South Dakota
Interior Least Tern (*Sterna antillarum athalassos*) and Piping Plover (*Charadrius melodus*) Management Plan

South Dakota Department of Game Fish and Parks
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Approved/Date _____

Secretary, Department of Game, Fish and Parks

DISCLAIMER
This is the completed South Dakota Interior Least Tern and Piping Plover Management Plan. It does not necessarily represent the views nor the official position or approval of any individuals or agencies involved in the plan formulation, other than South Dakota Game, Fish and Parks.

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*John Dinan passed away on August 13, 2005, prematurely ending a career dedicated to the wildlife resources of Nebraska and the Missouri River.

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Front Cover Photographs: Left-least tern pair USACE, Right-piping plover USACE

EXECUTIVE SUMMARY

In conjunction with approximately 91,178 acres of land that will be transferred from the US Army Corps of Engineers (USACE) to the state of South Dakota for recreation and wildlife purposes along the Missouri River, South Dakota has developed this management plan for the endangered interior least tern (*Sterna antillarum athalassos* - hereafter least tern) and the threatened piping plover (*Charadrius melodus*). In this plan, we have set goals for both species that we believe, when met, will promote rangewide recovery. A summary of the goals for South Dakota and management actions to promote those goals follows.

We have set a three-pronged goal for least terns and piping plovers in South Dakota, incorporating fledge ratio, adult population numbers and nesting habitat. We have set these components such that when they are met, in conjunction with recovery throughout the rest of the species' range, they will serve as South Dakota's contribution to overall recovery. All three components must be met.

Fledge Ratio:

Least terns - 1.0 fledgling per adult pair over a ten-year running average

Piping plovers - 1.5 fledglings per adult pair over a ten-year running average

Population Goals:

Least tern - 653 adult birds (327 pairs) over a ten-year running average

Piping plover - 565 adult birds (283 pairs) over a ten-year running average

Habitat Goals:

By 2015, we anticipate 20 acres of sandbar habitat per river mile in the Fort Randall river stretch, 80 acres per river mile in the Lewis and Clark Lake stretch, and 80 acres per river mile in the Gavins Point stretch. The work to develop the above acreages will be done by the USACE as described in the 2003 Amendment to the Biological Opinion (hereafter 2003 BO) (USFWS 2003). South Dakota Game Fish and Parks (SDGFP) will evaluate lands as they are transferred, particularly along the reservoirs, and will maintain or enhance current or suitable nesting habitat where it is likely to be successful at reasonable cost.

The state has committed to the following management actions:

- hire three summer interns annually to assist with least tern and piping plover monitoring,
- monitor least terns on the Cheyenne River at least biennially,
- assist with monitoring piping plovers on alkaline lakes at least every five years,
- cage piping plover nests as appropriate to deter predators,
- perform predator control when requested as appropriate,
- inform the public about the need to avoid nesting locations during the nesting season through signs, outreach at campgrounds, and other means,

- fence off nesting areas to stop human disturbance,
- assist with enforcement efforts to patrol signed and fenced areas and
- evaluate 401 water quality certification permits as requested by the USACE.

Guiding Principles

1. Distribution

The current least tern and piping plover distribution should be maintained or expanded along the Missouri River and reservoirs. Regardless of whether the numerical goals are met, we will not consider the population goal to be met if the birds, their habitat, or the locations where nests are successful are artificially concentrated along fewer river stretches or in a small area within a river stretch.

2. Least Tern Fledge Ratios

Population models suggest that the fledge ratio of 1.0 fledgling per adult pair described here is sufficient for maintaining a stable population (Thompson 1982, Dugger 1997, Kirsch and Sidle 1999). For population growth, a fledge ratio higher than 1.0 would likely need to be maintained. Since South Dakota is on the northern end of the least tern's range and rangewide least tern population numbers appear to be fairly stable, we believe that this is a reasonable long-term goal.

3. Piping Plover Fledge Ratios

Models suggest that the fledge ratio goal this plan sets for piping plovers, 1.5 fledglings per adult pair, will lead to a slight increase in the piping plover population. Given the rangewide decline in the piping plover population indicated by the three international censuses (Ferland and Haig 2002), we feel that it is important to set a goal that will lead to population increase. However, at some point when the population reaches an equilibrium, the necessary fledge ratio will likely stabilize to a long-term average of around 1.25 fledglings per adult pair (Larson et al. 2002).

4. Habitat Availability

Recovery in South Dakota is dependent on sufficient habitat being available for least terns and piping plovers during the nesting season. SDGFP has based this document on the premise that the USACE will honor the habitat commitments laid out in the 2003 BO (USFWS 2003).

5. Habitat and Flow

SDGFP endorses the use of natural river functions to create and maintain habitat, and encourages the USACE to choose natural, rather than mechanical means, to meet its habitat commitments.

6. Captive Rearing

SDGFP does not support the use of captive rearing facilities for least terns or piping plovers to help meet navigation needs. Use of captive rearing facilities in the past was promoted as an experimental effort in the event that use of these facilities was the only option for recovery or under extremely high-flow conditions when no other options were available to produce offspring. At this time, we do not see a role for captive rearing in the recovery of either species.

ACRONYMS

BO	Biological Opinion
CFS	Cubic Feet per Second
MOA	Memorandum of Agreement
msl	mean sea level
NE G&P	Nebraska Game and Parks
NPS	National Park Service
NRCS	Natural Resources Conservation Service
SDGFP	South Dakota Game, Fish and Parks
SDSU	South Dakota State University
USACE	U.S. Army Corps of Engineers
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WCO	SDGFP Wildlife Conservation Officer

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1 INTRODUCTION

The endangered interior least tern (*Sterna antillarum athalassos*) and the threatened piping plover (*Charadrius melodus*) both nest on relatively bare sandbar islands along the Missouri River in South Dakota. Productivity of both species has suffered as a result of the altered flow regime since the construction of six hydroelectric dams on the Missouri River. Nesting habitat is often inundated during the summer, leading to low numbers of birds initiating nests or reproductive failure when nests or chicks are flooded. At the same time, lack of flows sufficient to create new sandbar habitat since dam construction has resulted in a dramatic decrease in unvegetated sandbars (USFWS 2003), concentrating birds, predators and recreationists on the small amount of remaining habitat (Haig and Oring 1987, Kruse et al. 2002, Schwalbach 1988). South Dakota hopes to promote species' recovery both in South Dakota and rangewide by working with partners to develop the objectives laid out in this management plan.

In this plan, we identify goals that we believe, when met, will significantly contribute to the rangewide recovery of least terns and piping plovers. South Dakota Game, Fish and Parks (SDGFP) commits to on-going protection and identifies management actions for these species on the Missouri River. The plan is intended to be a flexible "living" document that will help managers make decisions that will promote recovery of both species. As we learn more about the birds and the Missouri River, this plan may change to reflect this new knowledge.

1.1 Purpose and need

1.1.1 Federal Land transfer

There are six major dams on the Missouri River, four of which are in South Dakota (Oahe, Big Bend, Fort Randall, and Gavins Point) Figure 1. The resulting reservoirs are flanked by lands that the federal government acquired during construction of the dams and filling of the reservoirs. The US Army Corps of Engineers (USACE) was given jurisdiction over these lands. The Water Resources Development Act of 1999 (Public Law 106-53, August 17, 1999) required the USACE to transfer lands and recreation areas along Lake Oahe, Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake to South Dakota Game, Fish and Parks, the Cheyenne River Sioux Tribe, and the Lower Brule Sioux Tribe. This transfer may eventually include up to 91,178 acres to the state of South Dakota: 49,585 acres along Lake Oahe region, 4,709 acres along Lake Sharpe, 31,078 acres along Lake Francis Case, and 5,806 acres along Lewis and Clark Lake (Figure 2). To date (2004), only the recreation areas have been transferred to the state. This includes 12,375 acres that have been transferred and 1,659 acres leased to the state.

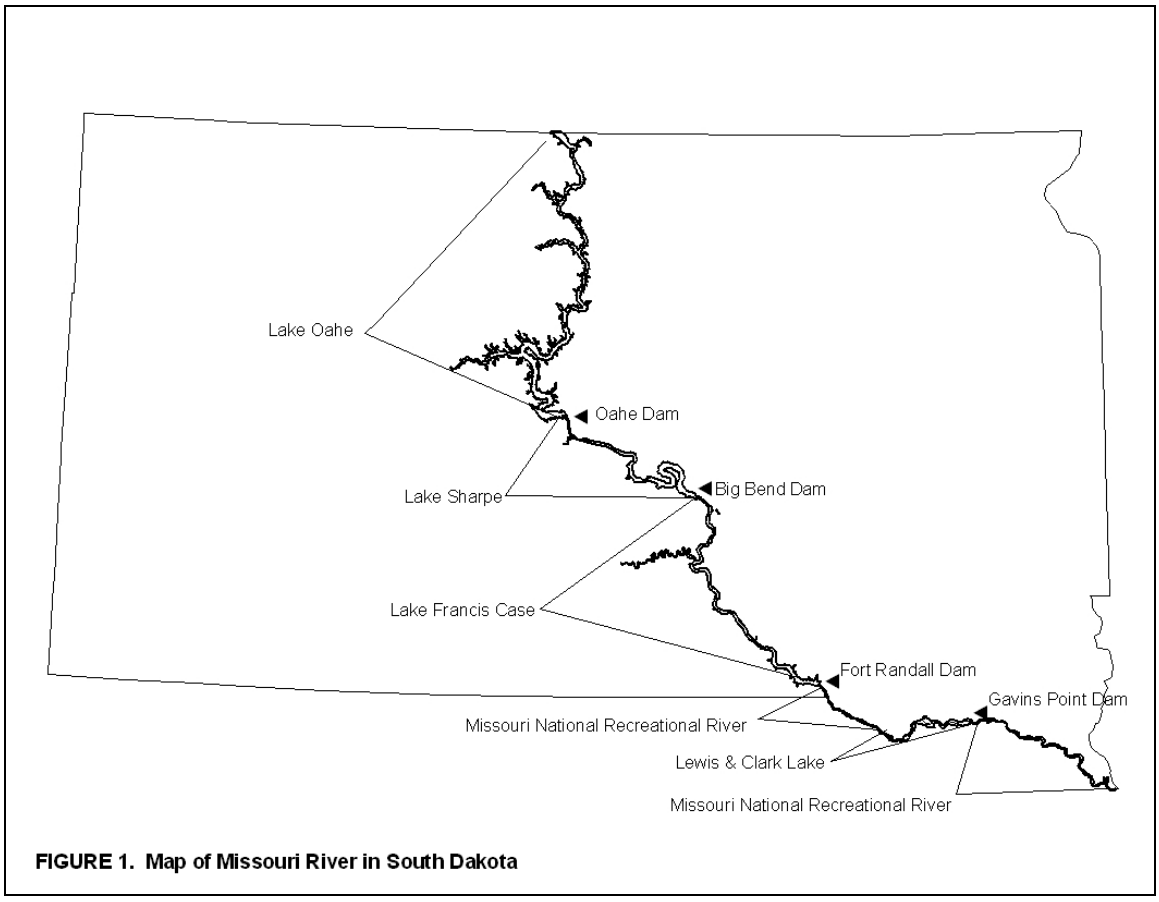

FIGURE 1. Map of Missouri River in South Dakota

From the time the land is transferred to South Dakota, state environmental laws apply (USACE 2001). To ensure that federally threatened and endangered species continue to be protected, SDGFP, US Fish and Wildlife Service (USFWS), US Army Corps of Engineers (USACE), and the National Parks Service (NPS) entered into a Memorandum of Agreement (MOA) (2004) (Appendix A). This agreement ensures continued conservation and active management for the least tern, piping plover, bald eagle (*Haliaeetus leucocephalus*), and pallid sturgeon (*Scaphirhynchus albus*). This state management plan for the least tern and piping plover is a multi-agency commitment identified in the MOA.

1.1.2 Tribal Issues

The Fort Laramie Treaty of 1868 called for permanent peace between the United States Government and the Sioux Nation. The US government ceded all land west of the Missouri River in South Dakota to the Sioux Tribe, in addition to providing schools, farming assistance, and other services to the tribe for a period of thirty years. The treaty could only be changed through a vote of three-quarters of the adult male tribal members (Treaty can be viewed at The Avalon Project Website, Accessed November 25, 2003).

Hostilities continued however, and with the discovery of gold in the Black Hills, the Treaty was abrogated as settlers rushed in. The US government attempted to buy the land, but the Sioux refused and a war erupted. The conflict ended with the tribes forced onto present-day reservations. Although a Supreme Court ruling attempted to end the conflict over the Black Hills with a monetary settlement to the tribes (United States v. Sioux Nation of Indians, 448 U.S. 371 [180]), the tribes have never accepted the money and the issue continues to be contentious.

The tribes hold that the lands west of the Missouri River were taken illegally. Thus, they argue that the USACE lands should have been transferred to the tribes, not to the state (USACE 2001). Since the land transfer was an act of Congress, and this document does not address the legal issues of the land transfer per se, the issue of land ownership will not be discussed further.

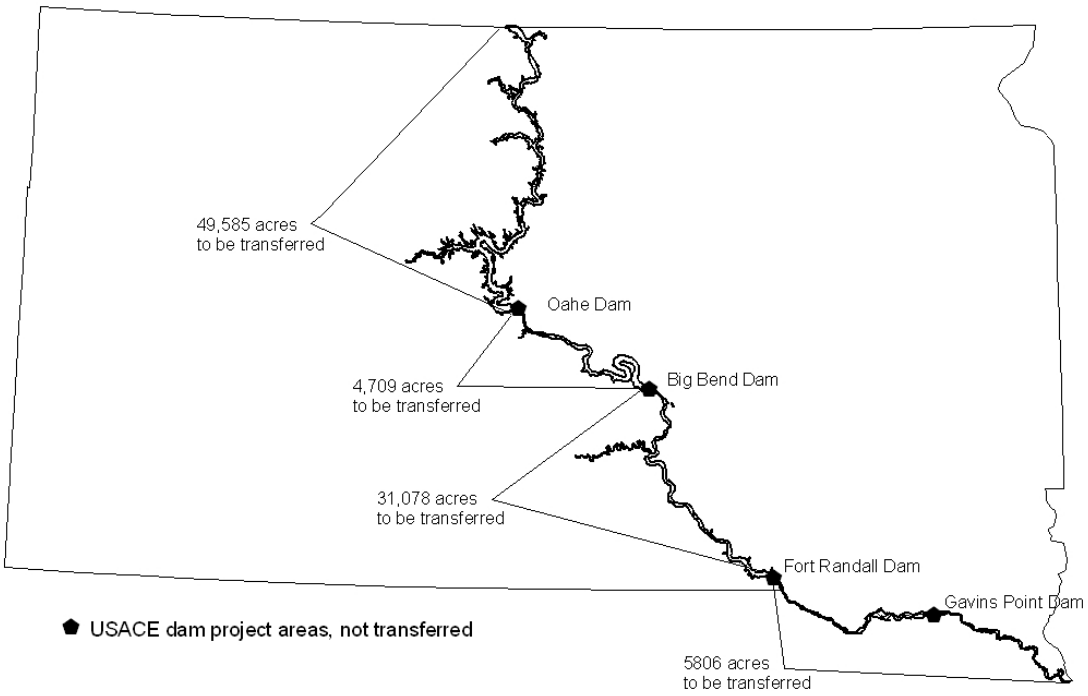

FIGURE 2. Lands to be transferred to South Dakota

1.2 General Species Accounts

1.2.1 Least Tern General Species Account

Least terns are the smallest members of the subfamily Sterninae and family Laridae of the order Charadriiformes. Adults measure approximately 21-24 cm (8 to 9 1/2 inches) long, with a 51-cm (20-inch) wingspan. The birds have a black cap, white forehead, grayish back and dorsal wing surfaces, and a black tipped bill (*in* USFWS 1990). Males tend to have a bright orange bill and bright orange legs, while the female's bill and legs are more yellow. Least terns can be readily differentiated from other tern species by their small size and the white triangular marking on the forehead.

Three subspecies of least tern have been identified; the eastern or coastal least tern (*S. antillarum antillarum*) that breeds along the Atlantic and Gulf Coast, the California least tern (*S. antillarum browni*) that breeds along the California Coast, and the interior least tern (hereafter least tern) that extends from Texas to Montana, and from eastern Colorado and New Mexico to southern Indiana (USFWS 1990). In South Dakota, least terns breed along the Missouri and Cheyenne Rivers. On the Missouri River, nesting is often associated with piping plover nests (Sidle et al. 1988). Due to channelization and subsequent sandbar habitat loss, much of the Missouri River no longer supports least tern nesting (Sidle et al. 1988, Smith and Renken 1990). There is some question about the validity of the distinction between subspecies. Genetic work to determine whether these subspecies are truly distinct is ongoing (USFWS 1990, Pers. Comm. Susan Haig, USGS).

Least terns are colony nesters, primarily using sandbars with sparse vegetation (Dinan 1982, Dryer and Dryer 1985, Evans 1984, Schwalbach 1988). The nest consists of a shallow scrape in the sand in which the female lays one to three eggs (USFWS 1990, Szell and Woodrey 2003). The eggs are sand colored with some darker spotting (Bent 1929). Incubation ranges from 17 to 28 days (USFWS 1990), but is usually 18 to 21 days in South Dakota (Pers. Comm. Greg Pavelka, USACE), with both parents sharing in incubation duties (*in* USFWS 1990). During the day, the parents often keep the eggs cool rather than warm them. They may stand over the eggs to provide shade or wet their breast feathers and drip the water over the eggs. During windstorms, the nest can become buried in a matter of minutes, so parents remain on the nest to keep sand off (Dugger 1997).

Chicks are able to walk almost immediately upon hatching, but they generally remain in the nest bowl for several days (Bent 1929). Upon leaving the nest, the young can run quite rapidly, but generally freeze when threatened, their cryptic coloration making them nearly invisible in the sand.

Least terns feed almost exclusively on small fish (Bent 1929, Atwood and Kelly 1984) with the parents feeding small fish to the young until migration (USFWS 1990). On the lower Mississippi, Tibbs (1995) found that the least tern nesting cycle corresponds with forage fish productivity, with nest initiation occurring just after forage fish begin to appear. Since least terns are so closely tied to forage fish production, changes in habitat that lead to decreases in forage fish or in least terns' ability to capture prey efficiently may lead to a reduction in fledging success. Dugger (1997) noted that a decrease in turbidity may correspond with lowered forage efficiency since the prey can more easily avoid capture. Furthermore, the lack of connectivity between the river and its floodplain due to dam construction as well as extensive bank stabilization may have led to a decrease in floodplain spawners. There are much higher young-of-the-year fish densities in areas where the river has retained connectivity to the floodplain. Lack of available forage, rather than limited available breeding habitat, may be the primary cause for the species' decline (Dugger 1997).

Least terns will fly some distance from nest sites to forage (Atwood and Minsky 1983, Dinsmore et al. 1993, Smith and Renken 1990), with the male extensively feeding the female (Dugger 1997), and both parents provisioning chicks (Bent 1929, Brubeck et al. 1981).

When an intruder enters the nesting area, the terns respond by circling overhead, calling, defecating, and vomiting on the intruder.

Overwintering locations are not well known, but least terns have been documented wintering along the Central American and South American coasts from Venezuela to northeastern Brazil. It is not known whether the subspecies mix on wintering grounds (USFWS 1990).

1.2.2 Least Tern Critical Habitat

Critical habitat as per the Endangered Species Act, as amended, 16 USC 1531 et seq. has not been designated for the least tern.

1.2.3 Status of Least Terns Rangewide

Least terns historically bred on major river systems from Texas to Montana, and from eastern Colorado and New Mexico to southern Indiana. The species continues to occupy most of its former range, but it is restricted to less altered river systems where there is still suitable breeding habitat. Because of dams and channelization, least terns no longer nest on the Missouri River within the state of Missouri or Kansas (Smith and Renken 1990, Pers. Comm. Roger Boyd, Baker University). In Nebraska, essentially

the only mid-stream sandbars utilized by terns on the Missouri River occur on the 59-mile National Recreational River stretch below Gavins Point Dam that is shared with South Dakota (Sidle et al. 1988). Least terns nest on sandbars associated with sand and gravel pits in Nebraska, but breeding success is often low due to human disturbance and predation (Dinan 1983, Dinsmore et al. 1993, Lingle 1993).

Numerous individuals and organizations (in particular state agencies and the USACE) monitor least tern numbers and breeding success, but these numbers have not been compiled. An effort is currently underway to standardize monitoring techniques and compile rangewide information through the American Bird Conservancy (Pers. Comm. Casey Lott, American Bird Conservancy). In 2003, the population of the interior least tern was estimated to be 12,000 individuals (USFWS 2003).

1.2.4 Status of Least Terns in South Dakota

Historically, least terns nested on sandbar islands on the Missouri and Cheyenne Rivers in South Dakota. The USACE has been monitoring least terns on the Missouri River since 1986. Numbers of birds have fluctuated annually, ranging from a low of 158 individuals in South Dakota in both 1996 and 1997 (when high water precluded nesting on much of the river) to a high of 521 individuals in South Dakota in 2003. The number of least terns on the Missouri River in South Dakota mirrors the number of birds on the entire Missouri River system, with a systemwide low of 427 adults in 1997, and a near-record high of 741 adults in 2003. (Systemwide, the most adults were counted on the Missouri River in 1994 - 777 adult terns). Figure 3 shows the numbers of adult least terns censused along the Missouri River in South Dakota from 1986 though 2004. The reproductive success of the birds in a given year is often described in terms of fledge ratio, defined as the number of young that survive to fledging age (the age when they can fly) per adult pair. This is calculated by dividing the total number of fledglings by the total number of adult pairs surveyed that year (USFWS 2003). For example, a fledge ratio of one would indicate that on average, each adult pair produced one offspring that survived to fledging age. In all but two years prior to 1998, fledge ratios in South Dakota did not exceed 0.5 fledglings per adult pair. Since 1998, fledge ratios have been consistently higher, ranging from a high of 1.74 in 1998 to a low of 0.87 in 2003. Figure 3 shows the least tern fledge ratio along the Missouri River in South Dakota from 1986 though 2004. The least tern population data collected on the Missouri River in South Dakota from 1986 through 2004 can be viewed in Appendix B.

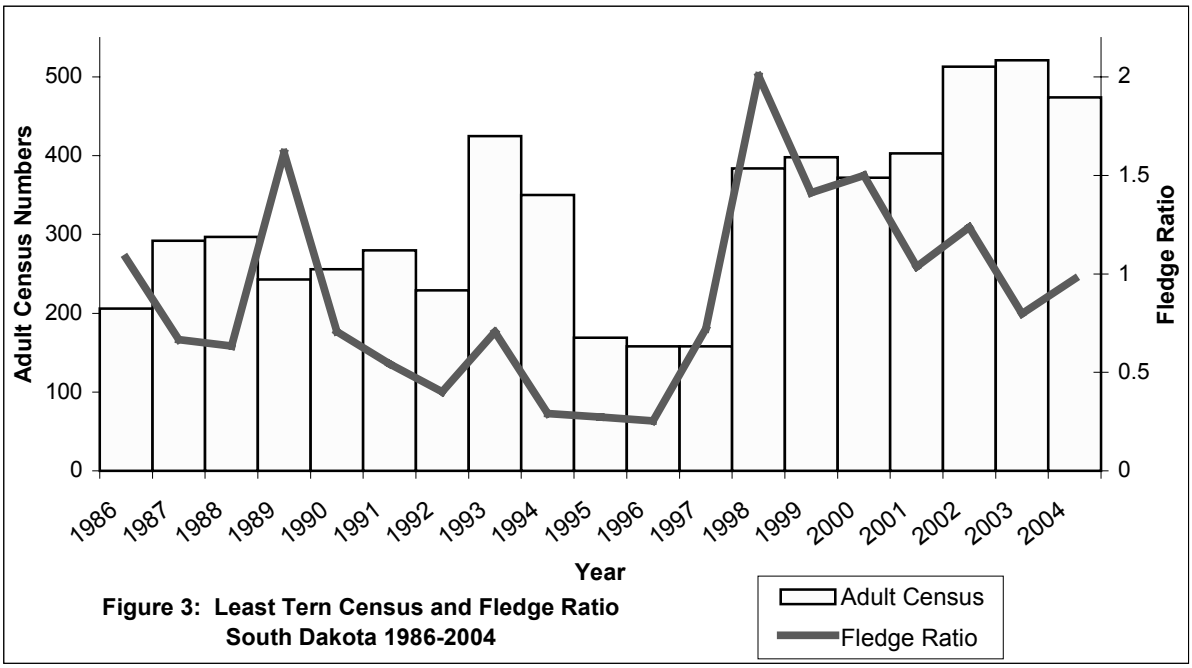

Figure 3: Least Tern Census and Fledge Ratio South Dakota 1986-2004

1.2.5 Piping Plover General Species Account

The piping plover (*Charadrius melodus*) is a small [about 16.5 to 17.5 cm (6.5 to 7 inches long); 46 to 64 grams (1.5 to 2 ounces)] migratory shorebird with a short, stout bill, pale underparts and orange legs. During the breeding season, it also has a black band across the forehead and a single black neckband. Piping plovers are further characterized by their melodic high-pitched call from which the scientific name is derived (USFWS 1988).

Piping plovers breed on open beaches, alkaline wetlands, and sandflats in North America. The USFWS has identified three major sub-populations of the piping plover; an interior (Great Plains) population that is found in South Dakota, an Atlantic Coast population, and a Great Lakes population (USFWS 1988). The interior population's breeding range includes Alberta, Saskatchewan, Manitoba, Montana, North Dakota, Minnesota, South Dakota, Nebraska, and Iowa (Haig and Oring 1985). There is also a small population of piping plovers in Colorado, and Kansas (Ferland and Haig 2002). Piping plovers are known to winter on the Atlantic Coast from North Carolina south to Florida, and on the Gulf of Mexico from Florida to Texas. Birds also overwinter in northern Cuba, Puerto Rico, the Bahamas, Greater Antilles and probably eastern Mexico and the Yucatan Peninsula (Nature Serve Website, Accessed February 17, 2005). However, only 40.2% of the known breeding population has been observed on wintering

grounds, so it is evident that there are other wintering locations that have not yet been located (Ferland and Haig 2002).

The birds feed on invertebrates found in wet and dry sand along the shore (Corn and Armbruster 1993). During the breeding season, piping plovers maintain nesting and feeding territories which may not be adjacent (Cairns 1982).

The nesting season in the Northern Great Plains extends from late April through August, with most nests initiated in May and June (Pers. Comm. Greg Pavelka, USACE). The birds arrive in April, and males establish breeding territories by displaying with aerial displays and calls. The female lays her eggs in a shallow scrape often lined with shells or small pebbles. Both males and females share incubation duties (Cairns 1982, Wilcox 1959). Plovers lay three to five eggs (generally four) (Greer 2003), and incubation lasts 22 to 31 days (Haig 1987). If the first nest fails, the birds will renest up to two times, although they raise only one clutch per season (Haig 1987) (but see Bottitta et al. (1997) for several cases of Atlantic piping plovers successfully fledging young from two nests in one breeding season).

Piping plover chicks are precocial, leaving the nest soon after hatching and foraging almost immediately (Haig 1992). The parents continue to brood the chicks for up to about 21 days post-hatch, although the female sometimes deserts the brood after 5 to 10 days (Haig and Oring 1988, Haig 1992). Chicks fledge 21 to 35 days after hatching, and are capable of sustained flight soon after fledging (Knetter et al. 2001).

Piping plovers exhibit high variability in site fidelity, with estimates ranging from approximately 25 to 70 percent of adults returning to the same location. First year birds often breed, but they rarely return to their natal site (Haig and Oring 1988). Annual survival for adults is estimated at 0.634 to 0.737 annually, with 0 being no survival and 1 indicating all birds survive (Larson et al. 2000, Root et al. 1992, Prindiville Gaines and Ryan 1988). Because of low return rate, first year survival is difficult to estimate. Larson et al. (2000) estimate survival from fledging to first year is 0.318, while Prindiville Gaines and Ryan (1988) suggest that juvenile survival might range from 0.507-0.634.

1.2.6 Piping Plover Critical Habitat

In 2002, the USFWS designated critical habitat for the piping plover (USFWS 2002). In South Dakota, Lake Oahe is designated as critical habitat, as well as the Missouri River from Fort Randall Dam south to Ponca State Park, Nebraska, including Lewis and Clark Lake (Figure 4). Critical habitat identifies specific geographic areas that are essential to the conservation and recovery of the species and may require special management considerations. Critical habitat does not set up preserves or refuges, and only affect

projects requiring a federal decision. Critical habitat only includes those areas which contain the "primary constituent elements" or the habitat components necessary for the essential life cycle needs of the species (50 CFR 424.12(b)).

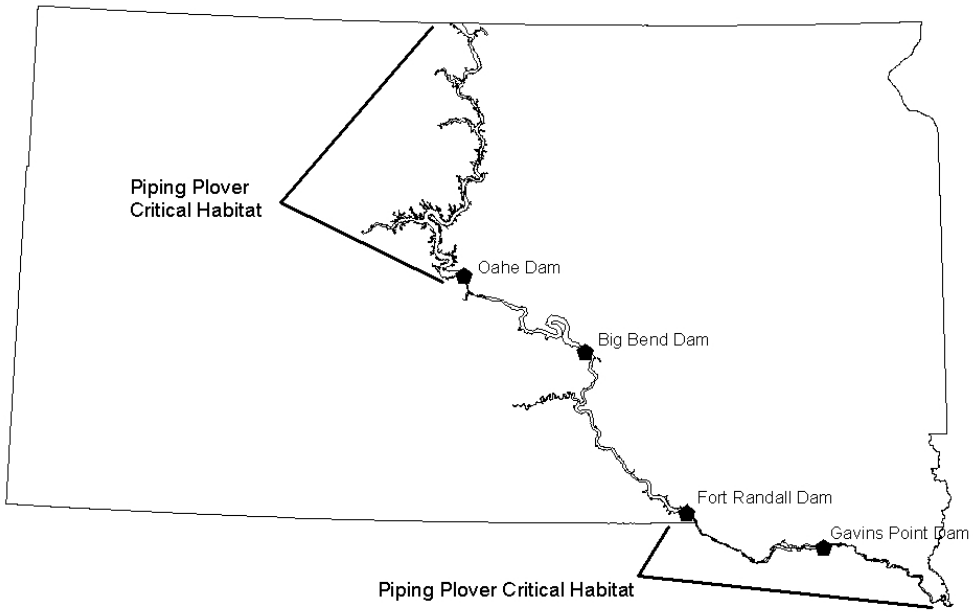

Figure 4: Piping Plover Critical Habitat

1.2.7 Status of Piping Plovers Rangewide

An international piping plover census, which coordinates attempts to locate all piping plovers on both the breeding and wintering grounds, has been conducted in 1991, 1996, and 2001. As a part of this project, biologists from the United States, Puerto Rico, Canada, Cuba, the Bahamas, and the French territories of St. Pierre and Miquelon, located off the south coast of Newfoundland (where there is a very small imported population) surveyed approximately 2,244 sites. To avoid double counting individuals, sampling was restricted to a narrow winter and summer timeframe in January/February and May/June.

The Atlantic and Great Lakes populations of piping plovers have shown consistent population increases, with a 78% increase in the Atlantic Coast population from 1991 to

2001, and an 80% increase over the same time frame in the Great Lakes population. This increase may be largely due to extensive management in these areas, where almost every nest is caged (Haig 2004). However, the Great Plains population decreased 14.9 percent between 1991 and 2001, and 10.1 percent from 1996 through 2001 (Table 1) (Ferland and Haig 2002).

Table 1 Adult piping plovers recorded in the 1991, 1996, and 2001 International Piping Plover Breeding Censuses. (Ferland and Haig 2002).

State/Province	Adults 1991	1996	2001	% Change (1991-2001)	% Change (1996-2001)
Northern Great Plains/Prairies	**3469**	**3286**	**2953**	**-14.9**	**-10.1**
Prairie Canada	*1437*	*1687*	*972*	*-32.4*	*-42.4*
Alberta	180	276	150	-16.7	-45.7
Saskatchewan	1172	1348	805	-31.3	-40.3
Manitoba	80	60	16	-80.0	-73.3
Ontario	5	3	1	-80.0	-66.7
U.S. Northern Great Plains	*2032*	*1599*	*1981*	*-2.5*	*23.9*
Minnesota	13	10	7	-46.2	-30.0
Montana	308	153	137	-55.5	-10.5
Missouri River	*26[c]*	*24[c]*	*7[c]*	n/a[b]	n/a[b]
North Dakota	992	1004	1112	12.1	10.8
Missouri River	*307[c]*	*125[c]*	*643[c]*	n/a[b]	n/a[b]
South Dakota	295	29	390	32.2	1244.8
Missouri River	*292[cd]*	*29[ce]*	*390[c]*	n/a[b]	n/a[b]
Nebraska	398	375	308	-22.6	-17.9
Missouri River	*0[c]*	*9[c]*	*8[c]*	n/a[b]	n/a[b]
Missouri River (MT, ND, SD, NE)	*625[c]*	*187[c]*	*1048[c]*	*67.7*	*460.4*
Iowa	13	14	11	-15.4	-21.4
Kansas	0	1	3	300.0	200.0
Colorado	13	13	13	0.0	0.0
Oklahoma	0	n.s.[a]	n.s.[a]	n/a[b]	n/a[b]

[a] n.s. = Not surveyed.
[b] n/a = Not applicable.
[c] Subtotals for reference only. Missouri River results by state are included in state results.
[d] Adjusted 1991 South Dakota tally due to previous error (originally reported as *n* = 290; revised *n* = 292).
[e] Adjusted 1996 South Dakota tally due to previous error (originally reported as *n* = 27; revised *n* = 29).

Since the Great Plains piping plovers are a large, mobile metapopulation extending into Canada, population trends must be examined rangewide as birds move large distances across the U.S. as well as between the U.S. and Canada in response to changing environmental conditions (Larson unpublished).

1.2.8 Status of Piping Plovers in South Dakota

Over the time that the USACE has monitored piping plovers in South Dakota (1986-2004), the numbers of adult birds censused has fluctuated from a low of 38 adults in 1996 to a high of 580 adults in 2004 as shown in Figure 5 (Pers. Comm. Greg Pavelka, USACE). (The number of adult piping plovers on the entire Missouri River system mirrors this trend, with a low of 86 adult piping plovers in 1997, and a high of 1587 adults in 2004.) The record high number of birds during the monitoring period can most likely be attributed to the habitat created during the high flows of 1997 followed by an extreme drought in the early 2000's that led to exposed habitat on Lake Oahe. Prior to 1998, fledge ratio exceeded 1.0 only once during the period of the Corps' monitoring (Pers. Comm. Greg Pavelka, USACE). Since the high water of 1997, fledge ratios have exceeded 1.0 in every year, and 1.65 in all but one year as of this writing (including

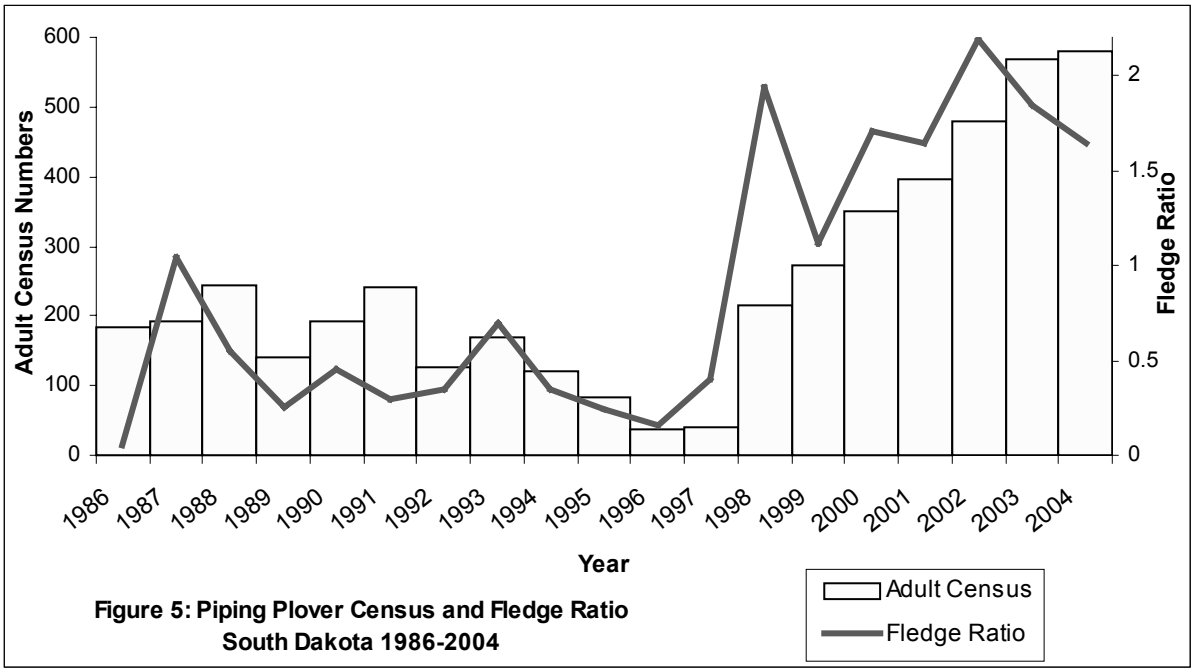

Figure 5: Piping Plover Census and Fledge Ratio South Dakota 1986-2004

summer 2004) (Figure 5). Appendix B shows the piping plover population data collected on the Missouri River in South Dakota from 1986 through 2004.

1.3 Reasons for Decline

Shorebird hunting likely caused the first major decline in both least tern and piping plover populations (Bent 1929, USFWS 1988), but since dam construction, the species' decline on major river systems can be primarily attributed to the Corp's water regime or to secondary effects relating to water management.

Starting in the early 1900s, large stretches of the river were channelized, eliminating nesting sandbars and backwater areas that produce fish (National Research Council

2002). Dam construction, beginning with the completion of Fort Peck in 1937, led to further deterioration of the river. There are four Missouri River dams in South Dakota; Oahe Dam, completed in 1958, Big Bend Dam, completed in 1963, Fort Randall Dam, completed in 1952, and Gavins Point Dam, completed in 1955 (Figure 1). The dams changed the riverine habitat in a number of ways, impacting tern and plover habitat and consequently reproductive success. The dams vastly reduced the acres of available nesting habitat by creating reservoirs that flooded former nesting habitat. There is no longer available nesting habitat in Lake Sharpe since all of the sandbar islands have been permanently inundated. On Lake Francis Case, only one small colony of least terns nested in 2003 and 2004. Birds do nest along the shores of Lake Oahe, especially in low water years when there is exposed unvegetated shoreline, but prior to 1998, fledging success was generally very low (Pers. Comm. Greg Pavelka, USACE).

Because the dams trap sediment, the water below the dams is sediment deprived, leading to bank and sandbar erosion without complementary accretion. This problem is compounded by bank armoring and channelization as landowners experiencing erosion place hard structures on their banks, further downcutting the channel and reducing the sediment available for sandbar creation (Elliott and Larix Systems, Inc. 2001, National Research Council 2002). In other locations, water control structures lead to accretion, connecting islands to shore so that they are no longer suitable for least tern and piping plover nesting (Funk and Robinson 1974). Furthermore, water control has led to a leveling out of the natural annual hydraulic cycle (National Research Council 2002), with the regular high water flows that used to create new sandbar habitat and scour existing habitat rarely occurring. This has led to a drastic reduction in available habitat, from an estimated 10,000 acres available in the Gavins Point stretch in the pre-dam period to 1,760 available acres in 2003, a 568 percent decrease. Of this, only 260 acres are considered suitable for nesting: with sufficient size, a high enough elevation to avoid flooding and with less than ten percent vegetative cover (USFWS 2003). Since islands are rarely scoured of vegetation, quality and quantity of available habitat have declined since dam construction. Recovery plans for both the least tern (USFWS 1990) and piping plover (USFWS 1988) cite habitat loss as one of the main reasons for species decline.

Inappropriately timed water releases are a major cause of nest failure along the Missouri River (Dryer and Dryer 1985, USFWS 1988, USFWS 1990). Prior to dam construction, the river's natural cycle typically included a rise in March or April, as a result of snowmelt on the plains and in-channel icebreak. A second rise occurred in June, caused by snowmelt from the mountains and rainfall throughout the basin (Dugger 1997, Hesse et al. 1989, National Research Council 2002). Since dam construction, the water management regime has generally allowed water levels in Oahe reservoir to increase

through June, and then decrease throughout the remaining summer months as water is released for navigation needs downstream. Water levels below Fort Randall Dam have been variable, while flows below Gavins Point Dam have increased through mid-June and then remained fairly stable (Schwalbach et al. 1993). This water regime has led to frequent island inundation, flooded nests and chick mortality (Larson Unpublished, USFWS 2003, Pers. Comm. Greg Pavelka, USACE).

Predation also destroys many nests and chicks of both species (Pers. Comm. Greg Pavelka, USACE). Although predation has always been a factor, today's limited available habitat restricts nesting, allowing predators to search more effectively (Kruse et al. 2002, Smith and Renken 1993).

2 THREATS TO LEAST TERNS AND PIPING PLOVERS

2.1 Summary of Threats in the Least Tern Recovery Plan

The Interior Least Tern Recovery Plan (USFWS 1990) identifies two major causes for the least tern's decline: habitat alteration and destruction, and human disturbance. Much of the least tern's historical sandbar nesting habitat has disappeared as a result of channelization, irrigation, and dam construction. These changes have also led to an altered water flow pattern, resulting in frequent nesting habitat inundation. Sediment deprived water below the dams means that there is less sandbar formation. This problem is compounded by increased recreational use of sandbars, further reducing reproductive success.

2.2 Summary of Threats in the Piping Plover Recovery Plan

The USFWS Piping Plover Recovery Plan (USFWS 1988) identifies numerous reasons that the population has declined. In the late 1800's and early 1900's, the population was decimated by hunting (Bent 1929). More recently, population decline has been caused by a number of factors including loss of habitat due to recreational and commercial development, reservoirs and channelization resulting in the elimination of sandbars, change in water flow regimes leading to unpredictable and untimely flows, increase in predation due to higher concentrations of predators, human disturbance, livestock and pet disturbance, and inadequate federal regulation. The recovery plan also notes that future changes in water regulation may have adverse impacts on plovers. As the population shrinks and study of the species intensifies, researchers themselves may also have adverse impacts on the species. The plan also identified oil spills, surface mining, agricultural runoff and other environmental contaminants as potential threats to the species, but concluded that these were either short-term or not major threats at the time of the recovery plan's development. The plan also notes that impacts on wintering

grounds may play an important, but as yet unrecognized part in the species' survival and recovery.

2.3 Threats to Least Terns and Piping Plovers in South Dakota

The Corps has been monitoring least tern and piping plover nest success on the Missouri River since 1986. As a part of this project, they have documented both successful and failed nests and, where possible, identified causes of nest failure. Tables 2 and 3 show some of the causes of nest failure for least terns and piping plovers. Discussion of these and other threats to the species are discussed below.

Table 2 Causes of least tern nest failures during the USACE monitoring period in South Dakota. Percentages show the percent of all nests monitored. Monitoring Periods: Lake Oahe 1995-2004, Fort Randall River 1986-2004, Lewis and Clark Reservoir 1986-2004, Gavins Point River 1986-2004. Source: Greg Pavelka, USACE.

Least tern Nests: Causes of Failure							
Total Nests Monitored 4,645							
Cause	**Predation**	**Flooding**	**Weather**	**Human Disturbance**	**Erosion**	**Livestock**	**Unknown (destroyed)**
Number Destroyed	488	238	128	20	21	10	323
Percent of all monitored tern nests	10.51%	5.1%	3.0%	0.43%	0.5%	0.22%	6.95%

Table 3 Causes of piping plover nest failures during the USACE monitoring period in South Dakota. Percentages show the percent of all nests monitored. Monitoring Periods: Lake Oahe 1995-2004, Fort Randall River 1986-2004, Lewis and Clark Reservoir 1986-2004, Gavins Point River 1986-2004. Source: Greg Pavelka, USACE.

Piping plover Nests: Causes of Failure							
Total Nests Monitored 2,564							
Cause	**Predation**	**Flooding**	**Weather**	**Human Disturbance**	**Erosion**	**Livestock**	**Unknown (Destroyed)**
Number Destroyed	295	132	79	38	9	9	318
Percent of all monitored plover nests	10.1%	4.5%	2.7%	1.3%	0.31%	0.31%	10.9%

2.3.1 Predation

Description: Predation is an important factor influencing nest success for both least terns and piping plovers rangewide. In South Dakota, 488 least tern nest losses and 295 piping plover nest losses were attributed to predation during the years the USACE has monitored, the largest cause of mortality of the known causes. Research on the

Missouri River (Kruse 1993, Kruse et al. 2002) identified American crow, raccoon, and mink as the primary nest predators, and American kestrel and great horned owl as the primary predators responsible for chick mortality.
Least terns and piping plovers evolved with predation pressure, and some loss due to predation is expected even in an unaltered system. However, without high water flows that create new sandbar islands and remove vegetative growth on existing islands, nesting is concentrated, allowing a predator to focus efforts on a smaller area. Also, with more vegetation, predators can hide undetected (Mayer 1993).

SDGFP Management Options: The USACE currently places nest cages on many piping plover nests. There is some evidence that protecting nests with predator exclosures may significantly improve the chances for piping plover recovery (Larson et al. 2003), although in some locations, cages may actually increase predation by providing perches for predators or providing a search image for predators to locate nests (Johnson and Oring 2002, personal observation). The USACE is considering options for caging least tern nests. However, since least terns jump up vertically when startled on the nest, the cages with tops used for piping plover nests would disrupt this behavior and possibly injure adult terns. On the Kansas River, least tern nests have been protected using 100-foot (30.5 m) fencing placed around the nest. Fence use has drastically reduced the incidence of predation on those nests (Pers. Comm. Roger Boyd, Baker University).

SDGFP has hired three summer interns to assist with least tern and piping plover monitoring and protection on the Missouri River throughout South Dakota annually since 2001. These interns assist the USACE with monitoring nests and placing predator control structures over plover nests. The field crew assigned to Lake Oahe did not cage most nests on the Lake Oahe shoreline in 2004. They reported that cattle are attracted to the cages, rubbing on them and thus destroying the nests.

Direct predator control is another option available to reduce predation pressure on least terns and piping plovers (Lingle 1993). However, predator control requires an ongoing effort and is unlikely to result in long-term benefits as new individuals tend to move into areas that have been vacated due to control activities. However, predator control in specific problem areas may allow a temporary increase in local nest success. If specific problem areas are identified, state trappers can be requested to assist. Additionally, state trappers can train interested USACE employees to trap specific predators.

2.3.2 Unpredictable water levels (Flooding)

Description: In the pre-dam era, water levels on the Missouri River followed a double peaking regime corresponding with snow melt and rainfall on the prairie in March or April and snowpack melt in the Rockies in June (Dugger 1997, Hesse et al. 1989, National

Research Council 2002). Today, under the USACE's water management regime, water levels often peak during the nesting season in the summer. This means that lower lying nests are inundated and chicks that can not yet fly are washed away or stranded on small, isolated islands. The USACE attributed 238 least tern nest failures and 132 piping plover nest failures to flooding in South Dakota during the monitoring period (Tables 2 and 3) (Pers. Comm. Greg Pavelka, USACE).

SDGFP Management Options: Since the USACE is responsible for water releases from the dams, SDGFP has little direct control over water levels. SDGFP can note impacts of the water regime on least terns, piping plovers and other species, and encourage the USACE to follow a more natural water regime that includes a high spring rise followed by low summer flows. This flow regime would also benefit native fisheries in the state and may provide a spawning cue for the endangered pallid sturgeon.

2.3.3 Weather events

Description: Least tern and piping plover chicks and eggs can be injured or killed by hail or severe rain events. Extremely hot temperatures are also stressful for both species. Incubating parents cool eggs by wetting their feathers and standing over the eggs to cool and shade them (Dugger 1997). Parents also shelter chicks from severe weather. In South Dakota, the USACE attributed 128 least tern nest losses and 63 piping plover nest losses to weather events (Tables 2 and 3) from 1986 through 2004.

SDGFP Management Options: While some loss due to weather events is unavoidable, reducing human disturbance on nesting areas would likely reduce the impact of severe weather. Human disturbance causes the birds to leave the nest and chicks, exposing them to the elements. SDGFP Wildlife Conservation Officers (WCO's) assist with patrolling nesting areas to keep the public out of nesting areas and participate in information efforts to raise awareness about the needs of rare species nesting along the Missouri River.

2.3.4 Human disturbance: recreation, vehicular, pets

Description: Human activities in nesting areas during the breeding season can disturb least terns and piping plovers and cause them to abandon nests. People may also crush nests directly by stepping on them, or keep the parents away from the eggs or young, leaving them vulnerable to heat or cold. All terrain vehicles (ATVs) can also crush eggs, chicks and adults (Smith and Renken 1993). Unleashed domestic dogs destroy nests, disturb parents and kill young.

The USACE attributed 20 least tern and 38 piping plover nest failures in South Dakota to human disturbance during the monitoring period (Tables 2 and 3).

SDGFP Management Options: SDGFP currently works with the USACE to sign nest colonies and put up psychological (twine) fencing to warn the public to keep out of nesting areas where human disturbance is likely to be a factor (primarily on sandbars below Gavins Point Dam). The use of cages on plover nests may also keep people from directly impacting nests. However, cage use can also lead to the opposite effect, by attracting curious people and leading to either intentional nest destruction or unintentional nest failure if onlookers cause the adults to stay away from the nest for too long. WCO's help patrol near nest areas to make sure that the public respects nesting areas.

As the signs informing the public about least tern and piping plover nesting at boat ramps show signs of wear, SDGFP can put up and maintain new signs as needed. SDGFP has printed its own supply of the "Missouri River Species at Risk" brochure and distributes this leaflet at state park and recreation sites along the Missouri River to increase visitor awareness of least terns and piping plovers. SDGFP employees have also done some outreach about endangered species at Lake Oahe boat ramps.

2.3.5 Livestock

Description: Livestock with access to nesting colonies may disturb the parents or directly crush nests or chicks. The USACE attributed 10 least tern and 9 piping plover nest losses in South Dakota to livestock during the monitoring period from 1986-2003, all on Lake Oahe (Appendix B, Appendix C).

SDGFP Management Options: On Oahe Reservoir, cattle graze much of the banks on both sides, and fencing such large areas may not be feasible. In specific identified problem areas, SDGFP will work with ranchers, the USFWS Partners for Fish and Wildlife Program and the Natural Resources Conservation Service (NRCS) to put up fencing to keep livestock from nesting sites and, if necessary, to provide an alternate source of water. Given the small number of nests that livestock impact and the high costs of fencing, we anticipate that fencing will not generally be economically feasible. A fence was placed around a tern nest on Lake Oahe in 2001 to prevent livestock trampling. The nest was successful (Pers. Comm. Greg Pavelka, USACE).

2.3.6 Food Availability and Water Temperature

Description: Piping plover chicks are able to forage almost immediately upon hatching. They feed primarily on invertebrates that live in moist sand along the water's edge. These macrobenthos are often adapted to specific environmental conditions. The highly variable water levels and temperatures caused by daily water fluctuations out of the dams is likely detrimental to the macrobenthic community and thus reduces available forage for piping plovers (Weisberg et al. 1990).

Following the release of the 2003 Amendment to the 2000 BO (hereafter 2003 BO) the USACE has attempted to create habitat by building emergent sandbar complexes. The USACE has made numerous efforts in manipulating habitat since 1987, and is currently evaluating these efforts. A report is expected in the near future (Pers. Comm. John Kirwan, USACE). Creating islands that provide sufficient nesting and foraging area will be critical to fledging success. Since piping plover adults and chicks feed exclusively on macroinvertebrates, it is critical that created habitat supports conditions in which these forage species can flourish. This requires creation of islands with some habitat appropriate for nesting with dry sand that does not flood during the nesting season, as well as areas with moist sand that can support an invertebrate population.

Least terns are strictly piscivorous (fish eating), and least tern chicks are fed small fish by their parents for several weeks after hatching (Atwood and Kelly 1984). Adult terns, and even newly fledged birds, can fly some distance to forage (Hill 1993), so least tern chicks can forage even if there is no appropriate habitat for small fish directly adjacent to the nest site. However, dams and bank stabilization have led to decreased habitat available for small fish to spawn system-wide. Altered water temperature and flows associated with the dams reduce the reproductive success of fish, negatively impacting the least tern forage base (Lingle 1993).

SDGFP Management Options: Since the State of South Dakota does not have control over water releases from the dams, there is little SDGFP can do to directly foster conditions for macroinvertebrates or fish through flow changes.

The USACE' crews will be monitoring the created habitat for fledging success. SDGFP summer interns will assist with the task of documenting both species' success on created habitat. The state will assist with monitoring specific areas as needed.

2.3.7 Lack of Habitat

Description: Prior to dam construction, annual spring flooding carried sediment downstream and eroded some islands while creating others. Since dam construction, the equilibrium between erosion and deposition has been altered, with erosion twenty-five percent and deposition one percent of pre-dam values (Johnson 1992). Banks and sandbars erode with very little accretion (National Research Council 2002). Since the sandbars are rarely scoured by high water events, they soon become vegetated. Both least terns and piping plovers prefer sparsely vegetated nesting habitat (Schwalbach 1988, Sidle et al. 1992). High flows out of the dams to mimic spring flows would help to both create new sandbar habitat and to scour vegetation from existing sandbars as was demonstrated during the 1997-1998 high flow years.

Losses attributed to erosion include 21 least tern nests and 9 piping plover nests in South Dakota during the monitoring period (Appendix B, Appendix C). However, these figures do not include pairs that did not nest on the Missouri River system at all due to lack of habitat. Nearly 99 percent of historic least tern nesting substrate on the Missouri has been lost due to river alterations (*in* Dugger 1997).

SDGFP Management Options: Since the state of South Dakota does not have control over water releases from the dams, SDGFP has little control over island creation and vegetation scouring through flows. SDGFP can help to facilitate the USACE's efforts to create new islands and to remove vegetation by expediting the permit review process for habitat manipulation. SDGFP summer interns working with USACE crews may also assist in vegetation removal projects.

Some of the transferred lands (Public Law 106-53, August 17, 1999) along Oahe Reservoir are suitable for least tern and piping plover nesting, depending on water level and amount of vegetation. SDGFP will evaluate the transferred lands as the state takes possession. Potential, historic, or currently used nesting habitat will be identified, and retaining and enhancing habitat will be given a high priority.

2.3.8 Contaminants

Description: Adverse effects from environmental contamination should be monitored for potential impacts to least tern and piping plover populations. A study on least terns and piping plovers on the Missouri River did not find any reduction in reproductive success attributable to contamination (Welsh and Mayer 1993). Researchers should be aware of potential impacts by contaminants in the future, but management actions do not appear to be necessary at this time.

2.3.9 Disease

Description: A dead piping plover tested positive for West Nile virus in 2003 on Lewis and Clark Lake (Pers. Comm. Greg Pavelka, USACE). The USACE crews are currently collecting dead least tern or piping plover specimens found during monitoring and shipping them to the USGS Wildlife Health Lab for analysis. A disease epidemic among least terns and piping plovers could have devastating effects on the populations.

SDGFP Management Options: SDGFP summer employees on the river with USACE least tern and piping plover crews will assist with specimen collection and documentation as they find carcasses.

2.4 Future Threats

Impacts caused by the water management regime are likely to continue, leading to flooded nests, decreased habitat availability, and concentration of predators. The plan to mechanically create islands described in the 2003 BO may alleviate the problem of sandbar availability in the short term, but will require regular maintenance. Created islands may not provide the macrobenthic community necessary for piping plover chicks to forage, causing chicks to starve (USFWS 2003). Additionally, islands that remain intact over long periods of time may concentrate predators. Mechanical construction and maintenance are very expensive, and the future of appropriate habitat is uncertain given the vagaries of budgeting.

Direct human disturbance (use of beaches for recreation, ATV's etc.) is currently responsible for only about 1.2 percent of all failed least tern nests and 4.5 percent of all failed piping plover nests. Human disturbance is primarily a problem below Gavins Point Dam, where most of the birds are also concentrated. As more people recreate in this stretch of river, impacts caused by human disturbance may also increase.

3 STATE GOALS

SDGFP managers recognize the state's importance in promoting recovery of both species. South Dakota may have an especially important role to play in the recovery of piping plovers. While all but approximately 400 to 800 (Pers. Comm. Greg Pavelka, USACE) of the estimated 12,000 interior least tern population nests on the lower Mississippi River (3.3 to 6.7 percent) (USFWS 2003), the Missouri River is a primary nesting system for piping plovers. In the 2001 International Piping Plover Census, approximately 35 percent of the piping plovers in the Northern Great Plains, including Canada, were found on the Missouri River in North and South Dakota (Ferland and Haig 2002). Of these, about 33 percent nest on the 98-mile stretch below Fort Randall Dam and Gavins Point Dam. In 2004, approximately one-quarter (1,587) of the worldwide population of adult piping plovers was located on the Missouri River, and nearly one-tenth (570) of the worldwide population was in South Dakota (Pers. Comm. Greg Pavelka, USACE).

We have set species' goals based on a three-pronged approach, all of which, when met, should promote species recovery. These include a fledge ratio goal, a habitat goal, and a population number goal. We hope that by incorporating all three parameters, the populations will be truly recovering when the goals have been met. These goals, in conjunction with recovery in the rest of the range, should lead to rangewide recovery.

In addition, both least tern and piping plovers are extremely mobile species that disperse quickly over large areas in response to changing environmental conditions. Data from

the International Piping Plover Censuses suggest an inverse relationship between the population numbers in prairie Canada and those on the United States Great Plains (Ferland and Haig 2002). In addition, historical events have demonstrated that conditions which temporarily make habitat unsuitable may improve habitat for several years. For example, during the high water of 1997, very few birds nested on the Missouri River and the birds that did nest experienced extremely low reproductive success. However, in the years following that high water event, numbers of both species increased dramatically, and fledge ratios were considerably higher than they had been since the USACE began monitoring in 1986. We recognize that both least terns and piping plovers can be expected to experience both highly productive years and years with very low success. We have developed this plan to be flexible enough to incorporate this natural variability. In addition, the effects from a single event can last for multiple years. The population numbers and fledge ratios have remained high through 2004 since the high waters receded in 1998. Therefore, we chose a ten-year average to include a range of conditions.

3.1 Fledge Ratio Goals

3.1.1 Analysis of Least Tern Fledge Ratio

There have been several analyses of least terns to determine the fledge ratio required to increase and stabilize the population. Researchers agree that longevity and survival are the most important factors in determining the necessary fledge ratio (Melvin and Gibbs 1994, Prindiville Gaines and Ryan 1988, Thompson 1982, Wemmer et al. 2001). In a study of California least terns, Massey et al. (1992) estimated that most breeding birds were between the ages of three and seven. Two least terns banded as chicks lived to 21 years old (Thompson 1982). Table 4 summarizes the studies examining least tern survival (Thompson 1982, Massey et al. 1992, Renken and Smith 1995). Although there have been few studies looking at survival, the adult survival estimates have been fairly similar to one another and also to estimates for other larid species (Table 5), suggesting that they are fairly accurate. Juvenile survival estimates are more difficult to determine as studies are confounded by the tendency of juveniles to disperse.

Using published survival estimates, researchers have estimated the fledge ratio required for least tern population stability. Thompson (1982) estimates that 0.5 to 0.65 fledglings per adult (1.0 to 1.3 fledglings per pair) are necessary for population stability. Dugger (1997) also suggests that a fledge ratio of 1.0 fledgling per adult is necessary for population stability, while Kirsch and Sidle (1999) suggest that only 0.51 fledglings per pair are required for population maintenance. In fact, Kirsch and Sidle (1999) point out

Table 4 Estimated Least Tern Survival

Location	# Adults Banded	Mean Annual Survival[a] (SE)[b]	# Fledglings Banded	Mean Survival[a]	Yrs. of Study	Source
Texas Coast	279	0.853-0.941	765	≤0.853-0.941 (fledge-adult)	3	Thompson 1982
California		0.88	1,940 (hatchlings)	0.16 (hatch-adult)	7	Massey et al. 1992
Mississippi River	194	0.85 (0.057)			5	Renken and Smith 1995

[a] Mean annual survival is measured on a scale from zero to one, with zero being no survival and one being all individuals surviving in a given year.
[b] SE = Standard Error

Table 5 Reported values of annual adult (birds old enough to breed) survival for larid species estimated from mark-recapture, mark-resighting, or band returns. *from* Kirsch 1996.

Species	Mean annual survival[a]	Method[b]	Source
Swallow-tailed gull (*Creagrus furcatus*)	0.94	MR	Harris 1979
Herring gull (*Larus argentatus*)	0.91-0.93	BR	Kadlec and Drury 1968
Red-billed gull (*L. novaehollandiae scopulinus*)	0.89 females, 0.84 males	MR	Mills 1990
Western gull (*L. occidentalis*)	0.81 females, 0.84 males	BR	Spear et al. 1987
Common black-headed gull (*L. ridibuncus*)	0.80 adults, 0.40 first yr. 0.82	BR JS	Isenmann et al. 1990 Clobert et al. 1987
Black-legged kittiwake (*Rissa tridactyla*)	0.81-0.86	MR	Coulson and Wooller 1976
Caspian tern (*Sterna caspia*)	0.89	BR	Gill and Mewaldt 1983
Roseate tern (*S. dougallii*)	0.74-0.75	JS	Spendelow and Nichols 1989
Common tern (*S. hirundo*)	0.92	MR	DiCostanzo 1980
Arctic tern (*S. paradisaea*)	0.87-0.88	MR	Coulson and Horobin 1976

[a] Mean annual survival is measured on a scale from zero to one, with zero being no survival and one being all individuals surviving in a given year.
[b] BR = calculated from band-return data; JS = calculated from mark-recapture or mark-resighting data and analyzed using a Jolly-Seber-type model (Pollock et al. 1990); MR = calculated from mark-recapture or mark-resighting data and analysis other than a Jolly-Seber-type model.

that even the 0.51 fledge ratio goal has often not been met in large portions of the least tern's range. In South Dakota, the average fledge ratio from 1995 through 2004 is 1.13,

and for the entire Missouri River system, it is 1.03 for the same time period (Pers. Comm. Greg Pavelka, USACE). Since the high water of 1997, the average fledge ratio for the Missouri River has been 1.21 (1998-2004).

3.1.2 Least Tern Fledge Ratio Goal

We have set the fledge ratio goal for South Dakota at 1.0 fledglings per pair over a ten-year running average. As discussed above, a ten-year running average should be a long enough period to include a variety of environmental conditions (i.e. droughts and floods) that adequately captures the natural variability in the Missouri River system and associated least tern population. For example, while the fledge ratio in South Dakota averaged only 0.49 during the 1996-1997 high water years, the habitat created in this high water event has led to several years of fledge ratios in excess of 1.0, much higher than the fledge ratios that had been recorded in most years previously (average fledge ratio from 1987 through 1995 in South Dakota was 0.46). A fledge ratio of 1.0 is believed to be sufficient for population maintenance (Thompson 1982, Dugger 1997, Kirsch and Sidle 1999), and given appropriate conditions, it is clearly attainable since higher fledge ratios have been recorded along the Missouri River in South Dakota since 1998.

Also, since South Dakota is near the northern edge of the least tern's range (USFWS 2003), the long-term fledge ratio probably cannot be expected to greatly exceed a maintenance level. However, to avoid shrinkage of the species' range, it is important to retain a viable breeding population in South Dakota.

3.1.3 Analysis of Piping Plover Fledge Ratio

As with least terns, researchers agree that survival and longevity are the most important factors in determining the fledge ratio necessary for piping plover population maintenance (Larson et al. 2000, Melvin and Gibbs 1994, Prindiville Gaines and Ryan 1988, Root et al. 1992). Several researchers have examined juvenile and adult piping plover survival rates as shown in Table 6. In a 20-year study of piping plovers, Wilcox (1959) found that piping plovers could live for eleven years or more.

Estimates of the fledge ratio needed to maintain a stable piping plover population range from 1.13 to 2.0 fledglings per adult pair as shown in Table 7.

Table 6 Estimated Piping Plover Survival

Location	# Adults Banded	Mean Annual Survival[a] (SE)[b]	# Fledglings Banded	Mean Annual Survival[a] (SE)[b]	Yrs. of Study	Source
Williams Preserve, ND	204	0.737 (0.092)	143	0.318 (0.075)	10	Larson et al. 2000
Chain of Lakes, ND, Saskatchewan and Minnesota	-	0.634	-	0.507-0.634	-	Prindiville Gaines and Ryan 1988
Chain of Lakes, ND	352	0.664 (0.057)	138	-	6	Root et al. 1992 [c]
Atlantic Coast Population (MA)	103	0.74	61	0.48	4	Melvin and Gibbs 1994
Great Lakes (MI)	-	0.73	-	0.24-0.312	-	Wemmer et al. 2001

[a] Mean survival is measured on a scale from zero to one, with zero being no survival and one being all individuals survive in a given year.
[b] SE = Standard Error
[c] Note: Survival estimates, especially for juveniles, are probably low due to band loss and dispersal. For this reason, Root et al. 1992 did not calculate mean juvenile survival.

Table 7 Estimated Piping Plover Fledge Ratio for Stable Population

Fledge Ratio (Fledglings/pair)	Source
1.15-1.44	Prindiville Gaines and Ryan 1988
1.13 (to stabilize the population) (For a population increase of 1% - 1.16, 2% - 1.19)	Ryan et al. 1993
1.7 -2.0	Plissner and Haig 2000
1.25 (entire Great Plains pop.) to 1.44 (alkaline wetlands)	Larson et al. 2002
1.245 (Atlantic Coast Population)	Melvin and Gibbs 1994

3.1.4 Piping Plover Fledge Ratio Goal

We set the fledge ratio goal for piping plovers at 1.5 fledglings per pair over a ten-year running average. This fledge ratio should allow for some population growth (Larson et al. 2002). In developing this fledge ratio, we examined the various models developed by a number of researchers (Prindiville Gaines and Ryan 1988, Ryan et al. 1993, Plissner and Haig 2000, Larson et al. 2002, Melvin and Gibbs 1994). The models are highly sensitive to changes in survival, so that even slight variations in survival estimates have dramatic impacts on the fledge ratio required for population stability. For example, a 0.127 difference in estimates of juvenile survival led to the fairly large fledge ratio range (1.15 to 1.44) that Prindiville Gaines and Ryan (1988) suggest is necessary to maintain a stable Great Plains population. We believe that the survival estimates and modeling techniques used by Larson et al. (2002) reflect the best and most recent information available. Thus, their conclusion that a 1.25 fledge ratio is necessary to

stabilize the population and a higher fledge ratio is needed to increase the population is robust. Plissner and Haig's (2000) model calls for a substantially higher fledge ratio to stabilize the population (1.7 to 2.0), but the survival rates that they use appear to be low compared with the estimates established by other researchers. A small increase in Plissner and Haig's (2000) survival estimates results in a much higher likelihood of population persistence, and thus a lower required fledge ratio (Larson et al. 2002).

With the habitat created in the high water of 1997, piping plover fledge ratios met or exceeded 1.5 in four out of the seven years from 1998 through 2004 in South Dakota (in 1999, fledge ratio was 1.12) (Pers. Comm. Greg Pavelka, USACE). Piping plover success can be expected to fluctuate annually or over a multi-year cycle in response to habitat conditions, so years in which fledge ratio is higher than necessary for population maintenance are needed to counteract those years when the fledge ratio is low (Larson unpublished).

3.2 Population Goals

For both the least tern and piping plover, the USFWS national recovery plans were developed prior to extensive species surveys. At that time (1990 for least terns, 1988 for piping plovers), biologists had little information available to help set population goals. Surveys have now been conducted on the Missouri River for 19 years (as of 2004), so SDGFP felt that it was reasonable to examine the substantial body of new information generated since the recovery plans were written and to develop new population goals based on this updated information. As new information becomes available, or when the Service updates the recovery plans or develops five-year status reviews, SDGFP will re-evaluate these goals in light of the new information or analysis.

3.2.1 Least Tern Population Recovery Plan Goals

The interior least tern recovery plan (USFWS 1990) requires 7,000 adult birds to be maintained on stretches of the Missouri, Mississippi, Ohio, Arkansas, Red and Rio Grande River systems for ten years. Kirsch and Sidle (1999) suggest that the rangewide population has been at or near the 7,000 bird mark from at least 1991 through 1995, largely due to a 901 mile stretch of the Mississippi River. Many areas where the birds occur seem to be a sink (production is not sufficient to support the numbers of least terns seen). The population may be made up of birds emigrating from other areas, or estimates of other parameters of the population (juvenile or adult survival etc.) may be inaccurate.

The recovery plan calls for 2,100 adult birds on the Missouri River system. Of these, the plan specifies that South Dakota should have 680 birds, broken down as follows: Lake Oahe - 100 adults, Fort Randall stretch - 80 adults, Gavins Point stretch - 400 adults,

other Missouri River locations - 30 adults, Cheyenne River - 80 adults. Table 8 shows the numbers of least terns observed in South Dakota since 1986. As the table shows, population numbers in South Dakota have yet to approach the numbers set out in the recovery plan.

3.2.2 Developing a Least Tern Population Goal

To set the population objectives, the least tern recovery plan (USFWS 1990) examined six criteria:

1. *current data on distribution and abundance of interior least terns on each river system*

Although there are many least tern monitoring programs throughout the species' range, the numbers are not regularly compiled, so it is not possible to determine how the species is doing as a whole. The recovery plan (USFWS 1990) reports number of birds observed throughout the species' range from 1985 through 1988. In those years, the highest concentration of birds was observed on the Mississippi River, with approximately half of the birds surveyed rangewide on a 684-mile (1,100 km) stretch of river.

2. *knowledge of how thoroughly each state has been surveyed*

Least terns have been surveyed on most river systems where they nest, although the results of these various surveys have not been compiled (e.g. Boyd 2001, Clark 1988, Dinan 1983, Hill 1993, Whitman 1988, Pers. Comm. Greg Pavelka, USACE, Pers. Comm Steve Wilson, National Park Service). Standard surveying methods would be helpful in determining the rangewide population. As Table 8 shows, the Missouri River has been surveyed annually since 1986, and the Cheyenne River has been surveyed annually or biannually since 1995, so the numbers in South Dakota and on the Missouri River as a whole are well documented. Since least terns are a highly mobile species, it is difficult to draw conclusions about the population as a whole without rangewide information.

3. *historic population data*

There is scant historic population information about least terns. Lewis and Clark apparently saw them frequently along the Missouri River starting in Nebraska (Ducey 2000), but there are no numerical estimates available. From 1986 through 2004, the USACE has censused most available habitat on the Missouri River, with more complete surveys from 1993. The highest number of least terns was observed on the Missouri River system in 2003, with 1,338 adults counted.

Table 8 Least Tern: Comparison of 1990 Recovery Plan Requirements with Least Terns Censused. Note: Measured in *Individual Adults*

Recovery Plan Nationwide Goal	7,000 Adults Maintained for 10 years
Missouri River-wide Goal	2,100 Adults Maintained for 10 years

South Dakota Least Terns	**Recovery Plan Requires (Adults):**	**Number of Adult Least Terns**																		
		1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Lake Oahe[1]	100	38[5]	30[5]	82[5]	97[5]	100[5]	143[5]	124[5]	39	52	50	46	37	58	37	50	54	73	59	44
Below Ft. Randall[1]																				
-Missouri River		*11*	*32*	*0*	*4*	*26*[6]	*32*	*13*	*38*	*43*	*10*	*2*	*0*	*64*	*124*	*106*	*71*	*84*	*50*	71
-Lewis and Clark Lake		*14*	*28*	*45*	*29*	*63*[6]	*55*	*29*	*76*	*44*	*16*	*28*	*6*	*118*	*76*	*10*	*46*	*42*	*46*	0
Combined	80	25	60	45	33	89	87	42	114	87	26	30	6	182	200	116	117	126	96	71
Below Gavins Point[1]	400 [4]	181	232	252	210	167	193	187	272	211	93	82	115	144	161	206	232	314	366	359
Other Missouri River Sites[2]	20																			
Cheyenne River[3]	80	NA	54	NA	NA	NA	NA	NA	NA	NA	54	28	NA	23	NA	6	11	NA	8	4
South Dakota Total	**680**	**244**	**376**	**379**	**340**	**356**	**423**	**353**	**425**	**350**	**223**	**186**	**158**	**407**	**398**	**378**	**414**	**513**	**529**	**478**

[1] Data collected by USACE
[2] The location of "other Missouri River sites" is not specified in the Recovery Plan.
[3] Data Collected by Monica Schwalbach
[4] Shared with Nebraska
[5] Includes data from Lake Oahe in North Dakota
[6] Subsample results
NA: Not available

4. loss of viable habitat

As discussed above (Section 3.2.1), following dam construction, the filling of the reservoirs inundated historical breeding habitat, and habitat was lost through erosion and vegetation growth on the riverine stretches. Nearly 99 percent of historic least tern habitat on the Missouri River has been altered due to dam construction and channelization (Dugger 1997). In South Dakota, even the free-flowing river stretch below Gavins Point Dam has less than one-third of sandbar habitat acres estimated to have existed in the pre-dam era (USFWS 2000, USFWS 2003). Rangewide, the trend is likely similar, as many rivers systems have been altered for flood control, navigation, and other purposes. Providing more suitable habitat would likely increase least tern numbers (Smith and Renken 1991).

5. assessment of the potential to increase breeding pairs at currently occupied sites

Following the 1997 high water, there was more available habitat on the Missouri River than in the previous 12 years that the USACE monitored the system (Pers. Comm. Greg Pavelka, USACE). From 1998 through 2003, least tern numbers increased on the entire Missouri River. However, available habitat is currently declining once again due to erosion and vegetation growth (USFWS 2003), and least tern numbers were down slightly in 2004 (Pers. Comm. Greg Pavelka, USACE). Least tern numbers on the Missouri River are expected to continue to decline in future years as habitat erodes or becomes covered with vegetation. Meanwhile, under the current drought conditions, more unvegetated areas are becoming exposed on Lake Oahe, where least terns have been nesting successfully. We should keep in mind however, that Lake Oahe water levels have dropped to record lows throughout 2004 (USACE unpublished A), and the available reservoir habitat will become inundated at some point in the future when water levels rise. The habitat currently available on the reservoirs cannot be relied upon to support breeding into the indefinite future as the water will eventually rise again.

6. assessment of the potential to establish breeding pairs at unoccupied sites

As discussed above, surveys suggest that birds will readily use newly exposed habitat on the reservoirs as it becomes available. The birds will evidently also use newly created habitat on the riverine stretches as well. A newly created sandbar island near Ponca, NE in 2004 was used by 84 least terns, with a fledge ratio of 1.52 (Pers. Comm. Greg Pavelka, USACE). There has been no evaluation of the long term value of natural versus artificial nest sites.

3.2.3 Least Tern Population Goal

The least tern population probably always fluctuated in response to environmental conditions, with years when there was little reproductive success counterbalanced by

years when most pairs produced a brood of young (Kirsch and Sidle 1999). In the pre-dam era, flooding in some years would have inundated sandbar islands, leading to low bird numbers and low reproductive success during those years. The sediment carried in the high water would have replenished the extensive sandbar system, creating more available nesting habitat, and ultimately higher numbers of birds in subsequent years. The 1997 high water demonstrated this principle, with low numbers of adults on the river while the water was high, but relatively high numbers of adults and good reproductive success (fledge ratio) for several years following (1.25 average fledge ratio from1998-2004 in South Dakota).

Following the 1997 high water, there were approximately 51 acres of suitable habitat per river mile on the Gavins Point stretch (USFWS 2000). While this represents a recent high, it is less than one-third of the estimated acreage available prior to dam construction. When more nesting habitat was regularly available, the river likely historically supported many more least terns than it does now even in good years. Therefore, we are basing our goal on the average number of least terns surveyed on the river from 1998 through 2004, including the years with the highest least tern population numbers in the 19 years of surveys on the river. By including the years directly after the high water events of 1997, we incorporated an element of the natural fluctuation in the system.

The 2003 BO calls for the USACE to create 80 acres of suitable habitat per river mile both below the Gavins Point dam and on Lewis and Clark Lake by 2015, or 1.56 times the acreage available after the 1997 high water (USFWS 2003). The 2003 BO requires the USACE to develop 20 acres per river mile on the Fort Randall stretch by 2015. On Lake Oahe, the USACE should identify and enhance potential nesting habitat on Lake Oahe by 2020, with no acreage specified.

We have set the goal for least terns in South Dakota at 653 adult birds (327 pairs) to be reached over a ten year running average. This goal is the average number of birds on the Fort Randall, Lewis and Clark Lake, and Gavins Point stretches from 1998 through 2004 multiplied by 1.56 as shown in Table 9. This goal incorporates both the number of least terns counted on the system from 1998 through 2004 as well as the present and projected available nesting habitat. Requiring the goal to be met on a ten year running average will enable managers to incorporate some high water years when adult bird numbers are low. Table 9 breaks down the goal by river reach for clarification, but we recognize that the birds' distribution may vary annually. Thus the population goal is for anywhere on the Missouri River system in South Dakota, not on specific river stretches, with the caveat that the birds should not all be artificially concentrated on a few stretches.

Since the amount of suitable habitat on Lake Oahe is not specified in the 2003 BO (USFWS 2003), and the number of birds nesting on Lake Oahe varies widely depending on runoff and water level, we did not use the multiplier on the Lake Oahe numbers. We are using the multiplier on the stretch below Fort Randall Dam even though the BO only calls for 20 acres of habitat per river mile on that stretch. We believe that the same increase on the Fort Randall stretch as the other river stretches is justified because the goal for the Fort Randall stretch will result in an increased (but unknown) amount of habitat from current conditions, so more birds, on average, can be expected. We believe that setting a goal that includes a higher number of least terns than was seen on average in the past is justified since suitable habitat should be more consistently available under the terms of the 2003 BO.

3.2.4 Piping Plover Population Recovery Plan Goals

The piping plover recovery plan (USFWS 1988) uses population goals as the primary criterion for recovery. It also requires protection of the essential breeding and wintering habitat. Delisting can be initiated when 1,300 pairs (2,600 birds) have been maintained rangewide for 15 years in addition to the Canadian goal of 1,250 pairs (2,500 birds). For South Dakota, the plan calls for 350 pairs (700 birds) maintained over a 15-year period

Table 9 Average number of adult least terns surveyed on the Missouri River in South Dakota from 1998 through 2004 and South Dakota's population goal.

River Stretch	Average # Birds on the Missouri River in South Dakota from 1998-2004	Goal based on Average from 1998-2004 (Previous column times 1.56)
Oahe	54	54[1]
Fort Randall	81	126
Lewis and Clark Lake	48	75
Gavins Point	255	398
Total # Birds	**438**	**653**
Total # Pairs	**219**	**327**

[1] Since the habitat available for nesting on Lake Oahe varies widely depending on the water level in the reservoir in any given year and the USACE is not required to provide a specific amount of nesting habitat, we are not using the multiplier for the number of adults on Lake Oahe.

allocated as follows: below Gavins Point - 250 pairs, other Missouri River sites - 75 pairs, other sites (presumably alkaline wetlands) - 25 pairs. Table 10 shows the number of piping plover censused in South Dakota since 1986 compared with the goals set out in the 1988 recovery plan (USFWS 1988). As the table shows, Lake Oahe has been much more productive than was anticipated, with more piping plovers nesting on Lake Oahe than the Gavins Point stretch in some years. A draft piping plover recovery plan was developed in 1994 (Haig et al. unpublished) with new recovery goal numbers

as shown in Table 11. Although the plan was never finalized, we present it here for completeness. It calls for considerably more birds than the 1988 plan, with 2,300 pairs (4,600 birds) rangewide to be maintained for 15 years in addition to the Canadian goal of 1,250 pairs maintained for 11 years. The South Dakota goal is 400 pairs allocated as follows: Gavins Point stretch - 300 pairs, other Missouri River sites - 75 pairs, other sites - 25 pairs.

The USFWS developed a second "unofficial draft" piping plover recovery plan in 2001. The 2001 draft plan suggested revising the population goals upward to 2,300 breeding pairs (4,600 birds) maintained for 15 years, in addition to a fledge ratio of 1.2, calculated every five years (Wemmer and McPhillips unpublished). The 2001 unofficial draft plan allocates 990 pairs to the Missouri River, but does not break down the numbers by state. Table 12 shows the goals suggested in the 2001 unofficial draft recovery plan.

In 2002, the Canadian Wildlife Service published an updated piping plover recovery plan (Goossen et al. 2002). In this plan, the population goal for Canada was reduced to 813 pairs (1,626 Birds) over 3 consecutive international censuses (11 years) in addition to meeting a fledge ratio goal of 1.25 chicks per pair per year. To develop the population goal, managers from the various areas where piping plovers breed developed estimates of the number of birds that they thought their area could support. These estimates were combined to develop the overall Canadian goal (Pers. Comm. Paul Goossen, Canadian Wildlife Service).

3.2.5 Developing a Piping Plover Population Goal

As with the least tern recovery plan, the piping plover recovery plan (USFWS 1988) based the population goals in the plan on six factors:

1) current data on distribution and abundance of piping plovers in each state

There have been three International Piping Plover censuses which attempted to census all breeding and wintering populations of piping plovers (Ferland and Haig 2002). Even though more areas have been surveyed in each census, the population numbers for the Northern Great Plains population (including Canada) have declined by approximately 14.9 percent from 1991 to 2001 as seen in Table 1. The data suggest that the northern prairie population represents a single metapopulation with the same population of birds moving throughout the Northern Great Plains and Canada. In 1996, when there were fewer birds on the Missouri River system due to high flows, the number of birds in Prairie Canada increased. Conversely, in 2001, when flows were lower on the Missouri River and there was more exposed habitat and a large number of breeding birds, the number of birds counted in Canada was down.

Table 10 Piping Plover: Comparison of 1988 Recovery Plan with Piping Plovers Censused. Note: Measured in *Breeding Pairs*

Recovery Plan Nationwide Goal	1,300 Pairs Maintained for 15 years (assuming three major censuses) (Plus: Canadian Great Plains 2,500 *Birds*)
South Dakota Goal	350 Pairs

South Dakota Piping Plovers	**Recovery Plan Requires:**	**Pairs of Piping Plover (Breeding Pairs)[1]**																	
		1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Lake Oahe	-	6.5[2]	8[2]	55[2]	70[2]	44[2]	43.5[2]	71.5[2]	8.5	15.5	8	3.5	8.5	26.5	6.5	38.5	57	71	116	138
Below Ft. Randall																				
-Missouri River		*1.5*	*2.5*	*0*	*0*	*6*	*12.5*	*4*	*6*	*8.5*	*0*	*1.5*	*0*	*16.5*	*25.5*	*31*	*19*	*17.5*	*18.5*	21
-Lewis and Clark	-	*4*	*5.5*	*15.5*	*9*	*15*	*16.5*	*3*	*16*	*6*	*2*	*3*	*0.5*	*40*	*33.5*	*13*	*13*	*21*	*7*	0
Lake		5.5	8	15.5	9	21	29	7	22	14.5	2	4.5	0.5	56.5	59	44	32	38.5	*22.5*	21
Combined																				
Below Gavins Point	250 Pairs[3]	86	88.5	106	61	74.5	83	56	54.5	31	31.5	11	11	24.5	70.5	93	109	130	143	131
Other Missouri[4] River Sites	75 Pairs																			
Other Sites[5]	25 Pairs																			
South Dakota Total	**350 Pairs**	**98**	**104.5**	**176.5**	**140**	**95.5**	**155.5**	**134.5**	**85**	**61**	**41.5**	**19**	**20**	**107.5**	**136**	**175.5**	**198**	**239.5**	**284.5**	**290**

[1] Since the data were taken as number of adults (not breeding pairs), the number of adults censused was simply divided by two. Hence these figures are probably an overestimate of the number of breeding pairs on the system.
[2] Includes data from Lake Oahe in North Dakota
[3] Shared with Nebraska
[4] The location of "other Missouri River sites" is not specified in the Recovery Plan.
[5] The location of "other sites" is not specified. The writers may have intended this to encompass nesting at alkaline lakes.
All data collected by USACE

Table 11 Piping Plover: Comparison of 1994 Draft Recovery Plan with Piping Plovers Censused. Note: Measured in *Breeding Pairs*

Recovery Plan Nationwide Goal	2,300 Pairs Maintained for 15 years (Plus Canadian Great Plains 2,000 birds)
Fledge Ratio	1.13 Fledglings/Pair
South Dakota Goal	400 Pairs

South Dakota Piping Plovers	**Recovery Plan Requires:**	**Pairs of Piping Plover (Breeding Pairs)[1]**																	
		1986	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Lake Oahe	-	6.5[2]	8[2]	55[2]	70[2]	44[2]	43.5[2]	71.5[2]	8.5	15.5	8	3.5	8.5	26.5	6.5	38.5	57	71	116	138
Below Ft. Randall																				
-Missouri River		*1.5*	*2.5*	*0*	*0*	*6*	*12.5*	*4*	*6*	*8.5*	*0*	*1.5*	*0*	*16.5*	*25.5*	*31*	*19*	*17.5*	*18.5*	21
-Lewis and Clark	-	*4*	*5.5*	*15.5*	*9*	*15*	*16.5*	*3*	*16*	*6*	*2*	*3*	*0.5*	*40*	*33.5*	*13*	*13*	*21*	*7*	0
Lake		5.5	8	15.5	9	21	29	7	22	14.5	2	4.5	0.5	56.5	59	44	32	38.5	*22.5*	21
Combined																				
Below Gavins Point	300 Pairs[3]	86	88.5	106	61	74.5	83	56	54.5	31	31.5	11	11	24.5	70.5	93	109	130	143	131
Other Missouri[4] River Sites	75 Pairs																			
Other Sites[5]	25 Pairs																			
South Dakota Total	**400 Pairs**	**98**	**104.5**	**176.5**	**140**	**95.5**	**155.5**	**134.5**	**85**	**61**	**41.5**	**19**	**20**	**107.5**	**136**	**175.5**	**198**	**239.5**	**284.5**	**290**

[1] Since the data were taken as number of adults (not breeding pairs), the number of adults censused was simply divided by two. Hence these figures are probably an overestimate of the number of breeding pairs on the system.
[2] Includes data from Lake Oahe in North Dakota
[3] Shared with Nebraska
[4] The location of "other Missouri River sites" is not specified in the Recovery Plan.
[5] The location of "other sites" is not specified. The writers may have intended this to encompass nesting at alkaline lakes.
All data collected by USACE

Table 12 Piping plover population goals suggested in 2001 unofficial draft revised recovery plan for the Great Plains rivers and off-river prairie ecosystems. Measured in breeding pairs (Wemmer and McPhillips unpublished).

Location	States	Potential Number of Breeding Pairs
Missouri River	MT, ND, SD, NE, IA	990
Niobrara River	NE	50
Platte and N. Platte Rivers	NE	150
Kansas, Elkhorn, Yellowstone, S. Platte Rivers	KS, ND, NE	30
Alkali Wetlands, Lakes and Reservoirs	CO, MT, ND, SD, NE	1,030
Lake of the Woods	MN	25
Total		**2300**

2) knowledge of how thoroughly each state has been surveyed

The USACE has censused the entire Missouri River since 1994, and has been monitoring most of the river since 1986. Thus, we have a very good understanding of recent population trends, although monitoring over a much longer time period would be necessary to fully understand the dynamics of the population over several weather cycles. As noted, there have been three international piping plover censuses which attempted to locate all piping plovers rangewide.

3) historic population data

There is very little information available about historic levels of breeding piping plovers prior to the 1980's. The 1988 Recovery Plan (USFWS 1988) documents historic breeding along the Missouri River as well as in alkaline wetlands in South Dakota (recent surveys have found few birds nesting in alkaline wetlands in South Dakota). However there is no historical documentation about numbers of birds that historically nested on the system.

4) loss of viable habitat

As discussed above (Section 3.2.1), following dam construction, reservoir filling inundated historical breeding habitat, and habitat was lost through erosion and vegetation growth on the riverine stretches. Even in the comparatively undisturbed Gavins Point stretch, less than one-third of the estimated historical habitat was available in 1998, the year with the most suitable habitat exposed since the USACE began monitoring in 1986. While population levels are not directly related to amount of suitable habitat present (Haig and Plissner 1993), the large numbers of birds observed on the newly created sandbars since the 1997 floods suggests that more available habitat could lead to more nesting birds.

5) assessment of the potential to increase breeding pairs at currently occupied sites
Following the 1997 floods, there was more available habitat on the Missouri River than in the previous 12 years that the USACE monitored the system (Pers. Comm. Bruce VanderLee, USACE). Since then, piping plover numbers have continued to increase in South Dakota. However, available habitat is declining due to erosion and vegetation growth (Pers. comm. Greg Pavelka, USACE), and numbers of birds using the existing islands are expected to decline in future years as habitat becomes unsuitable. Meanwhile, under the current drought conditions, more unvegetated areas are becoming exposed on the reservoirs, and piping plovers have been successfully nesting on this habitat. It is important to note that reservoirs in the upper basin have been at record lows throughout 2004 (USACE Unpublished A), and the available reservoir habitat will become inundated in the future when water levels rise. Thus it is not clear how long the current reservoir habitat will be available, and it cannot be relied upon to support breeding for the indefinite future.

6) assessment of the potential to establish breeding pairs at unoccupied sites
As discussed in number 5, recent surveys suggest that birds will readily use newly exposed habitat on the reservoirs as it becomes available. The birds will evidently also use newly created habitat on the riverine stretches as well. A newly created sandbar island near Ponca, NE was used by 18 piping plovers, with a fledge ratio of 2.56 (Pers. Comm. Greg Pavelka, USACE), well above the fledge ratio thought necessary for species' recovery. As discussed previously, the amount of available habitat does not necessarily correspond with the number of birds present (Haig and Plissner 1993), but in the current system with substantially less suitable habitat than historical levels (USFWS 2000), increasing the amount of habitat and sustaining it at that level may be expected to lead to a long-term increase in piping plover population numbers over time. With such a large-ranging species, bird numbers in South Dakota are influenced by conditions in other parts of their range, such that piping plovers may nest elsewhere even if there is abundant suitable habitat in South Dakota.

In addition to the six factors described above, Wemmer and McPhillips (unpublished) suggest that a seventh factor should also be considered in setting a scientifically sound recovery goal:

7) results of population viability analyses for recovery of the Northern Great Plains population in the United States and Canada.
The current population analyses are all in agreement that the average fledge ratio over the last 10 years is not sufficient to maintain the population at its current level (Larson et al. 2002, Melvin and Gibbs 1994, Plissner and Haig 2000, Prindivile Gaines and Ryan 1988, Ryan et al. 1993), let alone increase the piping plover population to the numbers

defined in the 1988 recovery plan (USFWS 1988). Given the annual variation in the population depending on ambient conditions, Larson et al. (2003) suggest that true population numbers would have to exceed the stated numerical requirements in order to reach the distributional requirements. They suggest that 2,500 pairs and as many as 4,000 females might be necessary to meet the goals set out in the recovery plan (USFWS 1988). The Draft 1994 and 2001 recovery plans suggest that the number of birds should increase to 2,300 pairs and be maintained for 15 years (Haig et al. unpublished, Wemmer and McPhillips unpublished). The population numbers suggested in both the official and unofficial plans are based on the professional judgement of the biologists involved. There was little data and modeling information available at the time the official plan was developed. It is not clear what data or information was incorporated in the unofficial plans.

3.2.6 Piping Plover Population Goal

Evidence from the piping plover international censuses and from limited banding data suggests that piping plovers will nest on alkaline wetlands or in Canada if conditions on the Missouri River are not suitable for nesting in a given year (Haig 2004, Licht 2001, Plissner and Haig 2000). In the pre-dam era, periodic flooding would have inundated sandbar islands, leading to low bird numbers on the Missouri River and low reproductive success for those birds that did nest on the river during those years. The sediment carried in the high water would have replenished the extensive sandbar system however, creating more available nesting habitat, and ultimately leading to higher numbers of birds in future years. The 1996-1997 floods demonstrated this principle, with low numbers of adults on the river while the water was high, but high numbers of adults and good reproductive success (average fledge ratio 1.75 from 1998-2004 in South Dakota) for several years following.

Following the 1997 high water, there were approximately 51 acres of suitable habitat per river mile on the Gavins Point stretch (USFWS 2000). While this represents a recent high, it is less than one-third of the estimated available acreage prior to dam construction, and when more nesting habitat was regularly available, the river likely historically supported many more piping plovers than it does now even in good years. Therefore, we are basing our goal on the average number of piping plovers surveyed on the river from 1998 through 2004, when piping plover numbers were high. By including the years directly after the high water events of 1997, we incorporated an element of the natural fluctuation in the system.

The 2003 BO calls for the USACE to create 80 acres of suitable habitat per river mile both below the Gavins Point dam and on Lewis and Clark Lake by 2015, or 1.56 times the acreage available after the 1997 high water (USFWS 2003). The 2003 BO requires

the USACE to develop 20 acres per river mile on the Fort Randall stretch by 2015. On Lake Oahe, the USACE should identify and enhance potential nesting habitat on Lake Oahe by 2020, with no acreage specified.

We have set the goal for piping plovers in South Dakota at 565 adult birds (283 pairs) to be reached over a ten-year running average. This goal is the average number of birds on the Fort Randall, Lewis and Clark Lake, and Gavins Point stretches from 1998 through 2004 multiplied by 1.56 as shown in Table 13. This goal incorporates both the number of piping plovers counted on the system from 1998 through 2004 as well as the present and projected available nesting habitat. Requiring the goal to be met on a ten year running average will enable managers to incorporate some high water years when adult bird numbers are low. Table 13 breaks down the goal by river reach for clarification, but we recognize that the birds' distribution may vary annually. Thus the population goal is for anywhere on the Missouri River system in South Dakota, not on specific river stretches, with the caveat that the birds should not all be concentrated on a few stretches.

Table 13 Average number of adult piping plovers surveyed on the Missouri River in South Dakota from 1998 through 2004 and South Dakota's population goal.

River Stretch	Average # Birds on the Missouri River in South Dakota from 1998-2004	Goal based on Average from 1998-2004 (Previous column times 1.56)
Oahe	130	130[1]
Fort Randall	43	67
Lewis and Clark Lake	36	56
Gavins Point	200	312
Total # Birds	**409**	**565**
Total # Pairs	**205**	**283**

[1] Since the habitat available for nesting on Lake Oahe varies widely depending on the water level in the reservoir in any given year and the USACE is not required to provide a specific amount of nesting habitat, we are not using the multiplier for the number of adults on Lake Oahe.

Since the amount of suitable habitat on Lake Oahe is not specified in the 2003 BO (USFWS 2003), and the number of birds nesting on Lake Oahe varies widely depending on runoff and water level, we did not use the multiplier on the Lake Oahe numbers. We are using the multiplier on the stretch below Fort Randall Dam even though the BO only calls for 20 acres of habitat per river mile on that stretch. We believe that the same increase on the Fort Randall stretch as the other river stretches is justified because the goal for the Fort Randall stretch will result in an increased (but unknown) amount of habitat from current conditions, so more birds, on average, can be expected. We believe that setting a goal that includes a higher number of piping plovers than was seen

in the past is justified since suitable habitat should be more consistently available under the terms of the 2003 BO.

3.3 Nesting Habitat

3.3.1 Current Available Nesting Habitat

Both terns and plovers nest on sandbars, preferably with less than 10% vegetative cover (Schwalbach 1988). Under the natural flow regime, these islands were generally scoured of vegetation during the high spring flows, and islands were continually being created and eroded away. Since dam construction however, the sediment-starved water erodes islands without corresponding accretion elsewhere (National Research Council 2002).

Dam construction caused a dramatic change in the riverine habitat, with chutes, pools, wetlands and oxbows decreasing dramatically (Schmulbach 1981). Prior to the closure of Gavins Point Dam in 1955, there were at least an estimated 10,000 acres (4047 hectares) of sandbar habitat in the 59-mile Gavins Point stretch, or approximately 169.5 acres (68 hectares) of sandbar habitat per river mile (USFWS 2000). This acreage has dropped drastically, such that even after the high flows of 1997, there were only 3,000 acres of unvegetated habitat available (a 70% reduction from pre-dam conditions) in the Gavins Point Dam stretch (USFWS 2000). In the ensuing years, available habitat has continued to decline through erosion and vegetation growth. In 2002, the USACE estimated that only 192 acres were available (a 98% reduction from pre-dam conditions) and suitable for nesting at a flow of 27,000 CFS in the Gavins Point reach (USFWS 2003).

While an average of 34 percent of the least terns and 24 percent of the piping plovers nesting on the Missouri River used the Gavins Point stretch from 1986 through 2003 (Pers. Comm. Greg Pavelka, USACE) Oahe Reservoir also supports piping plovers (approximately 19 percent of all Missouri River piping plovers from 1994 through 2004), and to a lesser extent, least terns (approximately 15 percent from 1994 through 2004). Amount of available habitat varies with the water level, such that in high water years, there is very little suitable habitat, while in drought years, more habitat is exposed. Over time, vegetation encroaches on the emerged habitat and impedes its use for nesting until another cycle of inundation and drought makes it available again. The amount of available habitat fluctuates annually as well as over the course of the summer nesting season depending on the amount of precipitation in the upper basin and releases from the dams. Much of the exposed habitat is not suitable for nesting, both because of excessive vegetation and inappropriate substrate. With the amount of habitat made available by the ongoing drought, both species have successfully nested on Lake Oahe

since 1998. Prior to 1998, fledge ratios for least terns were so low (0 to 0.39 fledglings per pair), that researchers considered Lake Oahe a sink for least terns, a situation in which the habitat attracted birds for nesting, but productivity was not high enough to support the local population.

3.3.2 Habitat Quantity and Requirements

Prior to dam construction, there were an estimated 169.5 acres (68 ha) of sandbar habitat per river mile on the Gavins Point stretch compared with 51 acres (20.6 ha) (70% reduction from pre-dam conditions) per river mile in 1998, a recent high (USFWS 2000). There are apparently no estimates regarding acres of sandbar habitat on other river stretches for either the pre- or post-dam periods, although the USACE is currently evaluating available habitat on Lake Sakakawea (Pers. Comm. Bruce VanderLee, USACE). The 2003 BO calls for 20 acres (8 ha) of emergent sandbar habitat per river mile for the Fort Randall stretch, 80 acres (32 ha) per river mile on Lewis and Clark Lake, and 80 acres per river mile on the Gavins Point stretch by 2015, with an intermediate goal of half of those acres of sandbar present per river mile by 2005 (USFWS 2003).

As of 2004, there have not been any habitat studies on Lake Oahe to determine the amount of suitable habitat present, and the amount of exposed habitat varies annually depending on water level. Nevertheless, Lake Oahe can be an important breeding area for both least terns and piping plovers, especially during drought conditions when there are large areas of unvegetated land exposed. From 2000 through 2003, approximately 13 percent of adult least terns and 19 percent of adult piping plovers nesting on the Missouri River from were found on Lake Oahe (Pers. Comm. Greg Pavelka, USACE). The 2003 BO calls for the USACE to identify potential nesting habitat on reservoirs by 2005 and to complete work to enhance those areas by 2020.

How habitat quantity relates to the number of birds using an area is not entirely clear. It is generally agreed that the Northern Great Plains piping plover population is part of a metapopulation extending into Canada. Presumably, if there is not sufficient nesting habitat in South Dakota as the birds migrate north in the spring, they will continue on in search of nest sites (e.g. Haig 2004, Larson unpublished). As the low numbers of piping plovers, and to a lesser extent least terns, along the Missouri River during the high water of 1997 demonstrate, the birds do not remain in areas where breeding habitat is unavailable. However, both least terns and piping plovers tend to be site-faithful (Atwood and Massey 1988, Atwood et al. 1984, Cairns 1982, Carreker 1985, Haig 1987, Haig and Oring 1988, Wiens 1986, but see Boyd 1984, Knetter et al. 2002), which means that they may continue to use an area that is no longer optimal for nesting while other more suitable habitat remains unused (Carreker 1985). Haig and Plissner (1993)

note that piping plovers breed on less than half of the apparently suitable habitat, making it difficult to relate available habitat to number of piping plovers expected to use an area. Habitat may be limiting for least terns, so additional habitat may lead directly to more nesting terns (Pers. Comm. Greg Pavelka, USACE, Smith and Renken 1991). For both species, providing additional habitat may improve nest success as limited appropriate habitat tends to concentrate predators (Kruse et al. 2002).

The quality of available habitat is also important for nest success. Under the current water control system, islands tend to persist for many years. This leads to less available habitat every year, as vegetation takes over and islands erode without being replaced. Vegetation grows best in the center of islands, forcing birds to nest on the edges in a narrow band between vegetation and water. Such conditions not only allow predators to concentrate their efforts (Kruse et al. 2002), but also increase the likelihood that nests will be inundated during a high water event since birds are forced to nest closer to the water (Sidle et al. 1992).

Ideally all of these problems would be ameliorated by following the natural water regime more closely as laid out in the 2000 BO (USFWS 2000). The natural regime would include a high spring rise that creates new sandbars and scours vegetation from existing sandbars followed by a low summer flow that leaves sandbars exposed and available for nesting and brood rearing. Without sufficient flows, sandbars can only be maintained via chemical and mechanical vegetation removal and new habitat would only be created using mechanical means as suggested in the 2003 BO (USFWS 2003). SDGFP encourages the Corps to develop and maintain islands through flow to the greatest extent possible. Using flows to create habitat would be cheaper and less likely to adversely impact other species then building and maintaining sandbars through dredging and herbicides. High spring flows would also likely benefit other riverine species, including the endangered pallid sturgeon.

3.3.3 South Dakota Habitat Goals

SDGFP is adopting the same habitat goals as are laid out in the 2003 BO. The response of both least tern and piping plover population numbers and fledge ratios during the late 1990's and early 2000's suggests that continuing to provide nesting habitat will help to recover both species. SDGFP relies on the USACE to meet the habitat commitments laid out in the 2003 BO to ensure that nesting habitat is available for both species (see Table 14 for summary). Both the number of birds present and their success at raising young are also strongly linked to the amount and quality of available habitat, so all three aspects of SDGFP's goals are based on the premise that the USACE will meet habitat goals.

Table 14 shows the specific acreage goals for nesting habitat on the Fort Randall, Lewis and Clark Lake, and Gavins Point stretches of the Missouri River in South Dakota as laid out in the 2003 BO (USFWS 2003). These goals include naturally created habitat in addition to artificially created or manipulated habitat. The USACE should ensure that habitat is available in one out of three years, except during years when high flows are authorized for habitat creation or other ecosystem or species benefits, or when high flows are unavoidable because of excessive snowmelt and resulting flooding potential. The 2003 BO reports little, if any available nesting habitat on Lake Sharpe and Lake Francis Case since all sandbar islands are inundated during the nesting season, and there are no plans to develop habitat on those river stretches.

Table 14 Total habitat acreage goals set in the 2003 BO (USFWS 2003) for the Missouri River in South Dakota

River Stretch	Goal by 2005 (per river mile)	Goal by 2015 (per river mile)
Fort Randall	10 acres	20 acres
Lewis and Clark Lake	40 acres	80 acres
Gavins Point	40 acres	80 acres

The available nesting habitat on Lake Oahe fluctuates annually as water levels change, with little habitat available when water levels are above pool level 1617.0 ft msl, a level which has been reached 18 percent of the time from 1967 to 1999 (*in* USFWS 2003). The 2003 BO directs the USACE to identify all potential nesting habitat enhancement on Lake Oahe by 2005, and to complete those projects by 2020, with 25 percent complete by 2010, and 50 percent complete by 2015. The USACE will transfer lands on Lake Oahe above 1620 ft mean sea level (msl) to SDGFP. As the lands are transferred, SDGFP will evaluate them to determine suitability for tern and plover nesting. Efforts will be made to enhance and maintain areas on SDGFP transferred or leased lands that have been used for nesting in the past or are likely to be used for nesting.

4 MANAGEMENT ACTIONS

4.1 Flow Changes

Altered flow with a spring rise sufficient to scour existing islands and create new sandbar habitat followed by a low summer flow would create and maintain nesting habitat for least terns and piping plovers. SDGFP strongly urges the USACE to return the Missouri River to a more natural flow regime and to assist in biological evaluations of flow impacts on native species, in particular spawning behavior of fishes, including the endangered pallid sturgeon. Natural flows would improve habitat for many native species including the pallid sturgeon.

4.2 Monitoring

4.2.1 Assist with monitoring on the Missouri River

SDGFP will continue to hire three summer seasonal employees annually as long as funding allows to assist the USACE in monitoring least tern and piping plovers along the Missouri River. These seasonals will participate in adult and chick censuses, will help determine fledge ratios, and will perform other monitoring tasks and educational efforts.

4.2.2 Monitor least terns on the Cheyenne River

SDGFP will continue to monitor least terns along the Cheyenne River on at least a biennial basis as funding allows.

4.2.3 Monitoring piping plovers on alkaline lakes

SDGFP will assist with alkaline lake monitoring in South Dakota for piping plovers at least once every five years to coordinate with the International Piping Plover Census.

4.3 Nest Protection

4.3.1 Nest Caging

As necessary and appropriate, seasonals (see 4.2.1) will assist with placing cages on nests to deter predators from piping plover nests.

4.3.2 Predator Control

In specific locations, SDGFP land managers may remove individual branches that an aerial predator is using as a perch to oversee least tern and piping plover nest site locations. The need to remove branches to reduce predators will be balanced with the need to protect trees for bald eagle and other raptor use.

Where ground predators (raccoons, coyotes etc.) are the major threat, SDGFP state trappers will assist with predator removal in specific locations upon request. Trappers will also help to train USACE staff upon request.

4.3.3 Human Disturbance

4.3.3.1 Communication and Coordination

Recreationists along the Missouri River often enjoy using some of the same lands that least terns and piping plover use for nesting. This conflict can be reduced or eliminated if users clearly understand which areas to avoid and why avoidance is important. To facilitate public outreach, SDGFP park managers will coordinate with the USACE during the nesting season to learn about nest locations so that they can communicate

information about area closures to the public as promptly as possible. SDGFP staff have access to the USACE Data Management System and have been encouraged to visit the website regularly. However, additional active communication from the USACE is needed during the nesting season to keep SDGFP managers and enforcement personnel informed of new nest areas and nesting sites with the potential for conflicts with Missouri River recreationists. Improvements to interagency coordination will continue to be made as needed.

SDGFP staff presently prepare Environmental Assessments for all agency development projects planned for the Missouri River for consideration by the USACE and USFWS. This process will continue until replaced by conditions contained in a Missouri River Habitat Conservation Plan.

4.3.3.2 Signage at boat ramps

Put up/maintain signs at boat ramps to inform the public about the presence of least tern and piping plover nest sites and the need to avoid those areas.

4.3.3.3 Outreach/education at campgrounds

Inform campground users at sites near least tern and piping plover nest sites about the need to avoid those areas through signage, brochures, and talks with campers.

4.3.3.4 Human Disturbance

Fence off areas, as needed, to restrict human access on nest colonies where human disturbance is likely to/has occurred. Areas to fence may include sandbar habitat on the Fort Randall, Lewis and Clark Lake, and Gavins Point stretches as well as in campgrounds on Oahe. Oahe campgrounds that have had areas fenced in the past to protect nests include parts of Okobojo, Little Bend, and Cow Creek. Other areas may be fenced off as needed to avoid disturbance to nesting least terns and piping plovers.

4.4 Enforcement

SDGFP WCO's will coordinate with the USACE, SDGFP park managers, tribal enforcement personnel, the USFWS, and the NPS to patrol and enforce signed and fenced habitat from human disturbance.

4.5 Habitat Enhancement

As land is transferred, SDGFP will evaluate areas to determine if they may be enhanced to provide nesting and rearing habitat for least terns and piping plovers. Enhancement work will occur on areas with a high likelihood of successful use (e.g. recent nesting on site or close by, away from high human use areas, sandy substrate etc.).

4.5.1 Transferred Lands

SDGFP will evaluate transferred lands during the annual least tern and piping plover summer monitoring to determine if birds are using habitat along Oahe Reservoir for nesting and if there are areas which would likely be used for nesting with some maintenance (i.e. vegetation removal). Habitat enhancement for terns and plovers will be considered a high priority for state owned or managed lands along the Missouri River.

4.5.2 Permitting USACE Projects

SDGFP will evaluate and if appropriate, issue 401 water quality certification for USACE projects to create and enhance least tern and piping plover nesting habitat (creation, flows, sediment flushing etc.) as efficiently as possible (Pers. Comm. John Miller, DENR).

5 NEED FOR FURTHER INFORMATION/STUDIES REQUIRED

5.1 Habitat evaluation on Oahe Reservoir

The amount of nesting habitat available on Lake Oahe varies with the level of the reservoir and the amount of vegetation near the water. There have been no studies on Lake Oahe to determine the amount of potential nesting habitat. Identifying potential habitat enhancement on Lake Oahe by 2005 was identified as a Reasonable and Prudent Alternative (RPA) for the USACE to complete in the 2003 BO (USFWS 2003), with 25 percent of identified habitats enhanced by 2010, 50 percent by 2015, and 100 percent by 2020.

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Appendix A
Memorandum of Agreement

MEMORANDUM OF AGREEMENT

AMONG

**SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS,
U.S. FISH AND WILDLIFE SERVICE,
U.S. ARMY CORPS OF ENGINEERS, AND NATIONAL PARK SERVICE**

Least tern, piping plover, pallid sturgeon, and bald eagle management, protection, and recovery along the Missouri River in South Dakota

I. Purpose

The purpose of this Memorandum of Agreement (MOA) is to provide guidance and specific agency commitments for management, protection, and recovery of the least tern, piping plover, pallid sturgeon, and bald eagle along the Missouri River for the four signatory agencies, since each has a statutory responsibility for endangered species recovery. The signatory agencies agree that fulfillment of conditions contained in this MOA will help enhance annual productivity and in the long term contribute to recovery of these species.

II. Actions

It is the intent of the signatory agencies to cooperatively protect and manage nesting populations of the least tern and piping plover along the Missouri River in South Dakota through monitoring, site protection, law enforcement, and public outreach. It is also the intent of the signatory agencies to protect bald eagle nesting sites and important winter roost sites along the Missouri River in South Dakota. Additionally, signatory authorities will commit to protect pallid sturgeon and their habitat by minimizing threats from existing and proposed human activities, law enforcement and public outreach.

A. South Dakota Department Of Game, Fish And Parks (SDGFP):

1. Will hire at least three seasonal employees each nesting season to be stationed where most needed to assist the U.S. Army Corps of Engineers (Corps) in monitoring and protecting least tern and piping plover nesting areas.
2. Will provide law enforcement assistance where and when most needed to patrol for human disturbance at least tern and piping plover nesting colonies up to 10 potential weekend periods from Memorial Day weekend to August 15 (including the high use events such as the July 4 holiday). This would be a cooperative effort by both SDGFP and the U.S. Fish and Wildlife Service (Service) providing staff on the river for the tern and plover nesting period. The details of such efforts will be worked out on an annual basis and dependent on nesting locations and active recreation areas on the river.
3. Will make arrangements with the Service and the Corps to obtain the necessary tern and plover training for law enforcement and seasonal personnel.
4. Will work cooperatively with the Corps and the Service to develop a Missouri River Management Plan for least terns, piping plovers, pallid sturgeons, and the bald

eagles that establishes biological/conservation goals for South Dakota and management actions to achieve those goals. Management actions would include at least the following actions.

A.) On sites owned or managed by SDGFP, will close portions of the area where least terns or piping plovers are nesting, to include appropriate buffer zones.
B.) On sites owned or managed by SDGFP, will buoy off least tern foraging areas if potentially impacted by watercraft traffic.
C.) Will participate in public outreach efforts, including but not limited to placing informational posters at recreation sites, distributing informational brochures to recreation site users, random patrolling of nesting areas, and posting of nesting areas. Results of random patrolling of nesting areas will help set priorities for law enforcement follow-up.
D.) Will participate with signatory agencies and other interested entities in seeking solutions to site-specific threats to nesting success, such as livestock grazing.
E.) On sites owned or managed by SDGFP, will develop specific management strategies on sites consistently used each year by least terns and piping plovers, such as fencing or posting sites prior to arrival of nesting birds.
F.) Will not remove bald eagle nest trees on areas owned or managed by SDGFP, except for limited removal of single trees within campgrounds that pose a human safety hazard. Any tree removed will be replaced at a 4:1 ratio.
G.) Except for limited removal of single trees within campgrounds that pose a human safety hazard, will not remove trees from documented bald eagle winter roost sites if removal could adversely affect winter roost site use at areas owned or managed by SDGFP. Any tree removed will be replaced at a 4:1 ratio.
H.) Will continue winter recreational limits currently placed by the Corps of Engineers to protect known bald eagle roost sites, such as at Chief White Crane below Gavins Point Dam and Campground No. 3 below the Oahe Dam, and will evaluate future restrictions on a case-by-case basis.
I.) Will not construct within ¼ mile of bald eagle roost areas during the time of roost occupation.
J.) Will not construct within ½ mile of bald eagle nests during the nesting season.
K.) Will continue law enforcement and public outreach activities at State park and recreation areas in regard to State regulations prohibiting the take of pallid sturgeon.

B. U.S. Fish and Wildlife Service (Service):

1. Will investigate all Complaints of Violation concerning take and nest disturbances at tern/plover sites and/or colonies.

2. Will provide law enforcement assistance commensurate with State law enforcement action where and when most needed to patrol for human disturbance at nesting least tern and piping plover colonies up to 10 potential weekend periods from Memorial Day weekend to August 15 (including the high use events such as the July 4 holiday). This would be a cooperative effort by both SDGFP and the Service providing staff on the river for the tern and plover nesting period. The details of such efforts will be worked out on an annual basis and dependent on nesting locations and active recreation areas on the river.
3. Will provide law enforcement guidance and training to Corps and SDGFP personnel for proper documentation on investigation of potential violations.
4. Will work with SDGFP and the Corps to provide technical assistance and review the development of a Missouri River Management Plan that establishes biological/conservation goals for South Dakota and management actions to achieve those goals.
5. Will work cooperatively with the Corps and SDGFP to detail an experienced Service person to craft a legal process such as a Habitat Conservation Plan, or some similar process, that will allow the State to have assurances for active management and potential "take" opportunities.

C. U.S. Army Corps of Engineers (Corps):

1. Will provide yearly survey and productivity monitoring techniques training for all seasonal and permanent employees working with least terns and piping plovers.
2. With assistance from SDGFP seasonal employees, will conduct distribution and census surveys, and productivity monitoring on all potential nesting habitat.
3. Will ensure near real time data availability to all signatories, including all nest locations and nest and chick status, through its web based Data Management System.
4. With assistance from SDGFP seasonal employees, will implement nest specific management actions at all nesting sites (cages, moving nests, etc.).
5. On sites owned or managed by Corps, will close portions of the area where least terns or piping plovers are nesting, to include appropriate buffer zones.
6. On sites owned or managed by Corps, will buoy off least tern foraging areas if potentially impacted by watercraft traffic.
7. Will work cooperatively with SDGFP and the Service to develop a Missouri River Management Plan for least terns, piping plovers, pallid sturgeons, and the bald eagles that establishes biological/conservation goals for South Dakota and management actions to achieve those goals.
8. Will work cooperatively with SDGFP and the Service on a Habitat Conservation plan or some similar process for State actions.
9. Will participate with the Service and SDGFP on training Corps personnel for proper documentation on investigating potential violations of State and Federal law.

D. National Park Service (NPS):

1. On sites owned or managed by NPS, will close portions of the area where least terns or piping plovers are nesting, to include appropriate buffer zones.
2. On sites owned or managed by NPS, will buoy off least tern foraging areas if potentially impacted by watercraft traffic.

3. Will work cooperatively with SDGFP, the Service, and the Corps to develop a Missouri River Management Plan for least terns, piping plovers, pallid sturgeons, and bald eagles that establishes biological/conservation goals for South Dakota and management actions to achieve those goals.
4. Will work cooperatively with SDGFP, the Service, and the Corps on a Habitat Conservation plan or some similar process for State actions.
5. Will continue public outreach activities related to least terns, piping plovers, bald eagles, and pallid sturgeon at Missouri National Recreational River.
6. Will coordinate with SDGFP, the Service, and the Corps to conduct annual bald eagle nesting surveys from Fort Randall Dam to Ponca, Nebraska.

E. All signatory agencies:

1. Will participate in at least two meetings or conference calls per year, timed before the nesting season begins (to plan for the upcoming nesting season) and after the nesting season ends (to evaluate and report on success of cooperative efforts.) Other meetings or specific coordination will be scheduled as needed during the tern and plover nesting season or if other species management needs warrant an additional meeting.
2. Will participate in the identification of pallid sturgeon backwater restoration areas along the Missouri River below Gavins Point and Fort Randall Dam.
3. May assign special designation to areas under their authority for endangered species emphasis, as appropriate. For example, ownership of Blue Blanket Recreation Area will not transfer to SD Game, Fish and Parks on January 1, 2002. However, this area will be managed by the SDGFP Wildlife Division under a wildlife management lease agreement with the U.S. Army Corps of Engineers and will be designated as a least tern and piping plover recovery area to be managed specifically for the enhancement and recovery of nesting least terns and piping plovers.
4. Will participate in preparation of an annual accountability report, with SDGFP as lead agency for report preparation.

III. Principal Contacts

1. U.S. Fish and Wildlife Service
   Ralph O. Morgenweck
   PO Box 25486 DFC
   Denver, CO 80225
   (303) 236-7920
   (303) 236-8295 (fax)
   ralph_morgenweck@fws.gov

2. SD Dept. of Game, Fish and Parks
   John L. Cooper
   523 E. Capitol Ave.
   Pierre, SD 57501
   (605) 773-4229
   (605) 773-6245
   john.cooper@state.sd.us

IV. Agreement Term

This MOA will remain in force until November 8, 2006.

V. Approval

We, the undersigned designated officials, do hereby approve this Memorandum of Agreement.

Approved _____ Date 6/6/05
John L. Cooper
Secretary
SD Dept. of Game, Fish and Parks

_____ Date 6/23/05
for Ralph Morgenweck
Regional Director, Region 6
US Fish and Wildlife Service

_____ Date 6/14/05
Jeffrey A. Bedey
Colonel, Corps of Engineers
District Engineer

_____ Date 6·20·05
Paul Hedren,
MNRR Superintendent
National Parks Service

Appendix B
USACE Least Tern Monitoring Information for South Dakota, 1986-2004

SOUTH DAKOTA MAINSTEM MISSOURI RIVER LEAST TERN PRODUCTIVITY MONITORING 1986-2004

REACH	NESTS	NEST HAT.	NEST COLL.	NEST SUCC.	EGGS	EGGS HAT.	EGGS COLL.	COLL. HAT.	FATE DESTROYED									NON VIABLE	ADULT CENSUS	CHICKS FLEDGE	FLEDGE RATIO	COLL. CH. RELEASED
									FLOOD	PRED.	H. DIST.	BANK E.	WTHR.	LIVESTOCK	DES. UNKN.	FATE UNKN.	ABAN.					
L. Oahe(SD)																						
1993	13	6	0	46.15385	24	7	0	0	4	0	0	0	2	0	0	2	0	0	39	0	0	0
1994	15	1	0	6.666667	36	2	0	0	0	0	0	0	5	5	3	0	1	0	52	0	0	0
1995	13	3	0	23.07692	29	1	0	0	0	7	0	0	1	0	0	0	2	0	50	0	0	0
1996	7	5	0	71.4	14	10	0	0	0	0	0	0	0	0	0	2	0	0	46	9	0.391304	0
1997	30	3	0	10	70	7	0	0	2	0	0	0	11	1	1	10	2	0	37	5	0.27027	0
1998	29	24	0	82.75862	72	57	0	0	1	0	1	0	0	0	0	2	0	1	58	47	1.62069	0
1999	20	11	0	55	50	27	0	0	5	0	0	0	0	1	0	3	0	0	37	15	0.810811	0
2000	34	24	0	70.58824	87	59	0	0	0	4	0	0	0	0	1	5	0	0	50	33	1.32	0
2001	45	25	0	55.55556	103	60	0	0	6	2	0	0	3	2	0	5	2	0	54	43	1.592593	0
2002	42	31	0	73.80952	106	78	0	0	0	2	0	0	2	0	2	2	3	0	73	56	1.534247	0
2003	40	29	0	72.5	91	65	0	0	0	1	0	0	1	1	1	5	0	2	59	38	1.288136	0
2004	27	23	0	85.2	64	52	0	0	0	0	0	0	0	0	0	3	1	0	44	32	1.454545	0
TOTAL	315	185	0	58.73016	746	425	0	0	18	16	1	0	25	10	8	39	11	3	599	278	0.928214	0
FTRLRIV																						
1986	4	0	0	0.0	8	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	11	0	0.00	0
1987	28	0**	0	0.0	59	13	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	32	6	0.38	0
1988	3	0	0	0.0	9	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0.00	0
1989	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0.00	0
1990*	14	8	0	57.1	31	15	0	0	4	0	0	0	0	0	0	1	1	0	26	4	0.31	0
1991	20	8	0	40.0	40	16	0	0	5	0	1	0	0	0	3	2	1	0	32	10	0.63	0
1992	10	9	0	90.0	20	18	0	0	0	0	0	0	0	0	0	1	0	0	13	3	0.46	0
1993	15	6	0	40.0	32	13	0	0	0	0	0	0	1	0	0	8	0	0	38	0	0.00	0
1994	27	15	0	55.6	63	37	0	0	4	0	1	0	5	0	1	1	0	0	43	0	0.00	0
1995	26	0	11	0.0	32	0	17	10	11	4	0	0	0	0	0	0	0	0	10	0	0.00	0
1996	1	0	0	0.0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0.00	0
1997	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0
1998	33	31	0	93.9	83	76	0	0	0	0	0	0	0	0	0	1	1	0	64	30	0.94	0
1999	79	61	0	77.2	204	148	0	0	1	1	2	0	8	0	1	3	2	0	124	64	1.03	0
2000	72	52	0	72.2	176	132	0	0	0	1	1	0	4	0	4	4	3	3	106	67	1.26	0
2001	58	30	0	51.7	143	80	0	0	2	1	0	0	5	0	12	5	3	0	71	5	0.14	0
2002	71	25	6	35.2	161	63	12	12	11	14	0	0	3	0	1	8	0	3	84	30	0.71	10
2003	39	30	0	76.9	102	82	0	0	3	1	0	0	2	0	1	1	0	1	50	23	0.92	0
2004	67	22	0	32.8	139	50	0	0	1	24	0	0	2	0	13	4	0	0	71	13	0.37	0
TOTAL	567	297	17	55.1	1304	743	29	22	46	46	5	0	30	0	36	39	11	7	781	255	0.65	10
																			58			
LECLRES																						
1986	19	0**	0	0.0	60	11	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	14	6	0.86	0
1987	40	0**	0	0.0	82	16	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	28	7	0.50	0
1988	17	2	0	11.8	38	4	0	0	8	0	0	0	0	0	0	7	0	0	45	3	0.13	0
1989	30	11	0	36.7	73	22	0	0	12	1	0	0	0	0	0	5	1	0	29	9	0.62	0
1990*	56	9	0	16.1	131	23	0	0	6	18	3	1	1	0	2	14	3	0	63	11	0.35	0
1991	27	0	0	0.0	50	0	0	0	14	3	0	0	0	0	7	2	1	0	55	0	0.00	0
1992	23	11	0	47.8	45	25	0	0	0	2	0	0	0	0	7	1	2	0	29	23	1.59	0
1993	54	20	0	37.0	107	42	0	0	9	13	0	0	0	0	10	2	0	0	76	37	0.97	0
1994	21	0	0	0.0	32	0	0	0	11	10	0	0	0	0	0	0	0	0	44	0	0.00	0
1995	17	0	12	0.0	31	0	23	14	3	0	0	0	0	0	0	2	0	0	16	0	0.00	6
1996	7	0	7	0.0	16	0	16	13	0	0	0	0	0	0	0	0	0	0	28	0	0.00	13
1997	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0.00	0
1998	72	60	0	83.3	176	145	0	0	0	0	0	0	0	0	0	7	5	0	118	140	2.37	0
1999	64	17	0	26.6	150	45	0	0	8	11	1	0	5	0	9	11	2	0	76	8	0.21	0
2000	36	11	0	30.6	93	32	0	0	0	5	0	0	0	0	12	6	2	0	10	3	0.60	0
2001	30	15	9	50.0	75	40	22	22	3	0	0	0	0	0	0	2	0	1	46	34	1.48	20
2002	37	13	0	35.1	87	35	0	0	2	2	1	0	5	0	0	10	3	1	42	24	1.14	0
2003	41	13	0	31.7	101	32	0	0	8	0	0	0	14	0	0	1	3	2	46	9	0.39	0
2004	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	591	182	28	34.2	1347	472	61	49	84	65	5	1	25	0	47	70	22	4	771	314	0.81	39

REACH	NESTS	NEST HAT.	NEST COLL.	NEST SUCC.	EGGS	EGGS HAT.	EGGS COLL.	COLL. HAT.	FATE DESTROYED										NON VIABLE	ADULT CENSUS	CHICKS FLEDGE	FLEDGE RATIO	COLL. CH. RELEASED
									FLOOD	PRED.	H. DIST.	BANK E.	WTHR.	LIVESTOCK	DES. UNKN.	FATE UNKN.	ABAN.						
GAPTRIV																							
1986	173	0**	0	0.0	414	47	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	181	14	0.15	0
1987	189	0**	0	0.0	441	153	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	232	80	0.69	0
1988	248	81	0	32.7	577	202	0	0	0	30	3	3	7	0	51	52	21	0	252	62	0.49	0
1989	181	91	0	50.3	457	234	0	0	2	42	1	4	7	0	19	15	0	0	210	58	0.55	0
1990	134	71	0	53.0	327	179	0	0	2	15	1	0	0	0	12	26	7	0	167	38	0.46	0
1991	192	66	0	34.4	430	165	0	0	5	21	1	1	0	0	44	35	19	0	193	25	0.26	0
1992	130	45	0	34.6	269	106	0	0	1	53	0	2	3	0	7	8	12	0	187	20	0.21	0
1993	183	85	0	46.4	435	216	0	0	30	1	0	0	4	0	18	39	6	0	272	113	0.83	0
1994	218	75	0	34.4	513	179	0	0	13	69	0	5	11	0	14	21	10	0	211	51	0.48	0
1995	118	26	42	22.0	253	55	92	72	5	31	1	1	0	0	0	10	1	0	93	23	0.49	50
1996	96	6	56	6.3	179	9	108	95	0	2	0	0	0	0	12	16	4	0	82	11	0.27	91
1997	106	49	0	46.2	266	132	0	0	9	7	0	4	2	0	17	7	10	1	115	52	0.90	0
1998	83	70	0	84.3	214	178	0	0	0	0	0	0	0	0	0	8	5	0	144	168	2.33	0
1999	113	85	0	75.2	293	227	0	0	2	1	0	0	5	0	0	13	6	1	161	194	2.41	0
2000	149	123	0	82.6	388	318	0	0	0	3	1	0	0	0	8	6	7	1	206	176	1.71	0
2001	116	104	0	89.7	309	269	0	0	0	0	0	0	0	0	1	5	3	3	232	127	1.09	0
2002	216	157	0	72.7	538	409	0	0	2	25	0	0	4	0	7	5	14	2	314	207	1.32	0
2003	247	178	0	72.1	635	460	0	0	17	17	1	0	7	0	8	8	10	1	366	138	0.75	0
2004	280	169	0	60.4	663	419	0	0	2	44	0	2	12	0	14	12	21	3	359	186	1.04	0
TOTAL	3172	1481	98	52.7	7601	3957	200	167	90	361	9	22	62	0	232	286	156	12	3977	1743	0.88	141

Total																						
1986*	196	0**	0	0.0	482	58	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	206	20	1.08	0
1987*	257	0**	0	0.0	582	182	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	292	93	0.67	0
1988**	268	83	0	-2075.0	624	206	0	0	11	30	3	3	7	0	51	59	21	0	297	65	0.63	0
1989**	211	102	0	-167.2	530	256	0	0	14	43	1	4	7	0	19	20	1	0	243	67	1.61	0
1990**	204	88	0	-129.4	489	217	0	0	12	33	4	1	1	0	14	41	11	0	256	53	0.71	0
1991**	239	74	0	-224.2	520	181	0	0	24	24	2	1	0	0	54	39	21	0	280	35	0.54	0
1992	163	65	0	-59.6	334	149	0	0	1	55	0	2	3	0	14	10	14	0	229	46	0.40	1
1993	265	117	0	-1671.4	598	278	0	0	43	14	0	0	7	0	28	51	6	0	425	150	0.71	0
1994	281	91	0	1011.1	644	218	0	0	28	79	1	5	21	5	18	22	11	0	350	51	0.29	0
1995	174	29	65	-29.6	345	56	132	96	19	42	1	1	1	0	0	12	3	0	169	23	0.27	56
1996	111	11	63	-6.8	268	23	134	108	1	2	0	0	0	0	12	18	4	0	158	20	0.25	104
1997	136	52	0	-38.2	336	139	0	0	11	7	0	4	13	1	18	17	12	1	158	57	0.72	0
1998	217	185	0	-336.4	545	456	0	0	1	0	1	0	0	0	0	18	11	1	384	385	2.01	0
1999	276	174	0	4350.0	697	447	0	0	16	13	3	0	18	1	10	30	10	1	398	281	1.41	0
2000	291	210	0	1105.3	744	541	0	0	0	13	2	0	4	0	25	21	12	4	372	279	1.50	0
2001	249	174	9	-756.5	630	449	22	22	11	3	0	0	8	2	13	17	8	4	403	209	1.04	20
2002	366	226	6	240.4	892	585	12	12	15	43	1	0	14	0	10	25	20	6	513	317	1.24	10
2003	367	250	0	263.2	929	639	0	0	28	19	1	0	24	1	10	15	13	6	521	208	0.80	0
2004	374	214	0	209.8	866	521	0	0	3	68	0	2	14	0	27	19	22	3	474	231	0.97	0
GR. TOTAL	4645.00	2145.00	143.00	51.97	11055.40	5601.00	300.00	238.00	238.00	488.00	20.00	23.00	142.00	10.00	323.00	434.00	200.00	26.00	6128.00	2590.00	0.85	190.63

* = Subsample results

** = Data not available

Key:

L. OAHE (SD) - Lake Oahe in SD only
FTRLRIV - Fort Randall River
LECLRES - Lewis and Clark Reservoir
GAPTRIV - Gavins Point River
NEST HAT. - Number of nests hatched
NEST COLL. - Number of nests collected (eggs removed and hatched in captivity)
NEST SUCC. - Percent of nests that hatch
EGGS HAT - Eggs that hatch
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FLOOD - Nests destroyed by flooding
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DES. UNKN. - Nests destroyed due to unknown cause
FATE UNKN. - Unknown whether or not the nest hatched
ABAN. - Abandoned
FLEDGE RATIO - Number of chicks fledged divided by the adults censused divided by two (to determine number of adult pairs)
COLL. CH. RELEASED. - Captive reared chicks which were released

Appendix C

USACE Piping Plover Monitoring Information for South Dakota, 1986-2004

SOUTH DAKOTA MAINSTEM MISSOURI RIVER PIPING PLOVER PRODUCTIVITY MONITORING 1986-2004

REACH	NESTS	NEST HAT.	NEST COLL.	NEST SUCC.	EGGS	EGGS HAT.	EGGS COLL.	COLL. HAT.	CHICKS COLL.	FATE DESTROYED						DEST. UNKN.	FATE UNKN.	ABAN.	NON VIABLE	ADULT CENSUS	CHICKS FLEDGE	FLEDGE RATIO	COLL. CH. FLEDGED	COLL. RELEAS.
										FLOOD	PRED.	H. DIST.	BANK E.	WTHR.	LIVEST									
L. Oahe(SD)																								
1993	9	5	0	55.6	29	15	0	0	0	0	1	0	0	0	0	0	3	0	0	17	0	0	-	0
1994	5	1	0	20.0	20	4	0	0	0	0	0	0	0	3	1	0	0	0	0	31	0	0	-	0
1995	12	3	3	25.0	40	7	8	6	0	0	3	0	0	0	0	3	0	0	0	16	5	0.625	-	4
1996	4	1	0	25.0	25	15	3	0	0	3	0	0	0	0	0	0	0	0	0	7	3	0.857143	-	0
1997	12	4	0	33.3	42	14	0	0	0	1	0	1	0	1	0	1	3	1	0	17	8	0.941176	-	0
1998	21	16	0	76.2	70	51	0	0	0	0	0	0	0	0	1	2	1	1	0	53	32	1.207547	-	0
1999	25	4	3	16.0	76	11	9	0	0	12	0	0	0	0	0	0	2	4	0	13	3	0.461538	-	0
2000	38	31	0	81.6	114	83	0	0	0	0	0	0	0	0	0	3	2	0	1	77	59	1.532468	-	0
2001	64	39	11	60.9	223	132	34	24	0	2	1	1	0	4	0	1	3	2	0	114	100	1.754386	-	24
2002	71	63	0	88.7	257	216	0	0	0	1	2	1	0	0	0	2	2	0	0	142	182	2.56338	-	0
2003	119	103	0	86.6	452	380	0	0	0	1	1	0	0	1	1	6	4	1	1	232	216	1.862069	-	0
2004	156	127	0	81.4	557	435	0	0	0	0	5	0	0	0	6	5	7	3	1	276	216	1.57	-	0
TOTAL	536	397	17	74.06716	1905	1363	54	30	0	20	13	3	0	9	9	23	27	12	3	995	824	1.656281	-	28
FTRLRIV																								
1986	1	0	0	0.0	4	0	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	3	0	0.00	0	-
1987	2	0	0	0.0	7	0	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	5	0	0.00	0	-
1988	1	0	0	0.0	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.00	0	-
1989	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	-
1990*	5	4	0	80.0	16	15	0	0	0	1	0	0	0	0	0	0	0	0	0	12	4	0.67	0	-
1991	17	4	0	23.5	47	10	0	0	0	2	1	0	0	0	0	10	0	0	0	25	6	0.48	0	-
1992	4	2	0	50.0	12	6	0	0	0	0	1	0	0	0	0	0	0	1	0	8	3	0.75	0	-
1993	4	2	0	50.0	12	8	0	0	0	1	0	0	0	0	0	1	0	0	0	12	0	0.00	0	-
1994	6	4	0	66.7	21	13	0	0	0	0	0	0	0	1	0	1	0	0	0	17	0	0.00	0	-
1995	7	0	0	0.0	9	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0.00	0	-
1996	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0.00	0	-
1997	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00	0	-
1998	14	11	2	78.6	56	43	8	8	0	1	0	0	0	0	0	0	0	0	0	33	21	1.27	8	-
1999	30	12	1	40.0	94	42	1	1	0	2	2	1	0	4	0	3	4	1	0	51	26	1.02	1	-
2000	40	19	0	47.5	126	65	0	0	0	0	1	0	0	10	0	10	0	0	0	62	27	0.87	0	-
2001	26	11	0	42.3	82	40	0	0	0	5	2	0	0	4	0	3	1	0	0	38	14	0.74	0	-
2002	31	8	3	25.8	88	28	9	9	0	6	4	0	0	4	0	5	0	1	0	35	18	1.03	9	-
2003	22	14	0	63.6	78	53	0	0	0	1	0	0	0	2	0	4	0	1	0	37	27	1.46	0	-
2004	23	16	0	69.6	76	58	0	0	0	0	4	0	0	1	0	1	0	0	1	42	15	0.71	0	-
TOTAL	233	107	6	45.9	732	381	18	18	0	27	15	1	0	26	0	38	5	4	1	383	161	0.84	18	-
LECLRES																								
1986	4	0**	0	0.0	12	6	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	8	1	0.25	0	-
1987	18	0**	0	0.0	58	3	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	11	1	0.18	0	-
1988	9	1	0	11.1	28	3	0	0	0	2	0	0	0	0	0	3	3	0	0	31	1	0.06	0	-
1989	9	5	0	55.6	34	17	0	0	0	1	2	0	0	0	0	0	1	0	0	18	5	0.56	0	-
1990	35	6	0	17.1	116	21	0	0	0	4	14	2	0	0	0	5	4	0	0	30	10	0.67	0	-
1991	27	2	0	7.4	83	4	0	0	0	12	3	1	0	1	0	8	0	0	0	33	0	0.00	0	-
1992	6	2	0	33.3	21	8	0	0	0	0	1	0	0	0	0	3	0	0	0	6	0	0.00	0	-
1993	16	5	0	31.3	51	16	0	0	0	0	5	0	0	0	0	5	1	0	0	32	1	0.06	0	-
1994	10	1	0	10.0	37	4	0	0	0	1	6	1	0	0	0	0	0	1	0	12	2	0.33	0	-
1995	3	0	2	0.0	6	0	5	4	0	0	1	0	0	0	0	0	0	0	0	4	0	0.00	4	-
1996	18	0	17	0.0	39	0	38	31	0	0	0	0	0	0	0	1	0	0	0	6	0	0.00	29	-
1997	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0.00	0	-
1998	44	39	3	88.6	158	132	12	11	0	0	0	1	0	0	0	0	0	1	0	80	101	2.53	11	-
1999	62	3	1	4.8	177	12	1	1	0	18	16	0	0	0	0	20	1	2	0	67	10	0.30	1	-
2000	19	10	3	52.6	73	38	12	1	0	0	2	0	0	0	0	3	1	0	0	26	7	0.54	1	-
2001	15	10	3	66.7	53	42	12	12	0	2	0	0	0	0	0	0	0	0	0	26	11	0.85	12	-
2002	22	16	0	72.7	76	49	0	0	0	0	0	0	0	2	0	0	4	0	0	42	36	1.71	0	-
2003	10	5	0	50.0	33	14	0	0	0	1	0	0	0	2	0	0	0	2	0	14	11	1.57	0	-
2004	4	0	0	0.0	16	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0.00	0	-
TOTAL	331	105	29	34.0	1071	369	80	60	0	41	51	5	0	8	0	48	15	6	0	447	197	0.88	58	-

REACH	NESTS	NEST HAT.	NEST COLL.	NEST SUCC.	EGGS	EGGS HAT.	EGGS COLL.	COLL. HAT.	CHICKS COLL.	FLOOD	FATE DESTROYED PRED.	H. DIST.	BANK E.	WTHR.	LIVEST	DEST. UNKN.	FATE UNKN.	ABAN.	NON VIABLE	ADULT CENSUS	CHICKS FLEDGE	FLEDGE RATIO	COLL. CH. FLEDGED	COLL. RELEAS.
GAPTRIV																								
1986	88	0**	0	0.0	310	19	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	172	4	0.05	0	-
1987	109	0**	0	0.0	388	125	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	177	100	1.13	0	-
1988	159	44	0	27.7	559	163	0	0	0	4	28	4	4	6	0	46	19	3	1	212	66	0.62	0	-
1989	112	36	0	32.1	419	129	0	0	0	0	27	2	1	1	0	32	10	3	0	122	13	0.21	0	-
1990	85	42	0	49.4	305	154	0	0	0	1	13	2	0	0	0	17	8	2	0	149	29	0.39	0	-
1991	108	59	0	54.6	377	211	0	0	0	3	13	2	0	0	0	25	3	3	0	166	29	0.35	0	-
1992	94	36	0	38.3	326	130	0	0	0	1	42	1	0	0	0	9	2	1	0	112	19	0.34	0	-
1993	54	37	0	68.5	195	130	0	0	0	4	1	1	0	3	0	5	3	0	0	109	58	1.06	0	-
1994	52	23	0	44.2	177	80	0	0	0	0	15	0	1	2	0	6	3	2	0	62	19	0.61	0	-
1995	56	9	28	16.1	189	29	93	78	7	3	12	1	0	0	0	0	2	1	0	63	5	0.16	76	-
1996	17	0	8	0.0	46	0	20	18	0	2	3	0	0	0	0	2	1	1	0	22	0	0.00	15	-
1997	14	7	0	50.0	50	23	0	0	0	1	1	1	1	0	0	1	1	1	0	22	0	0.00	0	-
1998	28	20	1	71.4	100	70	4	4	0	0	1	0	0	0	0	3	1	1	1	49	54	2.20	2	-
1999	95	49	5	51.6	348	184	14	13	0	7	7	0	0	1	0	13	8	2	3	141	113	1.60	11	-
2000	125	87	10	69.6	460	321	34	17	0	0	2	1	0	0	0	17	5	3	0	186	206	2.22	17	-
2001	114	96	0	84.2	429	358	0	0	0	0	0	2	0	2	0	6	3	5	0	218	201	1.84	0	-
2002	161	126	0	78.3	587	456	0	0	0	3	12	5	1	0	0	8	2	4	0	260	288	2.22	0	-
2003	176	121	0	68.8	653	442	0	0	0	12	10	5	1	9	0	11	2	4	1	286	271	1.90	0	-
2004	167	102	0	61.1	566	362	0	0	0	3	29	2	0	12	0	8	2	8	1	262	245	1.87	0	-
TOTAL	1814	894	52	55.3	6484	3386	165	130	7	44	216	29	9	36	0	209	75	44	7	2790	1720	1.23	121	-

Total																								
1986*	93	0**	0	0	326	25	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	183	5	0.05	0	0
1987*	129	0**	0	0	453	128	0	0	0	0**	0**	0**	0**	0**	0**	0**	0**	0**	0**	193	101	1.05	0	0
1988**	169	45	0	39	591	166	0	0	0	7	28	4	4	6	0	49	22	3	1	243	67	0.55	0	0
1989**	121	41	0	88	453	146	0	0	0	1	29	2	1	1	0	32	11	3	0	140	18	0.26	0	0
1990**	125	52	0	147	437	190	0	0	0	6	27	4	0	0	0	22	12	2	0	191	43	0.45	0	0
1991**	152	65	0	86	507	225	0	0	0	17	17	3	0	1	0	43	3	3	0	241	35	0.29	0	0
1992	104	40	0	122	359	144	0	0	0	1	44	1	0	0	0	12	2	2	0	126	22	0.35	0	0
1993	83	49	0	205	287	169	0	0	0	5	7	1	0	3	0	11	7	0	0	170	59	0.69	0	0
1994	73	29	0	141	255	101	0	0	0	1	21	1	1	6	1	7	3	3	0	122	21	0.34	0	0
1995	78	12	33	41	244	36	106	88	7	10	16	1	0	0	0	3	2	1	0	83	10	0.24	80	4
1996	39	1	25	25	110	15	61	49	0	5	3	0	0	0	0	3	1	1	0	38	3	0.16	44	0
1997	26	11	0	83	92	37	0	0	0	2	1	2	1	1	0	2	4	2	0	40	8	0.40	0	0
1998	107	86	6	315	384	296	24	23	0	1	1	1	0	0	1	5	2	3	1	215	208	1.93	21	0
1999	212	68	10	112	695	249	25	15	0	39	25	1	0	5	0	36	15	9	3	272	152	1.12	13	0
2000	222	147	13	251	773	507	46	18	0	0	5	1	0	10	0	33	8	3	1	351	299	1.70	18	24
2001	219	156	14	254	787	572	46	36	0	9	3	3	0	10	0	10	7	7	0	396	326	1.65	12	0
2002	285	213	3	266	1008	749	9	9	0	10	18	6	1	6	0	15	8	5	0	479	524	2.19	9	0
2003	327	243	0	269	1216	889	0	0	0	15	11	5	1	14	1	21	6	8	2	569	525	1.85	0	0
2004	350	245	0	212	1215	855	0	0	0	3	39	2	0	16	6	14	9	11	3	580	476	1.64	0	0
GR. TOTAL	2914	1503	104	56.3	10192	5499	317	238	7	132	295	38	9	79	9	318	122	66	11	4632	2902	1.25	197	28

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