

DISTRIBUTION AND STATUS OF THE PIPING PLOVER THROUGHOUT THE ANNUAL CYCLE

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Piping Plovers (*Charadrius melodus*) are migratory shorebirds that use isolated beaches and sandflats throughout central and eastern North America (A.O.U. 1983). Historically, Piping Plovers have undergone drastic fluctuations in population numbers. Uncontrolled hunting in the early 1900s brought the species close to extinction (Bent 1929). Protective legislation helped birds recover by 1925. Maximum densities were reached in the 1930s, but by 1945 increased recreational use of beaches caused numbers to plunge again (Tate 1981). Since then, numbers of Piping Plovers continued to decrease. In 1973, Piping Plovers were placed on the National Audubon Society's Blue List for threatened species (Tate 1981). Currently, they are classified as endangered in Canada (Haig 1985) and are under consideration for federal classification as threatened throughout their U.S. range (except for the Great Lakes where they are endangered; Sidle 1984).

Despite their seemingly precarious situation, prior to 1981 most information pertaining to the species was provided in breeding studies by Wilcox (1959) and Cairns (1977). Since breeding and winter distribution had not been satisfactorily documented for Piping Plovers and the species population had not been estimated, we began research in 1981 to investigate their population biology and life history strategies. In addition to providing essential information for management of Piping Plovers, current work represents an uncommon example of annual range and population estimates for a species with widespread distribution whose numbers have not dwindled to the point where recovery measures are unreasonable.

METHODS

Distributional data were gathered via direct censuses by the author and coordination of census data collected throughout North America between 1982 and 1984. An information clearinghouse was set up at Delta Waterfowl and Wetlands Research Station by requesting distribution information from over 700 government agencies, museums, universities, biologists, and conservation groups throughout North, Central, and South America, and the Caribbean. The 3354 sightings and museum records initially reported served as a data base for delineating a crude distribution of the species. Between 1983 and 1984 breeding censuses were carried out by the Canadian Wildlife Service, provincial biologists, or the authors in each appropriate Canadian province except Alberta. Breeding censuses in the U.S. were carried out by federal, state, Natural Heritage, or university biologists.

Winter distribution was also determined using clearinghouse information. In January 1983, all Texas coastal beaches from Corpus Christi to Galveston were surveyed for potential winter sites. From January to April 1984, 1228 km of Gulf of Mexico beaches, sandflats, and mudflats were ground-surveyed from Campeche (Mexico) to the Florida Keys for presence of Piping Plovers. An additional 960 km of coastal habitat, from Tampico to Matamoros (Mexico), were air-surveyed (for proper habitat) and later ground-censused where access proved feasible. A census of all shorebirds was carried out in 742 km of the surveyed habitat deemed most productive for Piping Plovers (Fig. 1). Weather, tide, habitat, and human disturbance variables were recorded for each kilometer as was flock size and microhabitat use for each shorebird species encountered. In November 1984, additional surveys and censuses were carried out on beaches and tidal flats from Rio Lagartos to Campeche (Yucatan) and from Corpus Christi to Brownsville (Texas).

RESULTS

Breeding distribution.—Recent censuses of Piping Plovers between May and July showed 3535 to 4147 adult birds using breeding areas (Table 1). Examination of distribution by region (Fig. 2) indicated 2137 to 2684 adults (1003 to 1265 pairs; unpaired adults in population account for discrepancy between number of individuals and pair counts) use prairie lakes, rivers, and sloughs of Alberta, Saskatchewan, Manitoba, Montana, North Dakota, Minnesota, South Dakota, Nebraska, and Iowa. Complete censusing was not carried out in Saskatchewan and Alberta. However all known major sites (Haig, unpubl. data, Harris et al. 1985, Renaud 1979, Weseloh and Weseloh 1983) were censused. An upper limit for Saskatchewan birds was reached using the Harris et al. (1985) estimation of further available habitat. Breeding sites in the Great Lakes region included 12 pairs (28 adults). Between 1370 and 1435 Piping Plovers (634 to 662 pairs) used Atlantic provinces and states during the breeding season.

Winter distribution.—Winter census totals (Table 2) for 1984 represent 2 to 3 times the number of Piping Plovers ever recorded on Christmas bird counts, yet they reflect less than 25% of the total population for the species. The heaviest concentration of birds (Fig. 2) was found in Texas, where complete censuses between Corpus Christi and Brownsville were impossible due to inaccessibility on Laguna Madre sandflats. A literature search and correspondence with individuals familiar with other possible winter sites revealed little new information (Table 3). In Mexico, Piping Plovers were seen at Anton Lizardo (Veracruz), Veracruz (Veracruz), and Tuxpan (Tamaulipas). Although aerial surveys were flown, only 66.4 km of habitat was ground-censused between Tuxpan and Matamoros (Tamaulipas), so it is possible more birds winter on this stretch of coastline.

An important result of winter censusing was discovery of a specific habitat preference by Piping Plovers during migration and on winter

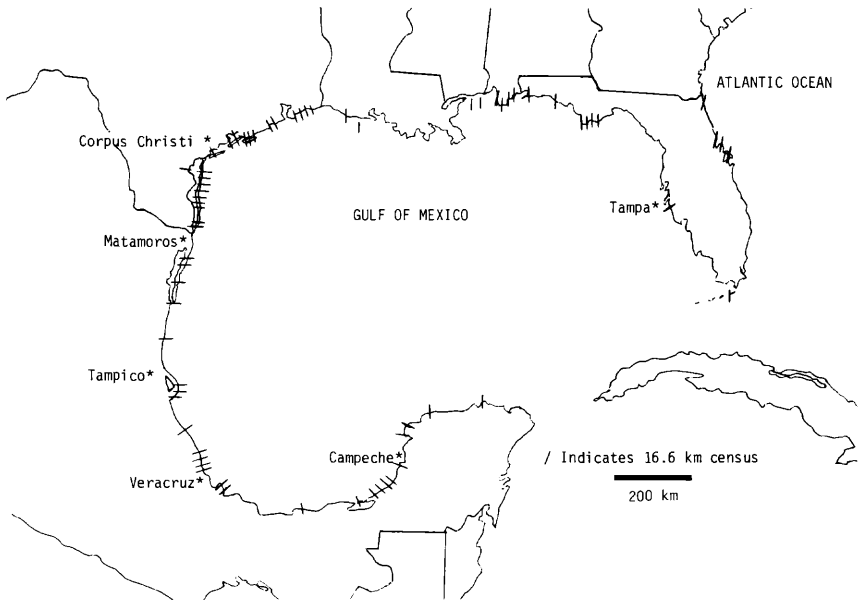


FIGURE 1. Location of Gulf Coast winter censuses 1984.

sites. Past records (T. Amos, S. Haig, unpubl. data) indicate pre- and post-breeding Piping Plovers use Gulf and Atlantic beaches from August through October and March through May. Examination of diurnal habitat use from January to March 1984 on 27 Gulf sites indicates some birds were still on beaches, but a significantly larger number of Piping Plovers used sandflats (Mann-Whitney $U = 32.5$, $P < 0.01$) adjacent to beaches or on coastal inlets.

Winter band recoveries.—Winter sightings of Piping Plovers color banded during the breeding season (Table 4) are sparse, but are beginning to illustrate movement of breeding birds into post-breeding areas. East coast data represent banding and recovery information prior to 1982, but indicate Piping Plovers may move farther south on the Atlantic coast rather than cross over into the Gulf of Mexico. Most mid-range birds (banded in Michigan or Minnesota) have been sighted from Alabama east to Florida. Few prairie birds have been sighted.

Population trends.—Since there are no population estimates for the species prior to this paper, it is impossible to quantify a comprehensive increase or decrease in numbers of Piping Plovers. Therefore, examination of population trends in local and regional areas may prove useful.

Short-term (1–2 years) increases are reported for Piping Plovers moving into newly-created or artificial habitat in Saskatchewan (Switzer 1979), Manitoba (Haig [1985], S. Sealy, D. Sexton, K. Whaley, pers. comm.), Prince Edward Island (W. Cairns, pers. comm.), Minnesota (J.

TABLE 1. Piping Plover breeding distribution and population estimate.

State/province	Number of adults	Number of pairs	Year of estimate	Source
Canada:				
Alberta	200-220	100-110	1977	Weseloh and Weseloh 1983 ^{a,c}
Manitoba	100-120	44	1984	Haig 1985 ^b
New Brunswick	170-190	85-95	1984	B. Johnson ^{a,d}
Newfoundland	8	2	1984	J. Brazil ^{b,d}
Nova Scotia	128-138	64-69	1984	Flemming 1984 ^a
Ontario	1-5	0-2	1983	J. Roseborough ^{b,d}
Prince Edward Is.	100-120	51-59	1984	B. Johnson ^{a,d}
Quebec	40-45	20	1982	B. Johnson ^{a,d}
Saskatchewan	700-1200	350-600	1984	Harris et al. 1985 ^b
United States:				
Connecticut	34	17	1983	J. Zickefoose ^{a,d}
Delaware	18	4	1983	L. Master and T. French ^{b,d}
Iowa	7	3	1984	B. Howe ^{b,d}
Maine	12	6	1984	J. Arbuckle ^{a,d}
Maryland	20-30	10-15	1983	Sidle 1984 ^a
Massachusetts	250	100	1982	B. Blodget ^{b,d}
Michigan	14	6	1983	Russell 1983 ^b
Minnesota	55-58	26	1984	L. Pfanmuller ^{b,d}
Montana	6	2	1976	Carlson and Skaar 1976 ^b
Nebraska	600	300	1984	J. Sidle ^{a,d}
New Jersey	120	60	1983	A. Galli ^{a,d}
New York	200	100	1984	Sidle 1984 ^a
North Carolina	40	20	1983	L. Master and T. French ^{a,d}
North Dakota	376	132	1984	P. Dryer ^{b,d}
Rhode Island	30	10	1983	C. Raithe ^{b,d}
South Dakota	100	50	1984	Sidle 1984 ^a
Virginia	200	85	1984	R. Duncan ^{b,d}
Wisconsin	6	2	1983	Russell 1983 ^b
Totals				
Canada	1447-2046	716-1001		
United States	2088-2101	933-938		
Species	3535-4147	1649-1939		

^a Estimate based on pair count.

^b Estimate based on individual adult and pair counts.

^c Incomplete census.

^d Pers. comm.

Mattson, pers. comm.), Kansas (K. Hansen, pers. comm.), and Iowa (G. Gage, B. Howe, pers. comm.). A longer-term population increase is reported in Kouchibouguac National Park (New Brunswick) where numbers increased from 11 pairs in 1973 (E. Tull, pers. comm.) to 21 pairs in 1983 (J. Brazil, pers. comm.). Piping Plovers in protected areas such



FIGURE 2. Breeding and winter distribution of Piping Plovers in 1984.

as Prince Edward Island National Park, Kouchibouguac National Park, and Chincoteague National Wildlife Refuge, appear stable (i.e., no recent decline in numbers), although the affect of the population decline in surrounding areas is not taken into account in this assessment.

Evidence for population decline (Table 5) in prairie areas is limited, but numbers on historically significant areas such as Big Quill Lake, Saskatchewan and Lake Manitoba, Manitoba are decreasing. In the Great Lakes, Piping Plovers have been extirpated from shorelines in Illinois, Indiana, New York, Ohio, Ontario, and Pennsylvania. For the past 5 years, the status of Piping Plovers on the Atlantic coast has been well-documented. Comparison of 1984 population estimates with Cairns

TABLE 2. Winter distribution and population estimate of Piping Plovers in the United States.

State	Estimate	Year
Alabama	80	1984
Florida	135	1984
Georgia	15	1983
Louisiana	33	1984
Mississippi	51	1984
North Carolina	100	1983 ^a
South Carolina	20	1984
Texas	400+	1984
Total	834+	1984

^a J. Fussell, pers. comm.

and McLaren (1980) censuses shows a 27% to 30% decline in number of pairs in 4 years

DISCUSSION

Breeding status.—Breeding censuses indicate a drastic decline in numbers on the Great Lakes and a significant decline in birds along the Atlantic Coast. Few areas contain stable or increasing populations although more thorough prairie censuses may contradict this.

Overall, Piping Plover breeding range does not appear to have changed dramatically from descriptions by A.O.U. Checklist (1957, 1983), Bell (1978), Bent (1929), and Cairns and McLaren (1980), but a serious decline in number of sites may be threatening the species. Loss of breeding activity on the Great Lakes not only decreases species' productivity,

TABLE 3. Occurrence of Piping Plovers throughout their winter range.

Location	Estimate	Year	Source
Bahamas	Rare	1981	R. Norton ^a
Barbados	Rare	1984	M. Hutt ^a
Bermuda	6-8	1983	D. Wingate ^a
Dominican Republic	Rare	1931	Wetmore and Swales 1931
Cuba	10+	1984	O. Garrido ^a
Ecuador	1 seen	1956	Marchant 1956
Haiti	2 seen	1929	U.S. National Museum ^b
Jamaica	0-2	1983	I. Goodbody, R. Sutton ^a
Mexico	20+	1984	This study
Netherlands-Antilles	1	1983	Voous 1983
Puerto Rico	Rare	1983	Raffaele 1983
United States	834+	1984	This study
Virgin Islands	0-5	1983	J. Ynetema ^a
West Indies	Rare	1982	R. Norton ^a

^a Pers. comm.

^b Museum skin.

TABLE 4. Winter sightings of Piping Plovers banded on breeding sites.

Breeding site	Winter site	Source
Manitoba	Bolivar, Texas (2 birds)	This study ^a , L. Gordon ^{a,c}
	Grand Terre, Louisiana	This study ^a
	Pinellas Co., Florida (Gulf)	M. Jones ^{a,c}
	Port Aransas, Texas	T. Amos ^{a,c}
Maryland	Bahamas	USFWS Banding Lab ^b
	Florida (Atlantic)	USFWS Banding Lab ^b
Michigan	Galveston, Texas	W. Smith ^{a,c}
	Naples, Florida (Gulf)	T. Below ^{a,c}
Minnesota	Dauphin Island, Alabama (4 birds)	C. Johnson ^{a,c}
	Casey Key, Florida (Gulf)	S. and A. Stedman ^{a,c}
	North Florida (Gulf)	USFWS Banding Lab ^b
	Sarasota, Florida (Gulf)	This study ^a
	Waveland, Mississippi	J. Toups ^{a,c}
New Jersey	Virginia	USFWS Banding Lab ^b
New York	Florida (Atlantic)	USFWS Banding Lab ^b
	North Carolina	USFWS Banding Lab ^b
	South Carolina	USFWS Banding Lab ^b
	Virginia	USFWS Banding Lab ^b
North Dakota	Gilchrist, Texas	L. Gordon ^{a,c}
Nova Scotia	Florida (Atlantic)	USFWS Banding Lab ^b

^a Sighting of color-banded bird.^b Recovery of bird.^c Pers. comm.

but creates major gaps between prairie and Atlantic breeding areas. Breeding site fidelity for Piping Plovers ranges from 25% in New York (Wilcox 1959) to 75% in Manitoba (Haig 1985) while natal philopatry varies from 4.8% in New York (Wilcox 1959) to 35% in Minnesota (Wiens and Cuthbert 1985). This wide spectrum of dispersal patterns suggests loss of intermediate sites between major breeding areas may severely inhibit interregional movement of birds (especially first-year adults). If the gap continues to grow (via extirpation of birds on the Great Lakes and declines in Manitoba and along midwest rivers) local populations will become more isolated and fewer birds will be able to move into abandoned nesting areas. Furthermore, since migratory patterns have never been described for Piping Plovers, it is not clear what affect loss of mid-continent sites has on possible migratory stop-over areas. On the Atlantic Coast, loss of sites on extreme northern and southern ends of the range leaves birds converging on mid-Atlantic states where recreation pressure already is high and continues to grow.

Winter distribution.—Although many more birds need to be accounted for, examination of winter habitat and censuses of post-breeding Piping Plovers offer a strong starting point for further delineation of the species' winter distribution and status. Discovery of a specific habitat preference was a turning point in unraveling the mystery of Piping Plover winter

TABLE 5. Documentation of Piping Plover decline throughout North America (values represent number of adults).

Location	Date		Source	Date		% decline	Source
	1st estimate	1st estimate		2nd estimate	2nd estimate		
Connecticut	1980	40	Cairns/McLaren 1980	1983	34	15	J. Zickefoose ^a
Delaware	1978	80	L. Master/T. French ^a	1984	18	78	Sidle 1984
Illinois	1876	250	Russell 1983	1983	0	100	Russell 1983
Indiana	1900	100	Russell 1983	1983	0	100	Russell 1983
Lake Manitoba, Manitoba	1980	27	R. Phillips ^a	1984	9	67	Haig 1985
Maryland	1972	85	Cairns/McLaren 1980	1984	25	71	Sidle 1984
Maine	1976	48	J. Arbuckle ^a	1982	12	75	Sidle 1984
Michigan	1979	77	Lambert/Ratcliff 1981	1982	14	82	Russell 1983
Newfoundland	1980	20-30	Cairns/McLaren 1980	1984	4	80-87	J. Brazil ^a
New Hampshire	1958	25	L. Master/T. French ^a	1976	0	100	Master/French ^a
New Jersey	1980	118	A. Galli ^a	1983	64	46	A. Galli ^a
Cadden Beach, Nova Scotia	1976	56	Cairns 1982	1983	28	50	Flemming 1984
Lake Ontario, New York	1935	54	Bull 1974	1974	0	100	Bull 1974
Long Island, New York	1939	1000	Wilcox 1959	1983	200	80	Sidle 1984
Ohio	1935	50	Hicks 1935	1940	0	100	Russell 1983
Long Point, Ontario	1927	200	Snyder 1927	1983	0	100	A. Lambert ^a
Pennsylvania	1940	30	Todd 1940	1964	0	100	Poole 1964
Magdalen Is., Quebec	1973	100	McNeil et al. 1973	1983	40	60	B. Johnson ^a
Rhode Island	1945	80	C. Raithe ^a	1983	20	75	C. Raithe ^a
Big Quill Lake, Sask.	1978	126	Renaud 1979 (60% lake)	1984	149	11	Harris et al. (80%)
Middle Quill Lake, Sask.	1978	19	Renaud 1979	1984	4	79	Harris et al. 1985
Wisconsin	1900	140	Russell 1983	1983	6	96	Russell 1983

^a Pers. comm.

TABLE 6. Reproductive success of Piping Plovers nesting throughout North America.

Location	Year	No. pairs monitored	No. chicks fledged per pair per year	Source
Maine	1981	10	0.9	J. Arbuckle ^a
	1982	10	1.8	
	1983	6	1.2	
Manitoba	1982	8	0.3	Haig 1985
	1983	8	1.1	
	1984	24	1.3	
Minnesota	1982	15	1.7	Wiens and Cuthbert 1984
	1983	21	2.1	
	1984	24	1.3	
New Brunswick	1982	11	2.4 ^b	DuBois and Morgan 1982
New Jersey	1980	59	1.4	A. Galli ^a
	1983	32	1.2	
Nova Scotia	1976	30	1.3-2.1	Cairns 1982 Flemming 1984
	1983	62	1.2	
Rhode Island	1981	14	0.6	C. Raithel ^a
	1982	10	0.6	
	1983	11	1.4	
Saskatchewan	1980	9	1.1	A. Whyte ^a
	1981	15	0.4	

^a Pers. comm.^b Mean brood size.

distribution. Results suggesting that both beach and sandflat habitat are necessary for post-breeding birds help explain why so few birds are seen on Christmas bird counts and lead us to believe birds might not be moving as far south as was once thought. T. Amos (pers. comm.) gave further support for this contention with 1984 data showing that while birds had been gone from Padre Island (Texas) beaches for weeks, an overnight freezing of Laguna Madre brought numerous Piping Plovers back to the beach the following morning. Furthermore, a November 1984 census of south Texas revealed 0 Piping Plovers on South Padre Island beaches and several hundred on adjacent Laguna Madre sandflats. The vast expanses of sandflats north of Brownsville are difficult to census completely, but are necessary to inspect before significance of the area can be assessed. The highest Christmas bird count for Brownsville in recent years was 13 birds (S. Haig, unpubl. data).

Other Piping Plovers may be accounted for in the following ways. First, careful censusing of U.S. Atlantic winter areas has not been done. It is possible data would parallel results from Texas. Second, on the surface it is curious that more birds were not seen on what appears to be favorable habitat in northern Mexico. If current habitat-use hypotheses hold, Piping Plovers may not use these areas because water stabilization structures have been built between Laguna Madre and barrier islands. High water levels eliminate sandflats and carve rough slopes into

TABLE 7. Causes of Piping Plover nest losses in Manitoba, Minnesota, and Nova Scotia (values show source of destruction/total nests destroyed).

	Lake Manitoba Manitoba ^a	Lake of the Woods Minnesota ^b	Cadden Beach Nova Scotia ^c
Predators	27%	48–70%	8.5%
Storms	45%	19–30%	0.0%
Humans	27%	8–14%	4.4%
Unknown	1%	4–19%	87.1%

^a Haig 1985 (81.5% of all nests destroyed).

^b Wiens and Cuthbert 1984.

^c Cairns 1982.

shorelines. Not only were Piping Plovers absent, but during censuses few individuals of any avian species were present. Access to the area is quite difficult, but repeated censusing would lend more confidence to these ideas. Regular occurrence of Piping Plovers in South America or other continents has not been documented. Support for distribution of Piping Plovers throughout the Caribbean is sketchy at best, but O. Garrido (pers. comm.) suggests the northern shoreline of Cuba may have suitable habitat.

Limiting factors.—Across North America, Piping Plover productivity (Table 6) is low and highly variable (among sites and years), but success on the prairies does not differ from that on the Atlantic coast. In Nova Scotia, comparisons were made between productivity on recreational and isolated beaches. Cairns (1982) found fledging success ranged from 1.3 to 2.1 chicks per pair on isolated beaches and 0.7 to 1.1 chicks per pair on recreational beaches. Similarly, Flemming (1984) reported 3.1 chicks fledged per pair on isolated beaches and only 1.6 chicks per pair on disturbed beaches. Factors directly limiting reproductive success (Table 7) include nest destruction by predators, storms, and recreational use of beaches. Indirect factors such as increased water levels or water channelization on midwest rivers and lakes (Faanes 1983, Sidle 1984) and increased development on winter habitat (Haig 1985) have also contributed to the decline of the species.

SUMMARY AND CONCLUSIONS

The distribution and status of Piping Plovers was defined via coordination of researchers and agencies throughout the species annual range. While there is no doubt variation among censusers and/or single census data points can be quite limiting, until now there has been little baseline information that allows for assessment of population stability at the species level. Continued search for birds in prairie breeding areas, on migration, and during winter will clarify trends initially observed.

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