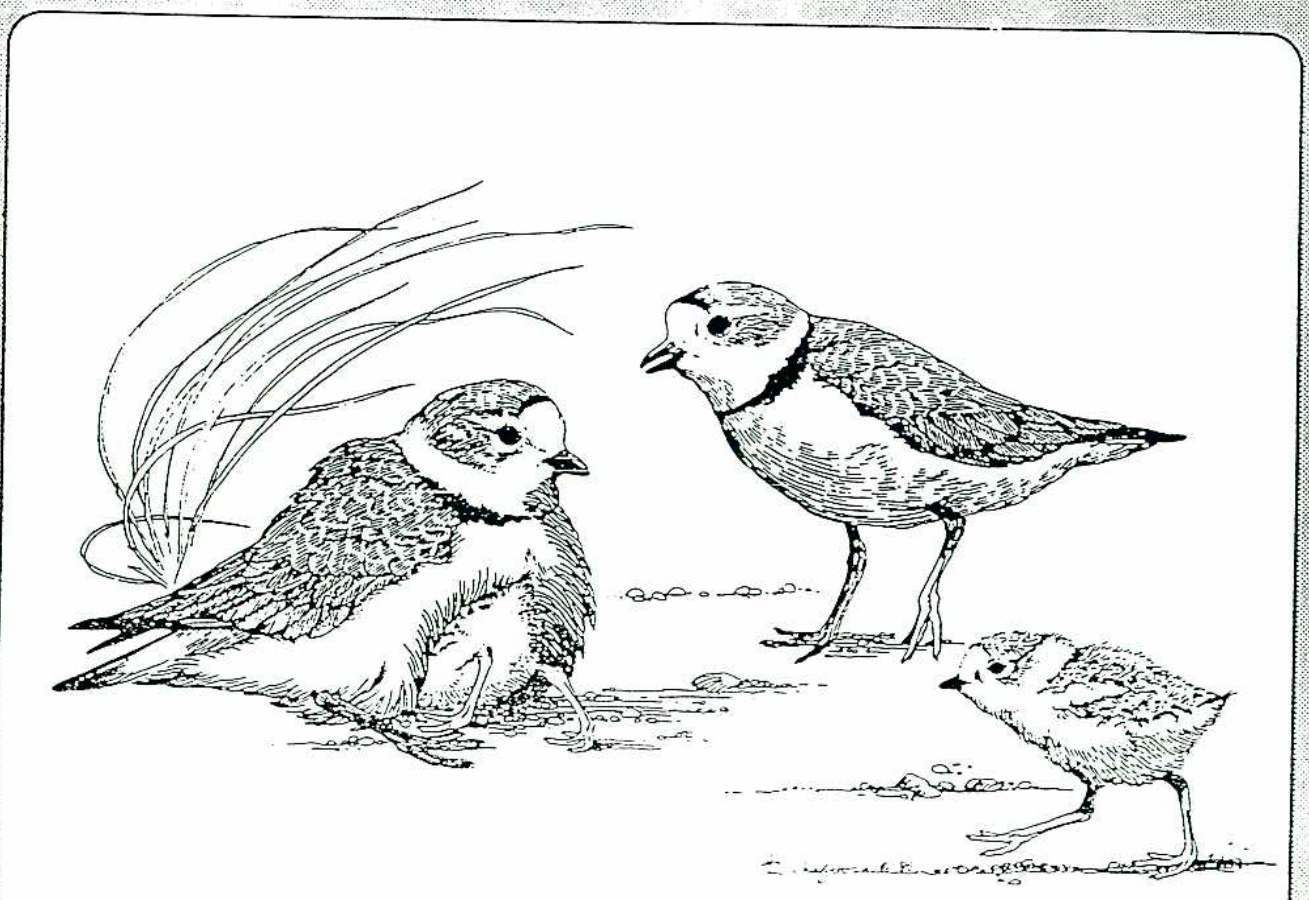
Great Lakes & Northern Great Plains Piping Plover

Recovery Plan



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

RECOVERY PLAN FOR PIPING PLOVERS

Charadrius melodus

OF THE GREAT LAKES AND NORTHERN GREAT PLAINS

Prepared by the Great Lakes / Northern Great Plains

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SUMMARY

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

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

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

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

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

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

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

DISCLAIMER

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

Literature Citation should read as follows:

U.S. Fish and Wildlife Service 1988. Great Lakes and Northern Great Plains Piping Plover Recovery Plan. U.S. Fish and Wildlife Service, Twin Cities, MN. 160 pp.

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U.S. Fish and Wildlife Service Reference Service

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ACKNOWLEDGEMENTS

The Great Lakes/Northern Great Plains Piping Plover Recovery Plan was prepared by the U.S. Fish and Wildlife Service in collaboration with the Great Lakes/Northern Great Plains Piping Plover Recovery Team. The following people are gratefully acknowledged for reviewing previous drafts of the Recovery Plan: T. Allan, J. Angelle, G. Baldassarre, D. Blankinship, D. Bowman, K. Burke, R. Crete, R. Cummings, F. Cuthbert, J. Dinsmore, R. Drobney, M. Dryer, P. Dryer, A. Dood, R. Dyer, J. Eldridge, T. Eubanks, D. Ewert, C. Faanes, J. Flynn, M. Friend, S. Fritts, G. Gage, J. Gauthier, P. Goossen, C. Griffin, K. Higgins, E. Hinds, F. Howe, D. Howell, C. Iverson, H. Kantrud, K. Keenlyne, R. Kreil, G. Lingle, A. Link, S. Matteson, B. Miller, R. Miller, L. Oring, D. Prellwitz, D. Reeves, R. Refsnider, D. Roosa, E. Russell, M. Schwalbach, J. Sedgwick, R. Sparrowe, J. Spinks, K. Strom, P. Sykes, N. Thomas, D. Trauger, G. Vandel, G. Waller, and G. Willson.

R. Sayler, Institute for Ecological Studies-University of North Dakota, donated use of office, computer, and other IES supplies for preparation of previous drafts of the plan. J. Sutherland, E. Carroll, and J. Ballou provided word processing services and computer expertise.

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I. INTRODUCTION

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

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

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

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

Description

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

Taxonomy

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

Distribution

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

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

Historic Distribution

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

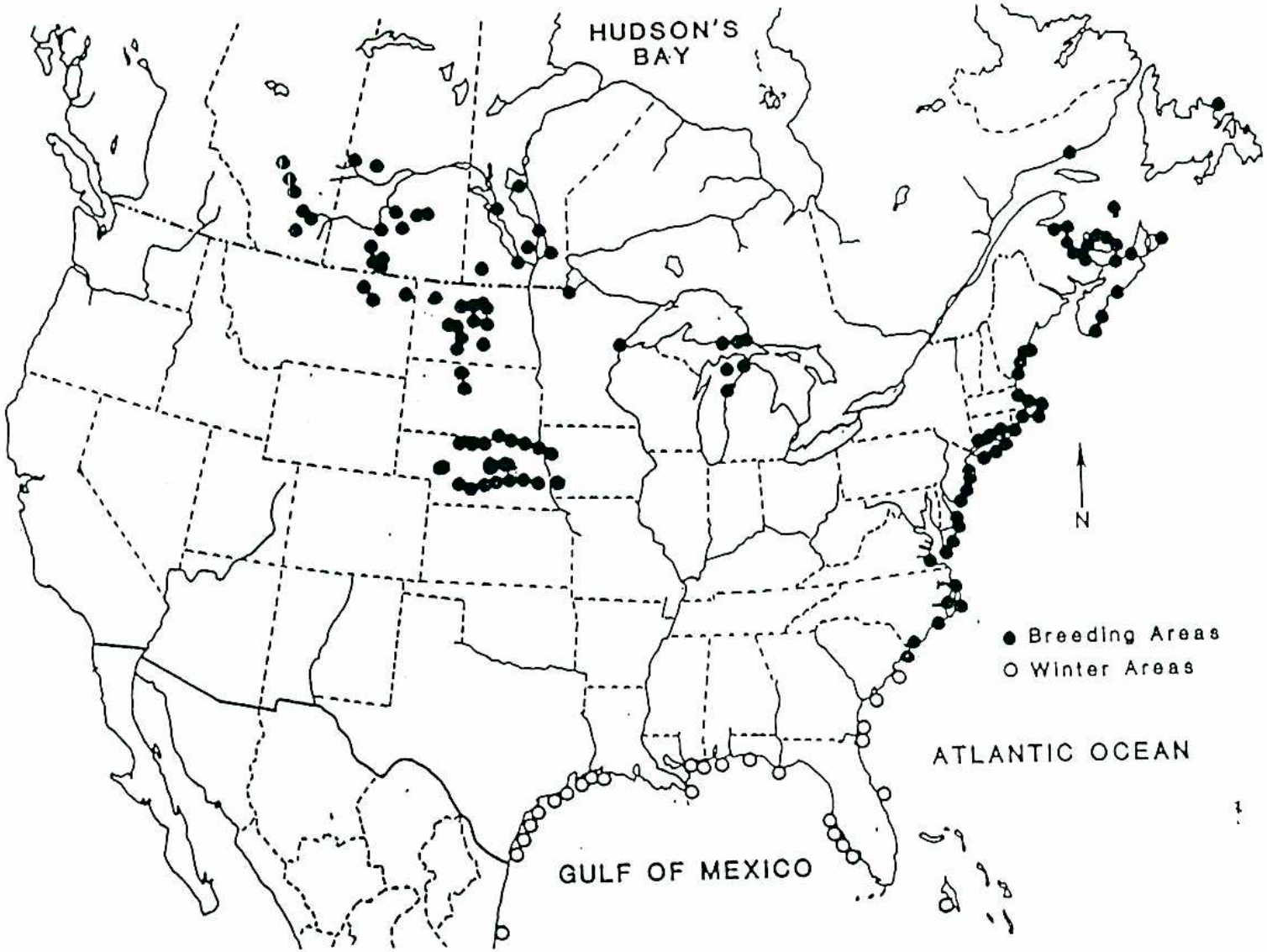

Figure 1. Breeding and winter distribution of Piping Plovers since 1986 (from Haig and Oring 1988c).

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

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

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

Table 1 continued

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

Table 1 continued

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

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

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

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

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

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

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

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

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

Current Distribution

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Life History

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Habitat Requirements

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table 4 continued

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

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

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

Reasons for Decline

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Conservation Efforts

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

II. RECOVERY

Recovery Objective

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

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

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

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

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

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

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

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

Montana - 60 pairs

North Dakota - 650 pairs

Missouri River - 100 pairs

Missouri Coteau - 550 pairs

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

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

Other Missouri River sites - 75 pairs

Other sites - 25 pairs

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

Platte River - 140 pairs

Niobrara River - 50 pairs

Missouri River - 250 pairs

Loup River system - 25 pairs

Minnesota - 25 pairs (Lake of the Woods)

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

A. Number of birds will increase to 150 pairs.

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

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

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

Duluth/Superior - 5 pairs

Wisconsin - 15 pairs (including Duluth/Superior)

Michigan - 100 pairs

Other Great Lakes sites - 35 pairs

Step-Down Outline

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

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

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

132. Annually census known wintering areas.

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

134. Assess mortality of wintering Piping Plovers.

2. Determine current habitat requirements and status.

21. Determine breeding habitat requirements and status.

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

212. Quantify and evaluate available breeding habitat.

213. Eliminate current or potential threats to breeding habitat.

22. Determine current migration habitat requirements and status.

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

222. Quantify and evaluate available habitat.

223. Eliminate current or potential threats to migration habitat.

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

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

232. Quantify and evaluate available winter habitat.

233. Eliminate current/potential threats to habitat.

3. Protect, enhance and increase Piping Plover populations.

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

311. Increase reproduction and survival at occupied breeding sites.

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

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

3113. Restrict human and vehicular access to nesting areas.

3114. Restrict livestock and domestic animals a nesting sites.

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

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

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

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

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

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

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

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

3222. Investigate the effects of environmental contaminants.

4. Preserve and enhance habitat.

41. Provide protection and management of breeding habitat.

411. Identify areas of essential habitat.

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

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

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

415. Develop criteria and priorities for habitat protection.

416. Develop management plans for riverine habitat.

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

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

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

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

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

417. Develop management plans for lake habitat.

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

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

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

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

418. Develop management plans for prairie wetland habitat.

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

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

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

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

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

420. Evaluate success of protection and management techniques.

42. Provide protection and management of migration habitat.

43. Provide protection and management of winter habitat.

431. Identify areas of essential habitat.

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

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

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

435. Develop criteria and priorities for habitat protection.

436. Develop management techniques.

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

438. Evaluate success of protection and management techniques.

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

51. Inform and educate the general public.

511. Identify target audiences among the general public.

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

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

514. Provide controlled viewing opportunities if and when appropriate.

52. Inform and educate public resource management agencies.

521. Identify critical resource agency constituents.

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

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

6. Coordinate recovery efforts.

61. Designate a recovery plan coordinator.

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

63. Coordinate international research and management activities.

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

Narrative

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

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

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

11. Assess status and distribution of breeding populations.

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

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

111. Survey beaches, sandbars, and other suitable habitats to determine breeding distribution.

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

112. Census known and potential breeding sites.

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

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

113. Monitor reproductive success.

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

114. Assess dispersal patterns and genetic diversity.

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

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

115. Assess mortality.

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

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

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

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

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

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

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

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

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

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

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

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

132. Annually census known wintering areas.

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

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

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

134. Assess mortality of wintering Piping Plovers.

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

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

2. Determine current habitat requirements and status.

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

21. Determine breeding habitat requirements and status.

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

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

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

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

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

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

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

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

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

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

213. Eliminate current or potential threats to breeding habitat.

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

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

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

22. Determine current migration habitat requirements and status.

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

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

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

222. Quantify and evaluate available habitat.

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

223. Eliminate current or potential threats to migration habitat.

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

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

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

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

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

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

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

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

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

233. Eliminate current or potential threats to winter habitat.

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

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

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

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

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

311. Increase reproduction and survival at occupied breeding sites.

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

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

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

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

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

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

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

3113. Restrict human and vehicular access to nesting areas.

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

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

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

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

3114. Restrict livestock and domestic animals at nesting sites.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3221. Investigate effects of human activities o
winter survival.

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

3222. Investigate the effects of environmental contaminants.

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

4. Preserve and enhance habitat.

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

41. Provide protection and management of breeding habitat.

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

411. Identify areas of essential habitat.

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

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

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

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

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

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

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

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

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

415. Develop criteria and priorities for habitat protection.

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

416. Develop management plans for riverine habitat.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

4173. Identify needs and techniques for managing water levels.

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

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

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

418. Develop management plans for prairie wetland habitat.

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

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

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

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

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

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

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

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

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

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

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

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

420. Evaluate success of protection and management techniques.

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

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

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

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

431. Identify areas of Essential Habitat.

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

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

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

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

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

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

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

435. Develop criteria and priorities for habitat protection.

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

436. Develop management techniques.

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

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

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

438. Evaluate success of protection and management techniques.

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

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

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

51. Inform and educate the general public.

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

511. Identify target audiences among the general public.

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

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

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

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

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

514. Provide controlled viewing opportunities if and when appropriate.

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

52. Inform and educate public resource management agencies.

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

521. Identify critical resource agency constituents.

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

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

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

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

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

6. Coordinate recovery efforts.

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

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

61. Designate a recovery plan coordinator.

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

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

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

63. Coordinate international research and management activities.

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

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

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

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

III. IMPLEMENTATION

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

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

KEY TO IMPLEMENTATION SCHEDULE
General Category (column 1):

Information Gathering - I or R (Research)

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

Acquisition - A

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

Management - M

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

Priority (column 4):

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

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

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

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

Agency Responsibility (column 6):

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

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

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

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

IMPLEMENTATION SCHEDULE A continued

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

IMPLEMENTATION SCHEDULE A (Continued)

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

IMPLEMENTATION SCHEDULE A continued

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

IMPLEMENTATION SCHEDULE B:

Priority Recovery Tasks for the Great Lakes

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

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

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

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

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

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

IMPLEMENTATION SCHEDULE C:

Priority Recovery Tasks for the Northern Great Plains

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

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

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

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

4161-4162 Determine effects of river hydraulics and sediment discharge on breeding habitat; identify flow regimes to protect habitat.

4183 Identify specific threats to prairie wetland habitats.

419 Modify and/or eliminate construction activities that impact breeding habitat.

437 Modify and/or eliminate construction activities that impact winter habitat.

61-63 Coordinate recovery activities.

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

Task # 115,117 Assess mortality and identify life history parameters (population modeling).

413 Establish liaison to protect breeding habitat.

4163 Determine relationship of existing artificial breeding sites to riverine sites.

4183 Identify need and techniques to protect wetland habitats.

433-434 Establish liaisons for winter habitat; revise or establish laws; develop priorities for habitat protection.

511-513 Inform and educate the general public.

52 Inform and educate public resource management agencies.

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APPENDIX 1

State Contact People

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

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

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

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

Ms. Nancy J. Craig
Louisiana Dept. of Wildlife & Fisheries
Louisiana Natural Heritage Program
DNR-CMD
PO Box 44124
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Austin, Texas 78744
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Nongame Biologist
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Madison, Wisconsin 53707
608/266-1571

APPENDIX 2

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

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

AREAS OF ESSENTIAL HABITAT

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

MONTANA

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

NEBRASKA

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

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

NEBRASKA/SOUTH DAKOTA (Common Border)

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

NORTH DAKOTA

All existing and reoccurring Missouri River sandbars suitable for Piping Plover nesting from Garrison Dam to the outflow of the Cannonball River.

Alkali wetlands with Piping Plover habitat characteristics (Whyte 1985, Prindiville 1986) within the two glacial outwash plains of central North Dakota (centered in Kidder and McLean County) including the Chain of Lakes area in McLean County and Lostwood National Wildlife Refuge. The essential habitats are the wetlands and their shorelines.

Boundaries of these areas are:

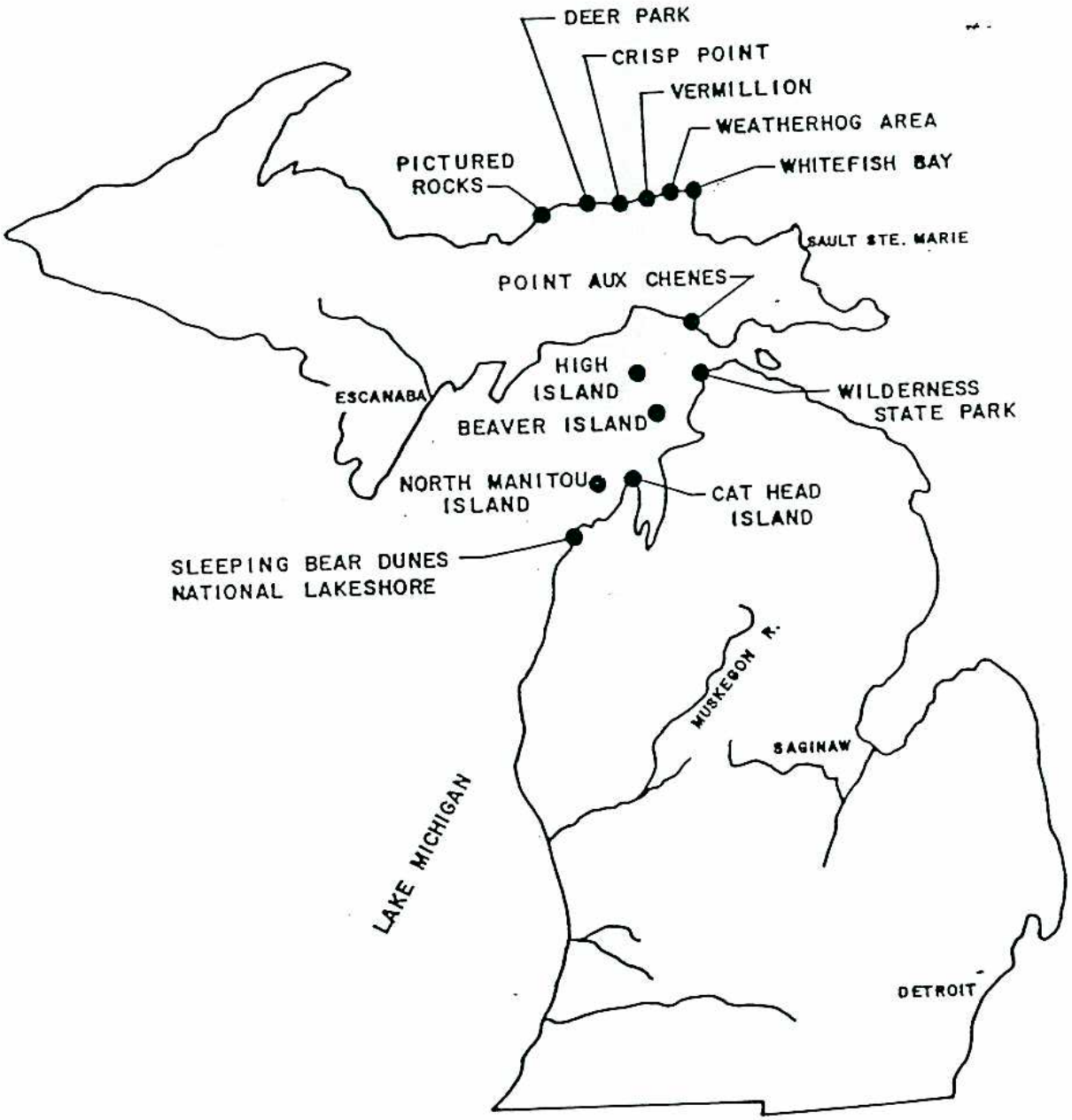
- Northwest portion of Benson County located west of State Highway 30 and north of State Highway 19.
- The portion of Kidder County located south of State Highway 36
- The portion of McHenry County located south of U.S. Highway 2 and east of State Highways 14 and 53.

NORTH DAKOTA continued:

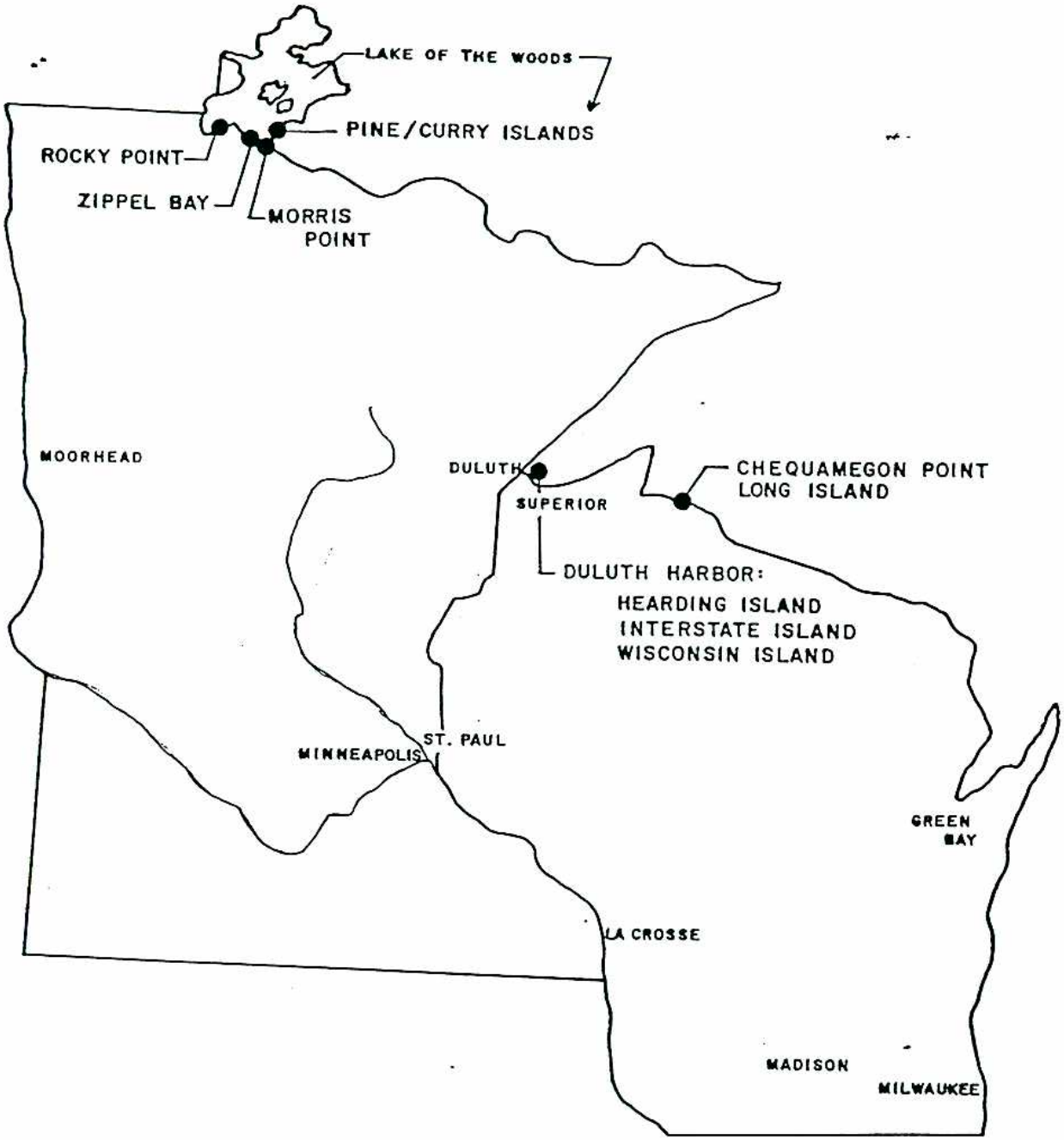
- The following townships in McLean County: Lake Williams (T147N R80W), Wise (T147N R79W), McGinnis (T149N R84W), and Rosemont (T150N R84W).
- The portion of Montrail County loeated north of U.S. Highway 2.
- The portion of Pierce County located south of U.S. Highway 2.
- The portion of Sheridan County located north of State Highway 200.
- Chase Lake National Wildlife Refuge in Stutsman County.
- Linton Township (T153N R86W) in Ward County.

SOUTH DAKOTA	All existing and reoccurring sandbars suitable for Piping Plover nesting within the Missouri River from Fort Randall Dam to Ponca, Nebraska; and beach and island habitats along Oahe Reservoir in Potter, Sully, Stanley, and Dewey County.	
TEXAS*	Jefferson Co.	- Sea Rim State Park
	Galveston Co.	- Galveston Jetty, San Luis Pass, Gilchrist, Bolivar Flats
	Brazoria Co.	- San Bernard NWR
	Calhoun Co.	- Matagorda Island
	Aransas Co.	- Aransas Co. airport flats
	Nueces Co.	- 1850 Pass
		- Packery Channel
		- Flats between Corpus Christi State Univ. & Corpus Christi Naval Air Station
		- Padre Island National Seashore
	Kleberg Co.	- Padre Island National Seashore
	Kenedy Co.	- Padre Island National Seashore
	Willacy Co.	- Padre Island National Seashore
	Cameron Co.	- Padre Island National Seashore
		Brazos Island State Park
WISCONSIN	Ashland Co.	- Chequamegon Point, Long Island
	Superior Co.	- Interstate Island
	Douglas Co.	- Wisconsin Point

* Essential areas are coastal beach, mudflat, and sandflat habitats.

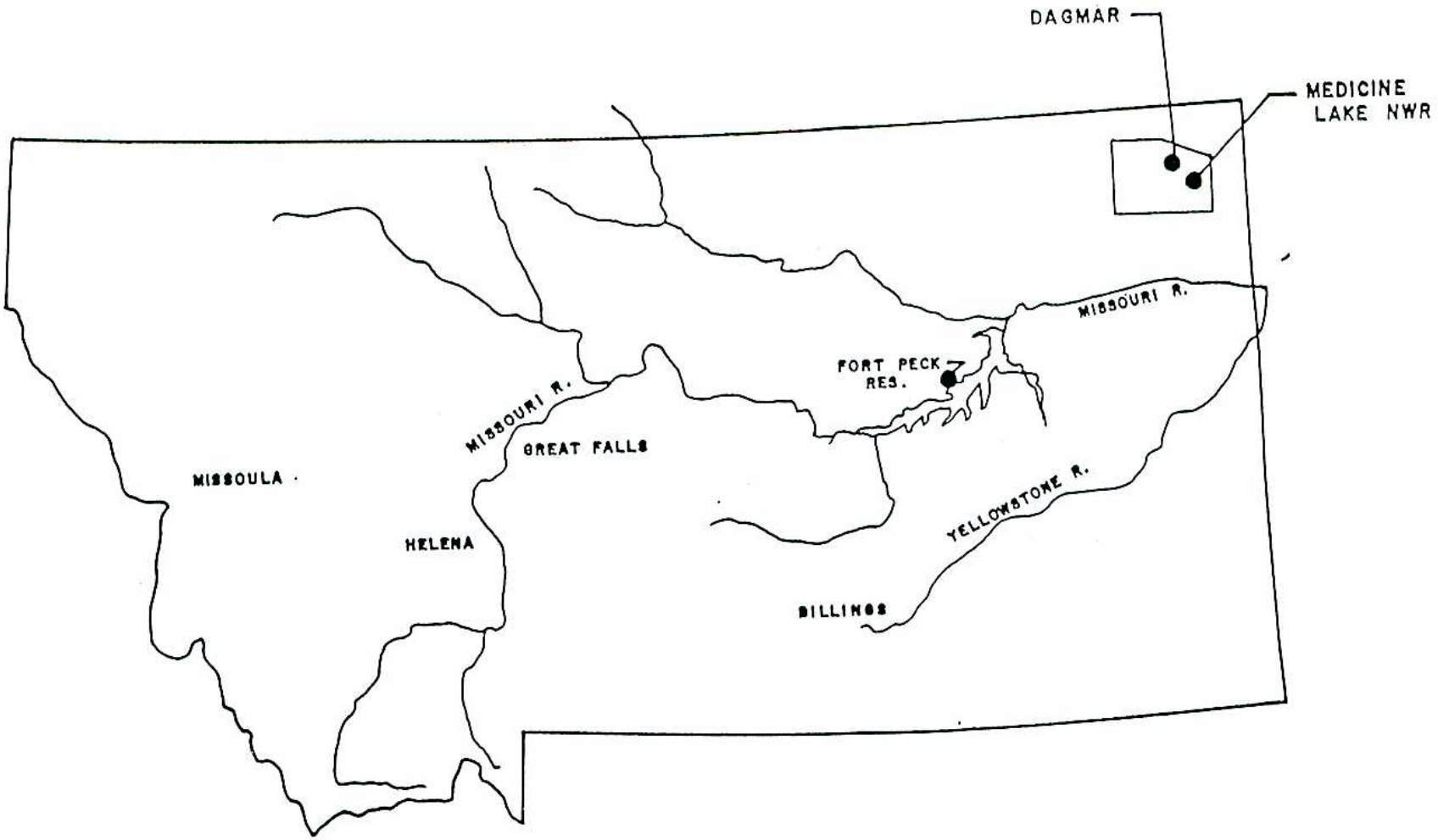


ESSENTIAL PIPING PLOVER HABITAT IN MICHIGAN
(DOTS INDICATE ESSENTIAL AREAS)



ESSENTIAL PIPING PLOVER HABITAT IN MINNESOTA & WISCONSIN

(DOTS INDICATE ESSENTIAL AREAS)



ESSENTIAL PIPING PLOVER HABITAT IN MONTANA
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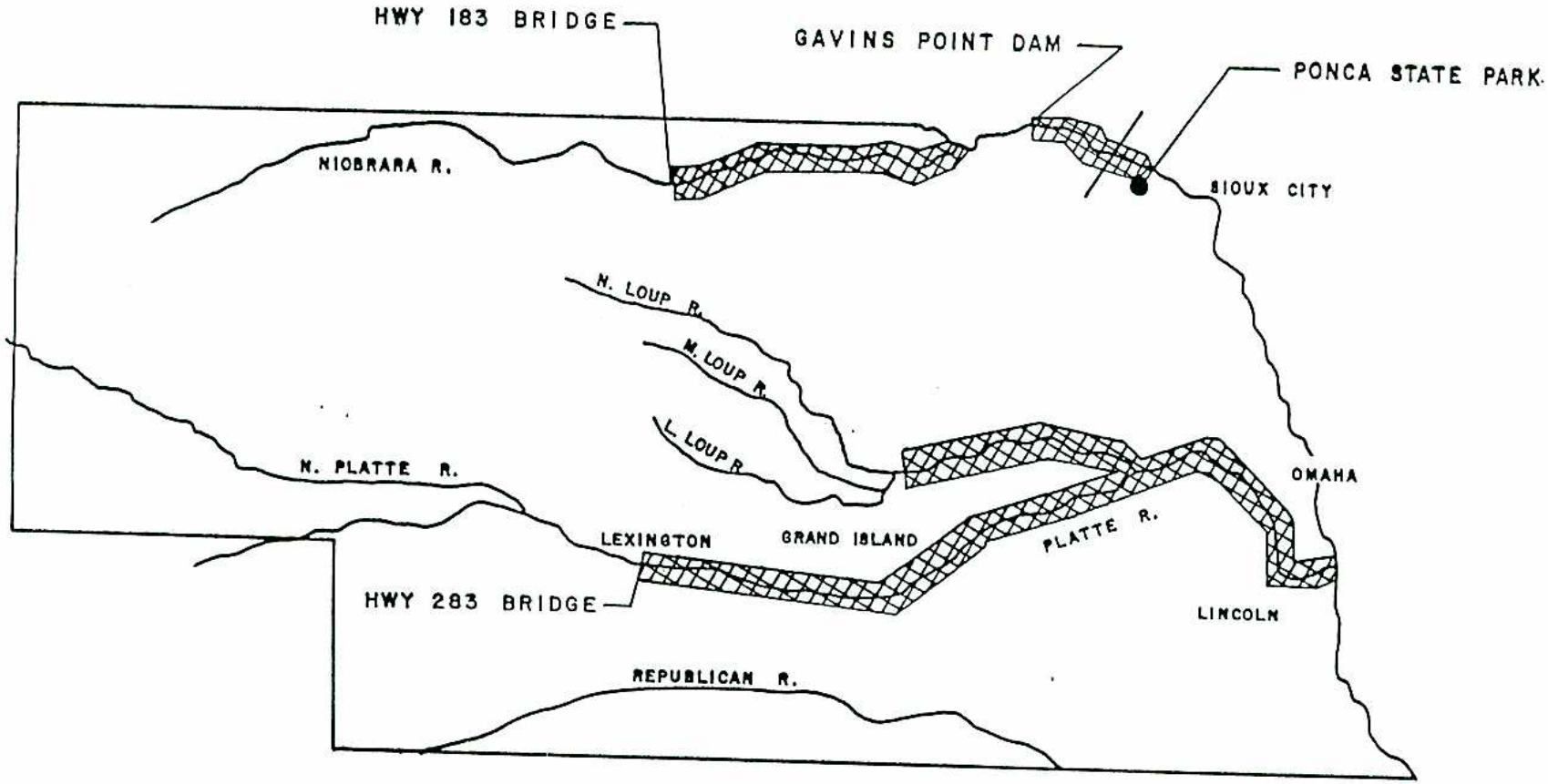
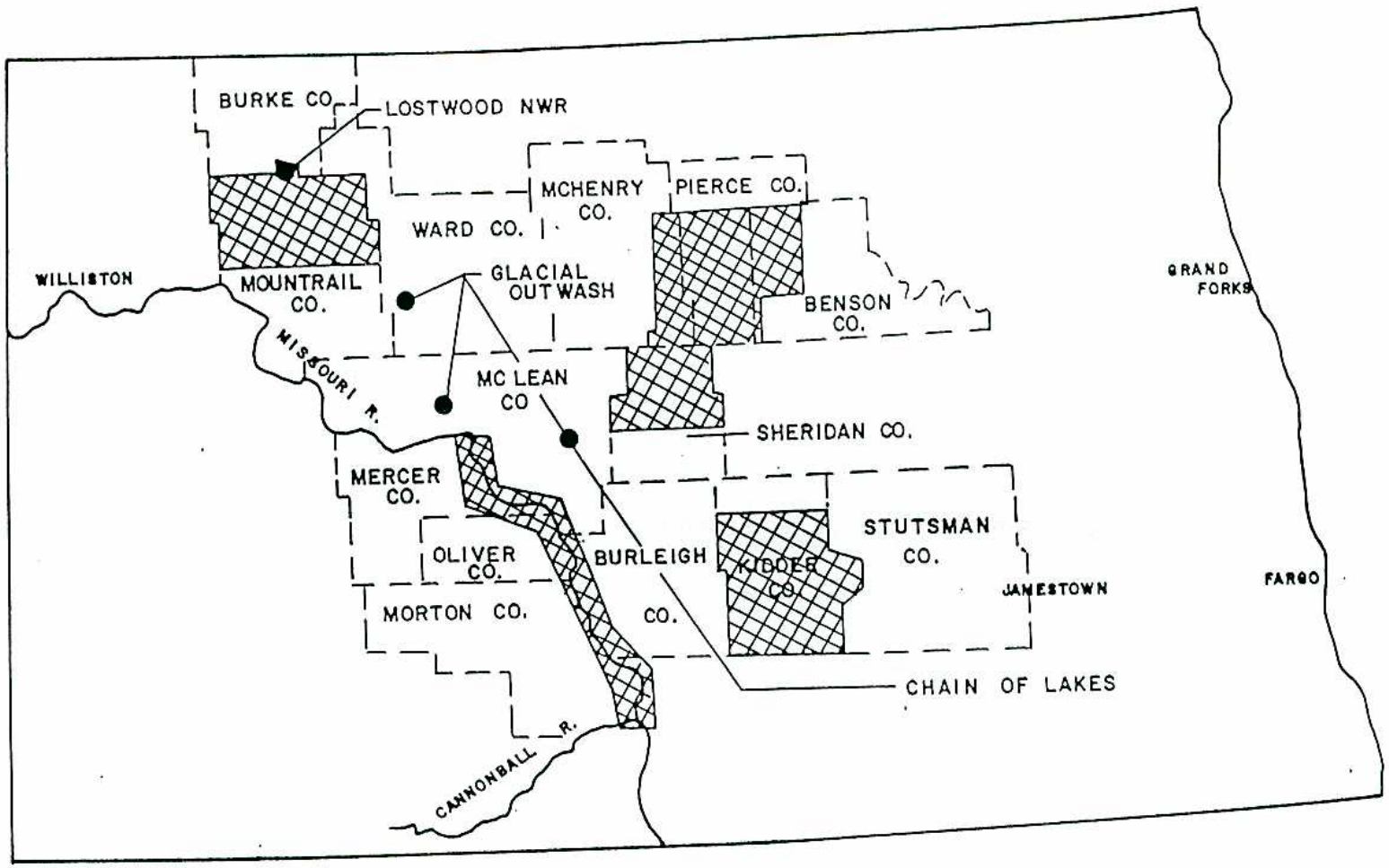


ESSENTIAL PIPING PLOVER HABITAT IN NEBRASKA

(EXISTING AND REOCCURRING SANDBARS WITHIN THE CROSS-HATCHED AREAS CONTAIN ESSENTIAL HABITAT)

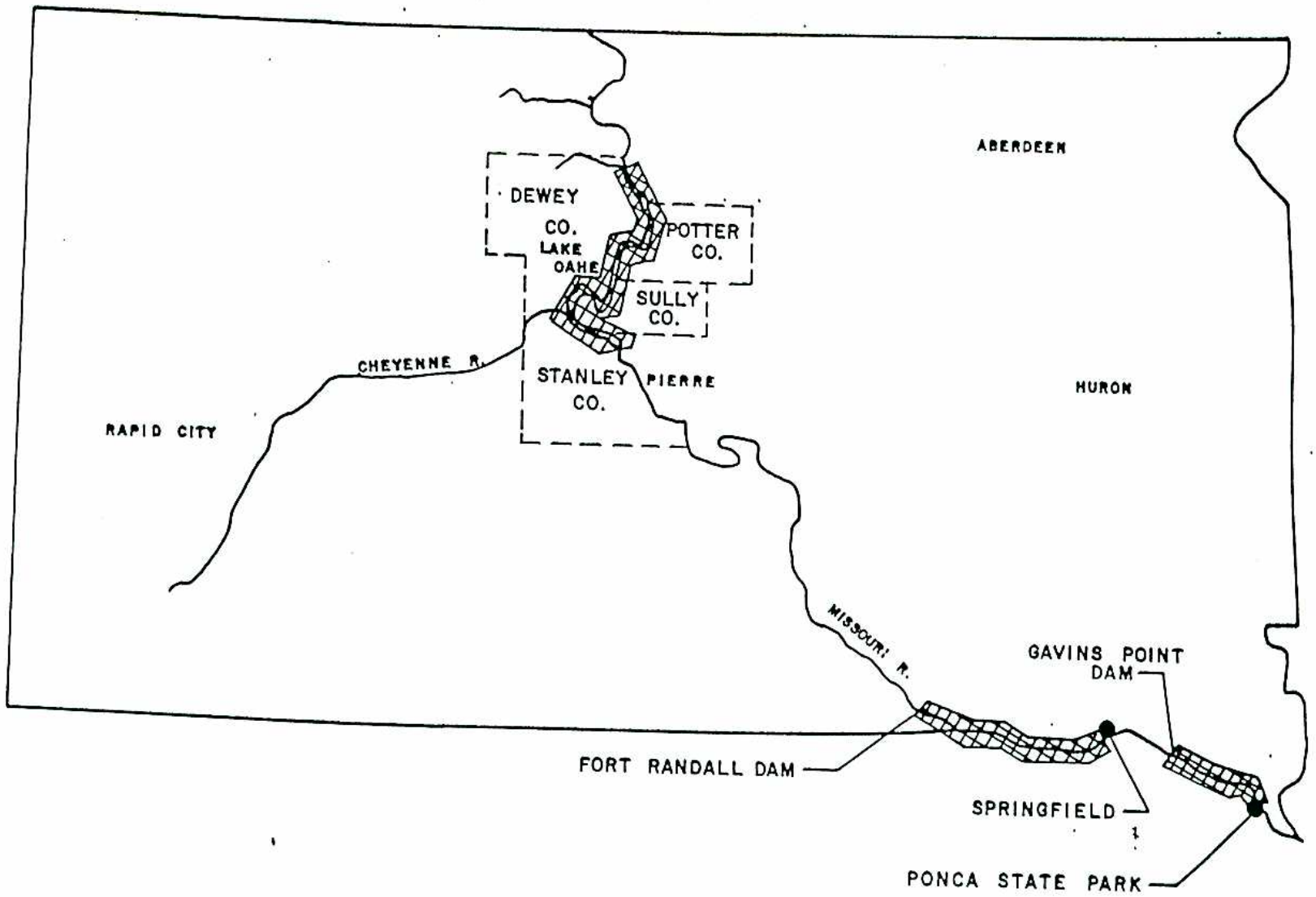
(DOTS INDICATE ESSENTIAL AREAS)



ESSENTIAL PIPING PLOVER HABITAT IN NORTH DAKOTA

(ALKALI WETLANDS AND EXISTING AND REOCCURRING SANDBARS WITHIN CROSS-HATCHED AREAS CONTAIN ESSENTIAL HABITAT)

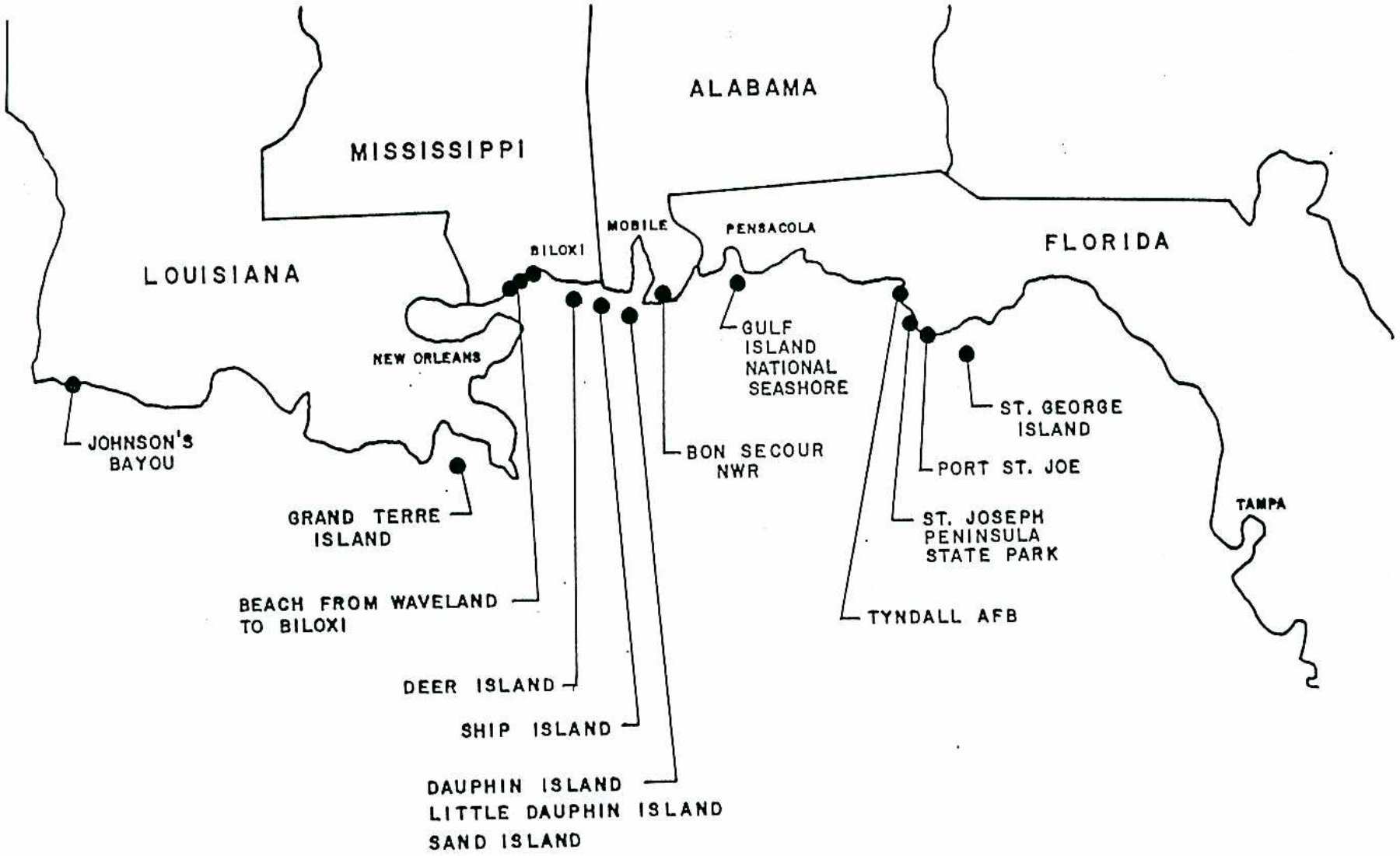
(DOTS INDICATE ESSENTIAL AREAS)



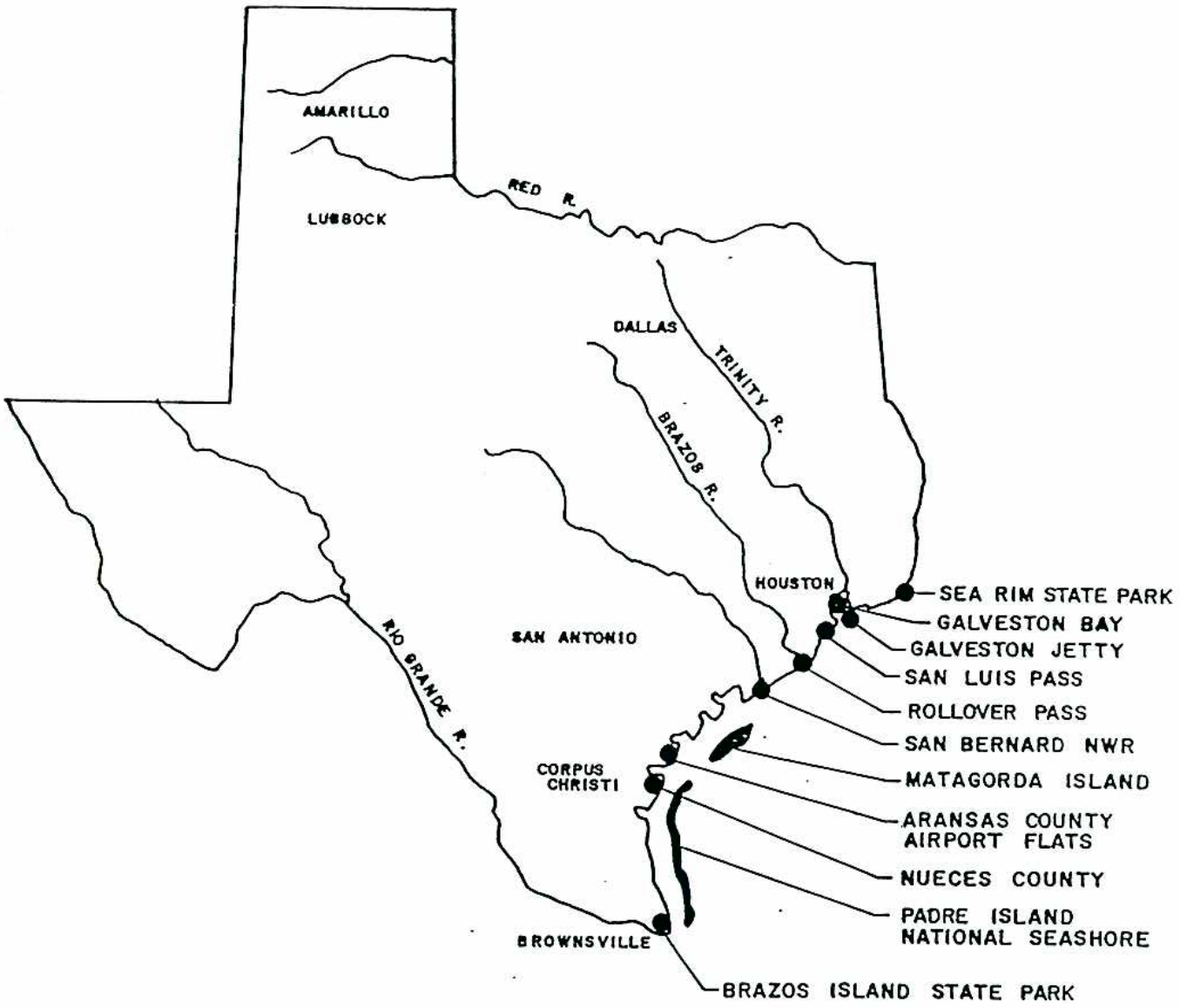
ESSENTIAL PIPING PLOVER HABITAT IN SOUTH DAKOTA

(EXISTING AND REOCCURRING SANDBARS WITHIN THE CROSS – HATCHED AREAS CONTAIN ESSENTIAL HABITAT)

(DOTS INDICATE ESSENTIAL AREAS)



ESSENTIAL PIPING PLOVER HABITAT IN LOUISIANA, MISSISSIPPI, ALABAMA AND FLORIDA (DOTS INDICATE ESSENTIAL AREAS)



ESSENTIAL PIPING PLOVER HABITAT IN TEXAS
(DOTS AND SHADED AREAS INDICATE ESSENTIAL AREAS)

APPENDIX 3

International Color Banding Scheme For Piping Plovers

In an effort to coordinate color marking of Piping Plovers, the Atlantic Coast and Great Lakes/Northern Great Plains Recovery Teams have developed a color flagging scheme that will provide information about the birds' population dynamics, migration, and wintering activities. A color flagging system using UV stable "DARVIC" blanks for forming leg flags will be required on all color marking authorizations. The color flagging scheme is:

ATLANTIC COAST	GREAT LAKES/GREAT PLAINS
Black - MA	White - Prairie Canada*
Red - VA, MD*	Green - ND, MN*
Yellow - NY, NJ*	Orange - MI, MT*
Brown - Maritime Canada	Light Blue - SD, NE*

*Alternate legs will be used to distinguish between States or Provinces.

Handling or disturbing Piping Plovers requires an endangered species permit which can be obtained from the U.S. Fish and Wildlife Service regional offices (State permits may also be required).

Authorizations to color mark or band Piping Plovers must be obtained from:

Bird Banding Laboratory
U.S. Fish and Wildlife Service
Office of Migratory Bird Management
Laurel, MD 20708

Report sightings to:

Bird Banding Laboratory
U.S. Fish and Wildlife Service
Office of Migratory Bird Management
Laurel, MD 20708

and:

Dr. Susan Haig
Dept. of Zoological Research
National Zoological Park
Smithsonian Institution
Washington, D.C. 20008

APPENDIX 4

Preparation of International Flags for Banding Piping Plovers

As outlined in Appendix 3, U.S. and Canadian recovery efforts have adopted an international flagging scheme to provide quick and precise identification of marked Piping Plovers, regardless of the time of year. Described below is the process for constructing the flags. They are quite simple to make, can be prepared before going into the field, and are placed on Piping Plovers in the same manner as a color band. Flags have been used successfully on Piping Plovers for four years or more in North Dakota, Minnesota, and Manitoba. Furthermore, they are used extensively on Sanderlings (Calidris alba), Red Knots (Calidris canutus), and other shorebird species (Myers et al. 1983) with great success.

Materials:

1. UV stable .5 cm x 3.5 cm DARVIC plastic strips in the appropriate color. Order from A.C. Hughes, 1 High St., Hampton Hill, Middlesex England, TW12 1NA.
2. A glass stirring rod of a diameter comparable to a Piping Plover color band.
3. A stove or bunsen burner
4. Pan or beaker of hot water
5. Pan of cool water
6. Tweezers or forceps

Procedure: (See illustrations below)

1. Bring water to a boil.
2. Using forceps, pick up one plastic strip, hold in hot water until pliable.
3. Remove plastic strip and immediately wrap around stirring rod so that equal amounts of the plastic strip are on each side of the rod.
4. Use forceps to tighten tabs at base end closest to stirring rod. Hold tabs together tightly so that when released, there is no gap between the two tabs and each is exactly parallel to the other.
5. Dip finished flag in cold water.
6. If finished flag is not correct, you may remelt the strip and start again, although the plastic does not wrap as tightly the second time.
7. In the field, use a banding spoon to place flag on Piping Plover. The two tabs should close tightly enough so that glue or further melting is not necessary. Be sure the flag is not too tight on the birds' leg.
8. Flags work best when placed above the USFWS band or a color band.
9. Wait to place flags on chicks until they are near fledging.

BIRD'S EYE VIEW OF FLAG PREPARATION

A. DARVIC Strip

B. Wrap around rod

C. Pinch to insure tightness.

APPENDIX 5

Guidelines For Conducting Piping Plover Censuses and Surveys

(Adopted from Dyer et al. 1987)

Recently, many surveys and intensive studies have been conducted on Piping Plovers. Concerns have been raised that such studies may affect productivity of breeding birds by disrupting incubation and brooding efforts, and by rendering nests and chicks more susceptible to predators. While it is recognized that such work is necessary to establish baseline data on population size and trends, it is hoped that research personnel will attempt to reduce stress to nesting birds and focus research efforts only on critical needs.

In order to analyze population size and trends, it is important that state surveys be conducted in a consistent manner, with standardized results. Currently, some states record nesting pairs while others tabulate only adult birds seen. For a one-time census, number of breeding pairs would be the most valuable data to record. Examples of "breeding pairs" would be a pair together on territory, a nest seen with either bird incubating, or adult(s) seen with young. A courting male should not be taken a prima facie evidence of nesting, as males may be unmated and still displaying or a member of the nonbreeding cohort. If a male is seen directing courting activity at a nearby female, a breeding pair should be recorded. All other adults, whether nonbreeders or transients, should be recorded but included separate from breeding pairs. If it is

possible to make a follow-up census to count fledged young, productivity information should be recorded as the number of fledged young/breeding pair. Ideally, "fledged young" should have acquired first juvenile plumage. However, if the young are nearly at that stage (20+ days old), it is safe to assume that they will eventually fledge and so can be included as fledged young.

General Survey Guidelines

For general censuses (for example: how many pairs of Piping Plovers nest in Nebraska?), observers should visit sites when plovers are on territory and visible, but when nesting birds are the least sensitive to disturbance. The best "window" is probably early in the morning during a two-week period from the middle to end of incubation. Total incubation requires 25 to 30 days after the clutch of eggs (n=4) is complete. Towards the end of incubation, adult birds exhibit great fidelity to the nest and are not as inclined to desert as at the beginning of incubation.

In a follow-up census to count young, the best period will occur when the young are able to fly and capable of leaving the nest area. From observations made from the initial survey, predict peak hatching dates and allow 20 days so that young will be nearly mature and less sensitive to disturbance and predation. Young chicks are often lead into the dunes by adults, making them impossible to find. Renesting attempts should be documented for accurate productivity estimates.

Survey Conditions

Early morning is the best time to survey nesting Piping Plovers. Adults and young are generally more active and feeding in the morning before beach use increases. While adults are incubating, excessive heat as well as cold, can be damaging to eggs. Disturbance should be minimized during the heat of mid-day when eggs need to be shaded by adult birds. If an early morning time frame is not practical, late afternoon is the second choice. Periods of rain or other inclement weather (very hot or cold days) should be avoided, since it is critical that adults be able to incubate or brood young without disturbance during such conditions.

Survey Methods

Recognizing that every site is unique in beach width, topography, etc., the following general suggestion are offered: Two observers are ideal to efficiently conduct a census in a given area: one person monitors the nest and birds from a distance (100 yards), while the other approaches more closely.

Equipment: In most cases, a pair of binoculars (7X+) will be sufficient, although a spotting scope (of 20X+) will insure proper identification of color bands. The scope can be used by one observer to maintain visual contact with a potential nest site at a distance (100 yards), while another observer approaches the site more closely with binoculars. A field notebook is necessary to record observations, habitat parameters, etc.

Route: For a typical beach situation, most nests will be located near the vegetation line. Walk a route parallel to the shoreline, but not so far up the beach that nests are accidentally disturbed. Walk slowly and listen for birds that might not yet be visible to the eye. For wide areas of habitat, additional parallel transects may be necessary to get accurate results.

Locating Territories and Nests: As a nest is approached adult birds will usually be vocal (loud, two-note "peep-lo"), particularly later in incubation. During egg-laying, adults often leave the nest site silently, making it difficult to confirm nesting. After aggressive or vocal adults are located, both observers should continue past the nest site, with one observer maintaining visual contact with the birds. Once far enough past to calm adult birds (distance varies, depending on individual pairs), both observers should crouch to diminish their profile and continue to observe the birds. If the birds are not agitated, one adult will return to the nest site within a few minutes. If birds appear disturbed, move further away, maintaining eye contact with the birds. Once the incubating bird returns to the nest, one observer should use the spotting scope to watch the nest site, while the other approaches to get a closer look. The approaching observer should maintain vision on the exact spot that the bird was sitting. It should be possible to see the nest through binoculars at a distance of 30+ feet and further approach is discouraged. Human scent around nests may

draw in predators. Since it is well documented that Piping Plovers nests usually have a clutch of four eggs, the only reason for a close approach is to determine the exact stage of nesting. Observation of a four egg clutch does not allow prediction of hatching times, since the last egg could have been laid 1 or 30 days ago. Observed clutches of 1-3 eggs, however, are probable indications that incubation is about to begin or that a renesting is occurring.

"Broken Wing" Display: This activity, described by several authors, indicates that an observer is very close to a nest or young. It is usually performed when small chicks are present or when the nest is nearing the end of incubation. Observers encountering this display should immediately leave the area until the bird is calm, and then crouch to observe further activity through optics.

Non-Nesting/Transient Birds: With some practice, it is usually possible to delineate non-nesting birds from those actively defending territories. Transients, as well as pre- and post-nesting birds, are generally not very vocal and occupy mud flats or other neutral areas distinct from beach nesting habitat. Any suspected non-breeder should be watched carefully as it may ba a member of a breeding pair temporarily feeding away from the nest site.

Marking the Nest: Nest marking is not recommended during a general census. Instead, natural landmarks or photographs should be used. If two surveys are done during the season (one to count nesting attempts and the other to gather productivity data), they should be done in exactly the same manner, so that all territories located on the initial trip will be encountered again later, making marking unnecessary. If markers are deemed necessary due to beach dynamics and conditions, they should be innocuous, such as dull wooden stakes or objects already present on the beach (e.g. driftwood). Markers should be placed well away from the nest (at least 30 feet) with the relationship to the nest duly recorded. Avoid using markers which might attract visitation or which might be moved by beach-goers.

APPENDIX 6

Agreements and Easements for Protection of Essential Piping Plover Habitat

1. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service and Canadian Wildlife Service for coordination of protection, management, and recovery efforts for the Piping Plover.

2. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, National Park Service, U.S. Fish and Wildlife Service, and the state wildlife agency, for permanent protection and management of all essential habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

3. U.S. Fish and Wildlife Service, National Park Service, and Army Corps of Engineers should acquire easements and/or fee title of essential Piping Plover habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

4. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, Bureau of Reclamation, U.S. Fish and Wildlife Service, Platte River Whooping Crane Habitat Maintenance Trust, and the state wildlife agency, for the permanent protection and management of all essential habitat on the Platte River in Nebraska.

5. The U.S. Fish and Wildlife Service should provide land protection of essential Piping Plover habitat on the Platte River system.

6. Memorandum of Understanding should be developed between The Nature Conservancy, Bureau of Land Management, state wildlife agency, and the U.S. Fish and Wildlife Service for the permanent protection and management of essential Piping Plover habitat at the Chain of Lakes, North Dakota.

7. Memorandum of Understanding should be developed between the North Dakota Game and Fish Department and the U.S. Fish and Wildlife Service for the permanent protection and management of essential Piping Plover habitat owned and/or managed by the North Dakota Game and Fish Department.

8. The U.S. Fish and Wildlife Service should provide land protection of essential Piping Plover habitat within the two glacial outwash plains in central North Dakota. Land protection should extend over the wetland as well as the upland.

9. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service, State of Minnesota, Canadian Wildlife Service, and Province of Ontario, for the permanent protection and management of essential habitat at Lake of the Woods Minnesota/Ontario.

10. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, state natural resource agency, and the U.S. Fish and Wildlife Service for the permanent protection and management of essential habitat at Lake of the Woods, Minnesota.

11. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service, state wildlife agency, and the U.S. Army Corps of Engineers governing the deposition of dredge spoils within the Great Lakes for purposes of enhancing or creating Piping Plover habitat.

12. Memorandum of Understanding should be developed between the National Park Service, state wildlife agency, and the U.S. Fish and Wildlife Service for the permanent protection and management of essential habitat in the Great Lakes.

13. Memorandum of Understanding should be developed between U.S. Army Corps of Engineers, National Park Service, The Nature Conservancy, state wildlife agency, and U.S. Fish and Wildlife Service, for permanent protection and management of essential wintering habitat.

14. Memorandum of Understanding should be developed between Texas Parks and Wildlife Department, Texas General Land Office, The Nature Conservancy, National Park Service, and U.S. Fish and Wildlife Service for the permanent protection of essential Piping Plover winter habitat on lands owned and/or managed by the Texas Parks and Wildlife Department.

15. Due to the presence of Piping Plovers on Gulf and Atlantic coastal barrier habitat, U.S. Fish and Wildlife Service will participate closely with current Department of the Interior efforts in developing the Coastal Barrier Resource System.