Nongame and Endangered Species Conservation Act. 1975 (amended 1987). Revised Status of Nebraska, Sections 37-430 to 37-438.

Prohibits the sale or possession of listed plants and sets up procedures for the reintroduction of any species extirpated from the state. Includes powers to study and conserve, including land acquisition. *Platanthera praeclara* is listed as a rare native vascular plant in Nebraska and is protected by this law.

North Dakota

Nature Preserves Act, 1975. North Dakota Century Code, Sections 55-11-01 to 55-11-13.

Authorizes North Dakota Parks and Recreation Department to acquire and maintain a system of nature preserves by gift or purchase (with approval of the legislature) or by dedication of private or public lands. There are no endangered plant laws in North Dakota.

008508

APPENDIX C

Peer Review and Peer Contributors

The U.S. Fish and Wildlife Service extends special thanks to various experts, in addition to the experts on the recovery team, who reviewed drafts and/or provided their information or expert recommendations for the *Western Prairie Fringed Orchid Recovery Plan*. This peer input was invaluable in bringing current biological information on the species and ecosystem management concepts to the final plan.

The following expert peers provided review and/or scientific information to the recovery team:

Marlin Bowles, Morton Arboretum, Lisle, Illinois

Rochelle Bjugstad-Porter, University of Wyoming, Laramie

Daniel Cuthrell, North Dakota State University, Fargo

Michael Fritz, Nebraska Game and Parks Commission, Lincoln

Karen Johnson, Manitoba Museum of Man and Nature, Winnipeg

Lisa Mueller, Minnesota Department of Agriculture, St. Paul

John Pearson, Iowa Department of Natural Resources, Des Moines

John Pleasants, Iowa State University, Ames

Paige Wolken, University of Wyoming, Laramie

Carla Zellmer, University of Saskatchewan, Saskatoon

008509

APPENDIX D

Technical/Agency Draft Review

The Service transmitted the technical/agency review draft of the plan to involved technical and agency reviewers in May 1994; notice of availability of the draft plan for public review was published in the May 9, 1994, *Federal Register*. The Service and individual members of the Western Prairie Fringed Orchid Recovery Team received substantial formal and informal response addressing a variety of format, content, and organization points of the technical/agency draft. The team carefully considered all comments its members and the Service received. As a result of the technical/agency draft review response, the recovery team was able to substantially improve the final plan in its incorporation of the latest available biological information on the species and the measurement of its recovery, and in the flexibility and practicality of the plan's tasks and recovery criteria.

008510

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Fish, Marine mammals, Plants (agriculture).

Regulation Promulgation

Accordingly, part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, is amended as set forth below:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1543; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

2. Amend § 17.12(h) by adding the following, in alphabetical order, to the List of Endangered and Threatened Plants:

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

Species		Historic range	Status	When listed	Critical habitat	Special rules
Scientific name	Common name					
* * * * * * *						
Anacardiaceae—Cashew family:						
Rhus michauxii	Michaux's sumac	U.S.A. (NC, SC, GA)	E	366	NA	NA
* * * * * * *						

Dated: September 13, 1989.

Richard N. Smith,

Acting Director, Fish and Wildlife Service.

[FR Doc. 89–22848 Filed 9–27–89; 8:45 am]

BILLING CODE 4310–55–M

50 CFR Part 17

RIN 1018–AB23

Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for Eastern and Western Prairie Fringed Orchids

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: The U.S. Fish and Wildlife Service determines *Platanthera leucophaea* (Eastern prairie fringed orchid), and *Platanthera praeclara* (Western prairie fringed orchid) to be threatened species under authority of the Endangered Species Act (Act) of 1973, as amended. Both species have been extirpated throughout much of their former ranges by conversion of habitat for crop fields, grazing, intensive and continuous hay mowing, drainage, fire protection activities, and subsequent decline of prairie habitat. *P. leucophaea* remains extant in approximately 52 populations in seven States and two Canadian Provinces; however, many of these are small, unprotected, and unmanaged populations. *P. praeclara* remains extant in about 37 populations in seven States and one Canadian Province; many of these are small hay meadow populations, where plants are annually cropped before seeds are dispersed. This section will implement Federal protection provided by the Act for *Platanthera leucophaea* and *P. praeclara*.

DATE: Effective date of this rule is October 30, 1989.

ADDRESS: The complete file for this rule is available for inspection by appointment during normal business hours at the Service's Regional Office of Endangered Species, Federal Building, Fort Snelling, Twin Cities, Minnesota 55111.

FOR FURTHER INFORMATION CONTACT: James M. Engel, Endangered Species Coordinator at the above address (612/725–3276 or FTS 725–3276).

SUPPLEMENTARY INFORMATION:

Background

The prairie fringed orchids, *Platanthera leucophaea* and *P. praeclara* are closely related members of the orchid family and are referred to as a species pair (Sheviak and Bowles 1986). Prior to description of *P. praeclara* the two species were considered as *P. leucophaea*, with a total range including 21 states and two provinces (Correll 1950, Luer 1975). Their joint distribution pattern extends from Oklahoma north to Manitoba, and east in a narrowing peninsula through the Great Lakes states to Maine. Populations also range westward through Nebraska in groundwater maintained habitats. *P. leucophaea* occurs primarily east of the Mississippi River, while *P. praeclara* is restricted to west of the Mississippi (Sheviak and Bowles 1986). Both species require full sunlight and usually inhabit tall grass calcareous silt loam or sub irrigated sand prairies. In the east, *P. leucophaea* also occupies calcareous wetlands, including open portions of fens, sedge meadows, marshes, and bogs (Bowles 1983).

The prairie fringed orchids are perennial herbs which regenerate from a fusiform tuber rootstock. Their tubers are dormant during winter and thus are adapted to dormant season prairie fires; such fires and high precipitation levels appear to promote flowering (Sheviak 1974, Roosa and Eilers 1979, Bowles 1983, Currier 1984). Leaves and an inflorescence (if flower primordia were set the prior year) usually emerge in May, and flowering begins by late June to early July. These species are characterized by large white flowers (the largest in the genus) arranged in an inflorescence that may reach 12 decimeters (47 inches) high with up to 40 flowers. The flowers are fragrant after sunset and adapted to pollination by night flying hawkmoths which ingest a high volume nectar resource from long nectar spurs (Bowles 1983). Pollination is required for seed production, while seedling establishment depends upon development of mycorrhizae with a favorable soil inhabiting fungus (reviewed in Bowles 1983). Differences in flower structures and pollination mechanics serve to isolate the species from hybridization; these features can be used to identify living or preserved specimens (Sheviak and Bowles 1986). The western species has larger flowers adapted to placing pollinia (pollen masses) on the compound eyes of visiting pollinators In contrast, the eastern species places pollinia on the proboscis of visiting moths.

Platanthera leucophaea has declined over 70 per cent from original county records and now has about 52 extant populations in seven states. Primarily due to the destruction of large grasslands east of the Mississippi River, extremely large or extensive populations of this orchid do not exist in the United States. In Canada, 12 populations are known from fens and prairies in 12 Ontario counties; one fen population is estimated at 2000 plants (Brownell 1984).

008511

The plant is also known from New Brunswick, where it is considered rare (Hinds 1983). However, most of these populations are not representative of the once vast prairie habitat that supported most populations of this orchid.

Platanthera leucophaea is presumed extirpated from Oklahoma, where the type specimen was collected by Nuttall in 1819 near the confluence of the Kiamichi and Red Rivers; it may have occurred in similar floodplain habitat in adjacent Arkansas (Sheviak and Bowles 1986). This orchid reached its western range limit in Nebraska, where one historic record is known (W.J. Bailey, Jr., Nebraska Game and Parks Commission, *in litt.* 1988). It has not been relocated in Missouri (Morgan 1980), but one small population with three plants remains in Iowa. In the eastern United States, this orchid has not been relocated in New York, Pennsylvania, New Jersey, and Indiana; isolated disjunct populations still occur in Maine and Virginia (Bowles 1983). The Maine population occurs on private land, which is on the State's register of critical areas, in portions of an extensive fen that is undergoing some invasion by woody vegetation. Flowering plants appear erratically at this site. The current population appears to be about 20 adult individuals (Barbara Vickery, The Nature Conservancy, *in litt.* 1988). The small Virginia population occurs in a sedge meadow subject to light grazing. However, this population has not been observed since 1983 when three flowering stems were counted (S.M. Carbaugh, Virginia Department of Agriculture, *in litt.* 1988).

The eastern prairie fringed orchid is known historically from 23 Michigan counties; 18 populations (about half are protected) now are extant from nine counties, where 1322 flowering stems were counted in 1984 (Chapman and Crispin 1985). Southern Michigan populations are small and occur in isolated bog habitats; while several larger populations of over 100 plants occur in lakeside prairies bordering Saginaw Bay. Three large Michigan populations, totalling about 900 plants, occur on degraded upland prairies bordering Lake Erie. These sites are State owned, but extensive management is needed to maintain the orchids as their communities go through successional changes. A population near Bay City disappeared after severe flooding in 1986, and has not been observed since (G.T. Higgs, James Clements Airport Advisory Committee, *in litt.* 1988). The Saginaw Bay region continues to harbor the most viable populations in the state (Chapman and Crispin 1985). Frederick W. Case, Jr. (1987) states that *P. leucophaea* is possibly the region's most endangered orchid because of the destruction of its moist prairie habitat.

Platanthera leucophaea originally occurred in 11 Ohio counties and is now presumed extirpated from at least six. McCance (Ohio Department of Conservation, *in litt.* 1987) reported only two extant populations in 1987. The larger, containing about 60 flowering plants in 1987, was down from 367 plants in 1982. The other population contained 46 flowering plants in 1984, but only six plants were found in 1987. Smith (The Nature Conservancy, *in litt.* 1988) reports this population has further declined to two plants. Two other populations are known from sites frequently inundated by Lake Erie. One of these was located in 1987 when 24 plants were counted. Smith (1981) also observed this population in 1988 and counted 14 plants. The other site has not been relocated (C.R. Moseley, Jr. Ohio Department of Natural Resources, *in litt.* 1988). In Wisconsin, this orchid originally was known from 22 sites in 17 counties in the south and southeast portions of the state (Alverson 1981). Fourteen of these are known to be extirpated (J. Dobberpuhl, Wisconsin Department of Natural Resources, *in litt.* 1988). Nine small populations now occur in eight counties. One large population of several hundred plants occurs in a protected Lake Michigan border sand prairie in Kenosha County.

Illinois probably contained the largest and most extensive pre-settlement populations of the eastern prairie fringed orchid and also sustained the most drastic population decline of any state. Originally it was known from tall grass prairies in 33 counties across the northern two thirds of the State, an area now almost totally converted to agriculture (Bowles and Kurz 1981). Eighteen populations remain in eight counties concentrated in the Chicago region; two additional populations occur in cemetery prairies in eastern and western Illinois counties. Only two populations consist of over 100 plants; both are in a Lake Michigan border county. Most populations are offered some form of protection, and only eight occur on private unprotected land.

Platanthera praeclara has experienced over a 60 percent decline according to county records, with about 37 populations remaining in seven states (Bowles and Duxbury 1986). Apparently, it has been extirpated from South Dakota where it was originally known from two counties. Populations in the southern part of this orchid's range seldom are observed. The two Oklahoma populations occur in privately owned hay meadows and were only observed during their original discovery (Magrath and Taylor 1978). This orchid was widespread in eastern Kansas, where it was originally known from 14 counties. Now, populations are reduced to eight counties where it is believed to occur in seven privately owned hay meadows and one University of Kansas research area (R.E. Brooks, U. of Kansas, *in litt.* 1987). Two small populations currently are known to occur in northwest Missouri. One population of five plants occurs on a private tract, while a second, of about 25 plants, is in a hay meadow recently acquired by the state.

Populations in the northern and central portions of the western prairie fringed orchid's range are larger and more extensive, but still reduced in size and range. This orchid probably was most widespread in the deep loess soils of Iowa, where a total of about 600 plants currently exist. Now, 13 populations are known extant from 11 Iowa counties (D. Howell, Iowa Department of Natural Resources, pers. comm. 1987). Most populations are small, with the largest consisting of about 275 plants. Six of the Iowa populations are in public or private conservation ownership and are managed by burning or mowing.

Platanthera praeclara originally was widespread in eastern Nebraska (Bowles and Duxbury 1986). A questionable historic record from 1842 attributed to Wyoming is now considered to be from Western Nebraska (H. Marriott, The Nature Conservancy, *in litt.* 1987). Five populations are known from four counties. Two populations are small (less than 20 plants each) and disjunct in western Nebraska; one occurs on a railroad right-of-way, while the other is on Federal land (Valentine National Wildlife Refuge) administered by the U.S. Fish and Wildlife Service. The federally owned tract is undergoing brush invasion. Three other sites in eastern Nebraska are on private or public land managed for conservation. Four of the five sites in Nebraska receive some type of protection and management. The largest population consists of about 150 plants. Five other *Platanthera praeclara* sites in Nebraska are assumed extirpated as their status is unknown.

One large scattered population occurs in North Dakota with approximately 2000 plants (Bowles and Duxbury 1986). The North Dakota population represents the type locality for *Platanthera*

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praeclara (Sheviak and Bowles 1986) and occurs primarily on Federally owned sand prairie managed by the U.S. Forest Service. The Forest Service has initiated a monitoring program for *P. praeclara* in order to establish some baseline data. Guidelines to protect the plant during haying operations and herbicide applications to control leafy spurge are in place. Research is needed to determine what effects current management has on the orchids, and if increases in grazing intensity would negatively affect their populations. Six populations occur in four Minnesota counties (Smith 1981). The largest is in protected ownership and is found at five sites with about 500 plants. This orchid recently was discovered in similar prairie habitat in Manitoba (Brownell 1984).

Federal Government action on these plants began as a result of Section 12 of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), which directed the Secretary of the Smithsonian Institution to prepare a report on plants considered to be endangered, threatened, or extinct. This report (Ayensu and DeFilipps 1978), designated as House Document No. 94–51, was presented to Congress on January 9, 1975. *Platanthera leucophaea*, which at that time was placed in the genus *Habenaria* and included in part the then undescribed *P. praeclara*, was listed as "threatened" in that document. On July 1, 1975, the Service published a notice in the **Federal Register** (40 FR 27823) of its acceptance of the Smithsonian report as a petition within the context of section 4(c)(2) of the Act (now section 4(b)(3)) and of its intention to review the status of plant taxa named within. On June 16, 1976, the Service published a proposed rule in the **Federal Register** (41 FR 24523) to determine approximately 1,700 vascular plant species to be endangered species pursuant to section 4 of the Act. The list of 1,700 plant taxa was assembled on the basis of comments and data received by the Smithsonian Institution and the Service in response to House Document No. 94–51 and the July 1, 1975, **Federal Register** publication. *Platanthera leucophaea* was included in the July 1, 1975, notice of review and the June 16, 1976, proposal. General comments received in relation to the 1976 proposal were summarized in the **Federal Register** on April 26, 1978 (FR 17909). On December 10, 1979, the Service published a notice (44 FR 70796) withdrawing the portion of the June 16, 1976, proposal that had not been made final, along with four other proposals that had expired due to a procedural requirement of the 1978 Amendments to the Act. On December 15, 1980 (45 FR 82479), and September 27, 1985 (50 FR 39525), the Service published revised notices of review for native plants in the **Federal Register**. *Platanthera leucophaea* (including in part the then yet undescribed *P. praeclara*) initially was included in those notices as a category 1 species. Category 1 species are those for which biological information in the Service's possession warrants listing as endangered or threatened. Later, this orchid was dropped to category 2, indicating that further biological research and field study were needed to ascertain its status.

The Endangered Species Act Amendments of 1982 required that all petitions pending as of October 13, 1982, be treated as having been submitted on that date. The deadline for a finding on those species, including *Platanthera leucophaea*, was October 13, 1983. On October 13, 1983, and again in 1984, 1985, 1986, and 1987, the petition finding was that listing of *Platanthera leucophaea* (including in part the then yet to be described *P. praeclara*) was warranted pending finding of further biological information but precluded by other pending listing actions, in accordance with section 4(b)3(B)(iii) of the Act. Such a finding requires that the petition be recycled, pursuant to section 4(b)(3)(C)(i) of the Act. The October 11, 1988 (53 FR 39621) proposal to classify *Platanthera leucophaea* and *P. praeclara* as threatened constituted the final required finding.

Summary of Comments and Recommendations

In the October 11, 1988, proposed rule and associated notifications, all interested parties were requested to submit factual reports or information that might contribute to the development of a final rule. Appropriate State agencies, county governments, Federal agencies, scientific organizations, landowners, and other interested parties were contacted and requested to comment. Notices inviting public comment were published in the following newspapers: *Chicago Tribune*, Chicago, IL; *The Des Moines Register*, Des Moines, IA; *The Globe-Gazette*, Mason City, IA; *Sioux City Journal*, Sioux City, IA; *Waterloo Courier*, Waterloo, IA; *Lawrence Journal-World*, Lawrence, KS; *The Leavenworth Times*, Leavenworth, KS; *Ottawa Herald*, Ottawa, KS; *Topeka Capitol Journal*, Topeka, KS; *Bangor Daily News*, Bangor, ME; *The Bay City Times*, Bay City, MI; *Detroit Free Press*, Detroit, MI; *Three Rivers Commercial News*, Three Rivers, MI; *Austin Daily Herald*, Austin, MN; *Crookston Daily News*, Crookston, MN; *Rock County Stat-Herald*, Luverne, MN; *St. Joseph News-Press/Gazette*, St. Joseph, MO; *The Grand Island Independent*, Grand Island, NE; *The Lincoln Star* and *Lincoln Journal*, Lincoln, NE; *Valentine Newspaper*, Valentine, NE; *The Forum*, Fargo, ND; *The Ransom County Gazette*, Lisbon, ND; *Daily News*, Wahpeton, ND; *Tulsa Tribune*, Tulsa, OK; *Daily News Leader*, Staunton, VA; *Wisconsin State Journal*, Madison, WI; *The Janesville Gazette*, Janesville, WI; *The Milwaukee Journal*, Milwaukee, WI; *Oshkosh Northwestern*, Oshkosh, WI between October 25, and November 3; and in the *Sioux Falls Argus-Leader*, Sioux Falls, SD, on November 22, 1988. Twenty-four comments were received, none of which opposed the rule. A summary of substantive comments is presented below.

Comments were submitted by two Federal agencies, twelve State agencies, three conservation organizations, and seven individuals. Fourteen responses supported listing while the remainder did not express a position. The U.S. Forest Service commented that the area in North Dakota, within the Sheyenne Ranger District (Sheyenne National Grassland), containing an extensive population of *Platanthera praeclara* (Western Prairie fringed Orchid) has been grazed for about 100 years, and the continued existence of the species, and the possibility it may be increasing, indicates to them that there may not be a need to list the species. However, the Forest Service acknowledges that plants must be listed rangewide, and because the species is declining elsewhere within its range, does not oppose the listing. The Forest Service points out that while overgrazing may be contributing to the decline of the species, there does not appear to be strong evidence that grazing by itself is as detrimental to the species as cropland conversion. The Forest Service has recognized the need to integrate rare species management into management activities on the Sheyenne Ranger District and has developed guidelines to protect the plant during haying and pesticide application. The Forest Service looks forward to a cooperative recovery effort and is initiating an Interim Management Plan specifically for the enhancement of this species, until such time as research has provided the answers for further management. The Soil Conservation Service office in North Dakota commented that a litter buildup may suppress *P. praeclara*, and rotational grazing may be beneficial.

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The Sheyenne Valley Grazing Association commented that the Service is proposing to list *Platanthera praeclara* without knowing all the facts about the species, what is ideal habitat, how mowing affects the plant, and if anything other than cropping is harmful to the species. In addition, the Grazing Association expressed concerns about the methods of listing plants, and if plants could be listed by population, the more healthy populations like the one on the Sheyenne National Grasslands would be unaffected. The Association does not oppose the listing, but believes even with listing we will not have all the answers. They want to be kept informed of the situation. The Service has completed range wide status surveys for *Platanthera praeclara* and *Platanthera leucophaea*. As as result of these surveys, and other biological documentation, the Service believes listing is appropriate. There might be instances where some populations of the plant may be in better condition than others, but range wide, both species have declined significantly and will continue to face threats of habitat destruction and alteration. By placing these species under the protection of the Act, the Service, and other cooperating Federal and State agencies will be able to complete recovery plans, initiate and complete research, and complete other management actions that will provide information to enhance both species' survival.

The remaining comments, from State agencies, private conservation organizations, and individuals provided new species status information, advice of additional state protection, or lack thereof, mentioned the existence of localized threats to the species, and offered editorial comments concerning the rule. These comments have been incorporated into this final rule as deemed appropriate. A letter from a private conservation group supporting the listing was signed by 28 members of the organization.

Summary of Factors Affecting the Species

After a thorough review and consideration of all information available, the Service has determined that *Platanthera leucophaea* (Nutt.) Lindl. and *Platanthera praeclara* Sheviak and Bowles should be classified as threatened species. Procedures found at section 4(a)(1) of the Act and regulations (50 CFR part 424) promulgated to implement the listing provisions of the Act were followed. A species may be determined to be endangered or threatened due to one or more of the five factors described in section 4(a)(1). These factors and their application to *Platanthera leucophaea* (Nutt.) Lindl. and *Platanthera praeclara* Sheviak and Bowles are as follows:

A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

The prairie fringed orchids have declined significantly throughout their ranges due to conversion of most of their habitats to cropland, overgrazing, intensive hay mowing, drainage, and for fire protection; these and related threats continue. Many of the largest *Platanthera leucophaea* populations occur in habitats supporting successional vegetation. Without management these populations may decline in response to changing vegetation patterns. Many other populations are small and occur on small isolated prairie remnants, where seed set and reproduction is limited by dependence on chance visitation from pollinators. Over 35 percent of the known populations of *Platanthera praeclara* occur in hay meadows; these plants seldom are seen, and populations apparently are small. Hay mowing annually removes seed capsules and plant biomass before natural seed dispersal can occur. This prevents recruitment of seedlings into populations and probably weakens adult plants, resulting in gradual population decline through attrition (Bowles 1983, Bowles and Duxbury 1986). Changing land use also threatens hay meadow populations. At least four Kansas hay meadows known to support *Platanthera praeclara* populations have been converted to cultivated cropland since their discovery in the 1970's, while one Oklahoma hay meadow now is threatened with subdivision (Bowles and Duxbury 1986). The use of herbicides, especially on highway and railroad rights-of-way, continues to threaten these species in a number of instances (P.E. DeHond, Maine Planning Office, *in litt.* 1988, and L.G. Hiller,. Ft. Ranson, ND, *in litt.* 1988).

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Native terrestrial orchids rarely are grown from seed; adult plants are often sought for scientific and commercial purposes, or for private gardens. Smaller populations of the prairie fringed orchids would be adversely affected by collecting. Because of higher human population densities in the east, the eastern prairie fringed orchid is subject to greater scientific and commercial pressures; at least one Michigan population was affected by removal of plants. However, because of the recent description of *Platanthera praeclara* (western prairie fringed orchid) and its usually small populations, over-collecting may also become a serious problem for this species. At least one instance of removal of a western prairie fringed orchid plant for commercial purposes has taken place in Minnesota.

C. Disease or Predation

No diseases are known to be adversely affecting either prairie fringed orchid species. All inflorescences were removed from one Minnesota population of *Platanthera praeclara* by an unknown herbivore, but the long term impact remains unknown. Conehead grasshoppers (Orthoptera: *Neoconocephalus*) occasionally are observed eating the flowers or fruits of these orchids. However, the major predator is man through use of this orchid's community for pasture or hay. Long term overgrazing or haying apparently leads to population decline because plants either are harvested or are not allowed to complete their life cycles.

D. The Inadequacy of Existing Regulatory Mechanisms

The prairie fringed orchids are formally or officially listed as endangered, threatened, or rare in ten states (IA, IL, ME, MI, MN, MO, NE, ND, OH, WI) throughout their range. However, only a few states where these species are extant offer protection to listed plants beyond that afforded by their presence on public lands. State laws of Illinois, Iowa, Minnesota, Michigan, and Missouri prohibit the removal and sale of listed plants. Michigan prohibits transport, buying, selling, possessing, or destroying in any manner. In Wisconsin, Ohio, and New York it is illegal to harvest endangered or threatened plants. Although *Platanthera leucophaea* and *P. praeclara* are offered various forms of recognition or protection under state laws, the Endangered Species Act offers possibilities for protection through section 6 by cooperation between States and the Service, and cooperation with other Federal agencies through section 7 (interagency cooperation) requirements. The plants are considered rare in Canada, but are not afforded any official designation or protection.

E. Other Natural or Manmade Factors Affecting Its Continued Existence.

Pollination of the prairie fringed orchids is required for seed set, and is accomplished only by hawkmoths (Sphingidae). As a result, long-term

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population survival requires maintenance of hawkmoths. Any threat to these insects (such as the use of insecticides) or their habitats and food plants, is a threat to survival of prairie fringed orchids.

The Service has carefully assessed the best scientific information available regarding the past, present, and future threats faced by these taxa, in determining to make this rule final. Based on this evaluation, the preferred action is to list *Platanthera leucophaea* and *Platanthera praeclara* as threatened species, because of the known loss of most of their populations and habitat, and continued threats to existing populations. For reasons detailed below, it is not considered prudent to propose designation of critical habitat.

Critical Habitat

Section 4(a)(3) of the Act requires, to the maximum extent prudent and determinable, that the Secretary designate critical habitat at the time the species is determined to be endangered or threatened. The designation of critical habitat is not considered to be prudent when such designation would not be of net benefit to the species involved (50 CFR 424.12). In the present case, the Service believes that designation of critical habitat would not be prudent because no benefit to the species can be identified that would outweigh the potential threat of vandalism or collection, which might be exacerbated by the publication of a detailed critical habitat description.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Endangered Species Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in conservation actions by Federal, State, and private agencies, groups, and individuals. The Endangered Species Act provides for possible land acquisition and cooperation with the States. It also requires that recovery actions be carried out for all listed species. These recovery actions are initiated by the Service following listing. Some may be undertaken prior to listing, circumstances permitting. Potential habitat management actions that might benefit *Platanthera leucophaea* and *P. praeclara* include: evaluation and specific management actions on public lands to enhance orchid populations, land protection measures which will reduce frequent disturbance to both species' habitat, and a program for landowners to educate them about the nature of their orchid populations and how they might alter management of their property to benefit these species. The protection required by Federal agencies and applicable prohibitions are discussed below.

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is being designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(2) requires Federal agencies to insure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of a listed species or to destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible federal agency must enter into formal consultation with the service.

The Food Security Act of 1985 (Pub. L. 99-198) also provides at sections 1314 and 1318 opportunities for the Service and State conservation agencies to acquire restrictive easements beneficial to endangered and threatened species on lands acquired by the Farmers Home Administration in the course of farm foreclosures. Upon notification by the Farmers Home Administration of pending foreclosures, the Service is continually reviewing possible areas where restrictive easements would benefit endangered and threatened species.

No Federal involvement is expected for *Platanthera leucophaea* since the species is not known to occur on Federal lands. *Platanthera praeclara* is known to occur on lands under the jurisdiction of the U.S. Fish and Wildlife Service on the Valentine National Wildlife Refuge, in Nebraska. Grazing management plans on the refuge should consider the effects livestock has on the species. A population monitoring program for *P. praeclara* should be initiated. A widely scattered population of *P. praeclara* is found on the Sheyenne National Grassland, Custer National Forest, Ransom and Richland counties, North Dakota. This population extends over several thousand acres managed by the U.S. Forest Service which in turn leases the area to the Sheyenne Valley Grazing Association for livestock production. The Forest Service and the Grazing Association are aware of *P. praeclara*. The species is found on 25 of the 58 allotments within the Sheyenne National Grassland. In order to meet the intent of the Act, the U.S. Forest Service, in cooperation with the Service, the State of North Dakota, and the Sheyenne Valley Grazing Association, is initiating interim grazing management actions on the Sheyenne National Grasslands which is designed to safeguard *P. praeclara* until such time as recovery research has been completed that should provide results to guide us in future management. Research will soon be underway which will allow us to better understand which types of management actions within the Grassland area might be beneficial to *P. praeclara*. Cooperative discussions between the Forest Service, the Grazing Association, and the Service have been initiated. It will be necessary for the Forest Service to enter into consultation with the Service so that *Platanthera praeclara* plants are considered in the course of activities carried out by that agency. It has been the experience of the Service that the majority of section 7 consultations are resolved so that the species is protected and the project can continue.

The Act and its implementing regulations found at 50 CFR 17.71 and 17.72 set forth a series of general trade prohibitions and exceptions that apply to all threatened plants. With respect to *Platanthera leucophaea* and *P. praeclara*, all trade prohibitions of section 9(a)(2) of the Act, implemented by 50 CFR 17.71, will apply. These prohibitions, in part, make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale these species in interstate or foreign commerce, or remove and reduce to possession these species from areas under Federal jurisdiction. Seeds from cultivated specimens of threatened plant species are exempt from these prohibitions provided that a statement of "cultivated origin" appears on their containers. In addition, for listed plants, the 1988 amendments (Pub. L 100-478) to the Act prohibit the malicious damage or destruction on Federal lands and the removal, cutting, digging up, or damaging or destroying of listed plants in knowing violation of any State law or regulation, including State criminal trespass law. Certain exceptions would apply to agents of the Service and State conservation agencies. The Act and 50 CFR 17.72 also provide for the issuance of permits to carry out otherwise prohibited activities involving threatened species under certain circumstances. It is anticipated that some trade permits would be issued

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because these plants belong to the orchid family, species of which now are sought for cultivation.

On July 1, 1975, *Platanthera leucophaea* was included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which is implemented through section 8A of the Act. The effect of this listing is that generally, both export and import permits are required before international shipment may occur. Such shipment is strictly regulated by CITES member nations to prevent it from being detrimental to the survival of the species, and generally, cannot be allowed if it is for primarily commercial purposes. If plants are certified as artificially propagated, however, international shipment requires only export documents under CITES, and commercial shipments may be allowed. Requests for copies of the regulations on plants and inquiries regarding them may be addressed to the Office of Management Authority, U.S. Fish and Wildlife Service, P.O. Box 3507, Arlington, VA 22203, (703/358–2093).

National Environmental Policy Act

The Fish and Wildlife Service has determined that Environmental Assessments, as defined under the authority of the National Environmental Policy Act of 1969, need not be prepared in connection with regulations adopted pursuant to section 4(a) of the Endangered Species Act of 1973, as amended. A notice outlining the Service's reasons for this determination was published in the **Federal Register** October 25, 1983 (48 FR 49244).

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Author

The primary author of this rule is William F. Harrison (see **ADDRESSES** section). Preliminary documentation was prepared under contract by Marlin L. Bowles, The Morton Arboretum, Lisle, IL.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Fish, and Marine mammals, Plants (agriculture).

PART 17—[AMENDED]

Accordingly, part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, is amended as set forth below:

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1543; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

2. Amend § 17.12(h) by adding the following, in alphabetical order under the family Orchidaceae, to the List of Endangered and Threatened Plants:

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

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Species		Historic Range	Status	When listed	Critical habitat	Special rules
Scientific name	Common Name					
•	•	•	•		•	
Orchidaceae-Orchid family:						
•	•	•	•		•	
Platanthera leucophaea	Eastern prairie fringed orchid	U.S.A. (AR, IA, IL, IN, ME, MI, MO, NE, NJ, NY, OH, OK, PA, VA, WI), Canada (ON, NB).	T	367	NA	NA
Platanthera praeclara	Western prairie fringed orchid	U.S.A. (IA, MN, MO, NE, ND, OK, KS, SD), Canada (MB).	T	367	NA	NA
•	•	•	•		•	

Dated: September 14, 1989.

Bruce Blanchard,

Acting Director, Fish and Wildlife Service.

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Western Prairie Fringed Orchid
(Platanthera praeclara)

5-Year Review:
Summary and Evaluation

February 2009

Photo: J. Challey

U.S. Fish and Wildlife Service
Twin Cities Field Office
Bloomington, Minnesota

5-YEAR REVIEW
Western Prairie Fringed Orchid (*Platanthera praeclara*)

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5-YEAR REVIEW
Western Prairie Fringed Orchid (*Platanthera praeclara*)

1.0 GENERAL INFORMATION

1.1 Reviewers

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The following persons also provided helpful comments:

Mel Nenneman – Valentine National Wildlife Refuge
Gary Willson (RT)[1] – National Park Service
Tom Nagel (RT) – Missouri Department of Conservation
Tim Smith – Missouri Department of Conservation
Bill Watson (RT) – Cedar Falls, Iowa

1.2 Methodology used to complete the review:

The review was conducted by Phil Delphey in the Twin Cities Field Office in coordination with other field offices in the Mountain-Prairie and Southwest Regions. The Service solicited information from the public through a *Federal Register* notice (71 FR 16177) and also reviewed reports and scientific papers that had been completed since the November 1991 5-year review (which includes the species' 1996 approved recovery plan). We reviewed each document for significant information, beginning with the earliest document not cited in the recovery plan (i.e., Fauske and Rider 1996 – see References). In addition, we relied extensively on a database containing information on each occurrence of western prairie fringed orchid, which the Service maintains at its Twin Cities Ecological Services Field Office.

[1] "RT" indicates that this person is a member of U.S. Fish and Wildlife Service's Western Prairie Fringed Orchid Recovery Team.

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1.3 Background:

1.3.1 Federal Register Notice citation announcing initiation of this review:

71 FR 16176, March 30, 2006.

1.3.2 Listing history

Original Listing
FR notice: 54: 39857-39863
Date listed: September 28, 1989
Entity listed: *Platanthera praeclara*
Classification: Threatened

1.3.3 Associated rulemakings: None

1.3.4 Review History: Western prairie fringed orchid was included in a five-year review of all species listed before January 1, 1991 (56 FR 56882). The five-year review resulted in no change to the listing classification of threatened.

1.3.5 Species' Recovery Priority Number at start of 5-year review: 8C. A recovery priority of 8C denotes that the degree of threat is moderate, the recovery potential is high, the listed taxon is a species (e.g., as opposed to a subspecies), and that the species may be in conflict with construction, other developmental projects, or other forms of economic activity.

1.3.6 Recovery Plan

Name of plan: Western Prairie Fringed Orchid (*Platanthera praeclara*) Recovery Plan
Date issued: September 30, 1996
Dates of previous revisions, if applicable: N/A

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1 Is the species under review a vertebrate? *No*

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? *Yes*

2.2.2 Adequacy of recovery criteria

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2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? *No*

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

The recovery criteria in the 1996 recovery plan (U.S. Fish and Wildlife Service 1996) are:

Platanthera praeclara will be considered for delisting when sites that include occupied habitat harboring 90 % of plants in each ecoregion are protected at protection levels 4 through 9 (The Nature Conservancy 1996) and managed in accordance with a Service-approved management plan or guidelines. This plan must assure implementation of management practices that provide the range and spatial distribution of successional and hydrologic regimes required to maintain the species and its pollinators in self-sustaining, naturally occurring populations, and must remain in effect following delisting. Implementation of these criteria is further clarified in the strategy of recovery section above and in the recovery narrative below.

The recovery criteria may be divided into two distinct components – ensuring that (1) a minimum proportion of plants within each inhabited ecological region occur on lands that are protected from habitat destruction and (2) management of these protected habitats is conducive to the conservation of western prairie fringed orchid. Below we refer to these as the protection and management criteria, respectively.

Protection Criterion:
…sites that include occupied habitat harboring 90 % of plants in each ecoregion are protected at protection levels 4 through 9 (The Nature Conservancy 1996)…

Under this criterion, plants are protected only if they are on sites that are "permanently safe from conversion from grassland into any other use" (see Strategy of Recovery section in the recovery plan - U.S. Fish and Wildlife Service 1996:17). Levels 4 through 9 ensure protection in different ways, as listed below. The Nature Conservancy's 10 levels of protection are (The Nature Conservancy 1996):

0 No protection
1 Notification – Landowner or site manager notified of the species' presence

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2 Voluntary protection provided by landowner or site manager
3 Bequest – Will, right of first refusal, or other landowner/agency commitment
4 Lease, license, or management agreement
5 Undivided or remainder interest conveyed to a conservation entity
6 Public land designation
7 Conservation easement
8 Fee title or beneficial interest with management control
9 Dedication

This criterion addresses the following threats:

- Conversion of habitat to cropland
- Inter-seeding of non-native species, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail), into wet prairie in Nebraska. Inter-seeding of non-native species is only likely to occur on sites managed primarily for agriculture.

The recovery criteria do not specifically address the viability of protected populations. For example, an ecoregion could meet this criterion even if none of the protected populations are viable. Actions 421-423 in the recovery plan's step-down outline (U.S. Fish and Wildlife Service 1996:19-22) describe research needed to provide a basis for a population viability analysis (PVA) and action 424 calls for the development of a PVA for the species. The results of these actions could be used to revise the recovery criteria to address the viability of protected populations; a PVA based on demographic monitoring in Minnesota may be nearing completion (Nancy Sather, Minnesota Department of Natural Resources, pers. comm., 4/9/07).

We used data provided by the states and others to assess progress towards meeting the protection criterion.[2] Consistent with the recovery plan, we considered a population to be extant if one or more plants were recorded within the last 25 years – i.e., in 1983 or later – unless the population was known to be extirpated (e.g., Elkins Prairie in Kansas, which was plowed up in 1990). In addition, we used the highest counts for each population to determine the number of plants protected at each site. The plan does not state how plants are to be counted to assess progress towards the recovery, but the maximum number of flowering plants in any given year has been used by others to describe sizes of western prairie fringed orchid populations (e.g., Seifert-Spilde 2001) and Sather (1997) used the highest number of plants reported for sites to measure progress towards meeting the protection criterion for one ecological section.

[2] This data is maintained in a Microsoft Access database at the Service's Twin Cities Ecological Services Field Office in Bloomington, Minnesota.

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Alternatively, some authors have proposed using *mean* counts as a basis for assessing the conservation status of threatened plants (Bowles et al. 1999). The use of maximum counts of flowering plants (non-flowering plants are too difficult to find to include in censuses) may overestimate actual population sizes, but it is sufficient for determining the proportion of plants protected from conversion.

We counted *as protected* only those populations whose protection level was known to meet or exceed level 4, as defined in the recovery plan (U.S. Fish and Wildlife Service 1996:68) and assumed that populations whose protection level is unknown were unprotected. This is likely valid because our data sources, typically state conservation agencies, are usually aware of the status of populations that are under some type of protective ownership or agreement, but are often uncertain of the exact protective status of populations that are in private ownership. There are 75 populations with unknown protection levels in Nebraska and 7 in Minnesota.

The Western Prairie Fringed Orchid Recovery Plan (U.S. Fish and Wildlife Service 1996) based recovery on the status of populations within each ecoregional section occupied by the species (Bailey et al. 1994). Bailey's ecoregions are mapped at successively finer levels of detail. From coarse to fine they are: domain, division, province, section, and subsection. The Western Prairie Fringed Orchid Recovery Plan based recovery on the status of populations among the ecoregional *sections* occupied by the species. Since 1996, the boundaries of these sections have been revised to improve correspondence between finer-scale map boundaries and important ecological features such as glacial lines and landforms (ECOMAP 2007; McNab et al. 2007). These changes included modifications to the section boundaries that were used by the Service to guide western prairie fringed orchid recovery (U.S. Fish and Wildlife Service 1996:87). Therefore, we will describe progress toward meeting the recovery criterion in the context of revised ecoregional sections map (Figure 1, Table 1).

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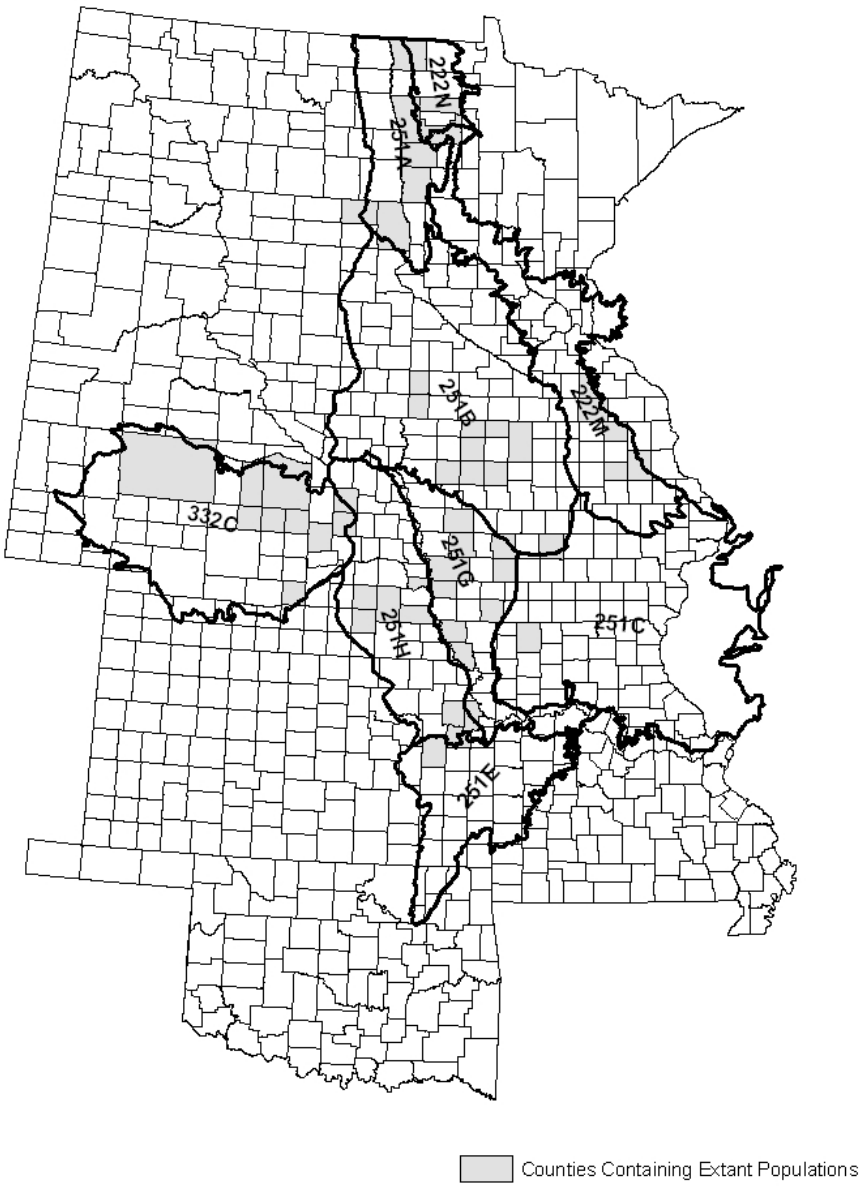

Figure 1. Revised ecological sections (McNab et al. 2007) that contain extant populations of western prairie fringed orchid.

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Table 1. Abundance of western prairie fringed orchid plants in each revised ecological section (Figure 1) and on sites with protections levels 4-9 (USFWS 1996:68). Numbers are based on high counts of flowering plants for sites known or presumed to be extant (at least one plant observed after 1982 and not otherwise known to have been extirpated) and were calculated based on data in the Service's files on September 23, 2008. Note that further investigation may be necessary to determine if sites are also protected from hydrologic alterations and from impacts of pesticides and herbicides.

Section Name	Section	Total Plants	Total Plants on Sites with Protection Levels 4-9	% Plants on Sites with Protection Levels 4-9
Minnesota and Northeast Iowa Morainal-Oak Savannah	222M	125	123	98
Lake Agassiz-Aspen Parklands	222N	11,788	10,064	85
Red River Valley	251A	12,768	11,770	92
North Central Glaciated Plains	251B	1,127	714	63
Central Dissected Till Plains	251C	51	51	100
Osage Plains	251E	14	0	0
Missouri Loess Hills	251G	938	515	55
Nebraska Rolling Hills	251H	158	71	45
Nebraska Sand Hills	332C	2,171	769	35
Total		29,140	24,077	83

Due to the revision of the section boundaries, there are two sections (McNab et al. 2007) that now contain *P. praeclara* that were not addressed in the recovery plan – 222N and 251H. In addition, the name of section 251G was changed from the Central Loess Section to the Missouri Loess Hills Section. Finally, sections 332D and 332E no longer contain any *P. praeclara* populations due to the relocation of the boundaries for these sections.

Based on this analysis, 90% or more of the plants in sections 222M, 251A, and 251C have been protected and the protection criterion has nearly been met in section 222N with 85% of plants under protective ownership. Protection actions are still needed to meet the recovery criteria, however, in the remaining five sections. Two sections, 251C and 251E, each contain only one recorded extant population.

Management Criterion:
… and managed in accordance with a Service-approved management plan or guidelines. This plan must assure implementation of management practices that provide the range and spatial distribution of successional and hydrologic regimes required to maintain the

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species and its pollinators in self-sustaining, naturally occurring populations, and must remain in effect following delisting.

This criterion addresses the following identified threats:

- Overgrazing
- Intensive hay mowing that may reduce primary productivity and seed dispersal and facilitate invasion of exotic cool season grasses
- Lack of management (woody plant invasion)
- Invasive species, including some cool season grass species
- Actions to control invasive species
- Herbicide use

The Service has not approved any management plans with clear reference to this recovery criterion or developed general management guidelines for the species. The recovery plan provides the following guidance, however, for evaluating management plans:

1. Populations must be protected from hydrologic alterations and pesticide impacts (p. 17);
2. Appropriate management must be implemented for at least three management cycles (e.g., if guidelines call for prescribed fire at a specified interval or range of intervals, the guidelines would not be fully implemented until the third prescribed burn has taken place at the appropriate intervals);
3. "Where sites are too small to permit natural succession to occur, manage communities to maintain the species' specific microhabitat requirements" (pp. 22-23);
4. "(F)ocus on maintaining or restoring the composition, function, and structure of the ecosystem on which *western prairie fringed orchid* depends, even though specific autecological and synecological information is lacking for the species" (p. 24);
5. Management practices should "duplicate the natural processes of the tallgrass prairie ecosystem" (p. 24);
6. Regularly review management practices and refine them as relevant research becomes available (p. 24).

Although this criterion has not been achieved, these six guiding principles for evaluating management plans may serve as interim guidelines to assess the adequacy of management of sites where western prairie fringed orchid is under protective ownership levels 4-9.

Sheyenne National Grasslands Management Plan

The Forest Service's "Recovery Strategy for the Western Prairie Fringed Orchid on the Sheyenne National Grassland" (USDA Forest

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Service 2001) may be the most explicit management plan focused on the conservation of specific western prairie fringed orchid populations. Therefore, we will use it here as an example of how the Service might evaluate management plans in light of the recovery plan's management criterion.

This strategy is intended to:

1. Implement management direction found in the Dakota Prairie Grasslands Land and Resources Management Plan and the Western Prairie Fringed Orchid Recovery Plan (USFWS 1996).
2. Provide a broad umbrella under which management activities will occur that will not adversely impact western prairie fringed orchid.
3. Provide the framework for implementing a realistic western prairie fringed orchid monitoring program specific to Sheyenne National Grasslands (SNG).
4. Provide the impetus to guide changes in allotment management plan revisions relative to management of western prairie fringed orchid and its habitat.

Threats Not Adequately Addressed by Recovery Criteria

Recovery criteria should address all threats to the species that are contributing to its status as threatened or endangered and should be objective and measurable to be effective in measuring progress toward recovery. The recovery criteria do not adequately address the following threats that were identified in the listing rule, recovery plan, or after the approval of the recovery plan:

- Off-site drainage that would directly or indirectly lower water levels in the *P. praeclara* rooting zone
- Pesticide and herbicide impacts
- Low seed set in small and isolated populations

The recovery plan clearly acknowledges the need for sites to be protected from "the plow", pesticide impacts, and hydrologic alterations (U.S. Fish and Wildlife Service 1996:17), but the *recovery criteria* do not appear to adequately address the latter two threats. Even if protective ownership and appropriate management guard against drainage within the protected site, drainage on neighboring properties or projects with broad effects could still affect otherwise protected populations. Likewise, inadequate protection from the effects of herbicide and pesticide use carried out on or adjacent to occupied sites may also threaten some populations. Therefore, our summary of protection at levels 4-9 (Table 1) may adequately address the potential threat of "the plow" and collection of plants from small populations,

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but may not adequately account for the level of threat posed by hydrologic alterations and pesticides.

Development of a population viability criterion may address the threat of small and isolated populations with low seed set if populations facing this threat would have to reach viable levels to be counted toward recovery.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

Pollination Biology

Although Western prairie fringed orchid forms tubers and vegetative shoots from existing plants, pollination is required for seed production (U.S. Fish and Wildlife Service 1996:7). Western prairie fringed orchid is pollinated by a few species of sphinx moths (Sphingidae, Table 2) (Vik in prep.; Westwood and Borkowsky 2004:17). Vik (in prep.) found that 96% of flowers with signs of moth visits ('pollinia missing', 'pollen deposited', or 'scales deposited') produced seed pods, whereas only 23% of flowers with none of these signs produced seed. Several studies have identified or reconfirmed various sphinx moths as pollen vectors (i.e., species observed with attached pollinia of *Platanthera praeclara*, Table 3) since 1996. Western prairie fringed orchid pollinia typically attach to the center of the moths' eyes (Vik in prep.; Westwood and Borkowsky 2004:18) and Sheviak and Bowles (1986) concluded that potential pollinators have a distance of 5.8-6.4 mm between the outer eye margins and probosces that are "sufficient to reach common nectar levels" (34-43 mm long). Westwood and Borkowsky (2004), however, concluded that in Manitoba a slightly shorter proboscis length of 30-35 mm may be sufficient to obtain nectar, based on a mean distance to nectar of 32.83 mm (n = 1016, SE = 0.2). They also found that distance to nectar decreased during the flowering period due to increasing volumes of nectar. Therefore, a proboscis as short as approximately 28 mm may be sufficient to reach nectar late in the flowering period (Borkowsky 2006:88). This was supported by Vik (in prep.), who captured 20 *Hyles euphorbiae* with attached pollinia in North Dakota between 2004 and 2007 – this species may have a proboscis as short as 28 mm (Table 2).

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Table 2. Documented pollen vectors for *Platanthera praeclara*. Except for *Hyles euphorbiae*, minimum proboscis lengths shown in table are based on measurements reported by Fauske and Rider (1996), representing extremes of material available at the North Dakota State Insect Reference Collection. For *Hyles euphorbiae* Jordan et al. (2006) reported simply "Proboscis length", not minimum proboscis length.

Species (Source)	Min. Length of Proboscis (mm)
Sphinx drupiferarum (Cuthrell 1994; Westwood and Borkowsky 2004)	31.6
Lintneria eremitus (Harris et al. 2004; Vik in prep.)	
Eumorpha achemon (Cuthrell 1994; Westwood and Borkowsky 2004)	32.2
Hyles euphorbiae (Jordan et al. 2006)	28
H. gallii (Westwood & Borkowsky 2004)	31.7
H. lineata (Vik in prep.)	32.5
Paratraea plebeja (Ashley 2001)	

Pollinator abundance and pollination rates may vary among geographic areas. Westwood and Borkowsky (2004:18) described the period of overlap between western prairie fringed orchid flowering and pollinators' flight periods as "restricted" at the Tallgrass Prairie Preserve (TPP) in southern Manitoba and suggested that low populations of pollinators may restrict seed production in southern Manitoba in some years. In 2001 and 2002, for example, about 1 of every 31 flowers produced seed 0.032 (seed capsules/flower, Borkowsky 2006:93). Of the 15 species of sphinx moths they captured at TPP, they confirmed only two species as pollen vectors (Table 3) and concluded that two other species, *Sphinx chersis* and *S. kalmiae*, may also be able to transfer pollen (Westwood & Borkowsky 2004:18). One of the confirmed pollen vectors, *S. drupiferarum* is "uncommon" near the TPP and populations of the other, *Hyles gallii*, fluctuate greatly in southern Manitoba (Westwood & Borkowsky 2004:19). Fauske and Rider (1996) speculated that cool and wet springs delay blooming in western prairie fringed orchid and may contribute to asynchrony with peaks in pollinator abundance in some situations. Cool and wet weather during the growing season may also depress local populations of pollinators, increasing reliance on sphinx moths emigrating from other areas (Fauske and Rider 1996:7).

Ultraviolet light may be used to artificially increase seed production, although it is not clear if and when this may be appropriate. Borkowsky (2006) lighted western prairie fringed orchid plants with ultraviolet light in Manitoba in 2001 and 2002 to determine its effects on pollination. In 2002, the mean percentage of pollinaria removed was significantly higher

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among plants in the ultra-violet (UV) light treatment than among controls and a greater proportion of the flowers in the UV treatment produced seed capsules (Borkowsky 2006:50).

It may be necessary to use a variety of techniques when attempting to identify *P. praeclara* pollen vectors at a site. Vik (in prep.), for example, captured 23 *Lintneria eremitus* (seven with attached pollinia) in net traps and only one in a standard light trap. About ten years earlier, Cuthrell (1994) had captured no *L. eremitus* in the same geographic area using only light traps.

The apparent importance of *Hyles euphorbiae* as a *P. praeclara* pollen vector at SNG is especially interesting. *Hyles euphorbiae*, the leafy spurge hawk moth, was released as a potential biological control of leafy spurge (*Euphorbia esula*) from 1960 to 1985, but an adult was not recorded in North Dakota until 2000 (Vik in prep.). Vik (in prep.) found it to be the predominant hawk moth at SNG during her study of potential *P. praeclara* pollinators from 2004 to 2007, comprising 69% of all moths captured with net traps over flowers and standard light traps. Collection dates ranged from June 14 to August 16.

Some observations suggest that non-sphingid moths may cause pollination in *P. praeclara*. *Catocala* spp. (Noctuidae) moths have been observed pulling western prairie fringed orchid pollinia down onto female flower parts at SNG in North Dakota. At least one plant caged with a *Catocala* spp. moth before and throughout its flowering period produced swollen pods, which is typically indicative of successful reproduction (Marion Harris, North Dakota State University, pers. comm., 3/24/07).

Habitat - Effects of Soil Moisture and Flooding

Soil moisture is a critical determinant of growth, flowering, and distribution of western prairie fringed orchid. At Sheyenne National Grassland soil moisture in the top 10 cm was higher in swales with western prairie fringed orchid than in swales without western prairie fringed orchid (Wolken et al. 2001) and 60% percent of orchids had their root systems entirely within 10 cm of the soil surface – maximum and mean rooting distances were 16 and 12 cm, respectively (Wolken 1995; Wolken et al. 2001). At Pipestone National Monument in southwest Minnesota, two variables – late August precipitation and October-March precipitation – explained 77% of the variation in numbers of flowering western prairie fringed orchid in the subsequent growing season (Willson et al. 2006:39). The late August period corresponds with plant senescence and development of a perennating bud, whereas the latter period encompasses the period of winter dormancy (Willson et al. 2006:39). Precipitation during late August was positively related to the number of

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flowering western prairie fringed orchid, whereas the relationship between flowering and October-March precipitation was the inverse (Willson et al. 2006:40). A preliminary analysis based on demographic monitoring, however, indicates that spring precipitation may have a greater impact on population growth than fall precipitation (N. Sather, pers. comm., 4/2/07). Therefore, precipitation may have effects on flowering and survival during different periods of the year.

Drought depresses the number of western prairie fringed orchid plants appearing aboveground, increases the proportion of vegetative plants, or both (Ashley 2001:9; Sather 2000:6). Viable seeds that persist from previous years (i.e., the seed bank) may be important for post-drought recovery of western prairie fringed orchid populations (Hof et al. 2002).

Although moist soil near the ground surface is critical to maintain western prairie fringed orchid populations, standing water may adversely affect populations depending on the depth and duration of flooding. Flooding decreases survival of all affected western prairie fringed orchid plants (Sieg and Wolken 1999), but flowering plants are more likely than vegetative plants to survive (Sieg and Wolken 1999). The hollow stems of flowering plants may conduct oxygen to roots and their greater height increases the odds that at least part of the plant remains above water and is able to photosynthesize. Plants are more likely to persist if they continue at least some photosynthesis during floods, as opposed to relying entirely on energy reserves (Sieg and Wolken 1999:199). Even among flowering plants, taller plants are more likely to survive flooding (Sieg and Wolken 1999).

Water may also disperse western prairie fringed orchid seeds (Sieg and Wolken 1999). From (2002) described western prairie fringed orchid seeds as "highly water resistant" due to hydrophobic and impermeable structures surrounding the embryo and found that the testa (seed coat) contained "considerable air space" that could "keep seeds afloat in water for long periods of time." Flooding at SNG resulted in a shift in the population from low swales to higher landscape positions where soil moisture was still suitable (Sieg and Wolken 1999). At sites with little topographic variation, the development of flowering plants may be reduced or eliminated during flood years or in subsequent years (see Sather 2002).

Wolken et al. (2001) developed a logistic regression model based on the percent cover of two associated plant species (*Juncus balticus* and *Stachys palustris*), the concentration of soluble magnesium, and August soil moisture between 0-2 cm below the surface that correctly classified 84% of swales that did or did not contain western prairie fringed orchid at SNG. The coverage of *Juncus balticus* alone allowed for the correct

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classification of 66% of the swales containing western prairie fringed orchid and soil moisture in the top 10 cm was greater in swales that contained western prairie fringed orchid than in swales where the species was absent (Wolken et al. 2001).

Mycorrhizal Associations, Seed Biology, and Artificial Propagation

Western prairie fringed orchid is dependent on mycorrhizal fungi, especially for seed germination and for nutritional support before plants are capable of photosynthesis (Sharma 2002). Orchids "face almost certain extinction in the wild if their mycorrhizal symbionts (mycobionts) were to disappear" and survival of the mycorrhizal species depends on the conservation of orchid habitats (Zettler et al. 2003). Western prairie fringed orchid is likely dependent on certain fungal species that are typical of its tallgrass prairie and wet meadow habitats (Sharma 2002:26) – that is, there may be a stronger association between the fungal species and the habitats of western prairie fringed orchid than there is specifically between the fungi and the species (Zettler et al. 2003:212).

Sharma et al. (2003a) isolated both *Ceratorhiza* and *Epulorhiza* spp. from a protocorm and adult plants in Minnesota, although adult plants and field-incubated seeds in Missouri yielded only *Epulorhiza* isolates. Western prairie fringed orchid may preferentially associate with *Ceratorhiza* species (Sharma et al. 2003a), which "appear to be the dominant orchid mycobionts in Midwestern prairies" (Sharma 2002). Sharma et al. (2003) found that fungus derived from mature western prairie fringed orchid plants "failed to promote seedling development to advanced growth stages." Therefore, fungal associates likely vary among life stages.

Inoculation with appropriate fungal isolates facilitates western prairie fringed orchid seed germination and enhances *in vitro* plant development (Sharma 2002; Sharma et al. 2003b). *In vitro* germination rates were higher for seeds inoculated with mycorrhizal fungi (31%) than for uninoculated seeds (13%). From et al. (2005) successfully propagated western prairie fringed orchid without symbiotic fungi (asymbiotically), but mean germination percentages of cold-stratified seed placed on asymbiotic media were only 2-4%. Protocorms that developed from seeds sown in association with symbiotic fungi (i.e., symbiotically germinated) developed a shoot when inoculated with an *Epulorhiza* sp. mycobiont, but only developed leaves and "mycotrophic ability" when cultured with a *Ceratorhiza* sp. (Sharma 2002:74). Protocorms were more likely to develop to later stages when inoculated with an isolate derived from a seedling (Sharma 2002; Sharma et al. 2003b). Therefore, Sharma et al. (2003b:114) recommended inoculating seeds with fungal isolates from both seedlings and "naturally-occurring protocorms" to produce plants for conservation projects.

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Studies of western prairie fringed orchid development suggest that seeds sown in actual prairie habitats of the species may be unlikely to develop into above-ground plants until at least one to two years after being sown (Alexander 2006; Sharma 2002; Sharma et al. 2003b, Figure 2). Western prairie fringed orchid seeds field-sown in nylon mesh bags at sites in Minnesota and Missouri yielded only protocorms with a few rhizoids and no visible leaf primordium after 20 months (Sharma 2002; Sharma et al. 2003b). At Sheyenne National Grassland, Alexander (2006:128) divided 18,717 seeds among 30 packets and planted them in western prairie fringed orchid habitat. After one year, she dug up the seed packets and divided the seeds into five groups (Figure 2). Plants may develop more quickly from seeds inoculated with a mycorrhizal symbiont and germinated *in vitro* (e.g., in a Petri dish) - some seeds sown in this way by Sharma (2002:138), for example, produced leaf-bearing seedlings within six to nine months.

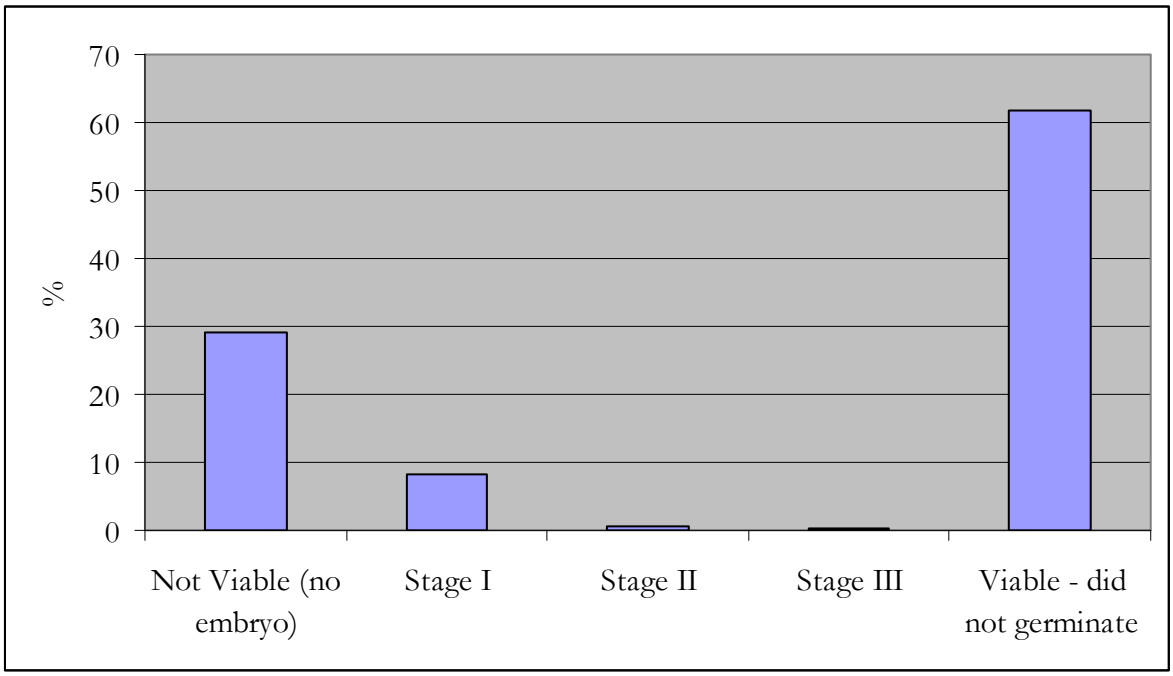

Figure 2. Developmental state of seeds recovered from seed packets twelve months after being sown in western prairie fringed orchid habitat at Sheyenne National Grasslands in 2004 (Alexander 2006). Stage I seeds (n = 1706) had doubled in size and showed signs of rupturing the seed coat one year later; Stage II seeds (n = 94) had developed to the protocorm stage; Stage III seeds (n = 51) had developed at least the tip of the first leaf and 5427 seeds lacked viable embryos (i.e., were non-viable). 11,584 seeds that were evidently viable had not germinated after one year *in situ*.

Cold stratification of seeds for at least six months combined with the addition of fungal mycobionts may maximize production of plants *in vitro*. For example, protocorms that developed from seeds stratified for six months developed *in vitro* to later stages than protocorms grown from

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seeds stratified for only four months (Sharma et al. 2003b); non-stratified seeds did not germinate (Sharma 2002). Western prairie fringed orchid seeds consist of a testa (seed coat) surrounding a carapace-like structure that contains a "rudimentary" embryo consisting of approximately 32 cells and containing nutrient bodies consisting primarily of calcium and potassium (From 2002). The testa is easily removed "by gently rubbing," but it and the carapace appear to function as separate layers that are each highly hydrophobic and impermeable to water (From 2002). Western prairie fringed orchid seeds delay germination even after removal of the testa, suggesting that chemical inhibitors are present in other structures (From 2002).

Sharma et al. (2003b:110) found that seed viability varied from 9-37% among five populations and was highest in the small populations sampled. Related propagation studies yielded advanced stage protocorms only from the small populations studied (Sharma 2002:98). In North Dakota, Alexander (2006, see above) found that only 5% of seeds sown in packets in North Dakota germinated after one year.

Dormancy and Mortality

In a preliminary analysis of 408 plants in four Minnesota populations, 4-12 % of monitored plants were dormant each year from 1986 to 1994 – approximately one-third of the plants experienced one or more periods of dormancy lasting one to three years (Sather 1997). Dormancy may last as long as eight years, but more than half of all dormancy episodes may be as short as one year (Quintana-Ascencio et al. 2004:17). Annual mortality rates of monitored plants were as low as 1.2 % and, in a drought year, as high as 13.5 % (Sather 1997).

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

Drought has significant and, in some cases, widespread effects on western prairie fringed orchid flowering and survival. Some Nebraska populations, for example, were depressed by a drought in 1999 (Steinauer 2000), although populations at Valentine National Wildlife Refuge (VNWR) in the Nebraska Sandhills mostly recovered to near high levels in 2005. In 2006, some VNWR populations remained at high levels, whereas others declined (M. Nenneman, unpubl. data, 2007). Drought conditions also affected western Iowa beginning in 1999 and continuing into 2000 when Watson (2001a:9-10) found flowering plants at only two of six western Iowa populations monitored and only in especially wet portions of the habitats. In contrast, northeast Iowa received high levels of

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precipitation in 1999 and Watson (2000:10) observed a record high number of flowering plants at Hayden Prairie in 2000.

2.3.1.3 Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

In 2002, Sharma completed a protein electrophoresis study that included eight Minnesota populations. She looked at variation in allozymes among 13 loci, 10 of which were polymorphic. She found that the number of alleles was higher in larger populations and that heterozygosity was positively correlated to population size (Sharma 2002:112). The high incidence of monomorphism among small populations indicated that genetic drift, not inbreeding, has caused low genetic variation and a loss of heterozygosity in these populations (Sharma 2002:119; Sharma 2005).

2.3.1.4 Taxonomic classification or changes in nomenclature:

No new information has come to light since the 1991 5-year review.

2.3.1.5 Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species' within its historic range, etc.):

Some background is warranted for this section. Published accounts and herbarium records suggest *P. praeclara* was widespread and perhaps locally common prior to European settlement (Bowles and Duxbury 1986). Historically, Brownell (1984) and Lobeck (1957) suggest western prairie fringed orchid was distributed throughout much of the western Central Lowlands and eastern Great Plains physiographic provinces of the central United States and Interior Plains in extreme south-central Canada. There are no recent records from South Dakota and Oklahoma, although surveys in potential habitat may be warranted in South Dakota and there is a current proposal to reintroduce the species in Oklahoma. In Iowa, southeastern Kansas, Missouri, and eastern Nebraska the species is now extirpated from a significant number of counties where it occurred historically. A single collection reported from Wyoming (Bowles 1983, Sheviak and Bowles 1986) is of dubious origin (Bjugstad and Fortune 1989).

In 2000, the Nebraska Game and Parks Commission conducted surveys to document new populations of western prairie fringed orchid along the Cedar Creek drainage of Garfield and southwestern Holt Counties in the central and eastern Sandhills region. This region had maintained "soil moisture levels favorable for the orchid development" during the prevailing severe drought when orchid numbers were depressed elsewhere

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in the state (Steinauer 2000:2-3). Of the 16 newly recorded populations discovered, all but 3 consisted of fewer than 15 plants at the time of the survey. Additional surveys in the Nebraska Sandhills may identify additional populations of western prairie fringed orchid (Steinauer 2000:4).

In Kansas, a survey of 249 native prairie remnants contained within a five-county area in the range of western prairie fringed orchid found no new western prairie fringed orchid populations and confirmed the extirpation of one population, which was plowed under by the landowner (Kindscher et al. 2005).

2.3.1.6 Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

Reed canary grass was described as a species associated with western prairie fringed orchid in the recovery plan, but was not described as a threat. Watson (2001a:11) described it as a threat, however, to one Iowa population.

2.3.1.7 Other Information:

Habitat Management

The persistence of western prairie fringed orchid is dependent on periodic disturbance by fire, mowing, or grazing, but these practices may also cause adverse effects and must be carefully implemented. Late May fires in Kittson County, Minnesota, for example, destroyed above-ground parts of western prairie fringed orchid plants for the entire growing season (Minnesota Department of Natural Resources 2000) and were implicated in the complete absence of plants at Blue Mounds State Park and Burnham Wildlife Management Area in Minnesota in 1986 and 1999, respectively. As with the conservation of other rare prairie species that exist in fragments of a once vast ecosystem, successful management consists of careful application of practices that are essential for conserving the habitat, while ensuring that associated adverse effects are avoided or minimized.

Adverse effects of fires in late May in Minnesota could last for two growing seasons, but minimal effects observed at some sites suggest that their impacts may vary due to differences in soil moisture and fuel loads (Sather 2000:6-7). Sather (2000:7) recommended avoiding burns in Minnesota after May 1 unless site inspections indicate that orchids are not yet aboveground. She later (Sather 2004) indicated, however, that western prairie fringed orchid may emerge as early as mid-April in southwest Minnesota. In 2002, a small fire experiment at Pipestone National

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Monument showed no effects of fire on flowering of the orchid when the locations of plants were burned on May 2 (Willson et. al 2006). Therefore, the timing of prescribed burns is best adjusted annually to western prairie fringed orchid phenology.

A study to assess the impacts of fall burning, spring burning, haying, and no management on western prairie fringed orchid was initiated at Pembina Trail Preserve Scientific and Natural Area in northwestern Minnesota in 1999. Each of the four treatments is replicated 21 times on the preserve within a series of 30 x 30 meter cells (Minnesota Department of Natural Resources 2002). The study is intended to assess the effects of typical management practices used on sites inhabited by western prairie fringed orchid in northwestern Minnesota, including four-year fire rotations, annual haying, and no treatment (idle). Baseline data on western prairie fringed orchid and associated species were collected annually from 1995 to 1999 and used to optimally assign management cells among treatments before experimental treatments were initiated (Minnesota Department of Natural Resources 2002) Since then, all management treatments have been conducted as scheduled and data have been collected annually, including number of flowering and vegetative western prairie fringed orchid plants per cell and number of flowers and seed pods per cell. A mid-project data summary and analysis are pending.

Sheyenne National Grassland contains several large populations of western prairie fringed orchid, all or most of which are subject to grazing. The Forest Service (USDA Forest Service 2001) ran a RAMAS stage model to predict the effects of grazing management there on the viability of the impacted western prairie fringed orchid populations. Populations were divided into "core" (n = 11), "satellite" (n = 13), and "other" (n = 6) populations. Core populations contained the highest numbers of flowering plants, were recognized for their importance in maintaining the geographical distribution of the species at SNG, and supported above ground plants in both wet and dry years. The RAMAS stage model was run under the assumption that one-third of the eleven core populations and one-tenth of the thirteen satellite populations, respectively, would be protected from grazing during the period when western prairie fringed orchid is particularly susceptible to the effects of livestock grazing (June 1 to September 15, USDA Forest Service 2001) – delaying grazing until after September 15 may be crucial for maximizing seed production because seed number and embryo size may still be increasing as late as September 9 at SNG (Alexander 2006). The resulting model predicted a population growth rate of 1.12. Continued monitoring is necessary to validate the model's predictions.

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Disease

No diseases that affect western prairie fringed orchid were noted in either the final listing rule (USFWS 1989) or the recovery plan. Carlson et al. (2001) noted that anthracnose leaf blight, which may have been exacerbated by insect herbivory, adversely affected orchid growth and flowering in Nebraska in 2000.

Effects of Invasive Species Control

Application of herbicides to control invasive plant species may also harm or kill western prairie fringed orchid, but effects vary among herbicides and with the timing of application. Herbicide damage to western prairie fringed orchid has been documented at Sheyenne National Grassland, with damage as high as 85% of plants within an allotment in at least one case (USDA Forest Service 2003:5). Erickson et al. (2006:464-465) found that imazapic applied at rates typically used for control of leafy spurge (140 g/ha), tended to cause western prairie fringed orchid to remain in a vegetative state ten months after treatment, be shorter, have fewer and deformed flowers, and produce less seed. In plots where the herbicide quinclorac was applied, however, they detected no effects on growth, persistence, or reproduction of western prairie fringed orchid. Kirby et al. (2003) evaluated the effects of three herbicides used to control leafy spurge and found no significant effects on the reemergence or density of western prairie fringed orchid in plots at SNG that were sprayed with three herbicides in mid-September when above ground orchid parts were senescent. Studies longer than two years, however, may be necessary to completely assess herbicide effects on reemergence, flowering, and seed production, especially if herbicide applications will be repeated in future years. Biological controls (*Aphthona* spp. - flea beetles) may also reduce leafy spurge, but may not be as effective as herbicides (Erickson and Lym 2004).

Arrested Floral Development

Sather (2000) documented arrested floral development in populations in extreme northwest Minnesota in 1998 and in southeast Minnesota in 2000. Plants developed buds that failed to develop into flowers. Among plants that developed buds in 1998 at demographic monitoring plots in northwest Minnesota, 95% aborted floral development in the bud stage (Sather 2000:4). Watson (2001b) recorded similar "arrested development" of flowers at Hayden Prairie in northeast Iowa in 2001 and suggested that it was caused by an "intense dry spell" that began in mid-June.

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2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

For each category of threat we provide a list of threats identified in the 1989 listing rule, the recovery plan, or since the approval of the recovery plan. We then discuss any information that we have obtained since 1996 regarding the magnitude (scope and severity) and imminence of new or previously identified threats. We also discuss measures that may be taken to alleviate these threats.

Threats Described at the Time of Listing

The Service described the following threats to western prairie fringed orchid at the time of listing [54 FR 39857 (28 September 1989)]:

- Conversion of suitable habitat to cropland
- Overgrazing
- Intensive hay mowing that may reduce primary productivity and reduce seed dispersal
- Drainage
- Lack of management (succession)
- Small, isolated populations with low seed set
- Herbicide use
- Collection of plants from small populations

Threats Described in the 1996 Recovery Plan

In its recovery plan (U.S. Fish and Wildlife Service 1996) the Service mostly reiterated the threats it described in the final listing rule, but emphasized that conversion of habitat to cropland was the greatest remaining threat to southern populations. It also emphasized that little was known about how to ensure that burning, grazing, and mowing are conducted in a manner not adverse to western prairie fringed orchid populations and pointed out that actions that directly or indirectly lower water levels in the rooting zone of plants "have the potential of serious adverse impacts." In addition, it implied that potential impacts of pesticides to western prairie fringed orchid and its pollinators were also a threat (U.S. Fish and Wildlife Service 1996:17). The listing rule included herbicides as a threat, but not pesticides.

In the recovery plan, the Service also clarified that invasion by exotic species is a threat not specifically addressed in the 1989 final listing rule. The recovery plan mentions leafy spurge (*Euphorbia esula*) and musk thistle (*Carduus nutans*) as the most severe threats in the northern and southern portion of the species range, respectively. It also mentions that

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actions to control these species may also threaten western prairie fringed orchid.

The recovery plan discusses potential threats posed by native and non-native herbivores, including mammals and insects. Although herbivore impacts may be significant locally in some years (Borkowsky 2006:62), it is not clear whether native herbivores threaten any populations. The recovery plan (p. 13) mentions several herbivores that have fed on western prairie fringed orchids. Since completion of the recovery plan, at least one additional taxon, rose chaffer beetles (assumed to be *Macrodactylus subspinosus*, Scarabaeidae), was found feeding on western prairie fringed orchid. Rose chaffer beetles fed on a significant number of western prairie fringed orchid plants in Nebraska's Pierce and Madison counties in 2002 and the affected plants later exhibited fungal infections. Levels of this herbivory decreased after 2002, but persisted at least until 2005 (Gerry Steinauer, Nebraska Game and Parks Commission, pers. comm., 2005). Watson (2001b) found predated seed capsules that contained unidentified insect pupae at Kalsow Prairie in Iowa in 2001.

Threats Described Since 1996

Inter-seeding of non-native species, especially Garrison creeping foxtail (a cultivated variety of *Alopecurus arundinaceus* Poir), into wet prairie or wet meadows to increase livestock forage is now promoted in Nebraska (G. Steinauer, pers. comm., 2005; Volesky et al. 2003). This grass may pose a previously unrecognized threat if it is introduced into sites inhabited by western prairie fringed orchid (G. Steinauer, pers., comm. 2005). Morse et al. (2004:37) list nine reproductive characteristics typical of invasive plant species, including:

- Has quickly spreading rhizomes or stolons that may root at nodes
- Resprouts readily when broken, cut, grazed, or burned
- Reproduces readily both vegetatively and by seed or spores

According to a plant guide produced by U.S. Department of Agriculture, *Alopecurus arundinaceus* "produces numerous aggressive underground rhizomes" and is able to "recover quickly from grazing" (USDA NRCS 2004). The following excerpt from this guide strongly suggests that it could become a threat if planted near or into habitats occupied by western prairie fringed orchid:

"In addition to aggressive rhizomes, creeping foxtail proliferates by windborne and waterborne seeds. Rapid reproduction can be useful in repairing damaged sites; however, creeping foxtail's ability to spread quickly may create management problems in canals, irrigation ditches, and other waterways."

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Staff at Valentine National Wildlife Refuge in Nebraska have been finding "small patches" of Garrison creeping foxtail on the refuge and are spraying each one with herbicide (Mel Nenneman, Valentine National Wildlife Refuge, Valentine, NE, pers. comm., 7/18/07). Exotic, cool-season grasses also are invading and increasing in western prairie fringed orchid habitats in Nebraska – a long-term trend that may be exacerbated by annual mid-summer haying (G. Steinauer, pers. comm., 2005).

Comprehensive List of Identified Threats

In summary, the following have been identified as threats in the 1989 listing rule, the 1996 recovery plan, or since the recovery plan:

- Conversion of habitat to cropland
- Overgrazing
- Intensive hay mowing that may reduce primary productivity and seed dispersal and facilitate invasion of exotic cool season grasses
- Drainage
- Lack of management (succession)
- Actions that directly or indirectly lower water levels in the rooting zone of plants
- Invasive species, including some cool season grass species
- Inter-seeding of non-native species, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail), into wet prairie in Nebraska
- Collection of plants from small populations
- Actions to control invasive species
- Small, isolated populations with low seed set
- Herbicide and pesticide impacts on western prairie fringed orchid and its pollinators

2.3.2.1 Present or threatened destruction, modification or curtailment of its habitat or range:

The following identified threats (see list above) are included in this category:

- Conversion of habitat to cropland
- Overgrazing
- Intensive hay mowing that may reduce primary productivity and seed dispersal and facilitate invasion of exotic cool season grasses
- Drainage
- Lack of management (succession)

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- Actions that directly or indirectly lower water levels in the rooting zone of plants
- Invasive species, including some cool season grass species
- Inter-seeding of non-native species, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail), into wet prairie in Nebraska

The U.S. Forest Service is currently implementing a grazing management plan at Sheyenne National Grassland that is intended, in part, to conserve western prairie fringed orchid populations. Effective monitoring and evaluation of grazing and its effects on western prairie fringed orchid populations at SNG may be important for designing grazing strategies elsewhere in the species' range. Most importantly, however, it will be crucial for determining whether grazing management is effective in conserving the important populations at SNG – 91% of the protected plants in the Red River Valley ecological section (251A, Table 1) are on SNG.

The Service identified intensive hay mowing that may reduce primary productivity and reduce seed dispersal as a threat at the time of listing in 1989. Steinauer (pers. comm., 2005) reconfirmed the importance of this threat in Nebraska, pointing specifically to annual mid-summer haying as a practice that is facilitating the long-term invasion of western prairie fringed orchid habitats by exotic cool season grasses. The research project at Pembina Trail Preserve Scientific and Natural Area described above (section 2.3.1.7, Habitat Management) includes an assessment of annual late summer (August/September) haying on western prairie fringed orchid survival and reproduction in northwest Minnesota. This study may shed some light on the relative impacts of this management practice, at least in the northern part of the species' range.

Although the Service has not compiled a complete list of threats to western prairie fringed orchid for each site, invasive species are noted as a current threat to about 20% of extant sites. Leafy spurge and reed canary grass are the two most frequently reported threats (Table 4). The Service should improve its tracking of invasive species threats for each site, in cooperation with the states and others, to determine the relative importance range wide of each invasive species. Invasive species should be identified as a threat to an extant population if they are present at the site and if current or anticipated management is unlikely to be sufficient to control them to the extent that they would no longer pose a threat to western prairie fringed orchid at the site. The latter may be primarily a function of management resources and, for private lands, landowner cooperation.

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Table 3. Invasive species reported as threats from sites inhabited by western prairie fringed orchid.

Species	No. Sites Reported as Threat
Leafy spurge (*Euphorbia esula*)	12
Reed canary grass (*Phalaris arundinacea*)	11
Smooth brome (*Bromus inermis*)	5
Redtop (*Agrostis gigantea*)	4
Canada thistle (*Cirsium arvense*)	2
White sweet clover (*Melilotus alba*)	2
Sericea lespedeza (*Lespedeza cuneata*)	2
Crown vetch (*Securigera varia*)	2
Timothy (*Phleum pratense*)	1
Clover (*Trifolium sp.*)	1
Bird's-foot trefoil (*Lotus corniculatus*)	1

The recovery plan recognized the potential threat of lowering groundwater levels (U.S. Fish and Wildlife Service 1996:12), but did not discuss any specific population that may be threatened in this way. The Forest Service (USDA Forest Service 2001), however, recognized this as a potential threat to populations at SNG in North Dakota. Since 1996, we have a better understanding of the extent of the rooting zone (see "Habitat - Effects of Soil Moisture and Flooding", above) and have also seen that soil moisture during late summer (late August in southwest Minnesota, Willson et al. 2006) affects abundance of flowering plants in the following growing season. Effects on soil moisture levels in the top 10 cm seem especially critical (Wolken et al. 2001).

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes:

Only one identified threat may be included under this category - collection of plants from small populations (54 FR 39857 [September 28, 1989]). We are aware of only one report that mentioned this as a potential threat to a western prairie fringed orchid population. Watson (2001b) reported that trails made by humans wound through Sheeder Prairie in Iowa and seemed to 'converge on areas where flowering orchids were located' and coincided with observations of missing flowers.

2.3.2.3 Disease or predation:

The recovery plan describes instances of herbivory by native and non-native species, but does not clearly recognize herbivory by wildlife as a threat to the species. Although wildlife herbivory by a variety of vertebrates and invertebrates likely occurs in all populations, it may have significant effects only on small populations and in years when drought or

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other factors may depress numbers of flowering plants and increase populations of insect herbivores (Fauske and Rider 1996). Watson (2001a:11) suggested that small western prairie fringed orchid habitats in predominantly agricultural landscapes may be vulnerable to white-tailed deer herbivory. In 2000, for example, white-tailed deer (*Odocoileus virginianus*) apparently damaged approximately one-third (9 of 32) of the inflorescences at Hayden Prairie. In those situations, buffers around occupied sites (e.g., restored habitats on lands currently used for agriculture) may reduce the vulnerability of western prairie fringed orchid if they would disperse deer foraging. Fauske and Rider (1996) found that insect herbivory had no significant effect on flowering at SNG in 1995 after four years of above average precipitation. Previous studies (Cuthrell 1994) had found significant effects of insect herbivores, suggesting that this type of herbivory fluctuates in inverse proportion to precipitation.

Above (in section 2.3.2, "Threats Described in the 1996 Recovery Plan"), we discuss the observations of significant damage during at least one year by rose chaffer beetles in Nebraska. Rose chaffer beetles predated a significant number of western prairie fringed orchid plants in Nebraska's Pierce and Madison counties in 2002 and the predated plants later exhibited fungal infections. Levels of this herbivory decreased after 2002, but persisted at least until 2005 (G. Steinauer, pers. comm., 2005).

2.3.2.4 Inadequacy of existing regulatory mechanisms:

Regulatory Protection in Canada

In 1996, western prairie fringed orchid was listed as endangered under the Manitoba Endangered Species Act, which specifically prohibits acts that destroy, disturb, or interfere with the habitat of an endangered species (Environment Canada 2006:6). In June 2003, the species was also listed as Endangered under the Canadian Species at Risk Act (Environment Canada 2006:6).

State Regulatory Protections

Among the six states in which the species occurs, it is listed as endangered in one, threatened in three, and is not listed under any endangered species statute in the remaining two states (Table 4).

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Table 4. Summary of listing status and protections afforded under state endangered species statutes.

State	Status	Summary of Protections
IA	T	"(A) person shall not take, possess, transport, import, export, process, sell or offer for sale, buy or offer to buy, nor shall a common or contract carrier transport or receive for shipment" the species without a permit. (Iowa Code chapter 481B)
KS	None	The Kansas state endangered species statute provides no authority to list plants as endangered or threatened.
MN	T	"Minnesota's Endangered Species Statute and the associated Rules impose a variety of restrictions, a permit program, and several exemptions pertaining to species designated as endangered or threatened. A person may not take, import, transport, or sell any portion of an endangered or threatened species. However, these acts may be allowed by permit issued by the DNR; plants on certain agricultural lands and plants destroyed in consequence of certain agricultural practices are exempt; and the accidental, unknowing destruction of designated plants is exempt." (Minnesota Department of Natural Resources. 2008. Endangered, threatened and special concern species. <http://files.dnr.state.mn.us/natural_resources/ets/endlist.pdf>. Accessed 2008 June 20.
MO	E	State regulations (3 CSR 10-4.111) prohibit the "exportation, transportation or sale of any endangered species of plant or parts thereof, or the sale of or possession with intent to sell any product made in whole or in part from any parts of any endangered species of plant."
NE	T	Under Nebraska Code, Section 37-806, it is unlawful to export, possess, process, sell or offer for sale, deliver, carry, transport, or ship, by any means whatsoever, any listed species.
ND	None	n/a

The protection afforded by state statutes and associated regulations seems to focus primarily on protecting western prairie fringed orchid from unauthorized commercial use and, in Minnesota and Iowa, "take" of the species. Commercial use of western prairie fringed orchid is not one of the twelve identified threats to the species (see section 2.3.2, "Comprehensive List of Identified Threats") and direct take of plants would address only one of these threats (collection of plants from small populations). Moreover, two of the six states (Kansas and North Dakota) that together contain about 42% of all western prairie fringed orchid plants have no direct legal or regulatory protection for western prairie fringed orchid.

2.3.2.5 Other natural or manmade factors affecting its continued existence:

Three identified threats fall under this category:

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- Actions to control invasive species
- Small, isolated populations with low seed set
- Herbicide and pesticide impacts to western prairie fringed orchid and its pollinators

Fauske and Rider (1996) observed fewer pollinators at a site in North Dakota where herbicides apparently reduced the density of nectar sources and western prairie fringed orchid, suggesting that the impacts on other nectar species should be considered when using herbicides to control invasive species. Erickson et al. (2006:464-465) found that imazapic applied at rates typically used for control of leafy spurge (140 g/ha), tended to cause western prairie fringed orchid to remain in a vegetative state ten months after treatment, to be shorter, to have fewer and deformed flowers, and to produce less seed. In plots where the herbicide quinclorac was applied, they detected no effects on growth, persistence, or reproduction of western prairie fringed orchid. (Also see "Effects of Invasive Species Control" in section 2.3.1.7, above.)

In some cases, drift of herbicides from adjacent properties or roadsides may pose a threat. For example, herbicide applied to control roadside weeds drifted into Powell Prairie in Iowa in 2001 – only one orchid may have been damaged, although damage would have likely been worse if some shrubs along the road had not blocked much of the drift (Watson 2001b:12). In this case, the county was contacted to make them aware of the threat posed by roadside spraying. Similar incidents in Polk County, Minnesota, have been addressed with annual pre-season coordination between the Minnesota Department of Natural Resources and the county highway department.

2.4 Synthesis

Significant progress has been made to protect western prairie fringed orchid populations in some portions of its range (see above – Table 1), where approximately 83% of the plants are on sites with protection, but substantial protective actions are still necessary in some ecological sections, especially 332C (Nebraska Sand Hills), 251H (Nebraska Rolling Hills), 251G (Missouri Loess Hills), and 251B (North Central Glaciated Plains). These sections are concentrated in the central and southern portions of the species' range. Populations under protective ownership must also be appropriately managed and not subject to threats from hydrologic alteration or impacts of pesticides and herbicides to be considered contributing to recovery.

As noted above, the Sheyenne National Grassland has prepared and begun implementing a comprehensive grazing management plan with a stated intention of conserving western prairie fringed orchid populations. Effective and comprehensive monitoring will be necessary to confirm that grazing will be implemented in a manner appropriate to the

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conservation of western prairie fringed orchid. The outcome of implementing the grazing plan will have a major impact on the recovery of the species in the Red River Valley ecological section (251A).

At present, the recovery criteria may not adequately address all current threats to the species. The Service will work with the recovery team to determine how the recovery criteria may be revised to address all current threats and the recent changes in ecoregional mapping and to ensure that criteria are objective and measurable. Issues that have arisen since the approval of the recovery plan that need to be addressed include: 1) drainage and other actions that directly or indirectly lower water levels in the rooting zone of plants; 2) collection of plants from small populations; 3) small, isolated populations with low seed set; and 4) herbicide and pesticide impacts to western prairie fringed orchid and its pollinators. It is unclear whether collection of plants from small populations is still a threat that is significantly affecting the likelihood that *P. praeclara* will become endangered in the foreseeable future. If the Service determines that it is a threat to the species, then the recovery criteria should be revised to address it. Development of a population viability criterion may address the threat of small and isolated populations with low seed set because populations facing this threat would have to reach viable levels to be counted toward recovery.

Previously recognized and new threats affect the existence of the western prairie fringed orchid to the extent that it may become endangered in the foreseeable future throughout all or a significant portion of its range. Therefore, this species continues to meet the definition of threatened. The listing classification of the western prairie fringed orchid should remain as threatened under the Endangered Species Act.

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3.0 RESULTS

3.1 Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
__X_ No change is needed

3.2 New Recovery Priority Number

We do not propose a change in the recovery priority number for western prairie fringed orchid.

Brief Rationale:

Although numerous threats to western prairie fringed orchid have been identified, a significant proportion of populations in some ecological regions have been protected from direct habitat destruction (e.g., plowing). Substantial actions to protect populations from habitat destruction, however, are still needed in some ecological sections. Therefore, it is still appropriate to describe the level of threats as "moderate." Significant questions remain as to how to best manage western prairie fringed orchid, but a fair amount of new information to guide management planning has been obtained since the approval of the recovery plan in 1996. The ongoing study in northwestern Minnesota and implementation of the grazing management plan at SNG, for example, will likely provide managers with useful information to conserve this species. Although many populations are small, especially in some ecoregions, we think that the recovery potential for the species is still "high", primarily due to the large proportion of populations that occur on areas protected from habitat destruction in some ecological sections (Table 1).

3.3 Listing and Reclassification Priority Number: N/A.

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4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- Revise the recovery criteria to include clear and measurable standards to determine whether western prairie fringed orchid plants are part of a viable population. The recovery criteria require that plants be under protective ownership or control and appropriately managed to count towards recovery in each ecoregion. There are no standards within the criteria, however, to assess whether these plants are part of populations that are viable. Although not addressed by the recovery criteria, actions 42 (Determine parameters required to maintain viable self-sustaining populations) and 424 (Conduct a population viability analysis for the species) do address this issue and a preliminary population viability analysis has been completed based on demographic monitoring.

- Ensure that any revised recovery criteria are objective and measurable and address the following threats, as appropriate:

    - Drainage and other actions that directly or indirectly lower water levels in the rooting zone of plants
    - Isolation and low reproduction of small populations
    - Herbicide and pesticide impacts to western prairie fringed orchid and its pollinators
    - Collection of plants from small populations
    - Effects of invading exotic species and actions to control those species
    - Inter-seeding of non-native species into wet prairie in Nebraska, especially creeping foxtail (*Alopecurus arundinaceus* Poir, also called Garrison creeping foxtail)

- Describe a process by which the Service will evaluate management plans for the purposes of measuring progress towards recovery. This should include a description of the Service's review process (e.g., who will conduct and approve these reviews for the Service) and the basis for evaluating the adequacy of each plan. The following excerpts from the recovery plan may be useful for evaluating management plans until more specific guidance is developed:

    - Populations must be protected from hydrologic alterations and pesticide impacts (p. 17).
    - Appropriate management must be implemented for at least three management cycles (e.g., if guidelines call for prescribed fire at a specified interval or range of intervals, the guidelines would not be fully implemented until the third prescribed burn has taken place at the appropriate intervals, p. 17).
    - "Where sites are too small to permit natural succession to occur, manage communities to maintain the species' specific microhabitat requirements" (pp. 22-23).
    - Plans should focus "on maintaining or restoring the composition, function, and structure of the ecosystem on which western prairie fringed orchid depends" (p. 24).

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    - Management practices should "duplicate the natural processes of the tallgrass prairie ecosystem" (p. 24).
    - The plan should include a process for regular review and refinement of the management practices as relevant research becomes available (p. 24).

- Compile existing management plans for sites where western prairie fringed orchid is extant and protected from conversion and determine whether they are adequate to ensure the conservation of the respective western prairie fringed orchid populations.

- Implement recovery action 33 – Develop or maintain appropriate mowing regimes (U.S. Fish and Wildlife Service 1996:20). Steinauer (2000:4) briefly summarized the importance of the Nebraska's eastern Sandhills region for the conservation of western prairie fringed orchid and suggested that significant progress towards the species' conservation could be made by modifying haying practices at some sites.

- Conduct additional surveys in the Nebraska Sandhills when soil moisture levels may be suitable for significant levels of flowering. Additional surveys in this region may identify additional populations of western prairie fringed orchid (Steinauer 2000:4), but significant surveys have not been conducted since 2000 (recovery action 52 – Identify and search potential new sites [U.S. Fish and Wildlife Service 1996:22]).

- Improve tracking of invasive species threats for each site, in cooperation with the states and others, to determine the relative range-wide harm of each invasive species. Invasive species should be identified as a threat at a site if they are present and if current or anticipated management is unlikely to be sufficient to control invasives to the extent that the invasive(s) will no longer pose a threat to western prairie fringed orchid.

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008555

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Platanthera praeclara*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review
___ Downlist to Threatened
___ Uplist to Endangered
___ Delist
X No change is needed

Appropriate Recovery Priority Number: 8C
Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Phil Delphey

FIELD OFFICE/REFUGE APPROVAL:
Lead Field Supervisor/Refuge Manager, Fish and Wildlife Service

Approve _____ Date 12/5/08

REGIONAL OFFICE APPROVAL:
Assistant Regional Director, Ecological Services, Fish and Wildlife Service, Midwest Region

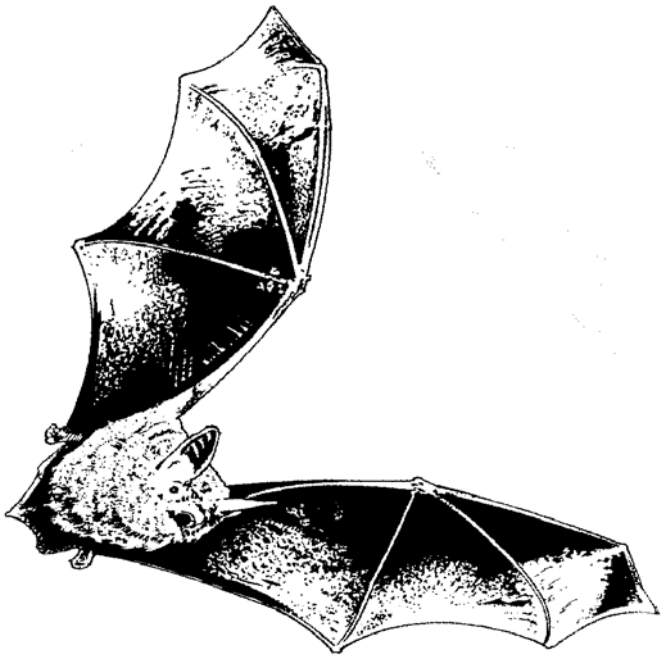
Approve Lynn M Lewis Date 2/5/09

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. Written concurrence from other regions is required.

ACTING
Cooperating Regional Director, Fish and Wildlife Service, Southwest Region
Signature _____ Date 4/27/09 X Concur ____ Do Not Concur

ACTING
Cooperating Regional Director, Fish and Wildlife Service, Mountain-Prairie Region
Signature Mike Stempel Date 2/18/09 X Concur ____ Do Not Concur

South Dakota Bat Management Plan



South Dakota Bat Working Group
Wildlife Division Report 2004-08
July 13, 2004

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Signature Page

Protecting wildlife diversity in South Dakota is important to conservationists alike thus we the undersigned vow to work tow ard protecting bat fauna throughout the state by implementing action items (e.g., strategies) in this plan.

Cooperators **Date**

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South Dakota Bat Working Group (SDBWG), President & Steering Committee (Management)
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Preface

Twelve bat species can be found throughout South Dakota comprising approximately 12 percent of the state's mammal fauna. As efficient predators of night-flying insects, bats are integral components of the environment and provide a substantial economical service as they feed on agricultural and forest insect pests.

Bat populations depend largely on their ability to find safe, secure roosting habitat. Unfortunately, this habitat is in jeopardy in many areas. Depending on the species of bat, bats may roost in a wide variety of sites from rock crevices and cavities (caves, abandoned mines) to trees, both living and dead (snags), and structures such as buildings, bridges and even the artificial 'bat houses' that are becoming somewhat popular. It is important to note that due to micro-site (temperature) conditions and other selection criteria that are not fully understood, bats can be very selective regarding roost sites.

Besides roosting habitats, bat foraging habitat is also being degraded or destroyed, which reduces the availability of insect prey and drinking water. As well, other factors such as lack of protective regulations and a general public image of being rabid and dangerous pose threats to bats.

Therefore, an increased effort to protect, conserve and manage bats and their habitats in South Dakota is required. The *South Dakota Bat Management Plan* (SDBMP) is designed to identify risks to bats, develop objectives and strategies to conserve bats and to educate people about them, and make management recommendations associated with protecting bats and their habitats in South Dakota.

All future bat conservation efforts in South Dakota will depend on cooperation among agencies, groups, organizations, and individuals in order to achieve these objectives and strategies.

The South Dakota Bat Working Group initiated the development of this management plan and formed the framework through meetings and group discussions. Sixteen agencies, organizations, and individuals were involved with developing the South Dakota Bat Management Plan. These and other agencies, individuals, and organizations will be the cooperators in this effort. Bat conservation has become an important wildlife management goal as agencies, organizations, and individuals recognize the ecological and economic value of bats. This State Management Plan is the first step. As time progresses, and we grow in our understanding of bats and their habitat needs the South Dakota Bat Working Group will utilize a pro-active approach to managing wildlife – *adaptive management* – to improve this plan.

Acknowledgements

The South Dakota Bat Working Group would like to acknowledge the efforts of individuals in the development of this plan. Working Group members include researchers, biologists, educators, and managers from different areas of the state. South Dakota Game, Fish and Parks personnel were particularly dedicated to the formulation and writing of the plan. People involved with the development of this plan include: Alyssa Kiesow, Barb Muenchau, Brad Phillips, Chad Tussing, Cheryl Schmidt, Doug Backlund, Eileen Dowd-Stukel, Joel Tigner, Lon Kightlinger/Linda Schaefer, Natalie Gates, Sara Reindl, Scott Pedersen, Stephanie Middlebrooks, and Vicki Swier.

Also, many individuals of state, federal, and other organizations reviewed drafts of this plan throughout its development and/pr provided their expertise in various areas covered in the plan. Those individuals include Barb Muenchau, Brad Phillips, Brian Scott, Cheryl Schmidt, Connie Vicuna, Dan McCormick, Dan Foster, Doug Backlund, Doug Hansen, Eddie Childers, Eileen Dowd Stukel, George Vandel, Karen Hall, Heather Johnson, Joan Bortnem, Joel Tigner, Kim Schultz, Lon Kightlinger, Marc Ohms, Paige Hoskinson, Renee Ohms, Rodd Horricks, Scott Pedersen, Shelly Diesch, Stan Michals, Steve Hirtzel, Steve Wilson, and Vicki Swier.

Executive Summary

Bat populations are declining locally, and continentally, due to habitat loss and fragmentation, roost disturbances, public lack of awareness, and poor regulatory measures. The South Dakota Bat Working Group and South Dakota Game, Fish and Parks recognize the ecological and economic benefits of bats and are initiating efforts to protect habitats and conserve bats in South Dakota. This South Dakota Bat Working Group seeks to protect bats and bat habitat through action, education, and cooperation with federal, state, and private landowners. Objectives include raising awareness concerning the role bats play in maintaining healthy ecosystems and working with public land managers and private landowners to reduce possible disruptions to bats and their habitat. South Dakota Game, Fish and Parks, specifically the Wildlife Diversity Program, seeks to inventory, protect, and manage species and habitats in a manner that meets the needs and desires of the people of the state while protecting South Dakota's biological diversity. Efforts towards conserving bats and their habitats in South Dakota include the development and implementation of a state bat management plan.

The South Dakota Bat Management Plan includes general background information, a management plan outline, and numerous appendices. General background information includes details concerning bats and their habitat, health issues, management justification, and bats' legal status. The management plan outlines objectives, strategies, and makes management recommendations by taxon or habitat of bat species in the management, research, and education sections. Numerous appendices include species accounts, written articles regarding bats, and current federal laws associated with bats and their habitat.

The main goal of the South Dakota Bat Management Plan is to provide guidance promoting long-term conservation of South Dakota bat species through research, management, and education. Through the implementation of this plan, bat conservation efforts will be strengthened and cooperation among agencies, organizations, and landowners, as well as regulatory measures, will be enhanced. The goal is a reversal of downward trends of particular bat populations noted in bat survey work conducted through the years.

Bats receive protection through proper habitat management, research, and education, therefore each objective and strategy contributes to the achievement of the plan's overall goal. The goals and objectives apply to all bats in South Dakota. While there has been no attempt to prioritized efforts by species, it is presumed that conservation efforts will be keyed to local conditions and situations. Resource managers will decide which objectives and strategies to apply under their authority and which ones are most urgent in their area.

Because the South Dakota Bat Management Plan is designed to be adaptive, each participating agency, group, individual, or organization will be asked to provide annual updates and progress reports regarding objectives and strategies they are conducting or have fulfilled. The updates will help refine goals, objectives and specific strategies. In addition, as new information is learned regarding habitat requirements, population data, or other vital information it will be incorporated into future plan revisions.

List of Participants

The South Dakota Bat Management Plan is a cooperative effort between local, state, and federal entities. Alyssa Kiesow (SDGFP) drafted most of the plan, though many individuals throughout the drafting process provided a great deal of help. Doug Backlund (SDGFP) and Joel Tigner (Batworks) provided identifying keys that appeared in the *Mammals of South Dakota* book, and Joel Tigner, Eileen Dowd Stukel (SDGFP), and Alyssa Kiesow provided articles that appeared in the *South Dakota Conservation Digest*. Individuals who contributed to the plan are listed below. These individuals participated in meetings and provided numerous comments regarding bat conservation and their agencies are potential cooperators in fulfilling this plan.

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General Information and Justification

Introduction

To help familiarize individuals, general information about bats as a group and specific information pertaining to the bat species that occur in South Dakota are included in this management plan. Information includes background knowledge (e.g., natural history), bats and health issues, studies and species in South Dakota, and reasons for bat declines. This information is provided in the general bat information and management justification section as the prelude to the actual strategic plan.

Background

Values and Concerns Worldwide

Bats play an ecological and economic role in their community, which is not duplicated by any other animal group. Worldwide, there are nearly 1,000 species of bats that feed on fruit, nectar, other animals, insects, and even blood. In tropical regions (where bats are most abundant), bats disperse seeds and pollinate flowers by feeding on fruit and nectar, thereby playing a significant role in resource production, plant evolution, and reforestation. An estimated 450 products used by humans are produced by bat-pollinated plants (Laubach et al. 1994). Notable products include food (e.g., bananas and cashews), wood (e.g., balsa), and beverages (e.g., tequila). In the New World tropics, three species of vampire bats are found (Laubach et al. 1994), which drink blood. The anticoagulant found in their saliva has been used for medicinal purposes and has saved lives.

In the United States, and more specifically in South Dakota, bats feed on insects. In South Dakota the role of bats is relatively unknown, but it is suspected that they play a major role in insect population control. For example, it has been reported that little brown bats (*Myotis lucifugus*) may consume 600 insects (e.g., mosquitoes) in one hour (Tuttle 1988), and may play a role in urban mosquito control. Big brown bats (*Eptesicus fuscus*) consume large quantities of beetles and agricultural pests. In one season, one maternity colony of nearly 150 bats consumed 38,000 cucumber beetles (*Diabrotica* spp.), 16,000 June bugs (*Phyllophaga* spp.), 19,000 green and brown stinkbugs (Pentatomida), and 50,000 leafhoppers (Cicadellidae) (Whitaker 1993). Tree-roosting bats (e.g., red bats [*Lasiurus borealis*], hoary bats [*Lasiurus cinereus*], and silver-haired bats [*Lasionycteris noctivagans*]) may help maintain forest health by consuming forest pests. Regardless of specifics, it is clear that bats serve a vital function in our ecosystem.

Lack of public awareness and understanding of the value of bats threatens their populations in North America (Luce 1998). Myth, superstition, and folklore continue to contribute to the decline of bat populations. People often associate bats as blood sucking, rabies infected animals that are blind and often tangle themselves in people's hair. European-American culture tends to link bats to evil or evil powers, such as witches and vampires. Contrary to such beliefs, bats are actually unique creatures that benefit humans, and in some cultures (Chinese, for example) are a symbol of good luck and prosperity.

Other factors that may impact bats include human disturbance or destruction of bat habitat. Humans may vandalize roosts such as caves or mines, exclude bats from buildings at inappropriate times or by improper methods (Williams-Whitmer and Brittingham 1996), and disturb roosting bats through recreational and commercial activities such as partying in caves or selective logging. Destruction or degradation of habitat may result from selective harvest

of large trees (Adam et al. 1994, Ochoa 2000, Sedgeley 2001), presence of toxins often introduced through pesticide use (O'Shea and Clark 2001, O'Shea et al. 2001), habitat fragmentation, human disturbance or vandalism at caves (Perkins 1985, Gore and Hovis 1992), and slowly disappearing or degraded riparian zones (Rich 2002). Because these threats may endanger important roosting, foraging, and watering areas, it has become necessary to safeguard critical habitat in order to conserve bat species in South Dakota.

Natural History

Overview

Bats belong to the group of mammals called Chiroptera, which constitutes nearly 1200 species worldwide. Chiroptera literally means hand+wing (MWCD 2002). In fact, bat wings are structured as greatly enlarged hands making them very different from bird wings. As a result of their highly developed wings, bats are the only mammals that have truly mastered powered flight. Other types of mammals can glide (e.g., flying squirrels) but are not capable of sustained flight.

Bats are often compared to rodents, but rodents are flightless and have large paired teeth (incisors) designed for gnawing. Bats are more closely related to primates and have extremely sharp teeth similar to large fangs (canines) found in carnivores. Bats' teeth are not suited for gnawing; instead they are used to puncture and cut apart the hard outer coverings (exoskeletons) of insects.

Physical Characteristics

Most bats in South Dakota have dark brown wing membranes and short brown or gray fur, so it is difficult to distinguish between species. Bat wings – large, five-fingered hands webbed with extremely thin skin stretching from fingertip to shoulder – provide lift and thrust for the animal during flight. Bats use their hind legs and tail, which are enclosed in very thin skin, to maneuver during flight, much like airplanes use ailerons and rudder. Because the wing membranes are so thin, it is easy to see blood vessels along their length. These thin membranes also pose great risk of dehydration, forcing bats to seek roosts with high humidity and minimal air movement. Since bat wings are so fragile and easily damaged, bats utilize their hind feet to move around in their roosts. With short toes and long claws, bat feet are well adapted for hanging upside down. Bats initiate flight from this position by dropping headfirst and spreading their wings.

Bats evolved from small bodied, large brained, insect eating mammals similar to shrews (Laubach et al. 1994). Much like their ancestors, many species of bats (and all of South Dakota's bat species) locate prey and avoid obstacles using a process called *echolocation*. Echolocation is much like the sonar navigational systems used by whales and dolphins. Bats emit high frequency sounds that strike objects (e.g., prey or obstacles) and reflect (echo) back to them, much like Doppler weather radar systems, telling bats the speed, direction, and size of their target (Simmons et al. 1978). Bats are able to adjust their flight accordingly. Once it detects prey, the bat captures it by scooping it up with its wing or tail membranes and transfers the food to its mouth. The bat immediately bites off the insect's wings and legs, and before it loses air speed, quickly chews and swallows the insect's body.

For South Dakota bats, the senses of vision and smell do not play a predominant role in hunting, but their sense of smell does play a significant role in social communication back

at the roost (Bradbury 1977). Most bats apparently lack cones in the retina, a characteristic of many nocturnal animals, but they are still able to see.

Physiology

Like humans, the operating body temperature of most bats is 37°C (98°F) (Lyman 1970). Maintaining body temperatures through internal regulation, called *endothermy* or *homeothermy*, takes a great deal of energy for bats to keep their bodies cool (panting) and warm (fat metabolism) (Licht and Leitner 1967). To conserve important resources, bats can allow their body temperatures to fluctuate with ambient temperatures ranging as high as 43°C (110°F) and as low as 0°C (32°F). This process, which is called *heterothermy*, conserves energy during times of stress (e.g., reproduction) when it is more important to protect body fat reserves than to sustain comfortable body temperatures. Periods of heterothermy are called *torpor* or *hibernation*. Torpor saves energy by reducing body temperature, slowing heart and respiratory rates, and reducing metabolic speed (Humphrey 1982, Luce 1998).

Periods of torpor may last from a few days to several months. Before entering long periods of hibernation, bats must feed excessively to build the large fat reserves needed to maintain body functions throughout the dormancy period. During hibernation, bats may rouse – though only occasionally and for short periods – to urinate, drink, or move to another roost site. During this dormancy period, bats are very sensitive to disturbances, which usually results in "emergency exits from torpor." This emergency activity burns up important energy, and when bats re-enter hibernation, they may no longer have sufficient fat reserves to survive until food and water become available.

During the day, bats often sleep and become semi-torpid. While being semi-torpid, bats are able to slightly reduce their oxygen consumption rates and body temperatures. Also, resting bats often groom themselves using their tongue and their toes. Upon awakening, bats raise their temperatures and increase their consumption rates. Thus, some bats spend much of their life in torpor or in a condition approaching torpor.

Reproduction

During the breeding season, male testes descend into the scrotum in preparation for mating. In South Dakota, bats typically mate in the fall before hibernation, though time of mating varies among species. Because bats are able to postpone egg fertilization or implantation, there is also variability as to when after mating the sperm fertilizes the egg (delayed fertilization) and when the fertilized egg begins development (delayed implantation). Pregnancy lasts approximately 50 to 60 days (Wimsatt 1945, Laubach et al. 1994), and 80 to 90 percent of the females in a nursery colony are reproductively active, depending on the year (Humphrey 1982). Typically, a single young is born in May, June, or late July and, while most species in South Dakota will typically produce only one offspring a year, the red bat (*Lasiurus borealis*) may produce up to four (Jones et al. 1983).

Six of the twelve bat species found in South Dakota are mouse-eared bats of the genus *Myotis*, which produce one young per year (Guthrie and Jeffers 1938, Wimsatt 1944); in some years, as few as 25 to 50 percent of the reproductive-aged females produce single offspring (Barclay et al. 2002). Because of this low reproductive rate, bat populations are more susceptible to dramatic declines in number, which results in subsequent periods of low reproduction.

Mothers usually feed and nurture pups until they become volant and full-grown. Pups and juvenile bats typically cling to their mother's underside, feeding alternately between the two teats located near the mother's armpits. (Most females have two functional mammae located in the chest region, but females of *Lasiurus* have four functional mammae.) Females may carry their young while traveling or foraging until the young become too large for their mothers to remain aloft or too restricting for them to hunt. As a result, young learn very quickly to fly and capture their prey. At 2.5 to 3.0 weeks of age, juvenile bats are nearly full-grown. Many species of bats in South Dakota are known to live an average of 20 years, with their first pregnancy occurring during the second year (Humphrey 1982).

Key Habitats

Foraging habitats vary depending on insect availability, weather, and bat species. Usually, bats forage over water (e.g., lakes, streams, etc.), along forest edges, along rocky escarpments and ravines, and near light sources because these features tend to concentrate insects (Humphrey 1982). Studies in South Dakota and Colorado have shown that small tree stands or water bodies are important features for bats in open prairies (Everette et al. 2001, Swier 2003).

The importance of watering sources is twofold. Most bats require more water than other mammals of comparable weight because their wing membranes have great evaporation surfaces in relation to their weight. Bats are able to drink water while in flight by flying low over the water, lowering their head, and taking a gulp of water. Watering holes also attract insects upon which the bats feed.

Bats roost in a variety of areas. Trees, rock crevices, caves, mines, and man-made structures (e.g., attics, walls or crevices in buildings) provide adequate roost sites for bats. However, some bats in South Dakota even roost under rocks on the ground. Because landscapes differ in South Dakota, all these roosts are important for maintaining bat populations in various areas of the state. Typically, day roosts – including nursery roosts, summer male roosts, transient roosts, and winter roosts (Humphrey 1982) – provide more security and stable conditions than night roosts, which offer areas for rest after feeding sessions. Most roosts are characterized by humid, cool, and dimly lit conditions (Luce 1998).

Nursery and winter roosts are particularly important to bat survival. Nursery roosts must afford protection from predators and provide beneficial microclimates for pregnant or nursing females and developing young (Humphrey 1982). Nurseries are typically located in hot, dark, poorly ventilated areas with several tiny openings. Winter roosts (*hibernacula*) offer bats stable environments, characterized by no air movement, humid conditions, and cool temperatures. Hibernacula typically include caves and mines, attics, walls, or lofts of old buildings, and males and females often share such hibernacula.

South Dakota offers fewer roosting opportunities to bats than are available in other states in the region. Any disturbance or destruction of roosts – particularly nursery or winter roosts – may be limiting factors to bats, not only due to South Dakota's limited roosting opportunities but also due to low reproductive rates and extreme sensitivity of bats to environmental changes (e.g., altered temperatures in hiberacula).

Food Habits

South Dakota bats feast on a wide variety of insects. Soft- or hard-bodied insects are selected as prey, depending on the species of bat. For instance, the diet of big brown bats in

eastern South Dakota includes Coleoptera (beetles), Hemiptera (true bugs), Diptera (flies), and Lepidoptera (moths) (Swier 2003). Generally, size and sturdiness of a bat's skull are correlated with size and hardness of favorite insect prey (Belwood 1979, Freeman 1979). In some instances, though, there may be no correlation. For example, hoary bats have very powerful skulls, yet they prefer soft-bodied insects (S. Pedersen pers. comm.).

Seasonal Behavior

Bats need to migrate or hibernate to survive when harsh northern winters cause insect prey to die and open bodies of water to freeze. Whether they migrate or hibernate depends on factors relating to animal size, flight characteristics, and proximity to over-wintering sites (e.g., *hibernacula*, Humphrey 1982). Very little is known of the migration routes and the migratory behavior of bats in South Dakota, though they may migrate north-south along the eastern and western state borders and along the Missouri River corridor. Bats may also migrate east-west from the Black Hills to the Missouri River drainage each season, though little concrete evidence is available to verify these movement patterns.

Different species of bats migrate at different times and over varying distances. For example, big brown bats move short distances from summer to winter roosts, while red bats travel long distances to follow warm weather and insect prey (Humphrey 1982). Usually, bats traveling short distances are hibernators traveling to and from their winter roosts, while bats traveling long distances are migrants moving southward with the onset of cool weather and returning northward with the onset of warm weather. In South Dakota, southward migration usually begins in late summer and northward migration usually ends in mid to late spring, while hibernation generally lasts from October to April (Tigner and Dowd Stukel 2003).

Mortality

In general, bat mortality rates are affected by many factors including human activities (e.g., entering roosts at sensitive times of the year, camping in or near caves, releasing environmental toxins, and destroying roost sites). In addition, accidental midair collisions with wind turbines (Johnson et al. 2003), trees, and barbed-wire fences, or accidental groundings during extreme weather may cause bat fatalities (Tuttle 1994). Midair predation by raptors (Byre 1990) and roost predation by snakes, raccoons, and skunks also contribute to bat mortality (Tuttle 1994).

Prenatal mortality is minimal among bats (Humphrey 1982), while newborn and juvenile bat mortalities are associated with litter size, environmental stress, accidents, and predation. Young bats have higher mortality rates than adults. Fatalities to young bats may be caused by crashing into foliage during first flights, being knocked out of the air by large gusts of wind, and being preyed on by owls and other night predators. First year hibernators also seem to suffer high mortality rates (J. Tigner pers. comm.), possibly due to inadequate foraging success and low body weights when they enter their first winter cycle. Most adult fatalities result from accidents, and mortality rates remain relatively constant throughout adulthood.

Bats and Health Issues

Rabies is one disease of many that can be transmitted to humans from wild or domestic animals in South Dakota. Bats are one of many species that can transmit rabies to humans. Rabies is a fatal viral disease infecting the central nervous system (SDDOH 2002).

After infection, symptoms appear in three to eight weeks and may include headache, behavior and sensory changes, paralysis, fever, and malaise.

The South Dakota Department of Health records indicate that skunks are the most prevalent carriers of rabies in the state (Table 1). Since 1990, only 59 of the 1,656 bats tested for the rabies virus in South Dakota proved to be rabies-positive (rabid) – a 4 percent rabies infection rate during this 13-year period (SDDOH 2003a). During 2000, 12 of 357 bats tested positive for rabies, while in 2001, only 11 of 406 bats tested positive for rabies – together, a 3 percent infection rate. In 2002, 9 of 378 bats tested positive for rabies – a 2 percent infection rate (SDDOH 2003a).

Table 1. Number of animals testing positive and negative for rabies in South Dakota, 1990 - 2002 (SDDOH 2003a).

Animal	Positive	Negative	Percent Positive
Skunk	1056	512	67%
Horse	42	240	15%
Cattle	189	1633	10%
Bat	59	1597	4%
Dog	87	2380	4%
Cat	76	1597	2%

Most bat rabies cases come from Sioux Falls, Minnehaha County, where the Animal Control Department collects an abundance of bats – the majority of specimens tested in South Dakota – from private residences each year. Most collected bats are sent to and tested by the Animal Diseases Research and Diagnostic Laboratory at South Dakota State University in Brookings. The South Dakota Department of Health (SDDOH) also receives and tests dead bats according to criteria established by the Centers for Disease Control (CDC). Note that the infection rates given here do not represent actual rabies infection rates in wild bats, because they do not represent a random sampling of wild bat populations. Test results, therefore, overestimate the incidence of bat rabies in South Dakota. Nationwide, approximately 10% of bat specimens submitted for rabies testing were positive for rabies (O'Shea et al. 2003), but this number is inflated and does not represent actual infection rates of wild bats (S. Pedersen, pers. comm.).

Rabid bats have been collected in Clay, Davison, Fall River, Lake, Lawrence, Meade, Miner, Minnehaha, Pennington, and Turner counties (SDDOH 2003b). Big brown bats are the most common – and most commonly tested – bats in South Dakota. As a result, over 50 percent of tested rabies-positive bats are big brown bats. Other species that have tested positive include the northern myotis (Myotis septentrionalis), long-legged myotis (Myotis volans), and hoary bat.

Rabies is only transmitted through contact with rabid animals (including bats). Usually, people contract rabies from a bite, scratch, or mucous membrane exposure from rabid animals. Rabies cannot be contracted from droppings or urine. When exposed to rabies, SDDOH recommends seeking immediate medical care. This ensures prompt treatment through post-exposure prophylaxis shots, which prevents rabies in humans. If humans are exposed to rabies, they must have anti-rabies shots to prevent rabies infection and fatality.

Some individuals risk rabies infection through work (e.g., wildlife researchers) or recreational activities (e.g., cavers). To avoid rabies infection, SDDOH recommends pre-exposure rabies vaccination to wildlife researchers working with bats and cavers entering

potential bat roosts. Usually, three shots are given over a three to four week period. These shots do not prevent rabies, though they help ensure complete protection with only two additional booster shots after exposure to rabies. Those individuals should also check their antibody titer every two years, and if it measures below acceptable levels, receive booster rabies shots. (Note: May was declared as Rabies Awareness month in South Dakota on May 3, 2001 by Governor Janklow.)

Some additional diseases affecting bats are histoplasmosis and West Nile virus. Histoplasmosis is a fungal disease that can be transmitted from bats to humans. This disease is most prevalent in droppings of birds and fruit eating bats found commonly in moist, tropical regions. Bats in South Dakota have dry droppings (guano) composed of insect remains; their droppings are unlikely to support the *Histoplasma capsulatum* fungus (S. Pedersen pers. comm.). West Nile virus may infect bats or humans, though this disease is a mosquito-borne infection. At this time, bats are not known to transmit West Nile virus to humans (L. Kightlinger, pers. comm.). West Nile virus may cause mild flu-like illness or severe infection of the brain (SDDOH 2003c).

Like all mammals, bats are infested by ectoparasites including fleas, mites, chiggers, and lice (Humphrey 1982, Laubach et al. 1994), but none of these invertebrates pose a threat to public health.

Bat Studies in South Dakota

Few studies have been conducted in the past in South Dakota. Most current reports belong to unpublished literature, and they generally only note the presence or absence of species from local, regional, and statewide perspectives. Findley (1956) conducted local presence or absence surveys of mammals, including bats, in Clay County South Dakota, while Wilhelm et al. (1981) conducted parallel surveys at LaCreek National Wildlife Refuge. Turner (1974) conducted surveys of mammals, including bats, in the Black Hills, and Froiland and Weedon (1990) conducted similar studies in the Badlands. Over and Churchill (1941 and 1945), Jones and Genoways (1967), Choate and Jones (1981), Sharps and Benzon (1984), and Blumberg (1993) presented checklists or conducted surveys of mammals, including bats, in South Dakota.

Specific bat research includes studies of individual species or surveys of bats in particular areas in South Dakota. Studies of individual species include research by Bole (1934), Moulthrop (1936), Jones and Packard (1958), Long and Severson (1969), Gunier (1971), Tuttle and Heaney (1974), Jones and Choate (1978), and Mattson et al. (1996). Regional surveys include research by Turner and Jones (1968), Turner and Davis (1970), Martin and Hawks (1972), Olson (1977), Farney and Jones (1980), Anderson (1993), Bogan et al. (1996), Choate and Anderson (1997), Cryan et al. (2000), Cryan et al. (2001), Swier (2003), and Lane et al. (2003). Also, a number of unpublished reports exist concerning bat surveys conducted through Wind Cave National Park, Jewel Cave National Monument, the USDA Forest Service, and South Dakota Game, Fish and Parks. Despite this wealth of survey data, relatively little natural history data are available for eastern and central South Dakota, and existing data are limited to presence or absence at single locations.

Species and Status of Bats in South Dakota

Species List

Forty-five species of bats are found in the United States (Pierson 1998). Of these, 12 species of bats have been documented in South Dakota. Four species are considered summer

residents or migratory species, and eight are considered year-round residents (Table 2). Summer resident and migratory species may travel northward and southward as a result of weather changes, and often year-round residents hibernate during cold, winter months.

Table 2. Summer resident or migratory species based on Swier (2003), and year-round resident species based on SDBWG (2002).

Common Name	***Scientific Name***	**Type**
Big Brown Bat	*Eptesicus fuscus*	Year-round resident
Eastern Red Bat	*Lasiurus borealis*	Summer resident
Evening Bat	*Nycticeius humeralis*	Migratory
Fringed Myotis	*Myotis thysanodes*	Year-round resident
Hoary Bat	*Lasiurus cinereus*	Summer resident
Little Brown Myotis	*Myotis lucifugus*	Year-round resident
Long-eared Myotis	*Myotis evotis*	Year-round resident
Long-legged Myotis	*Myotis volans*	Year-round resident
Northern Myotis	*Myotis septentrionalis*	Year-round resident
Silver-haired Bat	*Lasionycteris noctivagans*	Summer resident
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Year-round resident
Western Small-footed Myotis	*Myotis ciliolabrum*	Year-round resident

In January 2003, an eastern pipistrelle (*Pipistrellus subflavus*) was observed hibernating in the Black Hills. This is the first record of an eastern pipistrelle in South Dakota, though vocal signatures were recorded using an AnaBat bat detector in the southern Black Hills at an earlier date (Tigner and Dowd Stukel 2003). Since January 2003, two additional locations were recorded with hibernating eastern pipistrelle. At this time, eastern pipistrelles are not considered migratory or resident species in South Dakota.

Current State Status

In South Dakota, no bats are state listed as threatened or endangered. However, six species are considered rare (S1, S2, S3), according to the South Dakota Natural Heritage Program (SDNHP), while six bats are considered relatively common (Table 3). Six rare species include the long-eared myotis, fringed myotis, northern myotis, silver-haired bat, Townsend's big-eared bat, and evening bat, while six common species include the little brown myotis, big brown bat, hoary bat, red bat, western small-footed myotis, and long-legged myotis (SDGFP 2002).

South Dakota Natural Heritage Program monitors rare bat species in South Dakota. Information, such as maternity roosts and hibernacula, regarding these species is collected and recorded in the South Dakota Natural Heritage Database. The database helps SDNHP biologists monitor species indicating which species need greater management concern. Each species is ranked, at the global and state level, based on rarity. Listed below are South Dakota bat species and their global and state ranks. Global ranks ("G") indicate the relative status of the species throughout their range, while state ranks ("S") indicate the relative status of the species in South Dakota. Greater abundance relates to high numerical values (e.g., 4 or 5). Ranks report the relative rareness and degree of management concern regarding the species.

Table 3. Rare (above middle line) and common (below middle line) species in South Dakota with global and state ranks as determined by information in the South Dakota Natural Heritage Database, 2003.

Species Name	Common Name	Global Rank	State Rank
Myotis evotis	Long-eared myotis	G5	S1
Myotis thysanodes	Fringed myotis	G4G5	S2
Myotis septentrionalis	Northern myotis	G4	S3
Lasionycteris noctivagans	Silver-haired bat	G5	S4
Corynorhinus townsendii	Townsend's big-eared bat	G4	S2S3
Nycticeius humeralis	Evening bat	G5	S1
Myotis lucifugus	Little brown myotis	G5	S5
Myotis volans	Long-legged myotis	G5	S5
Myotis ciliolabrum	Western small-footed myotis	G5	S5
Eptesicus fuscus	Big brown bat	G5	S5
Lasiurus borealis	Eastern red bat	G5	S5
Lasiurus cinereus	Hoary bat	G5	S5

Rank Definition: **G1S1** Critically imperiled because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction. **G2S2** Imperiled because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range. **G3S3** Either very rare and local throughout its range, or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction throughout its range because of other factors; in the range of 21 of 100 occurrences. **G4S4** Apparently secure, though it may be quite rare in parts of its range, especially at the periphery. Cause for long term concern. **G5S5** Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery. **T** Rank of subspecies or variety (SDGFP 2002).

Current Federal Status

The United States Fish and Wildlife Service (USFWS) has not designated any South Dakota bat species as candidate, threatened, or endangered species (Table 4). Whereas, the United States Forest Service (USFS) – Rocky Mountain Region (Region 2 [R2]) including Wyoming, Colorado, and the Black Hills of South Dakota – has three bat species designated as sensitive species two of which occur in South Dakota (Table 4). Both species are located in the Black Hills National Forest in western South Dakota. The R2 Regional Forester's Sensitive Species List provides special management (i.e. Forest Plan Standards) to conserve sensitive species and their habitats on lands managed by the USDA, Forest Service. This step is taken in an effort to preclude the need for federally listing of these sensitive species. According to the USFS, "sensitive species" is a term used to describe plants and animals with population viability or habitat capability concerns.

The Western Bat Working Group (WBWG) designates priority ranks to bat species in the western United States. Priority ranks do not provide protection to bats rather they provide information on conservation or management concerns associated with bats. South Dakota is included in this group as Region 9 (Table 4). High priority species may be imperiled or at risk of imperilment, medium priority species are of concern but data regarding species and its threats are lacking, and low priority species are of little concern because existing data suggest species populations are stable and status changes are unlikely. This group published a list to avoid population declines thereby preventing federally listing (WBWG 1998).

Table 4. Federal status of species in South Dakota based on USFWS and USFS designations. Regional priority ranks of species in the western United States, according to the WBWG *Regional Priority Matrix*.

Species Name	Common Name	USFWS	USFS	WBWG
Myotis evotis	Long-eared myotis	-	-	L
Myotis thysanodes	Fringed myotis	-	S	M
Myotis septentrionalis	Northern myotis	-	-	L
Lasionycteris noctivagans	Silver-haired bat	-	-	M
Corynorhinus townsendii	Townsend's big-eared bat	-	S	H
Nycticeius humeralis	Evening bat	-	-	-
Myotis lucifugus	Little brown myotis	-	-	L
Myotis volans	Long-legged myotis	-	-	L
Myotis ciliolabrum	Western small-footed myotis	-	-	L
Eptesicus fuscus	Big brown bat	-	-	L
Lasiurus borealis	Eastern red bat	-	-	L
Lasiurus cinereus	Hoary bat	-	-	M

Rank Definition: **S** Identified as sensitive species according to USFS in Region 2. **L** Identified as low priority species, **M** considered medium priority species, and **H** considered high priority species according to WBWG in Region 9.

Reasons for Bat Declines

Roosting habitats are most affected by human-related threats throughout South Dakota. Roost sites are degraded or destroyed through ill-timed recreational activities in caves (J. Tigner pers. comm.), by sealing closed abandoned mines used as bat roosts (Luce 1998), by destroying tree roosts and removing or reconstructing bridges also used as bat roosts (Swier 2003), and by improperly excluding bats from building or homes (SBWG 2002). In addition, new data suggest that active wind generators may adversely affect bats through collisions resulting in death (Osborn et al. 1998, Keeley et al. 2001).

Much like roosting habitats, foraging areas are most affected by human-related activities. Use of pesticides may threatened bats by presumably reducing or contaminating prey populations thereby reducing prey availability or contaminating bats (O'Shea et al. 2001, Hartman 2002). Contamination or loss of watering sites may affect bat distribution and survival.

Natural threats also affect bat populations in South Dakota, such as disturbances (e.g., extreme winds) or catastrophes (e.g., tornadoes or fire, Pedersen 1996, Adams and Pedersen 1998). Each may destroy habitats or reduce populations. Additional threats include intense predation and reduced prey availability. Reduced prey availability may be the result of reduced species diversity of plants (C. Schmidt pers. comm.).

Management Plan

Introduction

In 1999, the North American Bat Conservation Partnership (NABCP) was developed to provide a framework for willing groups to participate in a cooperative effort to conserve North American bat species (http://www.batcon.org/nabcp/newsite/). NABCP is an alliance of working groups, bat researchers, non-governmental organizations, and state and federal agencies from Mexico, Canada, and the United States. Partners helped create a strategic plan that identifies conservation priorities regarding bat protection. Framework regarding bat protection includes research, education, and management initiatives.

The Western Bat Working Group (WBWG), of which the South Dakota Bat Working Group (SDBWG) is considered an active member, plays an active role in the NABCP. The Western Bat Working Group – formed as a result of conservation efforts regarding Townsend's big-eared bats – includes agencies, organizations, and individuals interested in bat research, management, and conservation from 13 western states and 2 western provinces. The SDBWG works as a partner with the WBWG and therefore the NABCP.

The South Dakota Bat Working Group works to protect bats and bat habitat by conserving bats and their habitats, educating the public, and participating with federal, state, and private landowners. The main objectives are to raise awareness about the roles bats play in maintaining healthy ecosystems and to work with public land managers and private landowners to reduce possible disruptions to bats and their habitat.

Because the SDBWG strives to protect bats and their habitats, the SDBWG, in cooperation with South Dakota Game, Fish and Parks, has taken the lead to develop a five-year state bat management plan. This plan is intended to help guide agencies, organizations, and individuals with bat management throughout South Dakota. Each year during implementation, an evaluation will be conducted to assess the progress of meeting objectives. After five years of implementation, the plan will be thoroughly revisited and appropriate changes will be made.

South Dakota has proposed a management plan with a framework similar to the strategic plan designed by NABCP in order to cooperate with other states on the national level. Three sections comprise the plan: management, research, and education. Each section is critical for conserving bats in South Dakota. The South Dakota Bat Management Plan's list of participants – comprised mainly of SDBWG members – identified potential threats to be addressed through objectives and strategies in each section. Threats are thoroughly described to understand and effectively address the problem. Objectives (specific short- or long-term goals) and strategies (actions) identify efforts that local, private, state, and federal agencies can take and/or continue to take regarding bat conservation in South Dakota. Strategies are not prioritized.

Goal

This plan seeks to initiate new conservation methods and continue current efforts to protect bats in South Dakota. Ultimately, the goal of this plan is to provide guidance for individuals and agencies to promote long-term conservation of South Dakota bat species through research, management, and education.

Threats to Bat Populations

Bats are affected by many factors, eight of which are addressed in this plan. Such threats relate to management, research, or education needs. As a result, objectives and strategies are segregated into one of these areas based on their focus.

Threat 1. Loss of habitat through natural and human-related factors.

Roosting Habitat

Bat populations are thought to be able to withstand and adapt to natural habitat degradation, but intensive human-related threats have a significant impact on bats (Lunney 1990). Loss of roosting habitat (degradation or destruction) can affect large numbers of bats thus protecting and enhancing this habitat is imperative. Roost sites provide areas for resting, rearing young, socializing, and hibernating. Such roost sites include underground structures, buildings, trees, bridges, and rock ledges. In the Black Hills, the greatest threat to caves is human disturbance (J. Tigner pers. comm.), whereas the greatest threat to mines is permanent and improper sealing of the mine for liability purposes or unexpected collapse of the mine due to natural degradation (Luce 1998).

Underground structures (caves and mines) provide hibernacula and maternity roosts, and often these roosts are lost by lack of protection or management. Furthermore, underground structures are limited in the Black Hills, so the loss of these structures is a significant threat to bats, particularly those using caves and mines as hibernacula.

Although the extended importance of bridges and abandoned buildings is relatively unknown, safeguarding bridges and abandoned buildings may help preserve important bat roosts. Often bridges are removed without proper bat surveys, and important bat roosts may be unknowingly destroyed. Aboveground structures like bridges (including box culverts) and abandoned buildings have been noted as bat roosts in South Dakota. Swier (2003) detected big brown bats and little brown bats using concrete bridges and picnic shelters as roost sites, respectively. Frequently, these structures are removed for liability reasons or damaged through natural causes or vandalism.

Living and dead trees in riparian and forested areas provide important roosts for resident and migratory bat species (Lacki and Schwierjohann 2001, Swier 2003). Removal of these habitats (riparian areas and forests) through commercial and residential development, agriculture, and selective forest harvesting destroys possible tree roosts, forage areas, or travel routes (Barclay and Brinham 1998). Silvicultural practices seem to favor monotypic stands, short rotation times, and selective tree harvest leaving minimal roosting habitat for tree-roosting species (Pierson 1998). Also, data show that bats select roost sites in areas with diverse vegetation, old trees, and numerous alternative roosts (e.g., snags, Waldien et al. 2000). Statewide riparian areas are often not specifically managed for bats, though some agencies provide standards and guidelines to protect and enhance riparian areas. Basically, Forest Service standards and guidelines strive to protect basic soil, air, water, and cave resources and provide for a variety of life through management of biologically diverse ecosystems (BHNF 2000). Forested areas in the Black Hills are not specifically surveyed for bats before removing trees for timber harvest (B. Phillips pers. comm.). If bat conservation is a management objective, protection of riparian and forest areas is necessary because riparian areas and other forested corridors (e.g., shelterbelts) connect isolated forested areas to each other providing travel routes for bats. If these travel routes are fragmented, the ability for bats

to move among different forested areas is greatly reduced. In addition, bats use multiple roosts often switching roosts during their active season (Swier 2003).

Snags in early to medium stages of decay are important roosts as bats have been observed roosting underneath the bark and within the hollows of dead trees (Weller and Zabel 2001). Federal forest management include provisions to leave two to four snags (dead trees) per acre as wildlife habitat (BHNF 2000 – Standard 2301), and state forestry works provide snags as well (B. Scott pers. comm.). However, studies show that these numbers are often too low to accommodate the needs of cavity-dwelling species (Pierson 1998, Rabe et al. 1998). Black Hills National Forest Plan also lists standards to provide future snags in areas where snags are below snag objectives by leaving large diameter green trees as snag recruitment (BHNF 2000 – Standard 2304, 2306).

Hibernating bats are susceptible to disturbance, and disturbance is considered one of the greatest threats to bats. During the winter, human disturbances (e.g., surveys, recreational activities, vandalism, and social gatherings), though seemingly small, may wake hibernating bats and cause them to use important fat reserves. Changes in cave or mine temperature due to the presence of humans or loud noises because of human voices or movements seem to affect most hibernators.

Summer maternity roost can also be disturbed as a result of human actions (e.g., removal of roosts, recreational caving activities, and house exclusions). Ill-timed house exclusions may cause roosting females with young to drop their pups while moving to another roost, relocate young to a less suitable roost, or separate from their pups that eventually die.

Often disturbances affect bats during critical phases of their life cycle (e.g., hibernation or reproduction) which has been shown to significantly reduce bat populations.

Foraging Habitat

Bats forage in areas where their prey is most available. Removal of trees can reduce potential foraging areas for bats in treed areas, as prey seems to concentrate near treetops, water sources, or forested edges (Verboom and Spoelstra 1999), yet properly thinned forests may provide foraging areas to bats (Adams and Golten 2003). Pesticides may also affect bats and their prey. Often prey (pest) populations are controlled through pesticide use, which may reduce insect prey numbers making less food available to bats (CWF 2001). In addition, bats may consume insects affected by pesticides. Pesticides remain in insect tissues, and therefore accumulate in the fatty tissues of bats. Pesticides in fatty tissues are released during hibernation, migration, or periods of stress and may be passed to nursing young (McCracken 1986).

Water sources supply water and prey to bats, but bank erosion and pesticide use threaten these water sources. Bank erosion and the resulting loss of riparian vegetation can occur from actions such as livestock grazing, road construction (Grace 2002), urban development (Nelson and Booth 2002), natural flooding, and agricultural practices (Souchere et al. 2003). Livestock with access to riparian areas may trample vegetation (Rich 2002), reducing plant diversity thereby reducing prey abundance. Pesticides used to treat mosquitoes may also kill other insects. Road construction, urban development, and agricultural practices (e.g., row crops) increase sedimentation of streams, which reduces water quality (Grace 2002, Nelson and Booth 2002, and Souchere et al. 2003). As a result, streams, ponds, or lakes may affect drinking water or prey availability for bats.

Threat 2. Regulations or policies associated with protecting bat species and roost sites are inadequate or poorly enforced.

Bats are exposed to increased biological threats (e.g., predation and weather) because of human disturbance. Protecting bats and their habitats is important to maintain population numbers and essential roosts (e.g., caves and mines), but there are few incentives for private landowners to protect bats and their roosts on private lands. Regulatory measures help protect important bat habitats and species and should be updated recurrently as an active part of species management.

State Regulations

State statutes provide some legal protection to bats. All bats in South Dakota are classified as nongame[1] species according to state statutes. Section 34A-8-2 of South Dakota Codified Laws and Constitution states that "the secretary of Game, Fish and Parks shall investigate endangered, threatened, and nongame wildlife to develop information relating to population, distribution, habitat needs, limiting factors, and other biological or ecological data to determine management measures necessary to ensure their perpetuation as viable components to the ecosystems and for human enjoyment." Section 34A-8-6 of South Dakota Codified Laws and Constitution states that "the Department of Game, Fish and Parks and the Department of Agriculture shall perform acts necessary for the conservation, management, protection, restoration, and propagation of endangered, threatened, and nongame species of wildlife." Nongame species are protected unless otherwise noted through law. As a result, nongame species, such as bats, cannot be killed without permission from the state. However, if a bat enters one's living area, by unwritten policy a person will not be reprimanded due to an incidental killing. To collect bats for research purposes, a scientific collector's permit (SDCL 41-6-32) is required. As indicated by section 41-2-18 of South Dakota Codified Laws and Constitution, the Game, Fish and Parks Commission has the option to adopt regulatory measures to provide additional protection or relax protection awarded to wild animals and threatened, endangered, and nongame species.

[1] Nongame species is any wildlife species not legally classified as a game species, furbearer, or threatened or endangered species by statutes of South Dakota (SDCL 34A-8-1).

Federal Regulations

The Federal Cave Resources Protection Act of 1988 (Public Law 100-691, November 18, 1988) provides regulatory measures for federal agencies, particularly the Department of Interior and Department of Agriculture, on federal lands (Appendix E). Federal Cave Resources Protection Act calls for federal agencies to inventory and list significant caves on federal lands and to protect such caves from harm, either to the cave or its biota (e.g., bats and other animals). This act also states that there can be valid reasons for not disclosing cave locations to the general public, which means that cave locations can be kept confidential and protected from Freedom of Information Act (FIA) requests.

Another act associated with bat resources is the National Cave and Karst Research Institute Act of 1998 (Public Law 105-325, Appendix F). This act was designed for the National Park Service to establish and administer a program on cave and karst research and to examine the feasibility of a centralized national cave and karst research institute. Through cooperative efforts by other federal agencies, organizations, experts, and individuals involved with caves, the feasibility study was prepared and forwarded to Congress. As a result,

Congress mandated the National Park Service to establish the National Cave and Karst Research Institute near Carlsbad Caverns National Park in New Mexico. This institute was formed to establish partnerships in order to foster research and education on caves and karsts. Federal funds must be matched by non-federal funds. More specifically, the Institute's mission is to facilitate speleological science, enhance public education, and promote environmentally sound cave and karst management, with bat conservation as a secondary focus. Thus far, partners include Bureau of Land Management, United States Environmental Protection Agency, United States Forest Service, United States Fish and Wildlife Service, and United States Geological Service.

Additionally, the National Park Service (NPS) has guidelines – NPS Natural Resources Management Guidelines – that provide direction on NPS policies, such as the NPS Management Policies. All caves are deemed to fall within the definition of significant cave, therefore they are provided protection and perpetuation of natural cave, karst, and hydrological systems (R. Horrocks pers. comm.). Management policies relating to caves and karst include: 1) managing karst terrain to maintain the inherent integrity of its water quality, spring flow, drainage patterns, and caves, 2) managing caves in accordance with approved cave management plans to perpetuate natural systems associated with caves, such as karst and other drainage patterns, air flows, mineral deposition, and plant and animal communities, 3) protecting wilderness, cultural resources, and values, and 4) preventing development or uses in, above, or adjacent to caves (B. Muenchau pers. comm., R. Horrocks pers. comm.)

Wind Cave National Park (WCNP), in western South Dakota, has a Superintendent's Compendium containing specific regulations to provide public health and safety and protect natural and cultural resources for caves in the park. All caves within the park are considered sensitive, so access is restricted and information regarding caves is confidential and thereby protected from FIA requests (R. Horrocks pers. comm.). In addition to this compendium, WCNP is currently developing a Cave and Karst Resource Management Plan to address management of caves and karst in the park. The main cave, though not considered a significant bat resource, as well as other caves within WCNP are managed to perpetuate natural systems associated with caves (e.g., karst, air flow, mineral deposition, plant and animal communities; M. Ohms pers. comm., D. Foster pers. comm.).

Jewel Cave National Monument (JCNM) and WCNP have active cave policies in South Dakota. JCNM has the only policy that manages a significant bat resource in a manner consistent with bat conservation guidelines. Currently, JCNM is also developing a Cave and Karst Management Plan to address management of caves and karst in the park (R. Ohms pers. comm.). This plan will include formalized policies to protect the large hibernaculum in the historic area of the main cave (R. Ohms pers. comm.).

The Missouri National Recreational River (MNRR) is a component of the National Wild and Scenic Rivers System and is administered by the National Park Service. The MNRR includes 39 miles of relatively free-flowing Missouri River from Ft. Randall Dam to the headwaters of Lewis and Clark Reservoir or approximately Running Water, South Dakota. In addition to the 39 miles above Lewis and Clark Reservoir, the National Park Service administers approximately 59 miles of Missouri River from just below Gavins Point Dam, Yankton SD to Ponca, Nebraska.

Within this section of river, the National Park Service strives to maintain the Missouri River so it functions in its most natural state. The MNRR is managed to ensure that its outstandingly remarkable values, including fish and wildlife, cultural, and historical are not

negatively impacted by any actions along or in the river. The policy for riparian habitat in the MNRR is similar to the river bank stabilization policy of the United States Fish and Wildlife Service, which is stated below. This policy works to protect and preserve river banklines, natural, cultural, and historical resources within the MNRR boundaries (MNRR 1999).

United States Fish and Wildlife Service (USFWS) has a policy regarding cave management (CFR Title 43 – Public Lands: Interior, Subtitle A – Office of the Secretary of the Interior, Part 37 – Cave Management). Cave management regulations seek to manage federal lands in a manner to protect and maintain significant caves and cave resources, as indicated in the Federal Cave Resources Protection Act. Caves or cave resources are deemed significant if the cave has one or more of the following features, characteristics, or values: biota (e.g., bats), cultural, geologic/mineralogic/palentologic, hydrologic, recreational, and educational/scientific. In addition, once caves are determined as significant the USFWS cannot disclose cave locations for purposes other than research.

According to the United States Fish and Wildlife Service, riverine and riparian habitats are high resource priorities in Region 6. USFWS Region 6 has a river bank stabilization policy, which is designed to restore or protect permanent infrastructure or cultural resources associated with riparian areas (USFWS 2001). As a result, any stabilization techniques should be designed to minimize impacts to river functions or impair overbank flooding. Basically, bank stabilization techniques should be assessed prior to implementation to ensure impacts to bank areas are minimal. At present, this policy does not include measures to protect trees for wildlife use (USFWS 2001).

Besides policies to protect significant caves or cave resources and riparian areas (in their natural state), the USFWS provides no management of bat habitat unless resident bat species are listed as threatened or endangered according to the Endangered Species Act (ESA). USFWS does not have jurisdiction to enforce habitat conservation practices relating to bat habitat unless mandated by the ESA. Most emphasis regarding habitat includes “Trust Issues” (e.g., wetlands and migratory birds) and threatened or endangered species, since the USFWS has the authority (N. Gates pers. comm.).

The Black Hills National Forest (BHNF) Land and Resource Management Plan (also referred to the Forest Plan) contains specific “standards” to protect cave resources, mines, and other known bat roost sites. Standard 3207 states, “protect known bat nursery roosts and hibernacula”.

The BHNF has started to manage a few caves and mines specifically as significant bat habitat (e.g., gated caves or mines). Maintenance of these gates becomes an issue. Thus far, there has been insufficient forest funding to adequately monitor gated and non-gated bat roost sites (B. Phillips pers. comm.). Since gated caves and mines are not frequently monitored or maintained, vandalism may occur potentially compromising the effectiveness (sometimes for years) of protecting (gating) bat resources (J. Tigner pers. comm.). To date, bat surveys have not been conducted on many caves and mines in the Black Hills, and some of these sites may need protection (e.g., gating).

Riparian areas are protected through South Dakota Best Management Practices (BMPs), which are designed to prevent or minimize the adverse impacts of forestry, agricultural, or recreational activities on water quality. By definition, BMPs are developed to protect water quality and not other functions or values of riparian areas (Phillips et al. 2000). In the Black Hills National Forest, no riparian management zones have been identified. The Forest Plan contains standards and guidelines that refer to water influence zones. In these

zones, only actions that maintain or improve long-term stream health and riparian ecosystem condition are allowed (BHNF 2000). As a rule, logging does not occur in these zones without some stream course protection. Livestock grazing in these areas is required to meet 'utilization standards' (BHNF 2000). Additional emphasis by the BHNF should be placed on evaluating this grazing intensity and, where needed, improve protection of these riparian areas and natural spring sources (B. Phillips pers. comm.).

Several agencies or groups provide information pertaining to conservation concerns relevant to bats in South Dakota. These agencies or groups include the USFS, SDGFP, and WBWG. Each designates rankings, maintains databases and observation records, or recommends management actions all without a cohesive link (refer to pages 9-10).

Threat 3. Insufficient interagency cooperation, funding sources, and educational outreach impact the effectiveness of conserving bats in South Dakota.

In the past, few organizations have taken steps to cooperate with other groups to manage or conserve bats in South Dakota. Although the SDBWG has initiated education, research, and conservation efforts in South Dakota, cooperative efforts across the state among state and federal agencies and the private sector are still minimal at best. Despite *'interagency memoranda of understanding and agreements'*, lack of funding and lack of *priority* have generally made these documents ineffective and short on substance soon after signing. To ensure the success of this plan, decision-makers should see bat conservation as a management priority.

At this time, several funding sources are available for research activities associated with nongame and often these funding sources are not widely known. Some of these funds are appropriated year to year and are not a guaranteed source of funds. Most funding sources are temporary. Funding sources include State Wildlife Grants (federal grants), Wildlife Diversity Program Small Grants, Wildlife Division monies, and Section 6 Endangered Species Act (ESA) Grants (Dowd Stukel 2003).

Threat 4. Inadequate standardized methods associated with monitoring or surveying bat species.

A standardized approach to monitoring efforts across the state would significantly improve our ability to measure the progress of achieving the management plan goal and to gauge the effectiveness of the management plan. As information associated with bat monitoring, biological needs, and habitat selection improve, the need to verify and standardize monitoring and surveying techniques increase, which ensures the accuracy and utility of this additional information.

South Dakota Department of Game, Fish and Parks (SDGFP) provides bat sampling and collection protocol guidelines for bat researchers that is available on the SDGFP Wildlife Diversity Program homepage (http://www.state.sd.us/gfp/DivisionWildlife/Diversity/index.htm) or SDBWG homepage (http://nat_hist.sdstate.edu/SDBWG/SDBWG.html). Increased interest in bats in the Black Hills led to concerns regarding impacts of sampling and collecting local bat populations, which prompted the designation of this protocol. This protocol states specific requirements and guidelines for bat sampling and collecting associated with research and monitoring in South Dakota and allows SDGFP to collect information regarding bat researcher qualifications and current/previous bat research methodologies and to review bat research and monitoring projects proposed for South Dakota.

The BHNF includes information pertaining to monitoring and evaluating sensitive species in their Land and Resource Management Plan, though these requirements are general and do not specify particular variables to collect or areas to visit during specific time periods. The approach involves general information of collecting and storing monitoring data and requires data collection every three years but does not involve or suggest standard methods.

Because bat research methodologies vary per species, region/habitat, and researcher, the implementation of a single bat research protocol is not proposed in this document. Although research methodologies vary, monitoring efforts should be standardized. Standardizing monitoring efforts (e.g., time spent surveying a site) will reduce redundant data collection and decrease disturbance to bats at important roosts during critical periods (e.g., lactation in females). Data consistency is a key component in obtaining meaningful data (e.g., surveying the same cave at the same time under similar conditions) (Petryszyn 1995). Effective bat conservation relies on gathering appropriate information to recognize population changes regarding bat species, especially those of conservation concern.

The WBWG is currently working with the USFS Pacific Northwest Research Station (Arcata, CA) to develop a set of guidelines for monitoring, surveying, and inventorying bats.

Threat 5. Data and knowledge associated with natural history are lacking regarding bats in South Dakota, and due to inadequate awareness regarding regional bat research efforts, participation as a cooperative unit is lacking.

Limited knowledge of factors affecting bat populations and insufficient data regarding aspects of bat natural history hinder bat conservation efforts. Conservation efforts throughout the United States are being designed and implemented with negligible documentation regarding the value in alleviating damage or enhancing habitats for bats. As a result, biologists are taking efforts to fill these information gaps by investigating species distributions, population trends, and habitat requirements.

At this time, information is limited to bat species in western South Dakota, particularly the Black Hills. Data gaps relating to bats include long-term monitoring of sites or populations, population status, population distribution, foraging habitats and habits, roosting sites, migratory patterns, effects of wind power, reproductive strategies, population structure, and genetic structure, particularly in central and eastern South Dakota. Bats are difficult to study, which limits a detailed understanding of their natural history. Factors making research difficult include extreme mobility, widely dispersed populations (some species), nocturnal activity patterns, and cryptic and/or inaccessible roost sites **(**Petryszyn 1995).

Current data have not been summarized nor reviewed to evaluate where research priorities lie because data are not readily accessible. Understanding which habitats (e.g., roosting and foraging areas) are selected by bats and are suitable for bats will help prioritize conservation efforts in order to favor the most critical sites. Databases help identify variables consistently collected by researchers and help manage an accumulation of data generated from various surveys. In order to recognize information gaps and research goals, current knowledge needs to be identified.

Research and monitoring of bats in South Dakota are important to conserve these species. Being aware of and participating in regional efforts associated with bats is an effective method of increasing an understanding of regional bat habits and habitats. Currently, aside from participation in the WBWG, few organizations, agencies, or individuals in South Dakota participate in any regional efforts regarding bats. Few programs are designed to monitor or research bats in a specific region, though some programs exist. For example,

some states (e.g., Minnesota) have adopted a program to monitor bats in mines in the Great Lakes region called the Great Lakes Regional Bat Conservation Initiative. Such efforts could be designed for the Great Plains Region.

Some programs are designed for national and international participation. Bat Conservation International (BCI) has taken the lead role to research and conserve bats thereby designing several research-oriented programs. Generally, these programs are designed to encourage state, federal, private, or individual entities to survey and enhance bat habitat. Three programs developed by BCI include the Bat House Project, Bats and Mines Project, and Bats in Buildings Project. Currently, agencies, organizations, and individuals in South Dakota have participated minimally in these efforts (M. Kiser pers. comm.).

Threat 6. Insufficient use of data associated with bats in South Dakota is a problem that can be changed by creating appropriate management recommendations.

Although data have been collected on bats in some regions of South Dakota, collected information is relatively unknown and thereby used inadequately. Data associated with bats may be applied to many areas: research, monitoring protocol, and management. Generally, management refers to conserving and protecting bats in South Dakota using various techniques or decisions. Establishing certain management recommendations may protect areas near rivers, in the Black Hills, and in large cities.

Often management recommendations are based on a variety of agencies, organizations, and individuals, therefore emphasis, interpretations, and formats may differ. This causes confusion among different groups or individuals concerning proper bat conservation methods. In order to alleviate confusion, universal management recommendations can be designed incorporating formats, interpretations, and ideas of groups and individuals with active policies or recommendations. To create these universal management recommendations, past recommendations should be reviewed. This will take cooperation among agencies and summarization of past data. Data can be used to bridge research findings and make management recommendations to resource managers.

By developing a general list of management recommendations, managers will essentially be provided with a condensed version of the South Dakota bat management plan. This offers a quick reference of some very important management steps to groups or individuals concerned with conserving bats in South Dakota. In addition, management recommendations will help guide managers with future research. As a result, it is important to analyze data, understand interpretations, recognize formats, and apply information towards identifying management recommendations related to bats.

Threat 7. Inadequate knowledge of bats is a problem that plagues many areas, particularly South Dakota, and contributes to loss of individual bats, unnecessary rabies testing of bats, lack of protection of roost sites, and poor understanding of bats.

Many people have an incomplete understanding of bats and their habitats. Negligible information sources and limited opportunities for school activities and volunteer programs are available for all ages to become knowledgeable in bat ecology. Education is the foreground of understanding, which often leads to the protection of bat species. The consequence of insufficient knowledge is increased anthropogenic (human related) threats to bats by the public sector. By informing the public about bats and their ecology, human associated threats to bats will hopefully be reduced. For example, people in Austin, Texas once sought to eradicate bats because they believed bats caused problems. Bat Conservation International

(BCI) educated people on the ecological and economic value of bats in this city. Consequently, people in Austin cherish their bats and consider Austin the "Bat Capitol of America". Tourists even travel to Austin to observe emerging bats.

Currently, the South Dakota Bat Working Group (SDBWG) has a website (http://nat_hist.sdstate.edu/SDBWG/SDBWG.html) that includes information pertaining to bats in South Dakota. This website includes bat facts, proper bat exclusions, bat species found in South Dakota, current and past research, educational tools, and other bat related information. Also, South Dakota Game, Fish and Parks (SDGFP) has several publications or educational tools concerning bats. These include AcroBATS of the Night (poster and activity booklet), Sharing Your Space: a homeowner's guide to attracting backyard wildlife, Bat Trunk, School Programs in the Black Hills, and Bat Awareness Week (2nd week in August). In addition, BCI has numerous educational materials related to bats for all age groups. Efforts by these groups may have helped protect bats, but bats are still unnecessarily killed for rabies testing and improperly excluded from roosts; misperceptions still plague many groups and individuals.

Folklore, myth, and superstitions involving bats have masked the ecological and economic role these species play in their ecosystems. For example, few bats carry rabies and few human rabies cases result from bat strains of the virus. Also, bats do not become tangled in one's hair, and no bats are vampires in the United States. Unjustifiable public perception presents a serious threat to bats. For approximately 20 years, public awareness concerning the value of bats has increased though lack of knowledge remains a hindrance to bat protection. Often agencies, organizations, educators, and individuals lack essential resources to inform the public to dispel misconceptions associated with bats. By educating the public, they may learn of the value of bats and ways to assist with their conservation. Education will help the public develop an appreciation for the role bats play, dispel myths and misperceptions associated with bats, create an awareness of human related threats to bats, and encourage students to maintain and/or create habitats suitable for bats. This will help to conserve bats in South Dakota.

Management Needs

There are specific management needs vital to protecting bats in South Dakota. Conserving bat habitats, enforcing regulations or policies, improving interagency cooperation, and locating additional funding sources are issues that require special emphasis to improve bat conservation.

HABITAT

Issue 1.1. – Caves and Mines

Bats residing year-round in South Dakota often use caves and mines as hibernacula or other roosts (e.g., maternity roosts). Caves on federal lands are protected through the Federal Cave Resources Protection Act of 1988 (Refer to Threat 2). Also, several caves are managed as bat hibernacula to protect hibernating bats (Tigner and Dowd Stukel 2003), and these caves are located on public lands (J. Tigner pers. comm.). Law does not protect mines, though several mines are managed and protected as bat habitat (Tigner and Dowd Stukel 2003). Mines are frequently being improperly closed (in reference to bats) due to liability issues or collapsing due to poor support within the walls. As part of their management, cave and mine

entrances are protected with "bat-friendly" gates to sustain current environmental conditions, allow bats to access the roost, and prevent human disturbance at critical times. Access by humans in managed caves is only restricted during the winter, while access in other managed mines is restricted year-round (J. Tigner pers. comm.). Because proper roosts are already limited in the Black Hills and slowly being depleted, it is necessary to continue protecting and restoring caves or mines in this region of South Dakota.

Objective 1.1.
Protect and restore bat caves and mines (e.g., hibernacula) and assess progress in the next five years. Continue to maintain and inventory protected caves and mines on federal and private properties.

Strategy 1.1A.
Evaluate mines (marked for closure on public lands or funded for closure by public monies) through biological survey and monitoring by bat biologists before closure to determine significance of bat habitat. Develop Black Hills-wide education process (e.g., newspapers, schools, and radio/TV PSA) for existing and new landowners that may have mine audits.

Strategy 1.1B.
Identify and determine whether those caves or mines have significant habitat for bats then prioritize caves or mines requiring *protection* (e.g., gate placement, gate reconstruction, or other means).

Strategy 1.1C.
Protect at least 10 additional caves or mines through landowner cooperation (on private or public lands), cost-share, and other means. Contact and cooperate with State Preservation Officers, where appropriate (see National Historic Preservation Act at **http://www.achp.gov/NHPA.pdf**). Investigate funding opportunities for cost share on private land closures. Note: *Protection* generally refers to gating but can include other human exclusion methods such as sign placement or road closure.

Strategy 1.1D.
Monitor significant hibernacula and maternity roosts through surveys, especially gated mines and caves.

Strategy 1.1E.
Cooperate with and educate the Paha Sapa Grotto (e.g., caving groups) to minimize inappropriately timed cave explorations and increase supervised, cooperative cave surveys by promoting compliance with the state's monitoring protocol. Develop a schedule of times, in one year, to avoid specific caves to prevent unnecessary bat disturbances.

Strategy 1.1F.
Cooperate and coordinate with regional private consultants, state biologists, and federal biologists to minimize repetitive cave surveys during the bat hibernation or

maternity period. Develop a survey schedule, in two years, identifying and recording specific surveys and survey times.

Strategy 1.1G.
Step up efforts to contact and cooperate with commercial cave operations in an attempt to improve communication and perhaps minimize negative effects of cave tours on bats. Develop a seasonal closure schedule, in one year, when bats are most susceptible to disturbance (e.g., maternity roosts and hibernacula), and make this schedule available to commercial cave owners.

Strategy 1.1H.
Provide cave and mine location data only to approved (approval requires understanding bats, conforming to bat educational materials and protocols, and providing better overall protection of bats through site or surrounding habitat) managing organizations such as federal, state, and private entities (unless caves are commercial) to restrict access to data. Communicate and cooperate with the Paha Sapa Grotto to keep non-commercial cave locations confidential, particularly cave locations with bats of special concern.

Issue 1.2. – Forested Habitat

Several bats (e.g., red bats, hoary bats, and silver-haired bats) depend on trees as habitat, while most bats forage near trees or vegetation in search of insect prey. Roosts may be found under bark, in holes or crevices, and amongst branches or limbs of both living and dead trees. Dead trees – *snags* – in the early to middle stages of decay provide good habitat for many tree-roosting species (e.g., bats) but other tree roosts are essential for many types of wildlife, including bats (Mattson et al. 1994, Waldien et al. 2000). In addition, foraging areas usually are found above or in the tree canopy. Removing trees particularly relating to over-story canopy affects availability of roosts (Adam et al. 1994) and potential foraging areas (Verboom and Spoelstra 1999).

Objective 1.2.
Provide federal, state, and private entities with bat habitat management guidelines for forest and/or riparian areas where wildlife, including nongame wildlife, is a primary and secondary forest management objective that will increase the available bat roosting habitat to approximately 8.5 dead trees (> 12" dbh) per acre by 2009 in forest areas.*

**Desired density of snags on forested lands for ideal bat habitat (Mattson et al. 1994).*

Strategy 1.2A.
Work with government (state and federal) and private foresters to encourage retention of a minimum of eight large snags per acre, particularly in riparian areas or in areas of known bat roosting sites, by preserving existing snags whenever possible (except where snags would have a severe negative affect on harvest operations or would cause a public safety hazard).

Strategy 1.2B.
Work with foresters, in areas where no snags exist, to encourage leaving at least eight large live trees per acre that can be preserved for future snag needs or created into snags and to leave at least 25-30% of salvage logging and fuelwood cutting areas as patches of land with large trees (dead or alive) representative of the entire stand for bat habitat.

Strategy 1.2C.
Work with land and resource managers to share information and management recommendations relating to bat roosts. Include information, recommendations, and procedures on how to maintain and enhance forest stands and riparians areas for bat habitat, survey timber sale areas for bat roosts, identify bat roosts for protection, and where appropriate, modify silvicultural activities to promote bat habitat.

Issue 1.3 – Riparian Areas and Water Sources

Aforementioned foraging areas usually are found above or in the tree canopy, but bats may also feed above or near riparian corridors. Removing or degrading riparian vegetation may affect water quality (Grace 2002, Nelson and Booth 2002, and Souchere et al. 2003) and plant diversity thereby affecting opportunities for bats to feed by reducing prey abundance (e.g., invertebrates; Verboom and Spoelstra 1999) and to drink by contaminating or eliminating water sources. Springs, seeps, ponds, creeks, and other wet areas provide feeding and drinking areas to bats, thus protecting these water sources is twofold.

Objective 1.3.
Protect and improve water sources and associated riparian areas to protect important feeding and drinking areas (and potentially roosting areas) for bats.

Strategy 1.3A.
Work with foresters, range specialists, and landowners to maintain and improve water influence zones and riparian areas by allowing only those actions that maintain and/or improve riparian ecosystem condition. Manage riparian areas to produce quality riparian communities by retaining woody vegetation along steam and lakes and providing large woody material in streams or lakes. Attempt to retain natural stream features (e.g., shallows), limit direct access to water (through fencing where applicable), retain and/or plant bank-side streams, and discourage season-long riparian grazing pastures (where applicable).

Strategy 1.3B.
Work with foresters, range specialists, and landowners to maintain and improve springs, seeps, ponds, or other wet areas as water sources. Attempt to retain natural features, protect water quality from livestock and pollutants, and protect springs sources (through fencing).

Strategy 1.3C.
Work with foresters, range specialists, and landowners to maintain and improve the management, production, and health of the nation's privately (through governmental

programs) and publicly owned grazing land, while protecting riparian areas and wetlands through allowable use or residual level practices.

Issue 1.4. – Bridges

Bridges – including box culverts – are known to provide roost habitat for bats in other regions (Keeley and Tuttle 1999). Bridges may have crevices or swallow nests (Tigner 1999) in which bats roost, however, the significance of these potential roost sites in South Dakota is relatively unknown. The schedule for bridge removal is not often communicated to enable bat surveys prior to removal. If bat surveys can be performed, bridges may be determined as important thus allowing bats to be appropriately excluded from the roost (bridge) and properly relocated to an alternative roost (e.g., bat house). In addition, surveys may help determine which bridge designs best support bats and other wildlife.

Objective 1.4.

Protect and enhance bat roosts associated with crevices or swallow nests in bridges or box culverts in five years.

Strategy 1.4A.

Make information available to surveyors of bridges and box culverts to increase awareness of bat use of these habitats. Provide funding for bridge or box culvert surveys. Determine which bridge and box culvert designs are used most frequently and/or may enhance use by bats in South Dakota and encourage construction crews, government agencies, county road crews, and private landowners to use these designs where feasible.

Strategy 1.4B.

Educate and cooperate with construction crews, government agencies, county road crews, and private landowners to protect roost bridges and box culverts by promoting sealing procedures to crevices (~30 cm deep and 2.5 cm wide) during appropriate times and with proper techniques and personnel. Sealing procedures are best completed when bats no longer use bridge or box culvert crevices as roosts. Replace sealed bridge or box culvert crevices with artificial roosts.

Strategy 1.4C.

Maintain and protect swallow nests by minimizing nest destruction. Create new bridge and box culvert roosts by constructing and placing artificial bat roosts under bridges. Improve culvert/bridge design specifications to include roost structures in all new construction or reconstruction. Attempt to protect or enhance 10 bridges or box culverts in five years. Use volunteers for additional help.

Issue 1.5. – Buildings

Some bats select human residences as their roosts, and most homeowners do not like the presence of bats in their homes. Therefore, these homeowners seek help from pest control groups or attempt to exclude bats from their homes by themselves. Few pest control groups have taken steps to actually conduct bat exclusions, and many that conduct bat exclusions are unaware of the life cycle and persistence of bats in roosts thereby excluding bats in a manner

that may negatively affect them. As well, homeowners are unaware of proper exclusion methods, which results in exclusion efforts during critical times in the bats' life cycle (e.g., during summer months). Bats roosting in homes during the summer may have young and are therefore highly susceptible to disturbance. Females or young may perish due to stress. The best method to exclude bats is performing a humane exclusion and providing alternate housing. Learning these proper bat exclusion methods is important to conserve bats.

Objective 1.5.
Promote bat friendly exclusions in houses or buildings with bat roosts – promote alternative roosts through artificial structures in these situations.

Strategy 1.5A.
Provide information to pest control groups regarding bat friendly exclusion procedures – SDBWG. Encourage house or building exclusions during appropriate seasons, with appropriate techniques, and by appropriate personnel during a period when bats are absent. Conduct at least one (educational) workshop and produce written informative material addressing these issues in one year.

Strategy 1.5B.
Develop a list of pest control operators practicing bat friendly house exclusions in one year. Provide homeowners with this list of pest control operators upon their request. Update this list every two years – SDBWG.

Strategy 1.5C.
Encourage entities providing bat exclusions to participate in certification program sponsored by Bat Conservation International (BCI). (Bat exclusionists are certified and listed on the BCI web site by being insured and licensed in the states they serve and using approved bat exclusion methods.)

Strategy 1.5D.
Provide easily accessible information (e.g., website, posters, and brochures) to pest control operators, homeowners, and educational facilities regarding proper timing and methods of conducting house or building exclusions and general background knowledge concerning bats. Encourage the construction and erection of bat houses and other artificial bat structures to provide potential roosts for excluded bats.

REGULATIONS

Issue 2.1. – Regulations

Caves and karst are protected by the Federal Cave Resources Protection Act of 1988 (Refer to Threat 2). In addition, several federal agencies have policies and/or management plans that protect caves and karst formations but do not necessarily translate to protection for roost habitat in these caves. Because bats use a wide array of habitats, it is necessary to evaluate and establish protection policies relating to all bat habitats in South Dakota. State and federal agencies should work together to enforce current regulations relevant to all bat habitats in South Dakota.

Objective 2.1.
Review regulations associated with bat habitats and recommend revisions (including incentive based protections) where necessary. Develop a policy statement from the SDBWG partners.

Strategy 2.1A.
Determine interpretation and evaluate implementation of policies and regulations associated with bats and their conservation. Work towards a broader understanding of bat policies and regulations over an ongoing timeframe.

Strategy 2.1B.
Review and summarize policies and regulations associated with roost sites (e.g., caves/mines) in South Dakota. Develop a list of recommended changes or additions to policies and regulations associated with bats and their habitat as needed.

Strategy 2.1C.
Provide information regarding regulations and policies associated with bat habitats to agencies, organizations, and individuals. Encourage increased enforcement of policies and regulations by managers and gain public support for protecting bat habitats. Use regulations and policies to guide management decisions.

Issue 2.2. – Species Status

According to South Dakota Codified Laws and Constitution (34A-8-1), bats are classified as nongame species (unless listed as a threatened or endangered species) and are protected as such. Also, the Game, Fish and Parks Commission has the opportunity to adopt additional rules to further protect threatened, endangered, or nongame species in the state (E. Dowd Stukel pers. comm.). Although six species of bats are considered species of concern according to the SDNHP, no state protection beyond their nongame status is provided to these species. Little legal protection is awarded to bats in federal lands unless they are listed as a threatened or endangered species. Only two species are considered R2 sensitive species in the BHNF (B. Phillips pers. comm.). Communication and cooperation are key to developing adequate official status regulations. Through research and communication, state and federal agencies can strive towards better protection of bats. Hopefully, this will alleviate the need for special status.

Objective 2.2.
Each year review species 'status' lists, particularly rare species monitored by the Natural Heritage Database, in South Dakota.

Strategy 2.2A.
Review official status (e.g., rare, threatened, or endangered species) of bat species, and initiate changes as necessary. Update these lists annually with changes based on state monitoring data and range-wide status. Recommend to agencies throughout South Dakota to review and reevaluate the official status of their priority species. Prioritize management needs and actions based on species status.

Strategy 2.2C.
Promote awareness and involvement with agencies throughout South Dakota and publics with regards to official species status. Provide information regarding bats and their value, protection status, and (if available) conservation incentives.

Strategy 2.2D
Encourage the Game, Fish and Parks Commission to adopt additional rules if determined necessary to protect threatened, endangered, and nongame species as indicated by SDCL 41-2-18. Make similar recommendations, as needed, to the USFWS, USFS, BLM, and NPS.

INTERAGENCY COOPERATION

Issue 3.1. – Information Sharing

The South Dakota Bat Working Group has identified improved coordination methods among different groups or individuals to assist in managing bats in South Dakota. Coordination involves communication and cooperation between agencies, organizations, and individuals, essential steps to fulfilling the goal of this plan. In the future, additional efforts should be taken to increase knowledge and therefore conservation of bats in South Dakota.

Objective 3.1.
Develop cooperation and involvement between different agencies, organizations, or citizens concerning bats through shared research and information exchange over the next five years.

Strategy 3.1A.
Promote increased attention and awareness in government and tribal agencies or other organizations of bat issues by requesting and providing information to these agencies or organizations. Invite these agencies or organizations to interact in information exchanges and develop better management of bats and their habitats.

Strategy 3.1B.
Endorse interagency and wide-ranging cooperation and interest by conducting three workshops (e.g., Sioux Falls, Rapid City, and Pierre) each year. Workshops include information exchange concerning bats and safe house exclusion. Workshops will attempt to reach publics like pest control operators, homeowners, teachers, biologists, and managers.

Strategy 3.1C.
Communicate with landowners and land managers at workshops or in person to create a good working relationship. Identify opportunities to work with landowners and/or land managers to protect and enhance habitats for bats.

Issue 3.2. – Funding Sources

Funding sources are available for nongame research, though many agencies, organizations, and individuals are not aware of these funding opportunities (Refer to Threat 3). Nongame research or education may or may not involve bats, and often money allocation

is competitive making monies difficult to obtain. Also, some funding sources are dependent on state or federal budgets, and monies may not be available each year. Therefore, agencies, organizations, and individuals should cooperate in making the best use of available funding sources and furthering available funding opportunities.

Objective 3.2.
Publicize funding sources and funding needs for bat research. Use available funding sources or opportunities for high priority bat research needs.

Strategy 3.2A.
Work with local, private, state, and federal agencies to identify available funding sources. Investigate opportunities and attempt to increase funding sources available for bat research, management, and/or education in two to three years. Publicize likely or potential funding sources, through personal communication, workshops, websites, and posters explaining ways to obtain funding for bat research to qualified groups or individuals over five years. SDBWG will update funding sources via website each year.

Strategy 3.2C.
Publicize funding opportunities to appropriate groups or individuals. For example, an annual research review meeting is held between South Dakota State University and South Dakota Game, Fish and Parks.

Research Needs

In South Dakota, research gaps exist regarding bats and their natural history. Therefore, research to fill these gaps becomes important to understanding bats residing or migrating through South Dakota in order to properly manage these species. Issues addressed in this section include data compilation, monitoring protocol, permits and their requirements, funding sources, and research goals.

RESEARCH PROTOCOL AND PERMIT

Issue 4.1.

Technology is advancing and research emphasis is changing, thus more researchers have shown increased interest in studying and monitoring bats. Bats are very sensitive to stress even stress that seems minimal, such as research activities. This emphasizes the need for establishing research protocols to reduce the potential of harming bats associated with repeated surveying and data collection. To prevent sickness or death to bats as a result of stress, specific guidelines and requirements (protocols) need to be identified for bat researchers. Researchers collecting data on bats in South Dakota must first apply for a South Dakota Collector's Permit and adhere to conditions of this license as a permittee.

Objective 4.1.
Develop protocols and review permit requirements for bat researchers and identify appropriate revisions on an annual basis.

Strategy 4.1A.
Develop protocols to provide researchers with uniform survey methods for data collection and guidance on mine and cave issues. Review and summarize permit requirements for bat researchers each year. Make necessary changes associated with these requirements.

Strategy 4.1B.
Design a program for monitoring bats in South Dakota, particularly caves and mines, in two years. Record time and number of visits, sites visited, and frequency of visits to guide researchers and biologists with monitoring surveys.

Strategy 4.1C.
Incorporate monitoring protocol as part of permit requirements for bat researchers in two years.

DATABASE SUMMARY AND RESEARCH

Issue 5.1. – Database

Because data regarding all bat research in South Dakota is not easily accessible or completely compiled, current knowledge and information gaps associated with South Dakota bats are not entirely known. As a result, data should be compiled and made accessible to biologists, managers, and researchers. Databases provide readily available information to professionals for tracking rare species and arranging regional survey efforts. Furthermore, creating an organized database will help organize and analyze data to understand bats residing in and migrating through South Dakota. Additionally, the sensitive nature of some of the data requires development of "special considerations", which will guide data distribution.

Objective 5.1.1.
Develop a database with resources, previous research efforts, trend data, and research techniques per specific locations for bats in South Dakota to match past and future efforts in two years.

Strategy 5.1.1A.
Create a database through state funding, which includes data collected from South Dakota, to help standardize monitoring methods, reduce survey repetition, and provide bibliographical information (e.g., literature sources) to bat researchers, regional biologists, and individual citizens. Database will be maintained by SDGFP.

Strategy 5.1.1B.
Provide data, upon request and after scrutiny, to our region (South Dakota, North Dakota, Wyoming, Nebraska, etc.) regarding current information and research techniques relative to bats.

Objective 5.1.2.
Summarize current knowledge on natural history and literature resources on each bat species in South Dakota in two years.

Strategy 5.1.2A.
Analyze database and determine the relative population trend of each bat species in South Dakota.

Strategy 5.1.2B.
Develop distribution maps and status reports for individual resident and migrant bat species in two years.

Strategy 5.1.2C.
Compile current information regarding maternity roosts and hibernacula in two years. Due to data sensitivity, this information will only be released when special consideration is given to each request and information remains confidential.

Strategy 5.1.2D.
Review research findings relative to migratory patterns in two years.

Issue 5.2. – Future Research

Research is important to understanding bats in South Dakota, particularly for conservation purposes. At present, research needs concerning bats in South Dakota appear to focus on natural history and hibernacula. Researcher, managers, and biologists throughout the state identified the following research needs based on past information and current observations. Time and finances may affect research needs in the future. At some point, analyzing current data and identifying current research needs are necessary to further understand and conserve bats in South Dakota.

Objective 5.2.
Conduct bat research based on research needs and secure financial assistance (where possible) to accomplish research. Future research needs (listed below as strategies) cover various issues associated with bats.

Prioritized Research Strategies

Strategy 5.2A.
Identify hibernacula and maternity roosts of bats, particularly for Townsend's big-eared bats, and identify sites for gate installations. Determine the effective size of buffer zones (based on each site) needed around occupied caves and/or mines.

Strategy 5.2B.
Continue to gather information on reproductive rates, home range, and movement patterns of each species, particularly rare species, in each region of the state. Continue to save and process bats tested by SDDOH each year (important for distribution, and reproductive data). Create GIS maps of high bat activity (e.g., roosting, foraging, or hibernating) and bat distributions in South Dakota for purposes of planning.

Strategy 5.2C.
Census bats along non-urban riparian corridors to understand the value of these habitats for foraging and roosting and as migration routes. Monitor bats along the

Missouri River and identify the importance of this river system for migrating bats. Survey bridges and box culverts along these riparian corridors to determine location and type (e.g., swallow nests or crevices) of bat roosts.

Strategy 5.2D.
Investigate and determine impact of plant diversity and structure on bat activity at bat foraging habitats. Determine the diets of each bat species and the relationship between invasive plant species, insect availability, and bat foraging success.

Strategy 5.2E.
Create a database of reference calls using AnaBat and Petterson bat detection systems.

Strategy 5.2F.
Determine the abundance and diversity of prey and investigate the impacts of pesticides on prey abundance and diversity and the effects on bats.

Strategy 5.2G.
Analyze the potential threats in areas selected as high priority for wind power generation and determine the effects of wind power generation sites on migratory bat populations in South Dakota.

Strategy 5.2H.
Investigate responses of bats to fire, whether prescribed, wild, or other disturbance and/or catastrophe.

Strategy 5.2I.
Continue to gather information on population genetic structure and evolutionary affinities of bat species and/or subspecies throughout the state.

Strategy 5.2J.
Examine the role bats play in contributing to the control of pest populations in South Dakota. Explore integrated pest management techniques for agricultural areas.

<u>Additional Research Strategies</u>
Strategy 5.2K.
Determine the effects of selective timber harvest on bat populations in the Black Hills. Employ experimental design for determination of effects before and after timber harvest.

Issue 5.3. – Modification of Research Needs

Research needs change through time. As specific research needs are addressed, new needs will be identified. New research often stems from old or past research.

Objective 5.3.
Evaluate and revise research topics every five years. Complete research topics depending on available resources, identify topics that require more time and emphasis, and regularly reevaluate research priority list.

Strategy 5.3A.
Conduct research based on research topic priority list as permitted or required during plan implementation.

Strategy 5.3B.
Continue to identify additional research needs for future planning. Record new research topics needing focus and revise research priority list after five years.

Issue 5.4. – Cooperative Research

In the past, South Dakota as well as other areas have not received much research attention associated with bats, though researchers are becoming increasingly interested in bats in this area. As a result, cooperative efforts by numerous groups or individuals will help increase understanding of regional bat habits and habitats helping conserve them. At this time, no regional research or monitoring organizations has been established for groups or individuals in the western region (e.g., SD, ND, MT, WY, CO, ID, CA, AZ, NM, TX, NV, OR, and WA). Therefore, there is need for cooperative research efforts in the western region, for established program members but also through new research programs.

Objective 5.4.
Investigate regional research topics or efforts, particularly those amongst western states, and cooperate as opportunities and monitoring activities arise. Participate in relevant and logistically feasible research and/or monitoring projects in the region in three to five years.

Strategy 5.4A.
Survey current biologists' research and regional (e.g., western states) bat research topics or efforts, and identify any projects or efforts South Dakota may want to join in two years. Revisit cooperative projects or efforts periodically.

Strategy 5.4B.
Develop cooperative research or monitoring projects in South Dakota to compliment efforts in other states in the western region in three years.

MANAGEMENT RECOMMENDATIONS

Issue 6.1.

This plan provides a list of *management recommendations* (Refer to Appendix D) from available local information and management advice. However, new research needs to be periodically reviewed and analyzed to continually refine and improve these recommendations. In addition, data collection and monitoring by agencies and individuals in South Dakota needs to be consulted and considered whenever these management recommendations are revised.

Objective 6.1.
Keep current on new scientific information to improve the list of management recommendations. Reevaluate the current list of management recommendations every two years, or as information becomes available.

Strategy 6.1A.
Itemize research findings and reports as it pertains to bat species and their conservation in South Dakota. Create a priority list of changes to current *management recommendations*.

Strategy 6.1B.
Determine how agencies or groups may use better use *these management recommendations*. Identify the most accommodating format and best method of distribution in two years.

Education Needs

Education provides the foreground to understanding bats in South Dakota. Through education, the public and professionals alike may learn about the value of bats and seek to conserve them. Education needs include understanding of public viewpoints, informative workshops, and information tools.

PUBLIC OUTREACH

Issue 7.1.

In South Dakota, public attitudes toward bats are relatively unknown. Many regard bats as a nuisance species or fear bats as a result of lack of awareness. Human related activities are a major threat to bats. As a result, it is important to evaluate public attitudes towards bats and determine focus groups for educational efforts hopefully reducing unnecessary killing of bats.

Objective 7.1. – Public Attitudes
Determine public and public educator attitudes towards bats. Inform the public (e.g., educators, students, pest control operators, public officials, agencies, and special interest groups or private organizations) of bat ecology and discuss the importance of bats by using different techniques (e.g., workshops, fieldwork, etc.) each year.

Strategy 7.1A.
Incorporate questions related to bats and their conservation needs in public attitude surveys conducted by SDGFP in one year.

Strategy 7.1B.
Use relevant findings of attitude surveys to shape direction of public information efforts. Familiarize public (e.g., educators, students, pest control operators, public officials, agencies, and special interest groups or private organizations) with bat ecology and bat species. Encourage media (e.g., television and newspaper) coverage on bats, particularly as critical components of ecological health.

Strategy 7.1C.
Promote and obtain public involvement and develop opportunities for public assistance (e.g., educators, students, and special interest groups) with bat conservation and management activities (e.g., habitat enhancement via snag production or bat house/roost construction and erection).

Strategy 7.1D.
Target information messages to specific topics, such as the number of bats tested for rabies by the South Dakota Department of Health along with rabies infection rate, improper house exclusions by pest control operators, or unnecessary disturbances to bats. Identify specific opportunities to reach publics (e.g., agencies, pest control operators, and special interest groups) during specific times (e.g., annual meetings and license renewals).

Issue 7.2. – Informational Tools

Minimal efforts have been taken to establish effective bat informational tools due to money and time constraints. Informational tools provide proper information to the public concerning bats and their habitats and are easily distributed to various groups. Hopefully, by identifying and developing effective informational tools, public misperceptions and unawareness will change to public interest and concern regarding bats and their habitats. This will help increase bat conservation in South Dakota.

Objective 7.2.
Identify effective information tools to address lack of adequate information or misinformation concerning bats and distribute to the public (e.g., educators, students, pest control operators, public officials, agencies, and special interest groups or private organizations). Update and renew informational tools as required.

Strategy 7.2A.
Identify and develop informational tools, such as posters, brochures, and short videos, to distribute to different publics (e.g., educators, students, pest control operators, public officials, agencies, landowners, and special interest groups or private organizations) throughout the state in one year. Update and renew informational tools as needed.

Strategy 7.2B.
Investigate the effectiveness of informational tools through surveys. Identify more effective informational tools according to certain publics (e.g., educators, students, pest control operators, public officials, landowners, agencies, and special interest groups or private organizations) and distribute informational tools to appropriate publics.

Summary Statement

Because bats are threatened by factors that range from loss of habitat to the publics' lack of knowledge, three sections in the management strategy were designated: *management, research, and education* needs. *Management* needs addressed issues relating to protecting

important bat roosts or habitat (e.g., caves and mines), investigating and improving regulatory measures, developing interagency cooperation, and publicizing or utilizing potential funding opportunities. *Research* needs focused on issues relating to establishing a database of current information on bats, developing monitoring protocol, identifying future research goals, and creating cooperative research and managing efforts. *Education* needs included information relating to understanding and respecting bats in South Dakota through informational tools. Major threats were identified, which created individual portions in the management plan. In each portion, issues, objectives, and strategies were addressed. Objectives were more broad-based and strategies were more specific relative to actions for achieving overall goals. Objectives and strategies associated with bat management may help guide various agencies or entities with protecting bat species in South Dakota.

With this management plan for bats in South Dakota, the South Dakota Bat Working Group (SDBWG) seeks to gain increased public and interagency support and awareness in addition to increased conservation of bats and their habitats.

Progress Evaluation

During the five-year implementation period of the state bat management plan, an annual review of the document is scheduled. Groups, agencies, organizations, and individuals participating in the plan will be asked to provide annual progress reports. These reports will be incorporated into the SDBMP annual progress report.

By conducting an annual review of the state bat management plan, the SDBWG will be able to measure the progress of strategy implementation or completion, determine areas needing greater focus, and assist in updating the plan. Time frames associated with strategies will also evaluated during the annual review and revisions will be made if needed.

Upon the completion of the annual progress evaluation, information regarding the progress of the plan will be available via SDBWG and SDGFP websites for public review. After the five-year implementation period is completed, an overall evaluation of the plan will be conducted.

List of Potential Cooperators

Listed below are local, state, federal, or tribal entities, which may cooperate in conserving bat species in South Dakota. Currently, some entities may actively conserve bat species in a manner consistent with this plan, though this plan will hopefully be used for all potential cooperators to strive in similar direction. Through cooperative efforts, this plan will more effectively conserve bat species in South Dakota.

Badlands National Park	http://www.nps.gov/badl/exp/home.htm
Barrick Gold Corporation	http://www.barrick.com/
Bat Conservation International	http://www.batcon.org/
Batworks	
Black Hills State University	http://www.bhsu.edu/
Bureau of Land Management	http://www.blm.gov/nhp/
Cheyenne River Sioux Tribe	http://www.sioux.org/
Crow Creek Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/crwcreek.htm
Custer National Forest	http://www.fs.fed.us/r1/custer/
Dakota Prairie Grasslands	http://www.fs.fed.us/r1/dakotaprairie/
Flandreau Santee Sioux Tribe	http://www.fsst.org/
Jewel Cave National Monument	http://www.nps.gov/jeca/index.htm
Lower Brule Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/lwrbrule.htm
Missouri National Recreational River	http://www.nps.gov/mnrr
Natural Resources Conservation Service	http://www.nrcs.usda.gov/
Nebraska National Forest	http://www.fs.fed.us/r2/nebraska/
Oglala Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/oglala.htm
Rosebud Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/rosebud.htm
Sisseton-Wahpeton Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/sisseton.htm
South Dakota Department of Environment and Natural Resources	http://www.state.sd.us/denr/denr.html
South Dakota Department of Game Fish and Parks	http://www.sdgfp.info/Index.htm
South Dakota Department of Health	http://www.state.sd.us/doh/
South Dakota Department of Transportation	http://www.sddot.com/
South Dakota National Wildlife Refuges	http://mountain-prairie.fws.gov/refuges/sd
South Dakota State University	http://www3.sdstate.edu
Standing Rock Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/strock.htm
State Historic Preservation Office	http://www.sdhistory.org/
The Nature Conservancy	http://nature.org/
University of South Dakota	http://www.usd.edu/
US Army Corp of Engineers	http://www.usace.army.mil/
US Army National Guard	http://www.arng.army.mil/
US Bureau of Reclamation	http://www.usbr.gov/main/
US Fish and Wildlife Service	http://www.fws.gov/
US Geological Survey	http://www.usgs.gov/
USDA Forest Service, Black Hills National Forest	http://www.fs.fed.us/r2/blackhills/
USDA Forest Service, Rocky Mountain Research Station	http://www.fs.fed.us/rm/
Wharf Mine (Goldcorp Inc.)	http://www.ame.com.au/mines/au/Wharf.htm
Wind Cave National Park	http://www.nps.gov/wica/Home.htm
Yankton Sioux Tribe	http://travelsd.com/history/sioux/tribes.asp http://www.mnisose.org/profiles/yankton.htm

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Appendices

Appendix A. Taxonomy

The 1200 species of bats alive today belong to the Order Chiroptera, which is the second largest group of mammals behind Rodentia. All bats found in North America belong to the Suborder Microchiroptera (small bats), and all bats found in South Dakota belong to the Family Vespertilionidae. Forty-two genera and 324 species comprise the Vespertilionidae family worldwide (Nowak 1999). Of the 42 genera, *Myotis* includes nearly 100 species alone and has the widest worldwide distribution of any genus of bat (Nowak and Paradiso 1983). Six genera are found in South Dakota: *Lasiurus*, *Lasionycteris*, *Myotis*, *Corynorhinus*, *Eptesicus*, and *Nycticeius*. All Vepertilionids are primarily insectivorous. In South Dakota, 12 species of bats have been documented (NSE 2002, SDBWG 2002):

Eastern Red bat	*Lasiurus borealis* (Muller 1776)
Hoary bat	*Lasiurus cinereus* (Palisot de Beauvois 1796)
Silver-haired bat	*Lasionycteris noctivagans* (LeConte 1831)
Northern myotis	*Myotis septentrionalis* (van Zyll de Jong 1979) (Prev. *M. keenii*)
Little brown myotis	*Myotis lucifugus* (Thomas 1904)
Western small-footed myotis	*Myotis ciliolabrum* (van Zyll de Jong 1984) (Prev. *M. leibii*)
Fringed myotis	*Myotis thysanodes* (Jones and Genoways 1967)
Long-eared myotis	*Myotis evotis* (Allen 1864)
Long-legged myotis	*Myotis volans* (Miller 1914)
Big brown bat	*Eptesicus fuscus* (Young 1908)
Townsend's big-eared bat	*Corynorhinus townsendii* (Tumlison and Douglas 1992) (Prev. *Plecotus*)
Evening bat	*Nycteceius humeralis* (Rafinesque 1819)

Appendix B. Species Accounts

Species accounts are based on research conducted in South Dakota, if available, and research conducted elsewhere. Species accounts include information pertaining to appearance, distribution and status, natural history, subspecies, and management notes concerning individual species found in South Dakota. Management notes are of great importance and each species is categorized under multi-habitat, cave-roosting, or tree-roosting bats. Multi-habitat bats roost in a variety of areas: trees, caves, mines, crevices, and buildings. Tree-roosting bats roost exclusively in trees, while cave-roosting bats roost nearly always in caves (or mines).

Tree-Roosting Bats

Eastern red bat *(Lasiurus borealis)*

Museum Records (4): BONHOMME County: 1 (KU); BROOKINGS County: 1 (SDSU); HANSEN County: 1 (SDSU); HUGHES County: 1 (TTU); MCCOOK County: 1 (SDSU); MINNEHAHA County: 1 (SDSU); PENNINGTON County: 2 (KU).

Appearance

Red bats (*Lasiurus borealis*) are medium-sized bats with average weight 11.03 g and forearm length 36.88 mm (Swier 2003). Generally, red bats are near 12 cm (5 in) in length (Over and Churchill 1945). Red bats are rusty yellow or reddish-orange with long, dense fur extending to the uropatagium. A small, distinct tail and long, pointed wings characterize red bats. Ears are short and rounded with little to no hair evident. Indistinct white hairs lay along the back and belly depending on the sex. Typically, males have bright orange fur, and females have frost-tipped orange fur (Nowak and Paradiso 1983).

Distribution and Status

Red bats range in the United States from east of the Rocky Mountains to the Atlantic coast, excluding the Florida peninsula (Nowak and Paradiso 1983); red bats are common throughout the United States. In South Dakota, red bats are found throughout the state except in the treeless areas (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000); red bats are least common in the Black Hills (Tigner and Dowd Stukel 2003). Population dynamics in the Black Hills are relatively unknown due to limited observations (5) and summer residency (Tigner and Dowd Stukel 2003). Shump and Shump (1982a) reported that red bats are probably found in areas of the Great Plains with adequate tree cover. This common migratory species was observed in Clay County in April and primarily used timbered areas (Findley 1956).

Natural History

Red bats are solitary tree roosting bats. If females have young, then mothers can be seen roosting with their young; small family groups of four to five bats may be formed during the summer months (Tigner and Dowd Stukel 2003). Deciduous and coniferous trees are considered appropriate tree roosts (Shump and Shump 1982a, Harvey et al. 1999, BCI 2001, TPW 2001). In Kansas, red bats selected tall, large-diameter deciduous trees as day roosts. These were selected within upland areas (Hutchinson and Lacki 2000). In eastern South Dakota, roosting and foraging habitat consists of cottonwood floodplain forest areas, deciduous forest areas, and urban areas (Swier 2003). Red bats roost in foliage of trees and do not depend on cavities for shelter (Barbour and Davis 1969); red bats hang from their roost by one foot disguising themselves as dead leaves or pine cones. Often red bats are seen or heard hunting at early dusk or during cloudy days and can be identified by their acoustic signatures. Feeding occurs in small areas above the tree canopy and beneath streetlights. Flight patterns are distinct; red bats repeatedly fly in large circles or in straight lines above tree canopies (Swier 2003). Primary prey species include beetles, moths, and other night flying insects. Hypothetically, red bats migrate to South Dakota in April and migrate from South Dakota in late August or early September (Swier 2003). In other states, red bats hibernate in tree snags or beneath tree litter during cold winter months, though this has not been documented in South Dakota. Red bats mate in August or September. Because of delayed fertilization, young are not born until late spring. After an 80 to 90-day gestation period, approximately two to four altricial (little to no hair and eyes closed) pups are born each year (Shump and Shump 1982a, Kunz 1982, Harvey et al. 1999, BCI 2001, TPW 2001). In response to increased susceptibility to predation (e.g., blue jays and raptors) due to tree-roosting habits, red bats produce a larger litter size in relation to other bats (Barbour and Davis 1969), which produce one to two pups per year.

Subspecies

Red bat subspecies located in South Dakota is *L. b. borealis*.

Management Notes

Red bats may be impacted by the loss of roost trees. Protecting deciduous and coniferous tree roosts is important to this species. Red bats are dependent on live trees with adequate foliage.

Hoary bat *(Lasiurus cinereus)*

Museum Records (30): BONHOMME County: 3 (KU); BROOKINGS County: 1 (SDSU); BROWN County: 1 (KU); CLAY County 1 (SDSU); CUSTER County: 3 (KU); DAVISON County 1 (FHS); FALL RIVER County: 2 (KU); HAMLIN County: 1 (SDSU); HARDING County: 1 (KU); HYDE County: 1 (SDSU); LAKE County: 1 (SDADR – rabies positive); LAWRENCE County: 15 (KU); MINNEHAHA County: 4 (SDSU); PENNINGTON County: 4 (KU); UNKNOWN County—Moreau River: 1 (USNM).

Appearance

Hoary bats (*Lasiurus cinereus*) are the largest bats found in South Dakota (Over and Churchill 1945, Turner 1974). Hoary bats can be easily recognized by their large size (Shump and Shump 1982b, Nowak and Paradiso 1983, Harvey et al. 1999); average forearm length measures 55.00 mm and average weight measures 32.5 g (Swier 2003). Generally, hoary bats are greater than 12 cm (5 in) long (Over and Churchill 1945). Hoary bat fur is a combination of black and brown with white "frosting" on the tips. Hoary bats have dark wing membranes, furred uropatagiums, large teeth, and short, round, black-edged ears.

Distribution and Status

Hoary bats are found in the 48 contiguous United States and Hawaii (Nowak and Paradiso 1983). Shump and Shump (1982b) reported that hoary bats, among North American bats, are the most widespread bats though they are never found in great densities. In South Dakota, the hoary bat ranges throughout the state (Over and Churchill 1945, Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000, BCI 2001). Hoary bats are relatively common throughout the Great Plains (Shump and Shump 1982b). In Clay County, the migratory hoary bat was found less commonly than the red bat, although this bat selected the same habitat as red bats (Findley 1956). In the Black Hills, hoary bats are plentiful where suitable habitat is available (Turner 1974, Mattson 1994).

Natural History

Being a solitary, tree roosting bat, hoary bats will cryptically roost in trees with adequate foliage cover above but minimal foliage cover below. Roost sites are maintained on edge trees with heights of 3 to 5 m (3.3 to 5.5 yds). In eastern South Dakota, hoary bats select trees in cottonwood floodplain forests along the Missouri River, but hoary bats also have been located using trees in urban areas (Swier 2003). Generally, hoary bats are found near water. Foraging periods begin after dark and persist until one hour before sunrise. Hoary bats can move up to 39 km (24 mi.) in one night due to fast, straight flight patterns. Being powerful fliers due to their large size, hoary bats are capable of flight from a level surface. Hoary bats are easy to detect by calls. They produce forceful calls while in flight and emit low frequency

(16 to 18 kHz) calls while not feeding. Foraging occurs over water sources or at treetop levels above the tree canopy. Typical prey consists primarily of moths and supplemented by beetles and mosquitoes (Black 1974, van Zyll de Jong 1985). In the Black Hills, most hoary bats are captured between early June and late August (Tigner and Dowd Stukel 2003). Hoary bats in South Dakota migrate south during cold winter months. Females precede males in the migration north; females seem to inhabit the plains or arid flats during warm months, whereas males inhabit higher altitudes or latitudes (Turner 1974). Generally, hoary bats mate in the late summer or the early fall. Fertilization occurs the following spring, and parturition occurs before mid-June (van Zyll de Jong 1985). Approximately two young are produced each year (Harvey et al. 1999, BCI 2001, TPW 2001). Females are often susceptible to severe windstorms, especially when carrying young.

Subspecies

Subspecies of hoary bat found in South Dakota is *L. c. cinereus.*

Management Notes

Hoary bats may be susceptible to the loss of selected tree roosts. Protecting deciduous and coniferous tree roosts is important to this species. Hoary bats are dependent on live trees at least 3 m tall with adequate foliage cover for roost sites. Typically, hoary bats select trees on the edges of forest areas.

Silver-haired bat *(Lasionycteris noctivagans)*

Museum Records (12): CUSTER County: 1 (KU); DAY County: 1 (USNM); FALL RIVER County: 3 (KU); HARDING County: 1 (KU); KINGSBURY County: 1 (SDSU); LAWRENCE County: 3 (KU); PENNINGTON County: 3 (KU).

Appearance

Silver-haired bats (*Lasionycteris noctivagans*) are medium-sized bats, which are noticeably smaller than hoary bats. Average forearm length measures 41.30 mm and average weight measures 12.31 g (Tigner and Dowd Stukel 2003). Silver-haired bats measure slightly over 10 cm (4 in) in length (Over and Churchill 1945). This bat has long, soft brown to black fur, which is silver-tipped across the body. Ears are hairless and round with blunt, rounded traguses; ears are nearly as wide as long. Fur continues onto uropatagium, and ears and wing membranes are black.

Distribution and Status

Silver-haired bats range throughout forested regions of the 48 contiguous states in the United States, excluding Florida (Nowak and Paradiso 1983). Silver-haired bats are erratically distributed and relatively uncommon throughout their range (Kunz 1982, BCI 2001). In South Dakota, silver-haired bats are found sporadically throughout the state (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Silver-haired bats are found in the northern and southern Black Hills, though silver-haired bats are more prominent in the southern Black Hills (Tigner and Dowd Stukel 2003). Seemingly, silver-haired bats migrate through the Black Hills region, although it is possible that a few silver-haired bats remain in the Black Hills throughout the year (Turner 1974, Tigner and Dowd Stukel 2003). In addition, Swier (2003) found silver-haired bats in northeastern South Dakota. Silver-haired

bats are considered a South Dakota species of concern due to its rarity or limited range (SDGFP 2002).

Natural History

Silver-haired bats are one of the slowest moving bats in North America (Harvey et al. 1999). Typically, silver-haired bats roost under bark, in snags, and in tree cavities or crevices (Mattson et al. 1996). More specifically, males roost solitarily beneath bark or in cracks/crevices on boles of trees at varying heights. Males change roosts frequently (e.g., daily), and roost inhabitance averages eight days (Mattson 1994). This bat species depends on old growth forests, generally coniferous forests, with diverse tree structure and ample snags, but silver-haired bats are also found in wooded areas along streams or rivers (Nowak and Paradiso 1983, Mattson et al. 1996). In eastern South Dakota, silver-haired bats inhabit cottonwood riparian forests and other deciduous forests (Swier 2003). Corridors, such as roads and water sources, accumulate prey and allow maneuverable flight by bats. This results in use of these areas for foraging. Silver-haired bats are opportunistic feeders; foraging occurs at seven meters or less above ground and includes prey such as termites, true bugs, moths, beetles, and mosquitoes (Kunz 1982, Whitaker et al. 1981a). Often silver-haired bats drink over woodland ponds prior to sunset. Kunz (1973) stated that silver-haired bats in Iowa display a bimodal activity pattern, appearing two hours after sunset for approximately two hours and two hours before sunrise for approximately two hours. Silver-haired bats migrate south during late summer or early fall with females moving farther south than males (Kunz 1982). Hibernacula include (beneath) bark, snags, open buildings, or underground structures, though the use of underground structures is not documented in South Dakota. Turner (1974) indicated that some individuals might winter in the Black Hills, but most silver-haired bats migrate south with the onset of cold weather. Most silver-haired bats are captured from June to September (Tigner and Dowd Stukel 2003). Each year silver-haired bats produce one to two pups, most commonly twins, in late spring or early summer after 50 to 60 days of gestation (Kunz 1982). Pups are raised in maternity roosts, and like most tree-roosting bats silver-haired bats often switch maternity roosts during the maternity season (Kunz 1982, Harvey et al. 1999, BCI 2001, TPW 2001). Maternity roosts were identified in ponderosa pine snags an average 10 m off the ground ranging from 6 to 55 individuals in the roosts (Mattson 1994). More specifically, maternity roosts were found in old woodpecker cavities of large (38 to 62 dbh) snags with unrestricted southern exposure (Betts 1996, Mattson 1994, Vonhof 1996).

Subspecies

No subspecies are recognized for the silver-haired bat (Jones and Genoways 1967, Kunz 1982, Wilson and Ruff 1999, NSE 2002).

Management Notes

Silver-haired bats are susceptible to forest habitat alterations. This bat is reliant on live and dead trees and selects a range of trees with diverse age structure. Snags are particularly important for the survival of young bats. Reductions in snag numbers will lead to less roosting opportunities and more competition among snag roosting species. Forest management practices (e.g., silviculture) must retain large snags through time to maintain this species (Tigner and Dowd Stukel 2003).

Multi-Habitat Bats

Northern myotis *(Myotis septentrionalis*, formerly known as *Myotis keeni* in South Dakota*)*

Museum records (23): BONHOMME County: 4 (KU); HUGHES County: 2 (TTU); PENNINGTON County: 17 (KU); STANLEY County: 1 (USNM).

Appearance

Northern myotis (*Myotis septentrionalis*) are rather small bats with average forearm length measuring 36.07 mm and average weight measuring 7.13 g (Tigner and Dowd Stukel 2003). Body lengths may reach 10 cm (4 in) (Fitch and Shump 1979), and overall ear lengths average 16.4 mm (Tigner and Dowd Stukel 2003). Northern myotis have similar light to dark brown fur as little brown myotis with dark backs and light bellies (Fitch and Shump 1979). Membranes and ears are dark brown. In addition, northern myotis have buffy shoulder patches and long, mouse-like ears. Northern myotis can be distinguished by ear length and tragus shape; traguses are long and narrow with pointed tips. Also, face masks, though similarly dark brown, are balder than comparable *Myotis* species.

Distribution and Status

In the United States, northern myotis range in forested regions from east to central and south to northern Florida (Nowak and Paradiso 1983). Northern myotis are common throughout their range, though they are found less commonly than little brown myotis (Fitch and Shump 1979). In South Dakota, northern myotis are found rather uncommonly throughout the state (Jones and Genoways 1967, Higgins et al. 2000). Conversely, northern myotis are rather abundant throughout the Black Hills, and few winter occurrences have been recorded (Tigner and Dowd Stukel 2003). Northern myotis are state species of concern due to their rarity and limited range (SDGFP 2002).

Natural History

The northern myotis is an aggressive species when handled. Typically, these bats bite and vocalize as defensive mechanisms, especially when captured. Northern myotis select roosts in tight crevices or holes sheltered from normal airflow. Often day roosts are selected in open buildings, under bark, or under house shutters, and night roosts or winter hibernacula comprise caves or mines. Northern myotis are dependent on night roosts, and hibernacula are selected in areas with standing water and high humidity (90%) (Tigner and Dowd Stukel 2003). Northern myotis may roost solitarily or in clusters of up to 100 bats, though clusters usually do not grow beyond 100 bats. In eastern South Dakota, northern myotis selected cottonwood floodplain forests or deciduous forests along the Missouri River (Swier 2003). In these areas, northern myotis probably selected trees as roost sites. Generally, northern myotis are found near water sources and dense forests. Foraging takes place over forested hillsides and ridges with prey consisting of night-flying insects. Northern myotis are food generalists (Nagorsen and Brighman 1993, van Zyll de Jong 1985). Northern myotis mate in late summer or early fall. In late spring or early summer, one young is born with minimal hair and closed eyes. Upon the arrival of the newborn pups, a small nursery colony is formed by females (Harvey et al. 1999, BCI 2001, TPW 2001). Tigner and Aney (1993) reported one maternity roost in an attic of a two-story brick building along the edge of the Black Hills.

Subspecies

No subspecies are recognized for the northern myotis (Wilson and Ruff 1999, NSE 2002).

Management Notes

Northern myotis are vulnerable to threats associated with humans. Because northern myotis have an affinity towards buildings as maternity roosts, public awareness of maternity roosts is particularly important with protecting this bat (Tigner and Dowd Stukel 2003). Also, this bat species is dependent on live trees, dead trees (e.g., snags), caves, and mines, which requires protection of these roost sites as well.

Little brown myotis *(Myotis lucifugus)*

Museum records (84): CUSTER County: 14 (KU), 8 (TTU), 2 (WCNP); FALL RIVER County: 1 (KU); GREGORY County: 1 (USNM); HARDING County: 27 (KU); LAWRENCE County: 16 (KU); MEADE County: 1 (KU); MINNEHAHA County: 1 (SDSU); PENNINGTON County: 12 (KU), 1 (TTU); STANLEY County: 1 (USNM); UNION County: 1 (KU); WALWORTH County: 2 (SDSU).

Appearance

Little brown myotis (*Myotis lucifugus*) are relatively small bats with average forearm length 37.49 mm and average weight 8.33 g (Tigner and Dowd Stukel 2003). Body length measures nearly 10 cm (4 in) (Over and Churchill 1945). Pelage coloration is similar to northern myotis, appearing light to dark brown. More specifically, fur appears glossy along the back and buffy along the belly. Wing and ear membranes are dark brown. Little brown myotis have shorter ears than northern myotis; their ears do not extend past nose tip when pressed forward (Tigner and Dowd Stukel 2003). Calcars are not keeled and traguses are blunt and measuring one half the length of the ears.

Distribution and Status

Little brown myotis range throughout the United States stretching north into Alaska, excluding the south-central United States (Nowak and Paradiso 1983). Throughout their range, little brown myotis are common and can exploit many habitats. Little brown myotis are found commonly throughout South Dakota, except in the extreme south central portion of the state (Jones et al. 1985, Higgins et al. 2000). In the Black Hills, little brown myotis are abundant (Turner 1974, Tigner and Dowd Stukel 2003). Little brown myotis are relatively common near urban areas.

Natural History

Forested areas (e.g., riparian areas) and mountainous forests are favored by little brown myotis, although they may be found near or among structures as well. Fenton and Barclay (1980) consider little brown myotis opportunistic species with reference to foraging habitat and roost selection. Generally, habitat in eastern South Dakota consists of cottonwood forests, deciduous forests, and urban areas (Swier 2003). Roost sites appear in buildings, trees, caves, and mines. Little brown myotis are associated with humans, more specifically human-made structures (e.g., houses) (Fenton and Barclay 1980). Often males roost (singly or colonially) separate from females during the summer. Day roosts usually are located in dimly lit areas (Fenton and Barclay 1980). Night roosts provide areas for bats to congregate

after feeding. At night roosts, males are usually found in the spring and early summer, while females are usually found in the late summer and early fall (Tigner and Dowd Stukel 2003). Little brown myotis hibernate in high humidity and temperature sites (Fenton and Barclay 1980), where noticeable droplets of condensation form on their bodies (Tigner and Dowd Stukel 2003). Limited roost entrance size is tolerated by little brown myotis. Usually little brown myotis forage over short distances above large bodies of water (Swier 2003) or infrequently terrestrial areas near roost sites. While foraging, little brown myotis fly low with slow wing beats. They primarily capture aquatic insects; little brown myotis prey consists largely of aquatic insects, although terrestrial insects, such as beetles and moths, may supplement their diet (Fenton and Barclay 1980, Harvey et al. 1999, BCI 2001). Individuals mate in autumn, prior to or during hibernation. One pup per year is born in late spring or early summer after a 50 to 60 day gestation (Fenton and Barclay 1980, Harvey et al. 1999, BCI 2001). At approximately three weeks, pups become volant. Females with pups form large nursing colonies in man-made structures, such as buildings and attics (van Zyll de Jong 1985). Trees may also serve as nursery roosts (Fenton and Barclay 1980). In the Black Hills, all identified maternity roosts are in buildings (Tigner and Dowd Stukel 2003).

Subspecies

The two subspecies found in South Dakota include *M. l. carissima* and *M. l. lucifugus*. *M. l. carissima* is paler with slightly larger cranial dimensions than *M. l. lucifugus* (Jones and Genoways 1967).

Management Notes

Because little brown myotis may select man-made structures for roosting, maternity and nursery roosts may be threatened more than roosts of bats choosing natural roosts (Tigner and Dowd Stukel 2003). By increasing awareness towards bats, human-related threats associated with bats may be reduced. Also, little brown myotis select certain hibernacula; it is imperative to protect these roosts.

Western small-footed myotis *(Myotis ciliolabrum*, formerly *Myotis leibii)*

Museum Records (108): CUSTER County: 15 (KU), 5 (USNM), 2 (UCB); FALL RIVER County: 5 (KU); HARDING County: 8 (KU); HUGHES County: 1 (TTU); JACKSON County: 27 (KU); LAWRENCE County: 5 (KU); PENNINGTON County: 40 (KU).

Appearance

Western small-footed myotis (*Myotis ciliolabrum*) are small bats with average forearm length measuring 31.27 mm and average weight measuring 5.72 g (Tigner and Dowd Stukel 2003). Their bodies can reach total lengths near 10 cm (4 in) (Over and Churchill 1945). In the Black Hills, western small-footed myotis are considered the smallest bats (Tigner and Dowd Stukel 2003). As their name implies, western small-footed myotis have small feet with average lengths of 6.5 mm (van Zyll de Jong 1985). Western small-footed myotis have cream-colored fur accented by black masks, ears, and membranes. Membranes are usually hairless. Calcars are keeled, skull appear flattened, ears are long, and traguses are narrow. Traguses measure one half the total ear length (Tigner and Dowd Stukel 2003).

Distribution and Status

Western small-footed myotis range in the western portion of the United States (Nowak and Paradiso 1983). This species is relatively uncommon throughout its range in the United States. As a result, western small-footed myotis are species of concern throughout the nation (Harvey et al. 1999). In South Dakota, western small-footed myotis are found in the western portion of the state (Jones and Genoways 1967, Higgins et al. 2000). According to Over and Churchill (1945), western small-footed myotis are uncommon in western South Dakota. Western small-footed myotis were present year-round in the five counties comprising the Black Hills, although populations were relatively small (Turner 1974, Tigner and Dowd Stukel 2003). *M. ciliolabrum* has been documented in Hughes County in central South Dakota as indicated by museum specimens.

Natural History

Western small-footed myotis are located in arid habitats with cliffs, talus fields, and prairies containing clay buttes and steep banks along rivers. Stebler (1939) reported that western small-footed myotis were found in western South Dakota near floodplain areas with cottonwood-willow associations. Typically, roost sites frequented by small-footed myotis include crevices and spaces beneath rock or clay areas, which are often found near water sources. Because of their small size and agile flying ablilty, western small-footed myotis are able to use small roost entrances. In the Black Hills, western small-footed myotis were discovered roosting in caves and mines (Tigner and Dowd Stukel 2003). Hibernacula include cool and dry caves or mines where western small-footed myotis roost in crevices, on walls, or off ceilings. Western small-footed myotis hibernate individually with minimal movement (Tigner and Dowd Stukel 2003). Foraging begins after dusk with peak foraging hours from 2200 h (10 PM) to 2300 h (11 PM) and from 0100 h (1am) to 0200 h (2am) (Harvey et al. 1999). Western small-footed myotis have slow, erratic flight patterns with very rapid echolocation calls while searching for food (prey). These bats are strong fliers that can obtain flight from level surfaces. Foraging occurs 1 to 3 m (1.1 to 3.3 yd) above ground over cliffs or clay buttes. Prey consists of small insects, such as flies, beetles, and moths (van Zyll de Jong 1985). Western small-footed myotis use hibernacula, such as caves and/or mines. Each year one pup or twin pups are born in late spring or early summer. Females care for young alone or may gather in a small group. No nursery or maternity roosts have been discovered in the Black Hills, though rocky outcrops and crevices throughout the Black Hills offer areas as summer roosts; nursery roosts were discovered in cracks and crevices of clay-volcanic ash areas of the Badlands (Tigner and Dowd Stukel 2003). Minimal data are available on western small-footed myotis (BCI 2001, TPW 2001).

Subspecies

Subspecies of western small-footed myotis found in South Dakota is *M. c. ciliolabrum*.

Management Notes

The main threat to this bat is availability of suitable hibernacula. As a result, identifying and protecting sites (or roosts) that offer suitable habitat for western small-footed myotis is important (Tigner and Dowd Stukel 2003). Because little is known regarding various aspects of western small-footed myotis, further research is needed particularly on maternity and nursery roosts in South Dakota.

Fringed myotis *(Myotis thysanodes)*
Museum Records (13): CUSTER County: 5 (KU), 1 (UM); FALL RIVER County: 1 (KU); JACKSON County: 2 (KU); PENNINGTON County: 4 (KU).

Appearance

Fringed myotis (*Myotis thysanodes*) are medium-sized bats with average length 40.82 mm and average weight 7.8 g (Tigner and Dowd Stukel 2003). Body length measures approximately 10 cm (4 in) (Harvey et al. 1999). Appearing similar to long-eared myotis (*M. evotis*), fringed myotis are classified as long-eared myotis with darkly colored fur minus a golden tinge. Ears are longer than other *Myotis* species, besides long-eared myotis, and measure less than half forearm length (van Zyll de Jong 1985). Long fur covers their back appearing darker than their belly fur. Ears and membranes are dark to black, and noticeable, stiff hairs are present down the free edge of the uropatagium.

Distribution and Status

Fringed myotis can be found in the United States from the Pacific Coast to the Black Hills of South Dakota and Wyoming (Nowak and Paradiso 1983). Throughout their range, fringed myotis are located sporadically resulting in the designation as a national species of special concern, according to Bat Conservation International (Harvey et al. 1999). In South Dakota, fringed myotis form a disjunct population in the Black Hills and possibly other western regions (Jones and Genoways 1967, Jones and Choate 1978, O'Farrell and Studier 1980, Jones et al. 1985, van Zyll de Jong 1985, Higgins et al. 2000). Turner (1974) stated that Black Hills fringe-tailed myotis were found in Pennington, Custer, and Fall River counties throughout the year. Due to their rarity or limited range in South Dakota, Black Hills fringe-tailed myotis are listed as a state species of concern (SDGFP 2002).

Natural History

Various habitats ranging from desert shrub to pine associations at moderate elevations are used by fringed myotis (O'Farrell and Studier 1980, Harvey et al. 1999, BCI 2001, TPW 2001). Fringed myotis use roost sites that consist of caves or mines and abandoned buildings. Typically, fringed myotis are found roosting in caves, natural rock crevices, and buildings (Tigner and Dowd Stukel 2003). Because these bats hibernate during the winter, they are considered year-round residents. Often hibernating individuals are difficult to locate and identify due to selection of cracks of crevices in mines or caves (Tigner and Dowd Stukel 2003). Usually males roost individually in rock crevices and females roost collectively forming small nursery colonies (average 18.9 individuals) (Cryan and Bogan 1996). O'Farrell and Studier (1980) reported that roost sites were usually in open areas where the fringed myotis could form tightly packed clusters of bats. Fringed myotis have characteristically deliberate and highly maneuverable flight while foraging. Foraging occurs over vegetative canopy from sunset until midnight with prey consisting of principally beetles but also moths (Black 1974). To survive the winter, fringed myotis form hibernacula colonies in typical roost sites (e.g., caves or mines) (Harvey et al. 1999, BCI 2001, TPW 2001). Fringed myotis mate in late summer or early fall prior to hibernation. In late spring or early summer, one pup is born each year after a 50 to 60-day gestation period (O'Farrell and Studier 1980). Large nursery colonies are formed upon the arrival of the pups. Adults typically roost separately

from the nursery colonies. Adults fly to nursery roosts to feed their young returning to their roost after feeding (Harvey et al. 1999, BCI 2001, TPW 2001).

Subspecies

Subspecies is the Black Hills fringe-tailed myotis*, M. t. pahasapensis*, which is briefly mentioned above.

Management Notes

Fringed mytois are reliant on caves or mines and abandoned buildings as roost sites. Captures are locally abundant indicative of unique or significant bat habitats (Tigner and Dowd Stukel 2003). These habitats should be recognized. Furthermore, information is required with regard to maternity and nursery roosts, relocation habits, and hibernacula requirements and availability.

Long-eared myotis *(Myotis evotis)*

Museum Records (20): HARDING County: 20 (KU).

Appearance

Long-eared myotis (*Myotis evotis*) are medium-sized bats weighing on average 7.5 g and forearm measuring on average 38.17 mm (Tigner and Dowd Stukel 2003). Body length measures approximately 9 cm (3.5 in) (Over and Churchill 1945). Long-eared myotis have pale yellow to light brown, glossy fur with dark brown shoulder patches. Ears and membranes are black. Long-eared myotis have ears that average longer than the ears of other American members of the genus *Myotis* (Manning and Jones 1989). Therefore, long-eared myotis appear similar to the Black Hills fringe-tailed myotis though hairs edging the uropatagium are indistinct and ears are much larger in long-eared myotis (van Zyll de Jong 1985). Ears extend 5 mm beyond their nose tip; overall ear lengths are greater than one half the forearm length.

Distribution and Status

Long-eared myotis range from the Pacific Coast to the extreme western Dakotas of the United States, typically in temperate areas (Nowak and Paradiso 1983, Manning and Jones 1989). Nationally, this species is of special concern (Harvey et al. 1999). In South Dakota, long-eared myotis are found in the Black Hills and the northwestern region (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). No winter roosts have been identified in the Black Hills (Tigner and Dowd Stukel 2003), though one specimen has been found in Harding County (northwestern SD) (Anderson and Jones 1971, Jones and Choate 1978). Because of their rarity or limited range in South Dakota, long-eared myotis are considered species of concern (SDGFP 2002).

Natural History

Long-eared myotis use coniferous forests at higher elevations or arid badlands of the Great Plains. Stebler (1939) reported that long-eared myotis were found near streams in the Black Hills bordered by bur oak associations. Generally, long-eared myotis are found in a variety of habitats though most habitats are associated with forest areas (Manning and Jones 1989, Nagorsen and Brigham 1993). Roost sites include live or dead trees (beneath bark), abandoned buildings, mines or caves, sinkholes, or cliff fissures. Night roosts consist of caves

or mines and nursery roosts usually occur in buildings (Tigner and Dowd Stukel 2003). Winter hibernacula include primarily caves or mines. Long-eared myotis have a slow maneuverable flight, which aids in foraging abilities. Foraging begins after dusk or well past dark over tree canopy, ponds, or streams. Beetles and moths comprise most of their diet (Black 1974). Breeding occurs in late summer or early fall before hibernation. One pup is produced each year in early to late summer. Once pups are born, long-eared myotis form maternity colonies on the ground in rock cervices, fallen logs, or other ground dwelling sources (Manning and Jones 1989, Harvey et al. 1999, BCI 2001, TPW 2001). Maternity colonies are relatively small, usually less than 30 individuals.

Subspecies

Subspecies found in South Dakota is *M. e. evotis*.

Management Notes

Little is known concerning long-eared myotis in South Dakota, particularly the Black Hills. Further information is required to properly protect this species (Tigner and Dowd Stukel 2003).

Long-legged myotis *(Myotis volans)*

Museum Records (103): CUSTER County: 20 (KU), 2 (UM), 1 (UCB); FALL RIVER County: 3 (KU); HARDING County: 43 (KU); LAWRENCE County: 12 (KU); MEADE County: 1 (KU); PENNINGTON County: 21 (KU).

Appearance

Long-legged myotis (*Myotis volans*) are medium-sized bats with average forearm length 37.93 mm and average body weight 7.84 g (Tigner and Dowd Stukel 2003). Characteristics of long-legged myotis include dull brown fur, small hindfeet, and short, rounded ears (Warner and Czaplewski 1984, Harvey et al. 1999). Ears and membranes are dark brown. In addition, long-legged myotis have long hair along the underside of the wing membrane, short rostrums, and steep foreheads (van Zyll de Jong 1985). Typically, females are larger than males, which is shown in forearm length. Often it is difficult to distinguish long-legged myotis from little brown myotis, especially during hibernation. Long-legged myotis have more dense fur along the ventral surface of their wing membranes and distinct keels. (Fur and keels are usually lacking in little brown myotis.)

Distribution and Status

Much like long-eared myotis, long-legged myotis range from the Pacific Coast to the extreme western Dakotas (Nowak and Paradiso 1983). This species is of special concern nationwide (Harvey et al. 1999). In South Dakota, long-legged myotis are found in the Black Hills and other western portions of the state (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Long-legged myotis are more commonly found in the Black Hills and are year-round residents (Tigner and Dowd Stukel 2003). Moreover, two studies indicate that long-legged myotis are the most common bat in Black Hills (Turner 1974, Mattson and Bogan 1993). Turner (1974) states all Chiropteran species found in the Black Hills are associated with long-legged myotis.

Natural History

Habitat of long-legged myotis consists of coniferous-juniper forest mountain regions at moderate elevations, although this bat may use lowlands or riparian areas (Warner and Czaplewski 1984). Barbour and Davis (1969) noted that long-legged myotis are closely associated with coniferous forests. Sometimes selected habitat areas can be relatively arid. Long-legged myotis use trees (under bark or in cavities), caves, mines, and rock crevices for roost sites in the Black Hills (Tigner and Aney 1994, Cryan and Bogan 1996). Selected hibernacula include abandoned mines and caves and are very humid (approximately 90%). During hibernation, droplets of condensation usually accumulate on the body while suspended from the ceiling or wall (Tigner and Dowd Stukel 2003). Foraging occurs after twilight for 3 to 4 hours throughout canopy, much like the long-eared myotis (Barbour and Davis 1969). Prey species include chiefly moths but also other soft-bodied insects (Whitaker et al. 1981b). One pup is usually born each year in July (Warner and Czaplewski 1984, Harvey et al. 1999, BCI 2001, TPW 2001). Males roost separately from females, while females roost communally in maternity roosts. Most maternity roosts are located in tree cavities (van Zyll de Jong 1985), but lactating females were discovered roosting beneath the bark of snags (dbh ≈ 66 cm) in the Black Hills (Cryan and Bogan 1996).

Subspecies

M. v. interior is the subspecies of long-legged myotis found in South Dakota.

Management Notes

Long-legged myotis require dead (e.g., snags) and live trees and caves or mines. To develop conservation strategies for this bat, habitat requirements of long-legged myotis need to be identified. More specifically, further information is required regarding maternity and nursery roosts (Tigner and Dowd Stukel 2003). Reproductive females were absent from foraging areas implying that roost sites with important characteristics might be present in the Black Hills (Cryan and Bogan 1996). Concentrations of bats at specific roost sites create greater susceptibility among bats to habitat alterations (Tigner and Dowd Stukel 2003).

Big brown bat *(Eptesicus fuscus)*

Museum Records (180): BEADLE County: 1 (SDSU); BON HOMME County: 30 (KU); BROOKINGS County: 5 (SDSU); BRULE County: 2 (SDSU); CHARLES MIX County: 1 (SDSU); CLAY County: 8 (KU), 2 (SDSU), 2 (USNM); CUSTER County: 17 (UM), 5 (KU), 4 (USNM), 2 (WCNP); DAVISON County 2 (SDSU); DEUEL County: 1 (SDSU); FALL RIVER County: 22 (KU); GRANT County: 1 (SDSU); HARDING County: 11 (KU); HUGHES County: 1 (SDSU), 8 (TTU); HUTCHINSON County: 1 (SDSU); JACKSON County: 30 (KU); LAKE County: 1 (SDSU); LAWRENCE County: 31 (KU), 5 (USNM); LINCOLN County: 9 (SDSU); MINNEHAHA County: ~600 (SDSU); MOODY County: 3 (SDSU); PENNINGTON County: 3 (KU); STANLEY County: 1 (USNM); TURNER County: 3 (SDSU); UNION County: 1 (KU), 1(SDSU); YANKTON County: 1 (SDSU).

Appearance

Big brown bats (*Eptesicus fuscus*) are large bats with average forearm length 45.72 mm and average body weight 17.54 g (Tigner and Dowd Stukel 2003). Body length measures nearly 13 cm (5 in) (Over and Churchill 1945). Big brown bats have pale brown, long fur,

which varies regionally. Wings are short and broad, and ears are pointed and furred at the medial side of the base. Ears and membranes are black. Big brown bats differ from *Myotis* species; heads and snouts are broader and body size is larger.

Distribution and Status

Big brown bats range throughout the United States with the exception of the extreme south central region and the Florida peninsula (Nowak and Paradiso 1983). Big brown bats are common throughout much of their range. In South Dakota, big brown bats range throughout the state and are very common (Over and Churchill 1945, Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Big brown bats are deemed the most common bat roosting in buildings and are one of the more successful bats residing in the Black Hills (Tigner and Dowd Stukel 2003)

Natural History

Forested areas are selected as primary habitat, although habitat may range from timberline meadows to lowland deserts. Historically, big brown bats selected roost sites in tree cavities or under bark. Stebler (1939) reported that big brown bats were found near floodplain areas of western South Dakota with cottonwood-willow associations. Currently, big brown bats are closely associated with humans because roosts typically occur in man-made structures (Nowak and Paradiso 1983). In Clay County, big brown bats probably day roost in man-made structures (Findley 1956). Over and Churchill (1945) added that big brown bats use day roosts, such as old buildings, rock crevices, and hollow trees. In eastern South Dakota, big brown bats select open areas in urban locales, cottonwood floodplain forests, and deciduous forests but are most abundant in urban areas where they utilize human-made structures (Swier 2003). In the Black Hills, big brown bats roost in buildings, trees, mines, caves, and railway tunnels (Tigner and Dowd Stukel 2003). Big brown bats spend the summer in eastern South Dakota but migrate to western South Dakota for winter hibernation, though some records indicate bats may stay in eastern South Dakota year-round (Swier 2003). Usually summer and winter roosts are in close proximity. Hibernacula microclimates vary due to their large size and high fat reserves (Kurta and Baker 1990). Usually big brown bats hibernate in caves, mines, and buildings (Tigner and Dowd Stukel 2003). (Big brown bats are the only species to hibernate in buildings in Black Hills [Tigner and Dowd Stukel 2003].) Hibernating colonies usually consist of females and males with more males than females present (Nowak and Paradiso 1983). Feeding occurs throughout the night with peak activity at dusk and just prior to sunrise (Kurta and Baker 1990). Big brown bats emerge with steady, straight flight patterns to feed over meadows, canopy vegetation, or water at nearly six to ten meters above ground (Nowak and Paradiso 1983). These bats are not as acrobatic and evasive as *Myotis* species in flight and must be at an elevated perch to initiate flight (Tigner and Dowd Stukel 2003). Big brown bats primarily prey on beetles, although many other insect species may comprise their diet. Mating occurs in the fall or winter before hibernation. One to two (twin) young are born each year in June after a 60-day gestation. Big brown bats form maternity roost sites of many individuals usually in man-made structures, but historically they roosted under tree bark and in tree cavities (Kurta and Baker 1990, Harvey et al. 1999, BCI 2001, TPW 2001). Brigham (1991) located maternity roosts in snags. Big brown bats select maternity roosts in older buildings with high temperatures, a great deal of access areas, and

wide temperatures gradients (Williams and Brittingham 1997), and large maternity roosts are not uncommon (Tigner and Dowd Stukel 2003).

Subspecies

Two subspecies found in South Dakota include *E. f. fuscus* and *E. f. pallidus*. These two subspecies differ: *E. f. fuscus* have larger craniums and darker pelages than *E. f. pallidus* (Jones and Genoways 1967), and *E. f. fuscus* is found east of the Missouri River, while *E. f. pallidus* is found west of the Missouri River.

Management Notes

Because this bat is associated with humans, the main threat to this bat is lack of public awareness. Therefore, increasing public awareness regarding roost sites and providing information on proper house exclusions is important to protect this bat.

Evening bat *(Nycticeius humeralis)*

Appearance

Evening bats (*Nycticeius humeralis*) are average-sized bats weighing from 7 to 14 g and measuring on average 10 cm (4 in) in body length (Watkins 1972, Harvey et al. 1999). Evening bats have thick, dark membranes and pale brown to reddish brown fur. Generally, the belly is lighter than the back. Ears and tragus (fleshy protrusion in ear) are more rounded than those of *Myotis* spp. This bat resembles a small big brown bat.

Distribution and Status

In the United States, evening bats range from the southeastern Atlantic Coast west to the central region and north to the Midwest (Nowak and Paradiso 1983). Evening bats are uncommon throughout their range, except for the southern coastal states (TPW 2001). Jones and Genoways (1967) noted that evening bats possibly occur in South Dakota, particularly in the southeast, due to the proximity of Nebraska's evening bat population. Evening bats were recently documented in South Dakota. Lane et al. (in press) captured three bats in Vermillion, Clay County; two bats were captured in 2000 and one bat was captured in 2001. As a result of these captures, evening bats are considered rare with a limited range in South Dakota (SDGFP 2002).

Natural History

Habitat consists of highly forested areas. Roost sites occur in trees or buildings and almost never caves. The evening bat forages on small nocturnal insects, such as June beetles, and leaves the roost to feed just after dusk foraging well into the night. During late evening foraging bouts, flight is low and steady in search of low-flying insects. The evening bat builds huge fat reserves for a long, southern migration, although much remains unknown about migration routes and hibernation sites (Watkins 1972, Harvey et al. 1999, TPW 2001). Males may not migrate during spring as far north as females (Watkins 1972). In late spring or early fall, young evening bats are born with a litter size consisting of two altricial pups. Pups are produced each year. Large nursery colonies are formed in buildings or attics, whereas small nursery colonies are formed behind loose bark or in tree cavities (Harvey et al. 1999, TPW 2001).

Subspecies

The subspecies of evening bat located in South Dakota is *N. h. humeralis*.

Management Notes

Little is known of evening bats in South Dakota. More data are recommended for proper management.

Cave-Roosting Bats

Townsend's big-eared bat *(Corynorhinus townsendii*, formerly *Plectotus townsendii)*
Museum Records (121): CUSTER County: 41 (KU), 9 (UCB), 8 (USNM); FALL RIVER County: 42 (KU); HARDING County: 3 (KU); JACKSON County: 4 (KU); LAWRENCE County: 1 (KU); MEADE County: 1 (KU); PENNINGTON County: 12 (KU).

Appearance

Townsend's big-eared bats (*Corynorhinus townsendii*) are relatively large bats with average weight 11.59 g and average forearm length 44.31 mm (Tigner and Dowd Stukel 2003). Townsend's big-eared bats measure approximately 10 cm (4 in) body length (Allen 1895, Over and Churchill 1945). Fur is buff along the back and pale buff along the belly (Tigner and Dowd Stukel 2003). Ears are hairless, large, long, and pointed, and measure approximately 2.5 cm (1 in) with long pinnae (Over and Churchill 1945). While roosting, ears are folded back exposing only the tragus. Visible traguses appear as ears of *Myotis* species. Two large bumps exist on the snout. Females are slightly larger than males as demonstrated by forearm lengths (Kunz and Martin 1982).

Distribution and Status

Townsend's big-eared bats range from the Pacific Coast to the extreme western portion of South Dakota (Nowak and Paradiso 1983). Nationally, Townsend's big-eared bats are considered of special concern (Harvey et al. 1999). In South Dakota, Townsend's big-eared bats are located in western portions of the state (Jones and Genoways 1967, Jones et al. 1985, Higgins et al. 2000). Formerly known as *Plecotus townsendii*, the Townsend's big-eared bat is a cave-dwelling bat distributed throughout the Black Hills (Turner 1974), and they are the most common underground roosting species in this region (Tigner and Dowd Stukel 2003). Due to their rarity and limited range, Townsend's big-eared bats are considered a state species of concern (SDGFP 2002).

Natural History

Habitat consists of arid western desert scrub and pine forest regions, while roost sites occur underground (Harvey et al. 1999, BCI 2001). Townsend's big-eared bats are dependent on underground structures year-round. Roost sites and hibernacula are selected in areas with minimal human intervention and relatively stable, cool temperatures. Selected hibernacula (e.g., mines and caves) are cooler and drier than *Myotis* hibernacula (Tigner and Dowd Stukel 2003). Townsend's big-eared bats hibernate in caves or mines in clusters of several to 100 individuals with a mixture of ages and sexes (Worthington 1992). Disturbance and temperature variation are detrimental to Townsend's big-eared bats; disturbance may cause hibernating clusters to relocate within or leave caves or mines altogether. Townsend's big-

eared bats are agile fliers searching for food in a variety of habitats. In the Black Hills, foraging primarily occurs along forested edges or in the canopy late at night (Kunz and Martin 1982); Townsend's big-eared bats emerge approxiamtely 30 minutes after sunset (Tigner and Dowd Stukel 2003). Food consists of primarily moths (Pierson et al. 1999). Townsend's big-eared bats occupy feeding perches in the Black Hills (Tigner and Dowd Stukel 2003). Mating occurs in fall or winter usually in winter roosts. In June of the following year, one pup per year is born after a 50 to 100-day gestation (Pearson et al. 1952). Young females are reproductively mature and may mate their first fall, whereas males are not reproductively mature until their second year. Females form maternity and nursery roosts in inaccessible, spacious areas in warm sections of underground structures (Tigner and Dowd Stukel 2003), while males continue to roost solitarily (Kunz and Martin 1982, Harvey et al. 1999, BCI 2001).

Subspecies

Subspecies of Townsend's big-eared bat found in South Dakota is *C. t. pallescens*.

Management Notes

Townsend's big-eared bats are strictly dependent on underground structures (e.g., caves and mines) and extremely sensitive to disturbance. As a result, protecting caves or mines especially those supplying roosts during critical periods (e.g., maternity or nursery roosts and hibernacula) is necessary to prevent human disturbance and to conserve Townsend's big-eared bats (Tigner and Dowd Stukel 2003). Parallel efforts include increasing public awareness and determining and designating no treatment (where timber harvest does not occur) buffer zones around each protected roost.

Appendix C. Identifying Bats

A key can be used to help identify species. Some mammal species are easily identified without the use of a key, while others are difficult to identify even with the use of a key. Chiroptera is among the more difficult species to identify. Keys help to identify a mammal, in particular bats, to genus and often species. If identification is questionable, do not hesitate to seek assistance from professional mammalogists in the various wildlife agencies and universities.

To use the keys, read the choices in descriptions of the same number and choose the best result. Go to the number that is indicated at the end of the chosen alternative and continue moving through the key until a final choice is indicated. However, a key seldom works for every specimen because each species varies in size, color, and other characteristics. It is best to have several specimens on hand for comparison. Characteristics in these keys apply to only adult animals.

This key is reproduced by permission from South Dakota, Game, Fish and Parks. Originally, the Order Chiroptera key was included in "Wild Mammals of South Dakota" copyrighted in 2000.

ORDER CHIROPTERA

Note: Because of the difficulty distinguishing South Dakota's Myotis species, two keys are included in this text. The second key emphasizes measurements obtained from bats found in the Black Hills.

1. Large bat, forearm length usually greater than 50 mm (1.97 in.). Fur is yellowish brown to mahogany and "frosted" with silver; rounded ears edged in black----------Hoary Bat
1. Forearm length usually less than 50 mm (1.97 in.). Fur not as described above----------Go to 2

2. Forearm length usually 41-48 mm (1.61-1.89 in.). Ears large, length greater than 25 mm (0.98 in.)---------Townsend's Big-eared Bat
2. Ears less than 25 mm (0.98 in.) length----------Go to 3

3. Large bat, forearm length usually less then 50 mm (1.97 in.) but greater than 41 mm (1.61 in.). Fur is brown, ears less than 20 mm length (0.79 in.), total length greater than 110 mm (4.33 in.); blunt tragus; broad head and snout----------Big Brown Bat
3. Forearm length usually less than 45 mm (1.77 in.), total length less than 110 mm (4.33 in.)---------Go to 4

4. Fur black to dark black-brown, "frosted" with silver or white----------Silver-haired Bat
4. Fur not as described above----------Go to 5

5. Fur bright reddish orange to chestnut, no "frosted" fur----------Red Bat
5. Fur not as described above----------Go to 6

6. Forearm usually less than 34 mm (1.34 in.), black facial mask, ears, and flight membranes contrasting with yellowish-brown to golden-brown fur----------Western Small-footed Myotis
6. Forearm usually greater then 34 mm (1.34 in.)----------Go to 7

7. Ears usually 18 mm (0.71 in.) or more in length----------Go to 8
7. Ears usually less than 18 mm (0.71 in.) in length----------Go to 9

8. Ears usually 22-25 mm (0.87-0.98 in.) in length, ears extend 5 mm (0.2 in.) or more beyond nose tip when laid forward, forearm usually less than 39.5 mm (1.56 in.) but may range from 36-41 mm (1.42-1.61 in.); indistinct fringe of minute hairs along edge of uropatagium----------Long-eared Myotis
8. Ears usually 18-20 mm (0.71-0.79 in.) in length but may range from 16-20 mm (0.63-0.79 in.), forearm usually more than 39.5 mm (1.56 in.); distinct fringe of small, stiff hairs along the edge of the uropatagium----------Fringe-tailed Myotis

9. Ear length usually 17-18 mm (0.67-0.71 in.) but may range up to 19 mm (0.75 in.); when ear laid forward extending beyond tip of nose (forearm length ranges from 32-39 mm or 1.26-1.54 in.)-------Northern Myotis
9. Ear length usually less than 16 mm (0.63 in.); when ear laid forward, extending to end of nose but not much past end of nose----------Go to 10

10 Ears usually 13-15 mm (0.51-0.59 in.), calcar keeled----------Long-legged Myotis
10. Ears usually 14-15 mm (0.55-0.59 in.), calcar not keeled---------Little Brown Bat (Little Brown Myotis)

ALTERNATE KEY TO ORDER CHIROPTERA

1. Ear length greater than 25 mm (0.98 in)----------Townsend's Big-eared Bat
1. Ear length less than 25 mm (0.98 in.)----------Go to 2

2. Fur extending onto dorsal side of uropatagium; ear shape rounded----------Go to 3
2. Sparse or no fur extending onto dorsal side of uropatigium; ear shape pointed----------Go to 5

3. Forearm length equal to or greater than 45 mm (1.77 in); fur multicolored yellowish and dark gray to black heavily tipped with white; rounded ear edged in black----------Hoary Bat
3. Forearm length equal to or less than 44 mm (1.73 in.)----------Go to 4

4. Forearm length 37-44 mm (1.46-1.73 in); dark brown to (usually) black with many hairs silver-tipped; ear round with short, blunt tragus----------Silver-haired Bat
4. Forearm length 36-42 mm (1.42-1.65 in.); fur color ranges from yellowish-orange to cinnamon; uropatagium is densely furred; tufts of pale fur frequently found at distal end of forearm----Eastern Red Bat

5. Distinct keel on calcar----------Go to 6
5. Calcar keel absent or weak----------Go to 7

6. Forearm less than 34 mm (1.34 in.); black mask, ears, and flight membranes contrasting with usually pale brown fur----------Western Small-footed Myotis
6. Forearm 41-51 mm (1.61-2.01 in.); ears short (less than 20 mm or 0.79 in.), barely reaching nose tip when pressed forward; blunt tragus; broad head and snout ----------Big Brown Bat
6. Forearm 35-41 mm (1.38-1.61 in.); usually furring on ventral side of wing membrane to a line from elbow to knee; fur dull lacking sheen; dark brown ears and flight membranes----------Long-legged Myotis

7. Ears short (13-15 mm or 0.51-0.59 in.) with blunt tragus approximately ½ length of ear; varying shades of brown often with sheen to fur; forearm 34-41 mm (1.34-1.61 in.); membranes and ears brown----------Little Brown Bat
7. Ears long (15-18 mm or 0.59-0.71 in.), extending beyond tip of nose when pressed forward; tragus long and narrow, coming to a point; ears, mask, and flight membranes brown; no fringe of hairs along free edge of uropatagium----------Northern Myotis
7. Distinct fringe of course hairs along free edge of uropatagium; ear length 16-20 mm (0.63-0.79 in.), ear length generally less than ½ length of forearm; ears extend less than 5 mm (0.2 in.) beyond tip of nose when pressed forward; blackish ears and flight membranes; forearm 39-44 mm (1.54-1.73 in.)----------Fringe-tailed Myotis
7. Ear length 22-25 mm (0.87-0.98 in.), ear length generally greater than ½ length of forearm; ears extending more than 5 mm (0.2 in.) beyond tip of nose when pressed forward; frequently displays indistinct fringe of hairs along free edge of uropatigium; ears and membranes blackish; forearm 36-41 mm (1.42-1.61 in.)----------Long-eared Myotis

Appendix D. Management Recommendations

1. Underground Roost Habitat

- All open underground cavities (e.g., natural caves, abandoned mines) irrespective of size should be evaluated as bat habitat by a qualified bat biologist. No actions that could potentially alter the site and its surrounding area should occur without this evaluation.
- An acceptable evaluation will consider hibernacula, maternity, and day roost potential therefore surveys must be conducted in the appropriate seasons (e.g., hibernacula surveys cannot be conducted outside of winter months).
- This will mean that land managers, state biologists, and private landowners will need to plan activities far enough in advance to accommodate evaluation requirements.
- The (written) evaluation should include a brief description of the site, proposed action, findings, and recommendations or mitigation required for the proposed action to continue.

Note: If the situation warrants a complete closure of the site, other than with a 'bat friendly' gate design, then the exclusion must be performed in the season and using methods that would

pose the least adverse affect to the bats. This can be accomplished by biologists and technicians trained in these procedures.

2. Water Source Protection

Depending on location and season springs, seeps, ponds, reservoirs, dugouts, stock tanks may provide important, and often limited, watering or foraging sites for bats. These sites need to be maintained in working order, and free of high levels of feculent material. Heavy levels of livestock congregation (soil compaction) need to be avoided around spring sources. Aquatic and emergent vegetation should be encouraged and maintained. Often these sites were originally created for livestock watering, however these recommendations will benefit livestock water quality and dependability, as well and improving wildlife watering opportunities. It is expected that watering sites located on public lands (National Forests, Grasslands, etc.) will be maintained in this *multiple-use* concept.

3. Riparian/Cottonwood

Riparian, cottonwood, green ash, box elder, or other wooded draw habitats provide critical foraging, roosting, and migration corridors for many bat species and other wildlife. Protect these habitats from activities that may contribute to loss or decline. Improve structural diversity where possible. Encourage that *public land* National Forest/Grassland Management Plans (Standards and Guidelines, Goals and Objectives) be followed.

Note: This is in agreement with the Western Bat Working Group (WBWG) resolution (9/29/2001) that supports the further research, inventory, conservation, maintenance, restoration and re-establishment of historic cottonwood (and sycamore) ecosystems across western North America.

4. Forestry Practices

- Dead Trees (snags) – Many wildlife species utilize snags for habitat but since this is focusing on bats we will limit our discussion. Snags provide roosting habitat, and critical maternity roosts have been found under bark and in old woodpecker cavities. Working towards an average of 8-10 snags per acre would likely provide sufficient roosting habitat for the variety of bats species (Mattson et al. 1994), as well as the customary cavity nesting bird species that depend on this habitat feature.
- Green Trees/Forest Fragmentation – Mature forests provide roost sites for tree bats, and produce insects where bats forage above the canopy. Large diameter, mature green trees provide the replacements for the snags that exist today. Even-aged forestry practices often remove the large diameter trees to make room for the next rotation of young trees. This plan supports un-even aged forestry practices that maintain a mix of old trees while planning for forest regeneration. This can be accomplished on a landscape (watershed) scale and need not necessarily be met at the individual stand level. However, it does need to be monitored and not lost to commodity driven intensive forestry practices. Forest management on public lands is more easily monitored but this multi-storied, un-even aged condition is equally important on state and private forest habitats. Forest fragmentation is a term used to describe breaking-up of large tracts of continuous forests. Due to the naturally fragmented condition of the forests in South Dakota, including the Black Hills it is mentioned only for

reference purposes. Naturally, fragmentation can and does occur on smaller scales. Some principle causes of forest fragmentation are fire, logging and insects (bug killed trees). Man-caused activities should consider any potential to decrease connectivity of forested habitats.

5. Buildings

- If a large number of bats are detected to be roosting in a building (e.g., house) during the summer, please have the site evaluated by a qualified bat biologist. Most likely this site serves as a maternity roost. No actions that could potentially alter this site and its surrounding area should occur without this evaluation.
- This evaluation will help determine the importance of this site and locate any other suitable sites nearby in the event that a proper bat exclusion is conducted.
- For information regarding proper bat exclusions, seek advice from bat biologists, seek information at the SDBWG website (http://nat_hist.sdstate.edu/SDBWG/SDBWG.html, see Help! Bats in My House!), or read Joel Tigner's article "Bats and Buildings" (Appendix G).

Appendix E. Federal Cave Resources Protection Act, 1988 (Public Law 100-691; November 18, 1988; 16 U.S.C. 4301-4309)

Overview. This Act helps protect significant caves on federal lands by identifying their locations, regulating their uses, requiring permits for removal of their resources, and prohibiting destructive acts. Caves must be considered in the preparation and implementation of land management plans and cave locations may be kept confidential.

Findings/Policy. Congress found that significant caves on federal lands are invaluable and irreplaceable parts of our cultural heritage. In some instances, caves are threatened due to improper use, increased recreation, urban sprawl, and lack of specific statutory protection. This Act helps preserve significant caves on federal lands for the perpetual use, enjoyment, and benefit of all people and foster increased cooperation and information exchange between government authorities and people using caves on federal lands for scientific, education, or recreational purposes. U.S. policy states that federal lands should be managed to protect and maintain significant caves to the extent practical. § 4301.

Selected Definitions. Cave: any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the earth's surface or within a cliff or ledge (excluding mines, tunnels and other manmade excavations) and which is large enough to permit an individual to enter. Cave resource: any material or substance occurring naturally in caves on federal lands, such as animal and plant life, paleontological deposits, sediments and minerals. Secretary: Secretary of Agriculture or Secretary of the Interior, as appropriate. § 4302.

Cave Management. Secretary is required to issue regulations to achieve the purposes of the Act no later than August 18, 1989. Regulations must include criteria for identification of significant caves. Secretaries must cooperate and consult with each other in preparing regulations, which should be similar to the extent practical. Secretary must take other actions to further the Act's purposes, which includes identification of significant caves on federal lands, regulation or restriction of use of significant caves as appropriate, entering into volunteer management agreements with people in the scientific and recreational caving community, and appointment of appropriate advisory committees. Secretary must ensure that significant caves are considered in the preparation or implementation of land management plans and foster communication and cooperation among land managers, cave users, and the public. § 4303. Specific locations of significant caves cannot be made available to the public unless the Secretary determines that disclosure of this information would further the Act's purposes and not create a substantial risk of harm, theft, or destruction of caves. Information on significant caves may be made available through written request by federal or state governmental agencies or educational and research institutions. Requests must describe specific sites or areas, explain purposes of seeking information, and include assurances that information will be kept confidential and caves will be protected from vandalism and unauthorized use. § 4304.

Collection Permits. Secretary may issue permits for the collection and removal of cave resources, if proposed activities are consistent with the Act's purposes. Secretary may issue permits for use on Indian lands only if the Indian or Indian tribe owning or having jurisdiction over the land consents. If a permit may result in harm to any religious or cultural site, the Secretary must notify any Indian tribe that may consider the site religiously or culturally important. Upon application of an Indian tribe, the Secretary may delegate to the tribe authority to issue and enforce permits for any cave resource located on the tribe's lands. Permits are not transferable and may be revoked by the Secretary for violation of the Act or failure to comply with the permit's conditions. Actions authorized by permit are not considered violations of the Act. § 4305.
Prohibitions and Penalties.. Act prohibits knowingly destroying, disturbing, defacing, removing, or harming any significant cave; altering free movement of any animal or plant life in or out of a significant cave; entering a significant cave with the intention of committing any prohibited act; possessing, selling, or exchanging any cave resource knowing that the resource was removed from a significant cave on federal lands; and employing or using another person to commit any act prohibited in this section. Violation of these prohibitions is subject to criminal and civil penalties. §§ 4306 and 4307.
Cave Research Program. Secretary of the Interior, acting through the Director of the National Park Service, must establish and administer a cave research program for the orderly and scholarly collection and analyze and disseminate research material on caves in lands managed by the National Park Service. Programs must produce educational information for public understanding of cave geology, assist students and researchers, and provide a comprehensive evaluation of cave resources and protection measures. § 4310.
Related Provision. Notes to this Act contain a related statute, the Lechuguilla Cave Protection Act of 1993. This statute designates approximately 6,280 acres of land in New Mexico as the Lechuguilla Cave Protection Area and protects it from development and mineral exploration. § 4301 note.

BE IT ENACTED BY THE SENATE AND THE HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED,

SEC. 1. SHORT TITLE. This Act may be referred to as the "Federal Cave Resources Protection Act of 1988."

SEC. 2. FINDINGS, PURPOSES, AND POLICY.
(a) FINDINGS.-The Congress finds and declares that-
(1) significant caves on Federal lands are an invaluable and irreplaceable part of the Nation's natural heritage; and
(2) in some instances, these significant caves are threatened due to improper use, increased recreational demand, urban spread, and a lack of specific statutory protection.
(b) PURPOSES.-The purposes of this Act are-
(1) to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people; and
(2) to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on Federal lands for scientific, education, or recreational purposes.
(c) POLICY.-It is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves.

SEC. 3. DEFINITIONS.
For purposes of this Act:
(1) CAVE.-The term "cave" means any naturally occurring void, cavity, recess, or system of interconnected passages which occurs beneath the surface of the earth or within a cliff or ledge (including any cave resource therein, but not including any vug, mine, tunnel, aqueduct, or other man-made excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or man-made. Such term shall include any natural pit, sinkhole, or other feature which is an extension of the entrance.

(2) FEDERAL LANDS.-The term "Federal lands" means lands the fee title to which is owned by the United States and administered by the Secretary of Agriculture or the Secretary of the Interior.
(3) INDIAN LANDS-The term "Indian lands" means lands of Indian tribes or Indian individuals which are either held in trust by the United States for the benefit of an Indian tribe or subject to a restriction against alienation imposed by the United States.
(4) INDIAN TRIBE.-The term "Indian tribe" means any Indian tribe, band, nation, or other organized group or community of Indians, including any Alaska Native village or regional or village corporation as defined in, or established pursuant to, the Alaska Native Claims Settlement Act (43 U.S.C 1601 et seq.).
(5) CAVE RESOURCE.-The term "cave resource" includes any material or substance occurring naturally in caves on Federal lands, such as animal life, plant life, paleontological deposits, sediments, minerals, speleogens, and speleothems.
(6) SECRETARY.-The term "Secretary" means the Secretary of Agriculture or the Secretary of the Interior, as appropriate.
(7) SPELEOTHEM-The term "speleothem" means any natural mineral formation or deposit occurring in a cave or lava tube, including but not limited to any stalactite, stalagmite, helictite, cave flower, flowstone, concretion, drapery, rimstone, or formation of clay or mud.
(8) SPELEOGEN.-The term "speleogen" means relief features on the wails, ceiling and floor of any cave or lava tube which are part of the surrounding bedrock, including but not limited to anastomoses, scallops, meander niches, petromorphs and rock pendants in solution caves and similar features unique to volcanic caves.

SEC. 4. MANAGEMENT ACTIONS.

(a) REGULATIONS-Not later than nine months after the date of the enactment of this Act, the Secretary shall issue such regulations as he deems necessary to achieve the purposes of this Act. Regulations shall include, but not be limited to, criteria for the identification of significant caves. The Secretaries shall cooperate and consult with one another in preparation of the regulations. To the extent practical, regulations promulgated by the respective Secretaries should be similar.
(b) IN GENERAL-The Secretary shall take such actions as may be necessary to further the purposes of this Act. These actions shall include (but not be limited to: identification of significant caves on federal lands;
(1)(A) The Secretary shall prepare an initial list of significant caves for lands under his jurisdiction not later than one year after the publication of final regulations using the significance criteria defined in such regulations. Such a list shall be developed after consultation with appropriate private sector interests, including cavers.
(B) The initial list of significant caves shall be updated periodically, after consultation with appropriate private sector interests, including cavers. The Secretary shall prescribe by policy or regulation the requirements and process by which the initial list will be updated, including management measures to assure that caves under consideration for the list are protected during the period of consideration. Each cave recommended to the Secretary by interested groups for possible inclusion on the list of significant caves shall be considered by the Secretary according to the requirements prescribed pursuant to this paragraph, and shall be added to the list if the Secretary determines that the cave meets the criteria for significance as defined by the regulations.
(2) regulation or restriction of use of significant caves, as appropriate;
(3) entering into volunteer management agreements with persons of the scientific and recreational caving community; and
(4) appointment of appropriate advisory committees.

(c) PLANNING AND PUBLIC PARTICIPATION.- The Secretary shall-
(1) ensure that significant caves are considered in the preparation or implementation of any land management plan if the preparation or revision of the plan began after the enactment of this Act;
(2) foster communication, cooperation, and exchange of information between land managers, those who utilize caves, and the public.

SEC. 5. CONFIDENTIALITY OF INFORMATION CONCERNING NATURE AND LOCATION OF SIGNIFICANT CAVES.

(a) IN GENERAL.-Information concerning the specific location of any significant cave may not be made available to the public under section 552 of title 5, United States Code, unless the Secretary determines that disclosure of such information would further the purposes of this Act and would not create a substantial risk of harm, theft, or destruction of such cave.
(b) EXCEPTIONS.-Notwithstanding subsection (a), the Secretary may make available information regarding significant caves upon the written request by Federal and state governmental agencies or bona fide educational and research institutions.
Any such written request shall, at a minimum:
(1) describe the specific site or area for which information is sought;
(2) explain the purpose for which such information is sought; and
(3) include assurances satisfactory to the Secretary that adequate measures are being taken to protect the confidentiality of such information and to ensure the protection of the significant cave from destruction by vandalism and unauthorized use.

SEC. 6. COLLECTION AND REMOVAL FROM FEDERAL CAVES.

(a) PERMIT.-The Secretary is authorized to issue permits for the collection and removal of cave resources under such terms and conditions as the Secretary may impose, including the posting of bonds to insure compliance with the provisions of any permit.
(1) Any permit issued pursuant to this section shall include information concerning the time, scope, location, and specific purpose of the proposed collection, removal or associated activity, and the manner in which such collection, removal, or associated activity is to be performed must be provided.
(2) The Secretary may issue a permit pursuant this subsection only if he determines that the proposed collection or removal activities are consistent with the purposes of this Act and with other applicable provisions of law.
(b) REVOCATION OF PERMIT.-Any permit issued under this section shall be revoked by the Secretary upon a determination by the Secretary that the permittee has violated any provision of this Act, or has failed to comply with any other condition upon which the permit was issued. Any such permit shall be revoked by the Secretary upon assessment of a civil penalty against the permittee pursuant to section 8 or upon the permittee's conviction under section 7 of this Act. The Secretary may refuse to issue a permit under this section to any person who has violated any provision of this Act or who has failed to comply with any condition of a prior permit.
(c) TRANSFERABILITY OF PERMITS. Permits issued under this act are not transferable.
(d) CAVE RESOURCES LOCATED ON INDIAN LANDS.-
(1)(A) Upon application by an Indian tribe, the Secretary is authorized to delegate to the tribe all authority of the Secretary under this section with respect to issuing and enforcing permits for the collection or removal of any cave resource located on the affected Indian lands.
(B) In the case of any permit issued by the Secretary for the collection or removal of any cave resource, or to carry out activities associated with such collection or

removal, from any cave resource located on Indian lands (other than permits issued pursuant to subparagraph (A)), the permit may be issued only after obtaining the consent of the Indian or Indian Tribe owning or having jurisdiction over such lands. The permit shall include such reasonable terms and conditions as may be requested by such Indian or Indian Tribe.

(2) If the Secretary determines that the issuance of a permit pursuant to this section may result in harm to, or destruction of, any religious or cultural site, the Secretary, prior to issuing such permit, shall notify any Indian tribe which may consider the site as having significant religious or cultural importance. Such notice shall not be deemed a disclosure to the public for purposes of section 5.

(3) A permit shall not be required under this section for the collection or removal of any cave resource located on Indian lands or activities associated with such collection, by the Indian or Indian tribe owning or having jurisdiction over such lands.

(e) EFFECT OF PERMIT-No action specifically authorized by a permit under this section shall be treated as a violation of section 7.

SEC. 7. PROHIBITED ACTS AND CRIMINAL PENALTIES.

(a) PROHIBITED ACTS.-

(1) Any person who, without prior authorization from the Secretary knowingly destroys, disturbs, defaces, mars, alters, removes or harms any significant cave or alters the free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intention of committing any act described in this paragraph shall be punished in accordance with subsection (b).

(2) Any person who possesses, consumes, sells, barters or exchanges, or offers for sale, barter or exchange, any cave resource from a significant cave with knowledge or reason to know that such resource was removed from a significant cave located on Federal lands shall be punished in accordance with subsection (b).

(3) Any person who counsels, procures, solicits, or employs any other person to violate any provisions of this subsection shall be punished in accordance with subsection (b).

(4) Nothing in this section shall be deemed applicable to any person who was in lawful possession of a cave resource from a significant cave prior to the date of enactment of this Act.

(b) PUNISHMENT: Punishment for violating any provision of subsection (a) shall be imprisonment of not more than one year or a fine in accordance with the applicable provisions of title 18 of the United States Code, or both. In the case of a second or subsequent violation, the punishment shall be imprisonment of not more than 3 years or a fine in accordance with the applicable provisions of title 18 of the United States Code, or both.

SEC. 8. CIVIL PENALTIES.

(a) ASSESSMENT.-(t) The Secretary may issue an order assessing a civil penalty against any person who violates any prohibition contained in this Act, any regulation promulgated pursuant to this Act, or any permit issued under this Act. Before issuing such an order, the Secretary shall provide such person written notice and the opportunity to request a hearing on the record within 30 days. Each violation shall be a separate offense, even if such violations occurred at the same time.

(1) The amount of such civil penalty shall be determined by the Secretary taking into account appropriate factors, including (A) the seriousness of the violation; (B) the economic benefit (if any) resulting from the violation; (C) any history of such violations; and (D) such other matters as the Secretary deems appropriate. The maximum fine permissible under this section is $10,000.

(b) JUDICIAL REVIEW.-Any person aggrieved by an assessment of a civil penalty under this section may file a petition for judicial review of such assessment with the United States District Court for the District of Columbia or for the district in which the violation occurred. Such a petition shall be filed within the 30-day period beginning on the date the order assessing the civil penalty was issued.

(c) COLLECTION-If any person fails to pay an assessment of a civil penalty-

(1) within 30 days after the order was issued under subsection (a), or

(2) if the order is appealed within such 30 day period, within 10 days after the court has entered a final judgment in favor of the Secretary under subsection (b), the Secretary shall notify the Attorney General and the Attorney General shall bring a civil action in an appropriate United States district court to recover the amount of penalty assessed (plus costs, attorneys fees, and interest at currently prevailing rates from the date the order was issued or the date of such final judgment, as the case may be). In such an action, the validity, amount, and appropriateness of such penalty shall not be subject to review.

(d) SUBPOENAS.-The Secretary may issue subpoenas in connection with proceedings under this subsection compelling the attendance and testimony of witnesses and subpoenas duces tecum, and may request the Attorney General to bring an action to enforce any subpoena under this section. The district courts shall have jurisdiction to enforce such subpoenas and impose sanctions.

SEC 9. MISCELLANEOUS PROVISIONS.

(a) AUTHORIZATION.-There are authorized to be appropriated $100,000 to carry out the purposes of this Act.

(b) EFFECT ON LAND MANAGEMENT PLANS.

-Nothing in this act shall require the amendment or revision of any land management plan, the preparation of which began prior to the enactment of this Act.

(c) FUND-Any money collected by the United States as permit fees for collection and removal of cave resources; received by the United States as a result of the forfeiture of a bond or other security by a permittee who does not comply with the requirements of such permit issued under section 7; or collected by the United States by way of civil penalties or criminal fines for violations of this Act shall be placed in a special fund in the Treasury. Such monies shall be available for obligation or expenditure (to the extent provided for in advance in appropriation Acts) as determined by the Secretary for the improved management, benefit, repair, or restoration of significant caves located on Federal lands.

(d) Nothing in this act shall be deemed to affect the full operation of the mining and mineral leasing laws of the United States, or otherwise affect valid existing rights.

SEC. 10. SAVINGS PROVISIONS.

(a) WATER.-Nothing in this Act shall be construed as authorizing the appropriation of water by any Federal, State, or local agency, Indian tribe, or any other entity or individual. Nor shall any provision of this Act-

(1) affect the rights or jurisdiction of the United States, the States, Indian tribes, or other entities over water of any river or stream or over any groundwater resource;

(2) alter, amend, repeal, interpret, modify, or be in conflict with any interstate compact made by the States; or

(3) alter or establish the respective rights of States, the United States, Indian tribes, or any person with respect to any water or water-related right.

(b) FISH AND WILDLIFE.-Nothing in this Act shall be construed as affecting the jurisdiction or responsibilities of the States with respect to fish and wildlife.

Appendix F. National Cave and Karst Research Institute Act of 1998

The National Cave and Research Institute Act of 1998 was formed to gather information regarding cave and karst, promote information exchange and education, and foster environmentally sound management practices. Part of this Act includes the development of a centralized location to facilitate these objectives. This location is near National Park lands in New Mexico.

SECTION 1. SHORT TITLE
This Act may be cited as the 'National Cave and Karst Research Institute Act of 1998'.

SECTION 2. PURPOSES
The purposes of this Act are-

1. to further the science of speleology;
2. to centralize and standardize speleological information;
3. to foster interdisciplinary cooperation in cave and karst research programs;
4. to promote public education;
5. to promote national and international cooperation in protecting the environment for the benefit of cave and karst landforms; and
6. to promote and develop environmentally sound and sustainable resource management practices.

SECTION 3. ESTABLISHMENT OF THE INSTITUTE

- MANAGEMENT- The Institute shall be jointly administered by the National Park Service and a public or private agency, organization, or institution, as determined by the Secretary.
- GUIDELINES- The Institute shall be operated and managed in accordance with the study prepared by the National Park Service pursuant to section 203 of the Act entitled 'An Act to conduct certain studies in the State of New Mexico', approved November 15, 1990 (Public Law 101-578; 16 U.S.C. 4310 note).
- CONTRACTS AND COOPERATIVE AGREEMENTS- The Secretary may enter into a contract or cooperative agreement with a public or private agency, organization, or institution to carry out this Act.

SECTION 4. ADMINISTRATION OF THE INSTITUTE

- FACILITY-
    1. LEASING OR ACQUIRING A FACILITY- The Secretary may lease or acquire a facility for the Institute.
    2. CONSTRUCTION OF A FACILITY- If the Secretary determines that a suitable facility is not available for a lease or acquisition under paragraph (1), the Secretary may construct a facility for the Institute.
- ACCEPTANCE OF GRANTS AND TRANSFERS- To carry out this Act, the Secretary may accept-
    1. a grant or donation from a private person; or
    2. a transfer of funds from another Federal agency.

SECTION 5. FUNDING

- MATCHING FUNDS- The Secretary may spend only such amount of Federal funds to carry out this Act as is matched by an equal amount of funds from non-Federal sources.
- AUTHORIZATION OF APPROPRIATIONS- There are authorized to be appropriated such sums as may be necessary to carry out this Act.

Appendix G. Proper House Exclusions

Proper house exclusions are important for conserving bats, such as little brown bats or big brown bats, that concentrate roosts in houses or other buildings. The following is an article published in the South Dakota Conservation Digest that reports methods to properly exclude bats from buildings. The author of this article, Joel Tigner, is a bat biologist and the owner of Batworks, a consulting firm specializing in bat study and bat-friendly exclusion.

BATS IN BUILDINGS

Joel Tigner

Having "bats in the belfry" usually means that a person is considered crazy or erratic. The phrase derives from observations of bat use of a tall structure, such as a watchtower, and the flurry of activity as they leave at dusk. In modern times, few people own actual belfries, but they may have bats in their attic, garage, or other building sites. This article provides an overview of bats in buildings and describes how to deal with unwanted roosts.

Timing is absolutely crucial when dealing with unwanted bat roosts. If you follow the guidelines outlined below at the wrong time of year, you may create new problems for the roost owner.

First, a bit about bats…Bats are not rodents. They do not make or enlarge holes in buildings, they do not chew wiring, and they do not build nests. They use a structure just as they find it, although they may cause damage. Over time, a large roost can damage a building because of accumulation of urine and droppings. Bat urine has a very pungent odor, particularly noticeable during warm weather. A homeowner needn't worry about rodent-like building damage, although removing the urine odor can be difficult without replacing affected building materials.

The same bats will use the same roosts from year to year. If you have bats this year, they will likely return next year unless you exclude them from the building.

Exclusion is the best way to deal with unwanted bats in buildings. Exclusion is a process by which bats are sealed out of a structure. Exclusions must be performed at the appropriate time of year and follow certain guidelines.

Why not use poisons?

Poisoning bats is illegal and irresponsible. Poisoning attempts seldom kill all the bats, leaving sickened bats that emerge, become grounded, and may be retrieved by children and pets. Poisoning also fails to address the real issue – that bats are gaining access to your structure in the first place. As bats are mammals, anything harmful to them will also be harmful to you and your pets.

In South Dakota, groups of bats in buildings are typically members of maternity/nursery roosts. In general, maternity roosts may number from less than 10 to more than 1,000 bats. Typical roost size in South Dakota is 20-30 bats. Bats differ from most other small mammals in that they give birth only once a year and generally only to a single pup. Adult females come together in the early spring to give birth and rear their pups. These roosts can form from wider areas with reproductive females sometimes traveling great distances to benefit from collective roosting. Considering the large area from which females may gather and the low reproductive rate of bats, destroying such roosts can have serious impacts to a particular population or species.

Exclusions must be timed to be completed before the females have given birth or postponed until after the pups have learned to fly. Optimal exclusion dates vary with a year's weather conditions, but in general, exclusions in South Dakota should not be done between mid-May and September 1.

Seasonal visitors

Most groups of bats in buildings are seasonal visitors, arriving in the spring and departing in the late summer or early fall. Bat species that roost collectively in buildings must hibernate during the winter, as there is no insect prey available. Buildings typically do not provide the necessary conditions for bats to survive the winter. As cold weather approaches, they begin to move out of their summer

roost and head for their hibernation sites (or to warmer climates farther south). By the time cold weather arrives, nearly all the bats will have left buildings. The ideal time to do exclusions is either after the bats have left for the winter or early in the spring before their arrival.

NOTABLE EXCEPTION - One particularly robust species, the Big Brown Bat (*Eptesicus fuscus*) has been known to winter in buildings in South Dakota, but not much is known about the extent of their winter building use. Buildings most likely to be used for hibernation generally contain brick or block sections (including foundations) where the bats can find a more stable temperature. Bats often move from their entry point to a distant location in the structure via cavities in walls to find their optimal seasonally specific temperature. Bat exclusion in buildings with such features should employ a more conservative treatment plan to prevent entrapping over-wintering bats. (Entrapment frequently causes bats to seek alternative ways to exit the structure, which may lead to their inadvertently entering the living space and confronting human inhabitants. In general, neither party is amused by such encounters.)

Excluding unwanted bat roosts

If you read the important preceding information and have decided to evict your bat tenants, here is the method to use when bats are (or may be) in residence. The following should only be used in roosts of less than 100 bats. For larger roosts, contact an experienced bat exclusion specialist for advice.

1 - Identify the bats' favorite point of entry (there may be more than one). If there is more than one point of access but you are certain they are connected within the structure (different openings leading into the same soffit, for example), you may proceed with the following directions. If you are uncertain the sites are connected or they are in different parts of the structure, each roost should be treated separately.

Identifying the entry point is usually not too difficult. Bat droppings may accumulate beneath the access points or a dark staining is sometimes visible around access points found in light-colored materials. If you have no idea where they are entering the structure, position yourself and some friends around the outside of the house at dusk to watch for the bats' nightly emergence. Do this on a warm, calm evening, since cool temperatures or rain will usually delay or prevent bat emergence.

2 - Once you have identified the entry point, thoroughly examine the structure during daylight hours and identify any additional openings. This is probably the single-most important step in the entire procedure. Many openings may not be visible from a ground level vantagepoint, particularly for multi-story structures. Use binoculars or examine the structure from a ladder.

3 - All openings except the bat's entry point should be sealed. Many people believe bats are larger than they actually are, requiring large holes to gain access. Some species are smaller than others, but you should fill any opening larger than ½ inch. (Smaller species can use the trough in the pointing between the ends of two bricks to pass under the fascia board and gain access to the soffit.) Use a good quality caulk to seal smaller holes or crevices and expanding aerosol foam for larger openings. (Remember: bats are not rodents; they do not make or enlarge holes. It is absolutely essential to identify and seal all potential entry points, except for the known entrance.)

If the building has vents at the ends, check carefully to be sure they are screened. Even if vents appear to be screened, check for unfastened corners or holes that may be difficult to see with a cursory look. Also check around flashing for other easily missed access points. If possible, enter the attic with the lights off (during daylight hours) and note places where you can see daylight.

The single most common bat entry points in western South Dakota are small gaps between an exterior chimney and where it adjoins the house. Fill all gaps on both sides of the chimney except for a single two-inch gap at the point where you've seen the bats enter or emerge.

When you are finished sealing all potential entry points, the only entrance to the structure should be the identified bat access.

4 - Over this final opening, temporarily install what will be a one-way escape vent or chute. This vent is fashioned from heavy mil plastic or poly tarp material, sized approximately 24 inches in overall length, and shaped as a cone (similar to a windsock). Duct tape works well to hold the cone together (put the tape on the exterior of the cone so the interior remains smooth). The large end of the cone should be large enough to cover the opening the bats have been using plus a couple of inches surrounding the opening. The small end of the cone should have a hole with a diameter about the size of your thumb. Attach the large end of the cone over this last opening in the structure, making sure to completely seal all the way around the cone. Duct tape works well for attaching the vent. The bats must not be able to emerge anywhere except through the small end of the funnel. The cone should hang away from the side of the house and not lie flat against the structure (that's the reason for using a heavier material like the poly tarp).

5 - . Leave the vent in place for 5 to 7 nights of good weather to give all bats the opportunity to get out. They can emerge but cannot get back into the building. At the end of this time, remove the cone and immediately seal this final opening.
If you have not missed any other openings, you have solved your bat problem.

REMEMBER: Simply blocking the bats' access holes without first treating the entire structure will usually result in the bats finding an alternate entry point. If done at the wrong time of year (see above for acceptable dates), you may simply exclude the adult females and entrap juveniles not yet able to fly. This generally leads to more determination on the part of the adult females to find another way to get back to their pups, which can often result in bats gaining access to the human living space. In addition, when the mother does not return, the juveniles begin to search for mom and often end up crawling into the human living space.

A NOTE OF CAUTION: Be forewarned that any activity on a ladder at any openings in the structure may startle an unseen roosting bat into flight. Try not to work immediately in front of or directly beneath an access point. Such a surprise can easily cause a fall from a ladder. Where possible, place your ladder to one side of your work area.

Where do we go now? Consider erecting an alternative roost location for your newly evicted bats, such as a "bat box." Designs and tips are available at Bat Conservation International's web-site: (http://www.batcon.org). Design and placement should be appropriate for the roost size and species. It is best to have this roosting alternative in place well before the exclusion is performed.

Properly timing exclusion of unwanted bats from roosts in combination with providing appropriate roosting alternatives (where applicable) is a workable, responsible method to deal with bat-related problems. Preventing contacts between bats and humans and bats and pets should be the goal of any control program, but this need not be done at the expense of the bats. The contribution of bats to a healthy ecosystem as the main predators of night-flying insects (many of which are forestry and agricultural pests) far outweighs any associated risks.

For more information about bats in South Dakota, consult the following website: http://nat_hist.sdstate.edu/SDBWG/SDBWG.html.

Original article was published in the South Dakota Conservation Digest. Citation should read: Tigner, J. 2002. Bats in Buildings. South Dakota Conservation Digest 69(4): 22-23.

Appendix H. Rabies Information

Rabies information is vital to understanding rabies and how humans might be infected. Bats may be infected with rabies though not to the extent as other species, such as skunks. The following information regarding rabies was provided by the Center for Disease Control through their website: http://www.cdc.gov/ncidod/dvrd/rabies/Bats_&_Rabies/bats&.htm. The Center for Disease Control has standards with dealing with potential rabid species, and the South Dakota Department of Health adheres to those standards.

What is rabies and how do people get it?

Rabies is an infectious viral disease that affects the nervous system of humans and other mammals. People get rabies from the bite of an animal with rabies (a rabid animal). Any wild mammal, like a raccoon, skunk, fox, coyote, or bat, can have rabies and transmit it to people. It is also possible, but quite rare, that people may get rabies if infectious material from a rabid animal, such as saliva, gets directly into their eyes, nose, mouth, or a wound.

Because rabies is a fatal disease, the goal of public health is, first, to prevent human exposure to rabies by education and, second, to prevent the disease by anti-rabies treatment if exposure occurs. Tens of thousands of people are successfully treated each year after being bitten by an animal that may have rabies. A few people die of rabies each year in the United States, usually because they do not recognize the risk of rabies from the bite of a wild animal and do not seek medical advice.

Why should I learn about bats and rabies?

Most of the recent human rabies cases in the United States have been caused by rabies virus from bats. Awareness of the facts about bats and rabies can help people protect themselves, their families, and their pets. This information may also help clear up misunderstandings about bats.

When people think about bats, they often imagine things that are not true. Bats are not blind. They are neither rodents nor birds. They will not suck your blood -- and most do not have rabies. Bats play key roles in ecosystems around the globe, from rain forests to deserts, especially by eating insects, including agricultural pests. The best protection we can offer these unique mammals is to learn more about their habits and recognize the value of living safely with them.

How can I tell if a bat has rabies?

Rabies can be confirmed only in a laboratory. However, any bat that is active by day, is found in a place where bats are not usually seen (for example, in a room in your home or on the lawn), or is unable to fly, is far more likely than others to be rabid. Such bats are often the most easily approached. Therefore, it is best never to handle any bat.

What should I do if I come in contact with a bat?

If you are bitten by a bat -- or if infectious material (such as saliva) from a bat gets into your eyes, nose, mouth, or a wound -- wash the affected area thoroughly and get medical advice immediately. Whenever possible, the bat should be captured and sent to a laboratory for rabies testing (see: How can I safely capture a bat in my home?).

People usually know when they have been bitten by a bat. However, because bats have small teeth which may leave marks that are not easily seen, there are situations in which you should seek medical advice even in the absence of an obvious bite wound. For example, if you awaken and find a bat in your room, see a bat in the room of an unattended child, or see a bat near a mentally impaired or intoxicated person, seek medical advice and have the bat tested.

People cannot get rabies just from seeing a bat in an attic, in a cave, or at a distance. In addition, people cannot get rabies from having contact with bat guano (feces), blood, or urine, or from touching a bat on its fur (even though bats should never be handled!).

What should I do if my pet is exposed to a bat?

If you think your pet or domestic animal has been bitten by a bat, contact a veterinarian or your health department for assistance immediately and have the bat tested for rabies. Remember to keep vaccinations current for cats, dogs, and other animals.

How can I keep bats out of my home?

Some bats live in buildings, and there may be no reason to evict them if there is little chance for contact with people. However, bats should always be prevented from entering rooms of your home. For assistance with "bat-proofing" your home, contact an animal-control or wildlife conservation agency. If you choose to do the "bat-proofing" yourself, here are some suggestions. Carefully examine your home for holes that might allow bats entry into your living quarters. Any openings larger than a quarter-inch by a half-inch should be caulked. Use window screens, chimney caps, and draft-guards beneath doors to attics, fill electrical and plumbing holes with stainless steel wool or caulking, and ensure that all doors to the outside close tightly.

Additional "bat-proofing" can prevent bats from roosting in attics or buildings by covering outside entry points. Observe where the bats exit at dusk and exclude them by loosely hanging clear plastic sheeting or bird netting over these areas. Bats can crawl out and leave, but cannot re-enter. After the bats have been excluded, the openings can be permanently sealed. For more information about "bat-proofing" your home, contact Bat Conservation International.

Things to remember when "bat-proofing"

- During summer, many young bats are unable to fly. If you exclude adult bats during this time, the young may be trapped inside and die or make their way into living quarters. Thus, if possible, avoid exclusion from May through August.
- Most bats leave in the fall or winter to hibernate, so these are the best times to "bat-proof" your home.

How can I safely capture a bat in my home?

If a bat is present in your home and you cannot rule out the possibility of exposure, leave the bat alone and contact an animal-control or public health agency for assistance. If professional help is unavailable, use precautions to capture the bat safely, as described below.

What you will need:

- leather work gloves (put them on)
- small box or coffee can
- piece of cardboard
- tape

When the bat lands, approach it slowly, while wearing the gloves, and place the box or coffee can over it. Slide the cardboard under the container to trap the bat inside. Tape the cardboard to the container securely, and punch small holes in the cardboard, allowing the bat to breathe. Contact your health department or animal-control authority to make arrangements for rabies testing.

If you see a bat in your home and you are sure no human or pet exposure has occurred, confine the bat to a room by closing all doors and windows leading out of the room except those to the outside. The bat will probably leave soon. If not, it can be caught, as described, and released outdoors away from people and pets.

How can rabies be prevented?

- Teach children never to handle unfamiliar animals, wild or domestic, even if they appear friendly. "Love your own, leave other animals alone" is a good principle for children to learn.

- Wash any wound from an animal thoroughly with soap and water and seek medical attention immediately.
- Have all dead, sick, or easily captured bats tested for rabies if exposure to people or pets occurs.
- Prevent bats from entering living quarters or occupied spaces in homes, churches, schools, and other similar areas where they might contact people and pets.
- Be a responsible pet owner by keeping vaccinations current for all dogs, cats, and ferrets, keeping your cats and ferrets inside and your dogs under direct supervision, calling animal control to remove stray animals from your neighborhood, and consider having your pets spayed or neutered.

Case study

In February 1995, the aunt of a 4-year-old girl was awakened by the sounds of a bat in the room where the child was sleeping. The child did not wake up until the bat was captured, killed, and discarded. The girl reported no bite, and no evidence of a bite wound was found when she was examined. One month later the child became sick and died of rabies. The dead bat was recovered from the yard and tested--it had rabies.

This case demonstrates several points:

- This child's infection with rabies was most likely the result of a bat bite. Children sleep heavily and may not awaken from the presence of a small bat. A bat bite can be superficial and not easily noticed.
- The bat was behaving abnormally. Instead of hiding, the bat was making unusual noises and was having difficulty flying. This strange behavior should have led to a strong suspicion of rabies.
- If the bat had been submitted for rabies testing, a positive test would have led to life-saving anti-rabies treatment.

Remember, in situations in which a bat is physically present and you cannot reasonably rule out having been bitten, safely capture the bat for rabies testing and seek medical attention immediately.

Are bats beneficial?

Yes. Worldwide, bats are a major predator of night-flying insects, including pests that cost farmers billions of dollars annually. Throughout the tropics, seed dispersal and pollination activities by bats are vital to rain forest survival. In addition, studies of bats have contributed to medical advances including the development of navigational aids for the blind. Unfortunately, many local populations of bats have been destroyed and many species are now endangered.

Where can I learn more about bats?

For information on bats in South Dakota…
South Dakota Game, Fish and Parks
523 E Capitol Ave
Pierre, SD 57501
605-773-3387
http://www.state.sd.us/gfp/

South Dakota Bat Working Group
Brad Phillips, President
3406 Ivy Ave
Rapid City, SD 57701
http://nat_hist.sdstate.edu/SDBWG/SDBWG.html

For information on bats in the western United States…
Western Bat Working Group
Lyle Lewis, Chairman
2105 Osuna Road NE
Albuquerque, NM 87109
(505) 346-2525 ext 14
http://www.batworkinggroups.org/

For information on bats in United States…
Bat Conservation International, Inc.
P O Box 162603
Austin, TX 78716
1-800-538-BATS
www.batcon.org

For information on federally listed species…
U S Fish and Wildlife Service
420 S. Garfield Avenue, Suite 400
Pierre, SD 57501-5408
605-224-8693
http://southdakotafieldoffice.fws.gov/

Where can I learn more about rabies?
For information on rabies and national infection rates…
Center for Disease Control and Prevention
1600 Clifton Rd.
Atlanta, GA 30333
1-800-311-3435
http://www.cdc.gov/ncidod/dvrd/rabies/

For information on rabies in South Dakota…
South Dakota Department of Health
615 E Fourth Street
Pierre, SD 57501-1700
1-800-592-1861
http://www.state.sd.us/doh/

For information on rabies testing in South Dakota…
Animal Disease Research and Diagnostic Laboratory
Department of Veterinary Science, South Dakota State University
Box 2175, North Campus Drive
Brookings, SD 57007-1396
605-688-5171
http://vetsci.sdstate.edu/

For information on veterinary and regulatory issues…
South Dakota Animal Industry Board
441 S Fort Street
Pierre, SD 57501-4503
605-773-3321
http://www.state.sd.us/aib/

Appendix I. Conservation Digest Articles

The South Dakota Conservation Digest is published bimonthly by South Dakota Game, Fish and Parks. The Natural Heritage Program has a column within the Conservation Digest called Dakota Natural Heritage that is used to publish articles on nongame species in South Dakota. Following were two articles published in the Dakota Natural Heritage section of the Conservation Digest. One article discussed Townsend's big-eared bats, and one article discussed South Dakota's tree bats. Eileen Dowd Stukel wrote both articles concerning bats in South Dakota. Eileen is a senior wildlife biologist for South Dakota Game, Fish and Parks and the coordinator of the Wildlife Diversity Program.

TOWNSEND'S BIG-EARED BAT

Eileen Dowd Stukel

When I was a little girl, I was terrified to visit the large city park next door after dark. My brothers had convinced me that the bats flittering through the air would entangle themselves in my hair. After futile attempts to free themselves, the bats would have to be removed by chopping my hair off.

This ridiculous bat myth is still believed by many, along with other incredible myths and superstitions. Why are bats the objects of such fear and suspicion? A common characteristic of most human fears is a lack of understanding. Combine this ignorance with a bat's secretive and nocturnal ways, its unusual appearance and its association with Count Dracula, and you have a serious public relations challenge.

If we're willing to set aside our preconceptions about bats, we can quickly come to appreciate this remarkable group of mammals. There are approximately 1000 bat species worldwide, and they are very similar to bat fossils 50 million years old. Bats are grouped in the Order Chiroptera, which translates to "hand-wing". Bats are the only true flying mammals, with elongated hands and fingers to support wing membranes. Diversity among bat species is immense. Bat sizes range from the world's smallest mammal, the bumblebee bat of Thailand, weighing less than a penny, to the flying foxes, some with wingspans up to six feet.

I had a recent conversation with someone about endangered species. After each description of a few of the rarest species found in South Dakota, the individual would ask: "But what's it good for?" Answering this question about bats is simple. In both the New and Old World tropics, many economically important plants rely on bat species for pollination. These include bananas, avocados, dates, figs, peaches, cashews, carob, mangoes, and even the tequila plant, from which we derive mescal. The African baobab, commonly called the "tree of life", is bat-pollinated, one of over 300 tropical plants of Asia and Africa that depends on bats for pollination or seed dispersal.

On a more selfish note, North American bats truly are insect-catching machines. As the major predator of night-flying insects, bats consume enormous quantities of mosquitoes, as well as many agricultural insect pests, including grasshoppers, corn borers, potato beetles and grain and cutworm moths. One little brown bat, a common North American species, can catch 600 mosquitoes per hour.

Despite their tremendous economic and ecological values, many bat species have declined. The tiny bumblebee bat is an endangered species, as are seven bat species found in the United States. The Townsend's big-eared bat is considered a rare and vulnerable species in South Dakota. This

species, sometimes called the lump-nosed or long-nosed bat, is found mainly in caves of western North America. Smaller populations are scattered through parts of the southern Great Plains, the Ozarks of Missouri, Arkansas and Oklahoma and portions of Virginia and West Virginia. Two subspecies, the Ozark big-eared bat and Virginia big-eared bat, are endangered. In South Dakota, this species has been found in caves and abandoned mine tunnels of seven western counties, in both nursery and hibernation colonies.

Female big-eared bats mate during October and November of their first year. Like most North American bats, this species exhibits delayed ovulation and fertilization. Not until the spring following fall mating is an egg released from the female's ovary, to unite with the sperm for fertilization. In the meantime, both sexes gather in caves and mines for hibernation, one of two winter options for an insect-eater. This species typically doesn't migrate for any great distance, but instead forms hibernation clusters of a few to several hundred bats in caves or mines with temperatures of 55 degrees F or less. Their sensitivity to temperature changes can cause them to shift to different sites within a cave or even to other caves during hibernation. Big-eared bats usually select the cool, well-ventilated parts of a cave, where they hang from an open ceiling.

Ovulation and fertilization occur usually just after bats have left their winter quarters. Pregnant females gather in nursery colonies, where they give birth to one young each, after a gestation period of 8-14 weeks. A big-eared bat is relatively large at birth, measuring one-quarter of its mother's size. During daytime roosting, young suckle and cling to their mothers. They are soon left in clusters as the females forage, leaving after dark in search of night-flying moths. A newborn can "chirp" a few hours after birth. It's possible that this vocalization may help a mother recognize her infant when she returns to the maternity roost.

Young big-eared bats grow rapidly, are flighted by three weeks of age and weaned at two months. By this time, usually late in the summer, nursery colonies disperse, to reform the following spring. Townsend's big-eared bats are extremely faithful to maternity roosts, returning annually if not disturbed or displaced.

This species is not considered common anywhere in its range, possibly due to its extreme sensitivity to disturbance. If disturbed in a maternity colony, pregnant females may abort or resorb an embryo. Mothers with young may drop their infants in panic or abandon helpless young at a maternity site. In any case, this can be a serious population loss for a species that gives birth to only one young per year.

Hibernating bats are likewise at great risk when disturbed, either accidentally or intentionally. Bats prepare for hibernation by adding fat that may amount to one-third of their body weight. This fat store is drastically depleted if a bat is aroused during hibernation. Each disruption can result in a bat losing up to 30 days worth of its winter fat storage.

What can you do to help this unique and sensitive element of our natural heritage?

1. Report any bat activity you see in South Dakota's caves or old mines. The Game, Fish and Parks Department, Black Hills National Forest and the Paha Sapa Grotto, a spelunking club, have embarked on an inventory of potential bat habitats in the Black Hills of South Dakota. Such information can help us identify and protect critical bat habitat for the eleven species found in the Black Hills.

2. Do not explore caves inhabited by bats. Human disturbance and persecution are two of the most serious threats to bats' survival. Unfortunately, many Black Hills caves aren't presently used by bats because of extensive human use, vandalism and soot build-up from campfires set inside caves.

3. Learn more about bats and their conservation by joining Bat Conservation International, a nonprofit organization dedicated to the worldwide conservation and management needs of bats. Membership information can be obtained by writing to:

Bat Conservation International
PO Box 162603
Austin, TX 78716

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SOUTH DAKOTA'S TREE BATS

Eileen Dowd Stukel

If you see a bat in South Dakota, it is likely to be a little brown bat or a big brown bat, two species commonly associated with buildings. Big brown and little brown bats are just two of the dozen or more bat species found in the state during some part of the year. Three of South Dakota's bat species are "tree bats," meaning that they prefer trees and forested areas for foraging, maternity, and resting sites.

South Dakota's tree bats are the hoary bat, the eastern red bat, and the silver-haired bat. In general, these tree bats may be seen almost anywhere in the state during migration, but their primary South Dakota breeding areas are in the Black Hills. In contrast to several species of the genus *Myotis*, which are difficult for anyone but an expert to distinguish, each of our tree bats is distinctive in appearance and quite beautiful.

The hoary bat (*Lasiurus cinereus*) is the largest bat species known in South Dakota, measuring 5 to 8 inches long and weighing ¾ to 1½ ounces. The fur is yellowish brown to mahogany colored with a silver frosted appearance, hence the name hoary bat. Longer hairs on the neck form a slight ruff. This bat ranges from southern Canada south through most of South America. The hoary bat is Hawaii's only native land mammal.

Hoary bats are mostly solitary, spending summer days hanging from tree branches in sites well covered by foliage above and open below. Hoary bats typically do not inhabit caves or buildings. Males and females come together only to mate in late summer or early fall. As is true for all bat species found in South Dakota, the male's sperm are dormant in the female until fertilization the following spring. The female typically gives birth to two pups during early summer. She carries her young until they are about a week old, then leaves them clinging to a twig or leaf during her nightly foraging trips. Young hoary bats can fly when 3 to 4 weeks old.

Hoary bats are often the last bats to begin foraging in the evening, starting several hours after sunset. Hoary bats do not hibernate in South Dakota, but rather travel south to warmer climates for the winter.

The red bat (*Lasiurus borealis*) is considered to be among the continent's most beautiful bats. Unlike most bat species, male and female red bats differ in color. The male's fur ranges from bright orange to pale yellowish-orange, with white-tipped hairs. Females have duller, buff-chestnut fur, with longer gray-tipped hairs that create a somewhat frosted appearance. Red bats have a yellowish-white patch of hair on each shoulder. Weight ranges from 1/5 to ½ ounce, and total length is 3¾ to 4½ inches. The eastern red bat ranges throughout most of the eastern United States and southeastern Canada as far south as northeastern Mexico. South Dakota forms part of the western boundary of the species' range. Red bats apparently do not winter in South Dakota, and this species is the least common bat of the Black Hills.

Like the hoary bat, the red bat spends the day sheltered by the foliage of tree limbs or low shrubs, usually hanging by one foot from a leaf petiole, twig, or branch and often resembling a dead leaf. Red bats are relatively early foragers, starting their slow, erratic foraging flights in late afternoon. As darkness falls, they drop to tree level and lower in search of moths, crickets, flies, mosquitoes, and beetles. Red bats may also forage beneath artificial light sources, such as streetlights.

Eastern red bats mate in late summer, with sperm stored in the female until fertilization the following spring. A female red bat may have 1 to 5 pups in late spring or early summer. The mother leaves her pups hanging on tree limbs while she forages. She may relocate her young if disturbed. Red bats typically do not frequent caves or buildings.

The scientific name of the silver-haired bat (*Lasionycteris noctivagans*) describes its appearance (*Lasionycteris* is from Greek words meaning "hairy bat") and its lifestyle (*noctivagans* is from Latin words meaning "night wanderer"). The dark fur on the back is silver-tipped. This bat weighs 1/5 to 1/3 ounce and measures approximately 4 inches in length. This wide-ranging bat occurs from southeastern Alaska and central Canada across most of the U.S. southward to northeastern Mexico. Silver-haired bats generally do not hibernate in South Dakota. A research study in the Black Hills confirmed that large dead or dying ponderosa pines (snags) are important roosting sites.

The silver-haired bat inhabits both coniferous and deciduous forests and forest edges along waterways. Roost sites for this solitary bat include hollow trees, spaces under loose tree bark, woodpecker holes, and, less commonly, buildings. In areas with few trees, the silver-haired bat may roost in piles of fenceposts, boards, or bricks. Hibernation sites include hollow trees, rock crevices, mines, caves, and buildings.

Silver-haired bats mate in late summer. The male's sperm are stored in the female's body until fertilization the following spring. The female gives birth to two pups in early summer, and females with young may roost together. Nightly foraging begins several hours after sunset, with another foraging period 6 to 8 hours after sunset. Foraging flights are slow, leisurely, and sometimes not far aboveground near and over woodland wetlands. Silver-haired bats may repeat the same feeding circuit in search of moths, insects, mosquitoes, termites, and caddisflies.

All three of South Dakota's tree bat species bear more than one pup each year. Nearly all other bat species found in the state give birth to a single pup each year. These species, which include the familiar little brown and big brown bats, typically find safety from predators and inclement weather in buildings, caves, or abandoned mines, in contrast to tree bats, which are more vulnerable to predators and to the elements. The larger number of pups borne by female tree bats may help offset the added risks associated with their maternity and roosting habitats.

Henry David Thoreau said: "The universe is wider than our views of it." Our views of bats are still evolving from fear and loathing to a deeper understanding and fascination for these members of South Dakota's natural heritage.

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THE FRINGE-TAILED MYOTIS (*Myotis thysanodes pahasapensis*)

Alyssa Kiesow

Evil and mysterious creatures emerge at night that may threaten, stalk, and attack people, at least according to folklore and legend. Folklore and legend conjure up our deepest fears. But, what really is fear? Fear is derived from the unknown. Many people fear creatures of the night because little is known about these elusive animals—including bats. Bats are often persecuted for their appearance and their habits. Bats are not ugly, blood-sucking vampires that tangle in one's hair. Such rumors began long ago, thanks to folklore, legend, and myth. Folklore, legend, and myth depict certain creatures, like bats, as scary, problematic animals. Actually, bats are an important part of the ecosystem and provide economic and ecological benefits to people. As a result, many groups and individuals are beginning to work towards understanding and conserving these organisms in South Dakota.

Twelve bats are found in South Dakota. Throughout South Dakota bats concentrate near insect clusters, which usually occur above or below tree canopies and over water sources. But, these

areas are slowly disappearing. Due to loss of habitat (e.g., roosts) and adequate foraging areas, six bats are considered rare in South Dakota. Among these rare bats is the Black Hills fringe-tailed myotis (*Myotis thysanodes pahasapensis*).

The Black Hills fringe-tailed myotis is a medium-sized bat with black, long ears and dark, long fur. Its fur appears darker along its back than along its belly. Being nearly black, the wing membranes have stiff hairs along the free edge between the hind limbs. These noticeable stiff hairs help distinguish the Black Hills fringe-tailed myotis from other bats in South Dakota.

The Black Hills fringe-tailed myotis is exclusively found in the Black Hills. Habitat in the Black Hills—as most people already know—primarily consists of ponderosa pine (*Pinus ponderosa*) and undergrowth vegetation. The Black Hills fringe-tailed myotis selects habitats ranging from dry shrub to pine woodlands at moderate elevations. In these habitats, the Black Hills fringe-tailed myotis roosts in caves, mines, natural rock crevices, and buildings. These roosts are used year round. Therefore, males and females are considered year round residents in South Dakota and often collectively hibernate in caves and mines to survive through the winter.

Before hibernation, these bats mate. Females retain sperm in their reproductive tract until the following spring. At this point, ovulation occurs and the egg is fertilized. One pup is born after 50 to 60 days of development. Because bats are mammals, young are born alive. After the arrival of pups, mothers form nursery colonies. These colonies may grow very large—though most colonies average about 20 individuals—and are usually located in open areas of their roosts. During the summer, males typically roost separate from females and their young.

To feed her young, the female Black Hills fringe-tailed myotis must search for food. Usually, food is collected over vegetative canopy or water from sunset to midnight. Prey includes primarily beetles and moths. The Black Hills fringe-tailed myotis has a very graceful flight that is long, deliberate, and highly maneuverable—this flight pattern is noticeable while this bat is foraging.

As a result of their habits, the Black Hills fringe-tailed myotis and other bats are beneficial to people and the environment. Since many bats are economically important to agriculture and gardening and ecologically important to the ecosystem, it is important to protect bats in South Dakota—particularly bats that are rare as the Black Hills fringe-tailed myotis. Because the Black Hills fringe-tailed myotis is unique to the Black Hills, protecting this bat is very important. Education and knowledge play a large role in protecting bats and their habitats. Some people in South Dakota are actively learning and teaching about bats and their habitats. As more people learn to understand bats and their habitats, we will slowly begin to conserve these animals through knowledge rather than destroy them from folklore, legend, and myth.

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