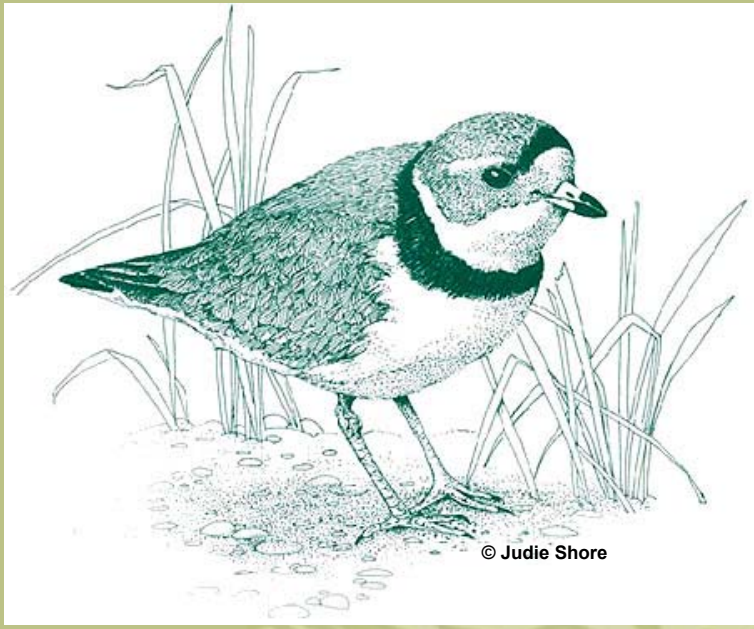
PROPOSED

Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Piping Plover (*Charadrius melodus circumcinctus*) in Canada

Piping Plover, *circumcinctus* subspecies



July 2006

Environment Canada Environnement Canada

Canada

About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened, or extirpated species is arrested or reversed and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency, and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

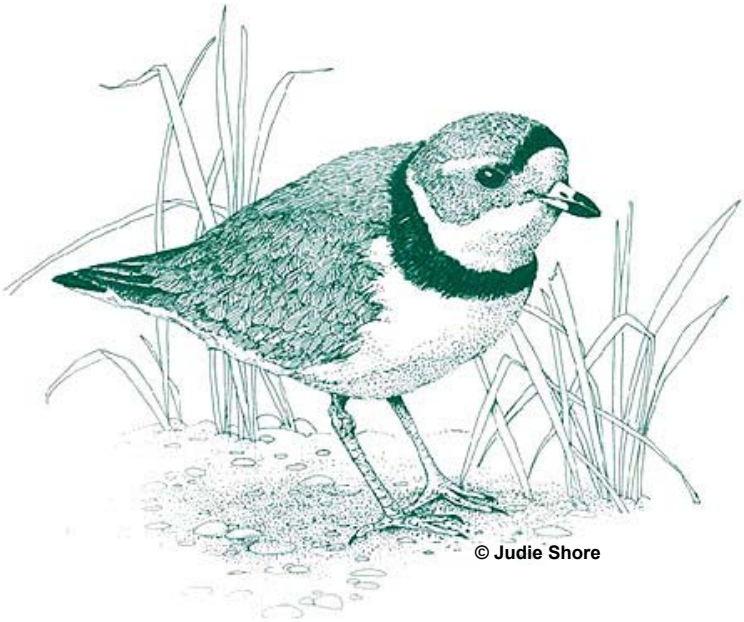
This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/) and the Web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/default_e.cfm).

Recovery Strategy for the Piping Plover (*Charadrius melodus circumcinctus*) in Canada [Proposed]

July 2006



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Additional copies can be downloaded from the SARA Public Registry (http://www.sararegistry.gc.ca/).

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DECLARATION

Environment Canada has developed its recovery strategy for the Piping Plover, *circumcinctus* subspecies, as required by the *Species at Risk Act*. This proposed recovery strategy has been prepared in cooperation with jurisdictions responsible for the species, as described in the Preface.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment Canada or any other jurisdiction alone. In the spirit of the Accord for the Protection of Species at Risk, the Minister of the Environment invites all Canadians to join Environment Canada in supporting and implementing this strategy for the benefit of the Piping Plover and Canadian society as a whole. Environment Canada will endeavour to support implementation of this strategy, given available resources and varying species at risk priorities. The Minister will report on progress within five years.

This strategy will be complemented by one or more action plans that will provide details on specific recovery measures to be taken to support conservation of the species. The Minister will take steps to ensure that, to the extent possible, Canadians directly affected by these measures will be consulted.

RESPONSIBLE JURISDICTIONS

Environment Canada
Parks Canada Agency
Government of Alberta
Government of Manitoba
Government of Ontario
Government of Saskatchewan

AUTHORS

This strategy was prepared by Diane C. Martens and J. Paul Goossen in consultation with the Prairie Piping Plover Recovery Team.

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STRATEGIC ENVIRONMENTAL ASSESSMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally-sound decision making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below.

This recovery strategy will clearly benefit the environment by promoting the recovery of the Piping Plover. The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. Refer to the following sections of the document in particular: 1.7 Description of Species Needs; 1.8 Threats; 2.4 Approaches Recommended to Meet Recovery Objectives; and 2.6 Effects on Other Species.

RESIDENCE

SARA defines residence as: *a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating* **[Subsection 2(1)]**.

Residence descriptions, or the rationale for why the residence concept does not apply to a given species, are posted on the SARA public registry:
http://www.sararegistry.gc.ca/plans/showDocument_e.cfm?id=596

PREFACE

The Piping Plover is a migratory bird covered under the *Migratory Birds Convention Act, 1994* and is under the management jurisdiction of the federal government. The *Species at Risk Act* (SARA, Section 37) requires the competent minister to prepare recovery strategies for listed extirpated, endangered, or threatened species. The Piping Plover was designated as Endangered by COSEWIC in 2001 and officially listed under SARA in June 2003. The Canadian Wildlife Service – Prairie and Northern Region, Environment Canada, led the development of this recovery strategy. The proposed strategy meets SARA requirements in terms of content and process (Sections 39–41). It was developed in cooperation or consultation with:

- all provincial jurisdictions in which the species occurs — Ontario, Manitoba, Saskatchewan, and Alberta;
- the federal government — Canadian Wildlife Service (National Capital Region, Ontario Region, Prairie and Northern Region);
- environmental non-government organizations — Nature Saskatchewan;
- industry stakeholders — SaskPower, Saskatchewan Watershed Authority; and
- the United States via representation on the Prairie Piping Plover Recovery Team.

This will be the first recovery strategy for the *circumcinctus* subspecies of the Piping Plover posted on the SARA Public Registry. A strategy for the *melodus* subspecies of the Piping Plover, found in eastern Canada, will be published separately.

EXECUTIVE SUMMARY

The Piping Plover (*Charadrius melodus circumcinctus*) is listed as endangered in Canada (Boyne 2001), threatened in the U.S. Northern Great Plains, and endangered in the Great Lakes region of the United States (Sidle 1985). The 2001 International Piping Plover Census estimated the Great Lakes and Northern Great Plains/Prairies populations at 3026 adults. Of these, 974 adults (32%) were in Canada (Ferland and Haig 2002). The Piping Plover has a small population with a wide distribution and faces continued threats. The greatest threats to recovery are predation, habitat loss, and human disturbance. Recovery will require continued management.

The recovery goal for the Prairie Canada population is a minimum of 1626 adult Piping Plovers (813 pairs) during each of three consecutive international censuses (i.e., over 11 years). The minimum provincial population targets (adults) are as follows: Alberta 300; Saskatchewan 1200; Manitoba 120; and Ontario (Lake of the Woods) 6. This should allow for the downlisting of *Charadrius melodus circumcinctus* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to the threatened category. For the Canadian Great Lakes population, the hope is that the Piping Plover, now extirpated as a breeding species from that area, will reestablish itself. This will depend largely on the success and dispersal of the population in the Great Lakes region of the United States. Population goals for the Canadian Great Lakes plovers will be proposed after recolonization of that region has occurred.

The recovery goal will be achieved primarily through habitat protection and increased productivity. Habitat will be protected through enforcement of protective regulations and conservation and stewardship agreements. Productivity will be increased through predator management, cattle management, and reducing human disturbance at plover sites.

Critical habitat is not being identified in this recovery strategy. Although several attributes and criteria have been described to assist in identifying critical habitat, there is a lack of knowledge on the specific locations that meet these criteria. Identification of critical habitat sites will be done within subsequent action plans.

To increase this subspecies' chance of survival and recovery, a better understanding of the movement of breeding birds between Canada and the United States, of threats on the wintering and breeding grounds, and of the wintering distribution, including in Mexico, is necessary. This will require effective international cooperation. The status of the U.S. population will be critical in considering downlisting the Canadian population.

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SPECIES ASSESSMENT INFORMATION FROM COSEWIC

Date of Assessment: May 2001

Common Name: Piping Plover *circumcinctus* subspecies

Scientific Name: *Charadrius melodus circumcinctus*

COSEWIC Status: Endangered

Reason for designation: The number of individuals of this subspecies breeding in Canada is small and the population is in decline. Reproductive success is low, especially in years of drought, and nests are regularly lost because of flooding. The quality of nesting habitat is decreasing in many places.

Canadian Occurrence: AB SK MB ON

COSEWIC Status History: The species was considered a single unit and designated Threatened in April 1978. Status re-examined and designated Endangered in April 1985. In May 2001, the species was re-examined and split into two groups according to subspecies. The *circumcinctus* subspecies was designated Endangered in May 2001. Last assessment based on an update status report.

1. BACKGROUND

1.1 Description of the Species

The Piping Plover (*Charadrius melodus*) is a small (18 cm; 43–63 g) migratory shorebird. It is highly cryptic, with a sand-coloured back and head, white underparts, and orange legs. In breeding plumage (Figure 1), the short bill is orange with a black tip, a single black band stretches between the eyes, and another black band runs across the breast (Haig 1992). The plover is superficially similar in appearance to the Killdeer (*Charadrius vociferus*), a shorebird that shares habitat with the Piping Plover. The Killdeer, however, is a larger shorebird with a dark brown head and back and two black breast bands. Piping Plovers are characterized by their clear-toned “pipe” call and habit of breeding on open sand or gravel beaches (Goossen *et al*. 2002).

Figure 1. Adult Piping Plover.

The Piping Plover is a member of the Charadriidae family (plovers). It is divided into two subspecies: the Atlantic *C. m. melodus* and the inland *C. m. circumcinctus* (AOU 1957). The *circumcinctus* subspecies includes two populations: Prairie Canada and Great Lakes. Both Canadian subspecies are listed as endangered (Boyne 2001) under Schedule 1 of the *Species at Risk Act*. This recovery strategy applies only to the inland subspecies. Within Canada, *C. m. circumcinctus* occurs in the provinces of Alberta, Saskatchewan, Manitoba, and Ontario. In the United States, *C. m. circumcinctus* is threatened in the Northern Great Plains and endangered in the Great Lakes (Sidle 1985), whereas *C. m. melodus* is listed as threatened on the Atlantic coast.

1.2 General Biology

These predominantly monogamous shorebirds are capable of breeding the first spring after hatch (Haig 1992). They have a modal clutch size of four eggs, with a seven-day laying period (Murphy *et al*. 1999). Replacement clutches are common due to frequent nest destruction. Double brooding is extremely rare for *C. m. circumcinctus* but has been observed in the Great Lakes (J. Stucker and C. Haffner, pers. comm., in Haig and Elliott-Smith 2004). Incubation over a 26- to 28-day period is shared by both sexes (Whyte 1985; Haig and Oring 1988b). Both sexes tend broods immediately following hatch, but females may desert broods within 10 days (Haig and Oring 1988b). The precocial young leave the nest within hours after hatching and begin to forage. Frequent brooding (every 5–10 minutes) is required for thermoregulation of young chicks (Haig 1992). Young are capable of sustained flight at 18–25 days (Murphy *et al*. 1999). Birds may begin migration as early as late June as a result of bad weather and failed nest attempts, although most leave by late July or early August. Peak migration from the wintering grounds is from March (Haig 1992) to April (K. Mehl, pers. comm.), with arrivals on the Canadian prairie breeding grounds occurring from late April to mid-May and in the Great Lakes region of the United States from late April to early May (Pike 1985). *C. m. circumcinctus* is assumed to be a non-stop migrant, as sightings at appropriate inland stopover sites are rare (Haig 1992). The Great Lakes population may be an exception, as birds have been observed at sites between breeding and wintering areas (U.S. Fish and Wildlife Service 2003).

1.3 Demography

C. m. melodus can live up to 14 years of age (Wilcox 1962); however, few survive beyond the age of nine (Wilcox 1959, 1962). Information on *C. m. circumcinctus* is limited, but individuals have been known to live up to five years of age (C. Gratto-Trevor, pers. comm.). The estimated mean annual survival rate for adult *C. m. circumcinctus*, derived from a North Dakota study site, is 0.74 (SE = 0.09), and that for immatures (i.e., fledging to one year of age) is 0.32 (SE = 0.08) (Larson *et al*. 2000). A Great Lakes study estimated adult survival at 0.73 (Wemmer *et al*. 2001). Adult breeding site fidelity is highly variable among study sites, but is often high. In five of eight studies, over 50% of adults returned to their former breeding areas (Haig and Oring 1988b). Natal site fidelity is lower than adult breeding site fidelity. Geographical variation in natal site fidelity is evident, with plovers at Lake of the Woods exhibiting the highest natal site fidelity, at 70% (Haig and Oring 1987), and plovers from Nova Scotia exhibiting the lowest, at 1.6% (Cairns 1982). Piping Plover reproductive success, without management and including all habitats used in the Northern Great Plains, is 0.89 chicks fledged per pair (Larson *et al*. 2002).

1.4 Population and Distribution

1.4.1 Canadian Breeding Distribution

The extant breeding range of *C. m. circumcinctus* extends from east-central Alberta through southern Saskatchewan and Manitoba to Lake of the Woods in southwestern Ontario (Figure 2). The northernmost known breeding occurrence of the plover is Lake Athabasca, in northern Saskatchewan; however, it is not known if plovers breed regularly there. In southern Ontario, confirmed breeding has not occurred along the shores of the Great Lakes since 1977 (Goossen *et al*. 2002). Historically, Piping Plovers were likely common residents along shores of the four Great Lakes in Ontario; breeding has been documented on Lake Ontario, Lake Erie, and Lake Huron (Russell 1983).

1.4.2 Wintering Distribution

Although the wintering ranges of the three continental breeding populations of Piping Plovers (Figure 2) overlap, the majority of inland breeders winter along the Gulf of Mexico (Haig and Oring 1988a). Banded Prairie Canada birds have been observed in Mexico, Texas, Alabama, and Florida (Mehl 2003; Stucker *et al*. 2003; D. Prescott, pers. comm.; Canadian Wildlife Service, unpubl. data). A few have also been seen along the Atlantic coast (Canadian Wildlife Service, unpubl. data). U.S. Great Lakes plovers predominantly winter on the Atlantic coast and Gulf coast of Florida (Haig and Elliott-Smith 2004). Plovers banded in Michigan have been sighted in Alabama, Louisiana, North Carolina, Georgia, Florida, southern Virginia, and the Bahamas (U.S. Fish and Wildlife Service 2003).

1.5 Population Size and Trend

Historically, little is known about the size and distribution of Piping Plover populations in the Canadian Prairies and Great Lakes. Bell (1978), using information from prior to 1978, estimated that there were 10 plovers in Manitoba, 300 in Saskatchewan, and 200–220 in Alberta. In 1985, Haig (1985) estimated 100–120 birds in Manitoba, 700–1200 in Saskatchewan, and 200–220 in Alberta. Estimates from Bell (1978) and Haig (1985) were derived from various sources over various years and were not necessarily complete. Russell (1983) estimated the historical Ontario Great Lakes population at 152–162 pairs.

The first comprehensive survey of Piping Plovers in North America was the international census of 1991 (Haig and Plissner 1992). The 2001 International Piping Plover Breeding Census estimated the North American population at 5945 adults, of which 3025 (51%) were *C. m. circumcinctus*. Of the 1454 (24%) adult Piping Plovers counted in Canada, 973 (67%) were *C. m. circumcinctus*, of which 972 were counted in Prairie Canada and one was counted on the Great Lakes in Ontario (Table 1). The entire Northern Great Plains/Prairies population showed a 15% overall population decline between 1991 and 2001 (Haig et al. 2005). The Prairie Canada population experienced a 32% decline from the 1991 (1437) to the 2001 (972) international census and a 42% decline from the 1996 (1687) to the 2001 international census; numbers did, however, increase by 17% between 1991 and 1996. In the United States, there was

a slight decline in Great Plains numbers from 1991 to 2001, but numbers increased by about 24% from 1996 to 2001. At Lake of the Woods, in Minnesota and Ontario, numbers declined from 18 adults in 1991 to 13 adults in 1996 to only eight adults in 2001. Declines in this remnant population are troubling, as it serves as the only geographical link between the Northern Great Plains/Prairies and Great Lakes. The American Great Lakes population has more than tripled in the last 15 years, from 40 individuals in 1991 (Haig and Plissner 1993) to ~125 individuals in 2005 (J. Stucker, pers. comm.).

Population trends are difficult to determine due to the ephemeral nature of plover habitat, the large extent of the habitat, the bird's mobility, and variation in survey efforts and site familiarity of observers. Consideration of U.S. populations is essential to interpret and assess Canadian *C. m. circumcinctus* population trends.

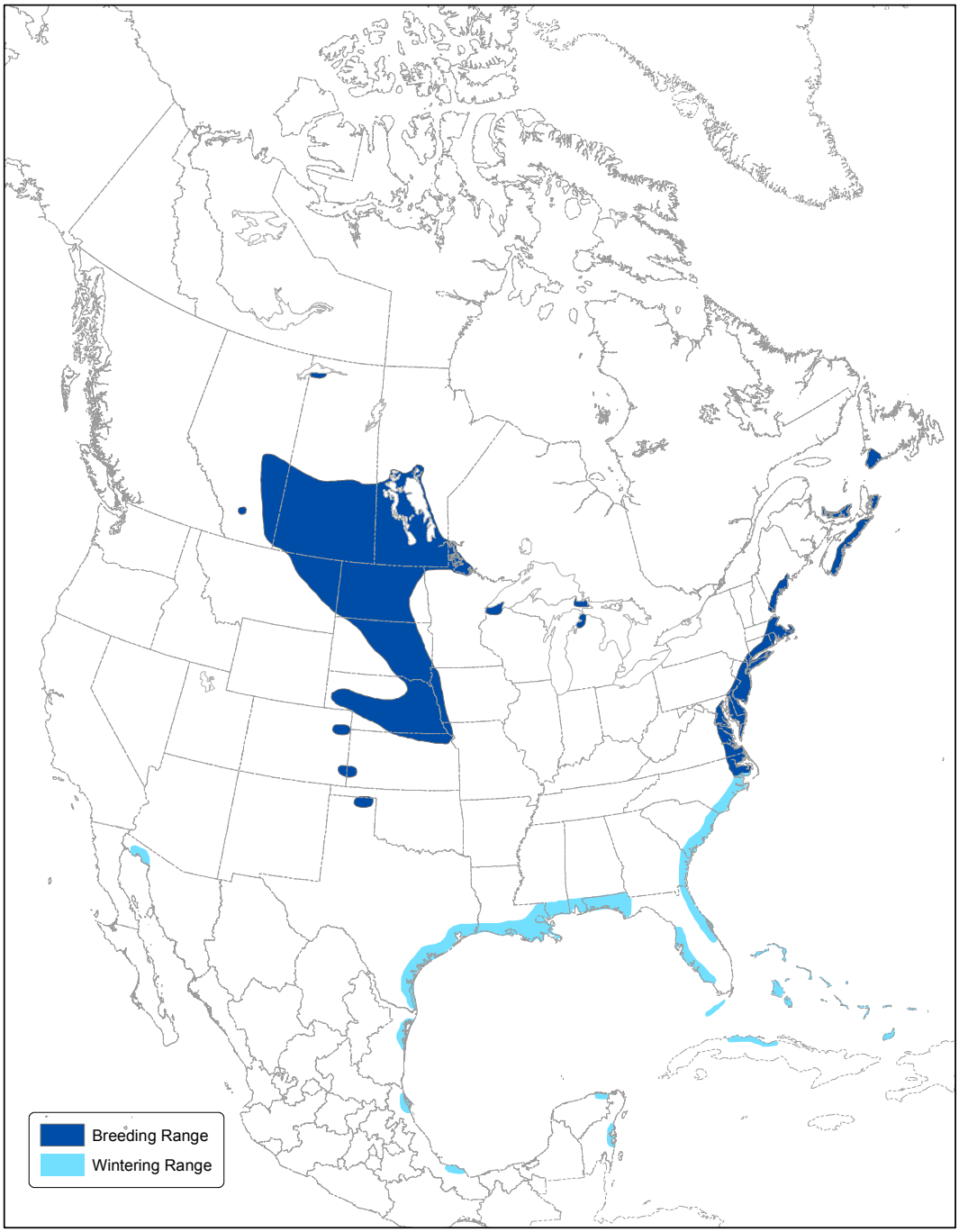

Figure 2. Breeding and wintering ranges of the Piping Plover (modified from Haig 1992).

Table 1. Comparisons of the 1991, 1996, and 2001 International Piping Plover Breeding Censuses in Canada and the United States for *C. m. circumcinctus* (Haig *et al.* 2005)

	Adults			Percent change		
Location	**1991**	**1996**	**2001**	**1991-1996**	**1991-2001**	**1996-2001**
Alberta	180	276	150	53.3	-16.7	-45.7
Saskatchewan	1172	1348	805	15	-31.3	-40.3
Manitoba	80	60	16	-25	-80	-73.3
Ontario	5	3	1	-40	-80	-66.7
Prairie Canada Total	1437	1687	972	17.4	-32.4	-42.4
U.S. Northern Great Plains	2032	1599	1981	-21.3	-2.5	23.9
Great Plains/Prairies	3469	3286	2953	-5.3	-14.9	-10.1
Canadian GreatLakes	0	1	1	n/a	n/a	0
U.S. Great Lakes	40	47	71	17.5	77.5	51.1
Great Lakes	40	48	72	20	80	50
Total Canadian	1437	1688	973	17.5	-32.3	-42.4
Total U.S.	2072	1646	2052	-20.5	-1	24.7
Total	**3509**	**3334**	**3025**	**-5**	**-13.8**	**-9.3**

1.6 Importance to Humans

Birdwatchers are a major economic factor in ecotourism. Piping Plovers are of interest to birdwatchers, particularly because of their endangered status. Having a high public profile, Piping Plovers contribute to environmental education and highlight endangered species concerns (Goossen *et al*. 2002).

1.7 Description of Species Needs

Piping Plovers need 1) adequate space for normal behaviour and population growth, including sites for breeding, rearing, feeding, and staging/migration/wintering; 2) a sufficient supply of aquatic and terrestrial invertebrates; 3) little disturbance; and 4) sites relatively secure from

predators. The dynamic ecological processes (e.g., water level fluctuations) that create and maintain Piping Plover habitat are essential to ensure the longevity and availability of that habitat.

1.7.1 Ecological Processes

Piping Plover habitat is ephemeral and is characterized by frequent successional disturbances. Precipitation, drought, and water management can significantly influence annual habitat availability. Cycles of alternating high- and low-water years and ice scour are necessary for habitat maintenance, particularly vegetation control on freshwater wetlands. High water levels are effective at removing encroached vegetation resulting from beach exposure during low-water years. Activities such as water level stabilization and management for hydropower disrupt the natural cycle (Hesse and Mestl 1993), which often results in a reduction in habitat availability due to flooding or vegetation encroachment (J.P. Goossen, pers. obs.). Ice scour promotes the maintenance of vegetation-free, early-succession habitat on sand spits and sites near channels (K. De Smet, pers. comm.). The salinity of alkali lakes further inhibits beach vegetation growth (Wershler 1992). Fire and grazing may be other influencing factors (Root and Ryan 2004). On the wintering grounds, hurricanes and tropical storms maintain coastal beach habitats.

1.7.2 Key Habitat Attributes

Piping Plovers prefer open sandy/gravelly beaches, islands, and peninsulas on alkali and freshwater lakes and riverine sandbars. Annual habitat suitability can be unpredictable due to the dynamic nature of the habitat, climate, and hydrological cycles of the Northern Great Plains. The most consistently available plover habitat in the prairies is wide, gravelly shores on permanent, saline water bodies (Wershler and Wallis 1987). The following attributes are typical of habitats where plovers are found, although composition, components, and combinations may vary:

- beach width >10 m;
- shoreline length >0.4 km;
- patches of gravel or sand/gravel;
- sandbars;
- distance to tree line from normal high-water mark >50 m;
- beach with <50% vegetation cover;
- access to wet, sandy shoreline or seeps, small streams, or interdunal wetlands for feeding;
- alkali deposits present somewhere on beach (for alkali lakes/wetlands);
- adjacent upland vegetation from where insect drift occurs; and
- key ecological processes that create, maintain, or affect habitat, such as weather, including precipitation and drought, wind, groundwater, salinization, water fluctuations, vegetation encroachment or succession, fire, and herbivory.

1.7.3 Nesting Habitat

In Prairie Canada, Piping Plovers choose sand/gravel beaches of permanent to semipermanent alkali lakes and wetlands, freshwater lakes, reservoirs, and occasionally river shorelines and sandbars for nesting and brood rearing (Boyne 2001). In the Great Lakes region of the United

States, plovers choose sand spits or sand beaches associated with dunes and swales. Habitat located on the inland side of foredunes is also used for breeding (Pike 1985; Powell and Cuthbert 1992). Piping Plovers prefer to nest on flat, wide, sparsely vegetated sand, gravel, or alkaline substrate (generally not bare alkali) (Haig 1992). Mixed substrates such as sand, gravel, and pebbles are preferred, as they provide camouflage for nests, incubating adults, and young (Boyne 2001). Periodic habitat disturbance such as grazing or flooding is needed, particularly on freshwater lakes, to minimize vegetation encroachment.

1.7.4 Brood Rearing Habitat

Brood-rearing habitat overlaps with nesting and feeding habitats. Often brood habitat is within a pair's territory; however, families may leave territories because of disturbance or food requirements. Young plovers may use sparse vegetation to provide shelter from the elements or escape from human disturbance or predators. Densely vegetated areas are rarely used by plovers, as these areas are difficult to traverse and limit visibility.

1.7.5 Feeding Habitat

There is little information on the plover's diet in the Northern Great Plains and Great Lakes (see Whyte 1985; Beckerman 1988; Staine and Burger 1994; Cuthbert *et al*. 1999). Piping Plovers feed on a variety of aquatic, benthic, and terrestrial invertebrates. Adult Piping Plovers and flightless juveniles feed at seeps, ephemeral river pools, or the river edge (Cuthbert *et al*. 1999), along the lakeshore, in vegetation, and at the high-water mark within the nesting territory. Non-tending adults and juveniles capable of flight will feed beyond the immediate nesting or brood-rearing area. Birds feed primarily within 5 m of the water's edge. Time spent at various feeding habitat types varies by sex, age, and stage of breeding (Haig 1992), as well as habitat availability and disturbance.

1.7.6 Staging/Migration Habitat

Piping Plovers stage on natal lakes before migration (Harris 1994). Great Lakes birds use migration habitat on stopovers between breeding and wintering areas (U.S. Fish and Wildlife Service 2003). Sightings at seemingly appropriate inland stopover sites in the Northern Great Plains are rare, suggesting that these birds are non-stop migrants (Haig 1992). Juveniles are capable of covering considerable distances within a few days of attaining flight. Results from a North Dakota study showed that two juveniles covered ≥50 km when 28 days old (Knetter *et al*. 2001). A colour-banded juvenile migrated >2000 km from North Dakota to the Gulf coast of Mexico in less than five days (M.R. Ryan, unpubl. data, in Knetter *et al*. 2001).

1.8 Threats

1.8.1 Predation

Boyne (2001) identified human disturbance as the primary threat to Piping Plovers in Canada; although this may be true for Atlantic Canada, predation appears to be the primary factor limiting Piping Plover productivity on the Northern Great Plains (see Whyte 1985; Haig and Oring 1987, 1988b; Prindiville Gaines and Ryan 1988; Richardson 1999; Westworth *et al*. 2004). Predation is rarely witnessed, and predator identification is therefore difficult and often inferred from tracks, nest condition, or other evidence. This approach is not always reliable in determining predator identities (Larivière 1999).

The predator complex has changed with the advent of European settlement. The following predator species have increased in numbers since 1966: American Crow (*Corvus brachyrhynchos*), Black-billed Magpie (*Pica hudsonia*), California Gull (*Larus californicus*), Great Horned Owl (*Bubo virginianus*), Merlin (*Falco columbarius*), and Ring-billed Gull (*Larus delawarensis*) in Alberta; Ring-billed Gull and Merlin in Manitoba; and American Crow, Black-billed Magpie, and Merlin in Ontario (Sauer *et al*. 2003).

Effective mechanisms for predator management have been identified (Schmelzeisen *et al*. 2004) and will be utilized at various sites where appropriate. The effectiveness of management tools will continually be assessed and refined to reduce predation on eggs, young, and adults.

Egg Predation

Predation of Piping Plover eggs generally involves the whole clutch. The following are confirmed predators of Piping Plover eggs: American Crow (Kruse *et al*. 2001), Common Raven (*Corvus corax*) (Schmelzeisen *et al*. 2004), Black-billed Magpie (Licht and Johnson 1992), American Kestrel (*Falco sparverius*) (Kruse *et al*. 2001), mink (*Mustela vison*) (Kruse *et al*. 2001), domestic dog (*Canis familiaris*) (Kruse *et al*. 2001), and raccoon (*Procyon lotor*) (Espie *et al*. 1992; Kruse *et al*. 2001). The following species are considered potential egg predators based on evidence near the nest or their presence near depredated nests: California Gull (Mayer and Ryan 1991a), blackbirds (Icteridae) (Ivan and Murphy 2005), striped skunk (*Mephitis mephitis*), American badger (*Taxidea taxus*) (Casler and Murphy 2001; Murphy *et al*. 2003a; Ivan and Murphy 2005), coyote (*Canis latrans*), red fox (*Vulpes vulpes*) (Goossen *et al*. 2002; Ivan and Murphy 2005), white-tailed deer (*Odocoileus virginianus*) (Ivan and Murphy 2005), and ground squirrels (*Spermophilus* spp.) (Ivan and Murphy 2005).

Chick Predation

Piping Plover chick loss on the Northern Great Plains is considerable, considering that from the average clutch of four eggs, only 0.89 chicks fledge per pair (Larson *et al*. 2002). Again, predation is rarely witnessed in the field, and chick remains are rarely found. Confirmed predators of chicks are Northern Harriers (*Circus cyaneus*) (Murphy *et al*. 2003a; Ivan and Murphy 2005), American Kestrel (Kruse *et al*. 2001), Great Horned Owl (Kruse *et al*. 2001), mink (Kruse *et al*. 2001), and coyote (C. White, unpubl. data; D. Martens, unpubl. data).

Adult Predation

Depredated adults are rarely found. Merlins (Michaud and Prescott 1999) and Peregrine Falcons (*Falco peregrinus*) (W. Harris, pers. comm., in Goossen *et al*. 2002) are known predators of plover adults. Potential predators of adult Piping Plovers include coyote, red fox, raccoon, American badger, striped skunk, gulls, Northern Harrier, Great Horned Owl, American Crow, Red-tailed Hawk (*Buteo jamaicensis*), and Swainson's Hawk (*Buteo swainsoni*) (Murphy *et al*. 2003a). Some plover management activities have attracted raptors, causing adult mortalities (see Murphy *et al*. 2003a).

Other Predators

Other possible predators of Piping Plovers include Herring Gull (*Larus argentatus*) (U.S. Fish and Wildlife Service 2003), Short-eared Owl (*Asio flammeus*) (W. Harris, pers. comm., in Goossen *et al*. 2002), Snowy Owl (*Bubo scandiacus*) (Cuthbert and Wemmer 1999), Common Grackle (*Quiscalus quiscula*) (Ivan and Murphy 2005), and short-tailed weasel (*Mustela erminea*) (Haig and Elliott-Smith 2004).

1.8.2 Habitat Loss or Degradation

Habitat loss can occur when nesting beaches or basins become unsuitable or unavailable to Piping Plovers through natural causes, such as drought, high precipitation, and vegetation encroachment (Goossen *et al*. 2002). Human activities, such as water management, recreational development, and oil and gas development, can further contribute to habitat loss (Boyne 2001). The quality of otherwise physically suitable habitat may be compromised by human disturbance, water management, and livestock disturbance. Threats to wintering habitat are also of concern, as plovers spend most of the year on coastal marine habitats.

Mitigation efforts and conservation agreements will address water management threats. Stewardship will be emphasized in future habitat protection. Habitat will be protected through stewardship, legislation, and enforcement. The establishment and enforcement of protected areas, such as at the Walter Cook Piping Plover Conservation Area (Manitoba), the Clandeboye Bay Piping Plover Conservation Area (Manitoba), and the Muriel Lake Waterbird Sanctuary (Alberta), will aid in protecting plover habitat and reproductive efforts.

1.8.3 Livestock Grazing

Livestock may trample nests, disrupt normal breeding behaviour, and alter characteristics of the habitat (Boyne 2001). Feeding habitat quality may deteriorate from cattle urine and manure contamination and trampling (Wershler 1992).

Fencing initiatives, delayed grazing agreements, and alternative watering sites can lessen negative impacts from cattle on Piping Plovers and their habitat (Goossen *et al*. 2002). If properly managed, cattle can improve habitat for Piping Plovers by reducing vegetation height and density along upper beaches. Landscapes where cattle grazing is the dominant land use may be superior, as they tend to be less fragmented than intensively farmed lands (R. Murphy, pers. comm.).

1.8.4 Human Disturbance

The Piping Plover's preference for wide sand and gravel beaches on freshwater lakes makes them more susceptible to human impacts. Pedestrians, all-terrain vehicles (ATVs), and other motorized vehicles may inadvertently destroy the highly camouflaged eggs and chicks. Human disturbance can interfere with chick behaviour by decreasing time spent foraging and brooding due to increased vigilance behaviour (Flemming *et al*. 1988).

Stewardship, education, and enforcement will address the threat of human disturbance. Educational materials, such as pamphlets, brochures, and web sites, will help increase public awareness, appreciation, and concern for the Piping Plover and its habitat. Parking lots, vehicle barriers, and signs identifying breeding beaches will also help to minimize human disturbance by reducing beach access. Guardian programs can be used to increase public awareness (see Dufour 2003; Jacobson 2003; Maconachie 2003). In some instances, increased enforcement may be required to protect Piping Plovers and their habitat.

1.8.5 Mortality on Wintering Grounds

Little is known about the survival of Piping Plovers on the wintering grounds. The only study conducted found no mortality among 49 radio-marked plovers in Texas, suggesting that winter mortality may not be a major factor contributing to population declines (Drake *et al*. 2001).

1.8.6 Other

Other potential threats include West Nile virus (C. Kruse, pers comm.), weather (Smith and Heilhecker 1995; Harris *et al*. 2005), and pollution, including oil. Concentrations of polychlorinated biphenyls (PCBs) found in plover eggs collected in Michigan have the potential to cause reproductive impairment (D. Best, pers. comm., in U.S. Fish and Wildlife Service 2003). The magnitude of these threats to the Piping Plover and its habitat is unknown.

1.9 Actions Already Completed or Under Way

In 1989, the first recovery plan (unpublished) for both subspecies was completed (Atlantic and Prairie Piping Plover Recovery Teams 1989) and provided direction for the early years of recovery activities. Later, under the Recovery of Nationally Endangered Wildlife (RENEW) program, a second plan was developed and then published in 2002 (Goossen *et al*. 2002). COSEWIC approved separate listings for the two plover subspecies in 2001; with the passing of the *Species at Risk Act* in 2002, separate recovery strategies were prepared for each subspecies (this strategy and Environment Canada in prep.). Recovery of *circumcinctus* in Prairie Canada has benefited from federal–provincial–non-government agency cooperation and international cooperation with the United States and Mexico.

To date, recovery actions for the Great Plains Piping Plover have focused on monitoring (annual lake censuses, four international censuses) (Haig and Plissner 1993; Plissner and Haig 2000; Schmelzeisen and Engley 2003; Haig *et al*. 2005), productivity enhancement (predator exclosures, clutch translocation, nest enclosures, water management) (Richardson 1997; Engley

et al. 2004; Harris *et al*. 2005), habitat management (Saskatchewan Watershed Authority 2004), research (habitat, population dynamics, and dispersal) (Espie 1994; Dundas 1995; White 2005), and communication (guardian programs, brochures, presentations, science workshop) (Dufour 2003; Westworth *et al*. 2004; Jacobson 2005).

1.10 Knowledge Gaps

The following lists, compiled from input by researchers at a recent Piping Plover workshop (see Westworth *et al*. 2004), identify and rank knowledge gaps in decreasing order of importance. Greater knowledge in these areas will benefit provincial, national, and international conservation efforts.

1.10.1 Research Knowledge Gaps

1. Accuracy of fledging rate estimates.
2. Standardize terminology (e.g., fledging success, pairs).
3. Movements of adults and young between areas.
4. Juvenile survival.
5. Detectability rate during International Piping Plover Censuses in different areas.
6. Role of various predators and predator ecology.
7. Landscape analysis related to plover productivity.
8. Wintering ground locations, detectability, and threats.
9. Demographics of dispersing adults.
10. Water regime effect on distribution and influence on census results.
11. Staging and migration.

In addition to the above, information is also lacking or limited on the role of food in habitat selection and plover management (E. Nol, pers. comm.), the amount of habitat and spatial distribution needed to reach the recovery goal, and the relationship, if any, between habitat quality and predator populations. There is also a need to revisit population models for this species.

1.10.2 Management Knowledge Gaps

1. Livestock impacts on plover habitats and productivity.
2. Influence of vegetation encroachment on plover site selection and productivity.
3. Recreational impacts on plover habitat and productivity.

2. RECOVERY

2.1 Recovery Feasibility

Determinations of recovery feasibility are based on the following criteria (outlined in Environment Canada 2005): 1) Are individuals capable of reproduction currently available to improve the population growth rate or population abundance? 2) Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration? 3) Can significant threats to the species or its habitat be avoided or mitigated through recovery actions? and 4) Do the necessary recovery techniques exist and are they demonstrated to be effective?

Recovery of the Piping Plover in Prairie Canada is both biologically and technically feasible. Piping Plovers can breed their first year after hatch and are capable of breeding in consecutive years (Haig 1992). The estimated adult survival rate (0.74; Larson *et al*. 2000) is similar to that of other plover species. Productivity from unmanaged pairs in the Northern Great Plains is 0.9 chicks fledged per pair and is thought to be insufficient to reach population stability, which requires an estimated productivity of 1.25 chicks fledged per pair (Larson *et al*. 2002). Productivity can, however, be increased by addressing the known threats of predation, human disturbance, and water management. Intensive management of people and predators on the U.S. Atlantic coast and the U.S. Great Lakes is credited with increasing plover numbers (A. Hecht, pers. comm.; J. Stucker, pers. comm.). Larson *et al*. (2002) suggested that the Northern Great Plains population can be stabilized or increased through increased management. In 2001, Piping Plovers were detected at only 91 of 424 (21.5%) recent breeding sites in Prairie Canada (Ferland and Haig 2002), where seemingly good quality habitat exists.

Predation on eggs and, to some extent, newly hatched chicks can be reduced with the use of predator exclosures (Murphy *et al*. 2003b). Human disturbance and conflicting land use practices can be lessened through increased public awareness and stewardship agreements. Threats of flooding and vegetation encroachment as a result of water management may be lessened with conservation agreements and inter-agency cooperation.

The Piping Plover is extirpated from the Canadian Great Lakes as a breeding species. Recolonization has not occurred to date. Development on and destruction of historical plover habitat in the Canadian Great Lakes have also led to habitat inadequacies. Owing to its small population size (58 pairs; J. Stucker, pers. comm.) and restricted breeding distribution in the United States (U.S. Fish and Wildlife Service 2003), the Great Lakes population may face genetic and geographical hurdles. The reestablishment of a Canadian Great Lakes population is dependent on the success of recovery efforts in the U.S. Great Lakes and protection of suitable breeding sites. It appears that plovers will soon breed in the Great Lakes area of Ontario, given the tremendous success in managing the expanding U.S. Great Lakes population and recent sightings of plovers in southern Ontario. Potential habitat for recolonization of historical breeding sites includes Long Point Provincial Park and Long Point National Wildlife Area, Presqu'ile Provincial Park, Wasaga Beach Provincial Park, and Wellers Bay National Wildlife Area.

2.2 Recovery Goal

The long-term recovery goal for *C. m. circumcinctus* is to achieve a viable,[1] self-sustained, and broadly distributed population, within the current prairie population range, and the reestablishment of the Piping Plover in the historical southern Ontario range.

Prairie Canada Population

The recovery goal for the Prairie Canada population is 1626 adult Piping Plovers and is based on historical provincial counts and/or estimates. The population goal will be considered achieved if met for each of three consecutive international censuses (i.e., over 11 years). The minimum provincial population (adults) targets are as follows: Alberta 300; Saskatchewan 1200; Manitoba 120; and Ontario (Lake of the Woods) 6. The Canadian *C. m. circumcinctus* population is currently listed as endangered because of its small population size and declining population. Any change in the status of *C. m. circumcinctus* in Canada should take into consideration the status of the U.S. population. The U.S. recovery goal is 2300 breeding pairs of plovers in the Northern Great Plains (U.S. Fish and Wildlife Service 1994).

Canadian Great Lakes Population

The reestablishment of Piping Plovers on the Canadian side of the Great Lakes will depend on the success of the U.S. Great Lakes population. It is too early to set a recovery population goal for this population, as no breeding has occurred since 1977 (Lambert 1987). An active pair at Wasaga Beach Provincial Park in 2005 (Heyens 2005b), provides some hope that Piping Plovers may successfully nest in Ontario in the near future. The objective at this time is to ensure protection and monitoring of historical breeding habitat and any breeding pairs or individuals that may appear. The goal for the U.S. population is to maintain a population of 150 pairs for at least five consecutive years. This goal serves to prevent extirpation and is expected to be reached by 2020 (U.S. Fish and Wildlife Service 2003). Achieving recovery will depend in part on active management by a variety of government and non-government agencies. The current recovery strategy's proposed activities are based on management tools (Appendix A) used in field situations and therefore are reasonable and useful for recovery efforts.

2.3 Recovery objectives (2006–2010)

1. Update Prairie Canada population status (numbers and distribution).
2. Increase knowledge of population dynamics and predators.
3. Achieve and maintain a fledging rate of at least 1.25 fledglings per pair per year for managed sites.
4. Identify critical habitat and achieve critical habitat protection to the extent possible through the setting of cooperative conservation measures.
5. Support relevant conservation practices, policies, and legislation.
6. Achieve effective protection of wintering habitat through international efforts.
7. Prepare for potential reestablishment of Canadian Great Lakes population.

[1] A viable population has a less than 5% probability of becoming extinct within the next 100 years (U.S. Fish and Wildlife Service 1996).

2.4 Approaches Recommended to Meet Recovery Objectives

Table 2. Recovery Planning Table for the Piping Plover (*C. m. circumcinctus*)[1].

Priority	Threat addressed	Broad strategy to address threats	Recommended approaches to meet recovery objectives
Objective 1: Update Prairie Canada population status (numbers and distribution).			
Necessary	All	Research and monitoring	• determine population trends, distribution, and status by carrying out local, regional, national, and international surveys
Objective 2: Increase knowledge of population dynamics and predators.			
Necessary	Predation	Research and monitoring	• monitor reproductive success at managed sites • investigate predator ecology as it relates to Piping Plover reproductive losses • determine survival, recruitment, and dispersal patterns
Objective 3: Achieve and maintain a fledging rate of at least 1.25 fledglings per pair per year for managed sites.[2]			
Necessary	Habitat loss; predation; livestock grazing; human disturbance	Habitat management	• continue to use adaptive management by adjusting management activities to maximize recovery efforts • identify and implement best management practices for water, habitat, and predator management • reduce cattle disturbance through fencing initiatives, delayed grazing agreements, and alternative watering sources • assess value of captive rearing and release for sustaining productivity in exceptional circumstances
Objective 4: Identify critical habitat and achieve critical habitat protection to the extent possible through the setting of cooperative conservation measures.			
Necessary	Habitat loss	Habitat evaluation	• determine habitat requirements, and quantify and evaluate available habitat through local and regional censuses and the 2006 international census • identify site-specific protection needed at critical habitat sites

[1] Objectives 1 – 6 refer to the Prairie population.
[2] Results of recent modelling (Larson *et al*. 2002) suggest that a rate of 1.25 fledglings per pair for the entire Great Plains population is required to stabilize the median population size.

Priority	Threat addressed	Broad strategy to address threats	Recommended approaches to meet recovery objectives
Objective 5: Support relevant conservation practices, policies, and legislation.			

Necessary	Habitat loss	Habitat protection	• establish liaison with agencies and organizations with land and water responsibilities
			• develop local management plans
			• develop and implement habitat conservation activities
			  • protect the natural processes that maintain essential breeding habitat through cooperative stewardship and grazing system management
			  • use signage, education, and protected areas to protect birds and habitats
			• continue or enhance enforcement of protective regulations
			  • water management agreements
			  • minimize detrimental industrial and recreational development
			• ensure that comprehensive project reviews are completed through a structured environmental assessment process and that the requirements for Piping Plovers are given due consideration
			• promote revision and/or establishment of land and water laws and regulations to provide protection for habitat
			• implement guardian and stewardship programs or activities at sites where human disturbance is high

Objective 6: Achieve effective protection of wintering habitat through international efforts.			
Necessary	Mortality on wintering grounds	International cooperation	• continue participation in the International Piping Plover Coordination Group • encourage and assist in identification of winter habitat; support and expand protection initiatives • participate in cooperative banding programs to monitor movements of birds across the United States/Canada border
Objective 7: Prepare for potential reestablishment of Canadian Great Lakes population.			
Beneficial	Habitat loss	Potential reestablishment	• evaluate habitat for the potential for reestablishment • develop a contingency plan to coordinate activities to protect breeding birds, territorial individuals, and their habitat • prevent disturbance and protect plovers on occupied sites • encourage protection of apparently suitable breeding habitat, including historical sites • continue liaison with the United States Great Lakes Piping Plover Recovery Team

2.4.1 Narrative to support Recovery Planning Table

The monitoring and research described in the first two objectives will guide future management decisions through evaluations of past management approaches and increased species knowledge. Monitoring is also an essential means of quantifying progress towards achieving recovery. Research should be conducted at managed sites to identify limiting factors and to refine management techniques. An expanded banding program of breeding Great Plains birds would provide a better understanding of movement and census interpretation. An understanding of habitat requirements and conditions that maximize reproductive success will assist in the identification and protection of important critical habitat.

Availability of suitable habitat to the Piping Plover year-round is essential to recovery. Habitat protection in Canada will help ensure maintenance of both quantity and quality of breeding habitat. The protection of peripheral populations may encourage the maintenance of the current distribution. Piping Plovers spend eight or more months on the wintering grounds each year. Efforts to enhance protection of wintering habitat are therefore key to successful Canadian recovery efforts. Cooperation among Canada, the United States, and Mexico will increase the Piping Plover's chance of survival and recovery. The International Piping Plover Coordination Group will continue to facilitate the exchange of information and the coordination of recovery efforts.

The reestablishment of a Canadian Great Lakes plover population depends on the success of the neighbouring U.S. population. Preparation for reestablishment is timely, as the U.S. Great Lakes population experienced a population increase of 51% between 1996 (47 adults) and 2001 (71 adults) (Ferland and Haig 2002).

2.5 Critical Habitat

Critical habitat is defined in the *Species at Risk Act* as "the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species" (Subsection 2(1)).

Critical habitat is not being identified in this recovery strategy. Although several attributes and criteria have been described (section 1.7.2) to assist in identifying critical habitat, there is a lack of knowledge of the specific locations that meet these criteria. Identification of critical habitat sites will be done within subsequent action plans (section 2.7) and will be updated a minimum of every five years (coinciding with the international censuses) based on the results of habitat and population assessments from the international censuses and other data sources.

2.5.1 Criteria and Delineation of Critical Habitat

Critical habitat will be defined on the basis of the basin, riverbed, and/or site within a basin wherein the key habitat attributes (here and in section 1.7.2) may occur. In some cases, the whole wetland/lake may be identified as critical habitat; in others, only a portion may be considered critical habitat. The upper extent of critical habitat will be defined by the ordinary high-water mark, which is defined as "The usual or average level to which a body of water rises at its

highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the 'active channel/bank-full level' which is often the 1:2 year flood flow return level. In inland lakes, wetlands or marine environments it refers to those parts of the water body bed and banks that are frequently flooded by water so as to leave a mark on the land and where the natural vegetation changes from predominately aquatic vegetation to terrestrial vegetation (excepting water tolerant species). For reservoirs this refers to normal high operating levels (Full Supply Level)" (Fisheries and Oceans Canada 2006).

Critical habitat will be identified within action plans, typically on a province-by-province basis, in cooperation with the provincial jurisdictions. Provinces are encouraged to identify and delineate site-specific critical habitat as well as its ownership and protection status. Ownership will be identified as private, provincial crown, or federal crown, and the level of protection will be determined. Site-specific delineation of critical habitat may not be required if protection is done at the quarter-section level. The minimum requirements for identifying critical habitat will include all three of the following criteria:

1) Average number of plovers over all surveys of ≥4 adults in Alberta and Saskatchewan, ≥2 adults in Manitoba and Ontario, or 5% of the province's recovery goal in any one year during the window.
2) A minimum of three surveys per site during the breeding season, each carried out on a separate year.
3) A floating window of at least 15 years (starting in 1991) to determine site (wetland, lake, riverbed) status. The 15-year window is based on three international censuses, occurring every five years.

Manitoba and Ontario are given a lower target of ≥2 adults because Manitoba's population is small and Ontario has a remnant population that serves as an important geographical link between the Great Plains and Great Lakes populations. The Alberta and Saskatchewan populations are larger and have more habitats available to them. Although all Piping Plover habitat is important to the populations, these criteria allow for identifying sites that have had substantive use over a considerable time frame. Criteria will be re-evaluated in 5 years.

2.5.2 Schedule of Studies to Identify Critical Habitat

1) Ongoing inventory of birds and habitat areas used (2006–2010).
2) Habitat assessment and Prairie Canada population census at known sites (2006).
3) Review, refine, and update critical habitat (2006–2010).

Critical habitat will be identified in provincial action plans. The above studies will aid in completing the identification process, as required. Units for current and future consideration in action plans as critical habitat for *C. m. circumcinctus* include 58 basins and one riverbed section.

2.5.3 Existing and Recommended Approaches to Habitat Protection

Federal Land

Federal protection could be provided through a variety of legislation, including the following five acts:

1) The *Species at Risk Act, 2002* provides for the protection of the individual, the residence, and critical habitat identified in a recovery strategy or action plan.
2) The *Canada Wildlife Act, 1994* protects and conserves wildlife and wildlife habitat in Canada through permitting the establishment of National Wildlife Areas and Protected Marine Areas.
3) The *Canadian Environmental Assessment Act, 1992* ensures that any potential impacts on a listed wildlife species are considered during a project evaluation.
4) The *Canada National Parks Act, 2000* ensures continued ecological integrity of national parks, and Parks Canada Agency ensures protection of species at risk within National Parks.
5) The *Canadian Environmental Protection Act, 1999* deals with controlling pollution and toxic substances and waste management.

Non-federal Land

Non-federal lands are those that fall under provincial or private ownership. Protection of provincial lands can occur under a variety of provincial legislation. Lands under private ownership may require a stewardship approach.

Non-legislative forms of habitat protection may include guardian programs or designation under the Western Hemisphere Shorebird Reserve Network program, the Ramsar Convention, and UNESCO's Man and the Biosphere Programme. Several nesting areas are recognized as endangered species sites under the Western Hemisphere Shorebird Reserve Network program (Beaverhill Lake, Chaplin/Old Wives/Reed lakes, Last Mountain Lake, and Quill Lakes), three prairie nesting areas are designated as Wetlands of International Importance under the Ramsar Convention (Beaverhill Lake, Last Mountain Lake, and Quill Lakes), and one is designated as a Biosphere Reserve (Redberry Lake). In Manitoba, the Clandeboye Bay and Walter Cook special conservation areas, established at Lake Manitoba and Lake Winnipeg, respectively, recognize important plover habitats, as does Alberta's Muriel Lake Waterbird Sanctuary. Sable Islands, a provincial nature reserve in Ontario, offers some level of protection to an area that has previously supported breeding Piping Plovers.

Existing provincial laws and/or stewardship agreements that effectively prevent destruction as described in this document will provide a first level of protection. The *Species at Risk Act* can also grant protection through federal prohibitions, if necessary, and also gives federal ministers the emergency authority to prevent critical habitat from being destroyed if it is in imminent danger. Specific details relevant to each jurisdiction will be outlined in the individual action plans.

2.6 Effects on Other Species

Management options used to benefit Piping Plovers will likely benefit a host of other species that utilize permanent to semipermanent alkali or freshwater lakes and wetlands. Breeding species that will likely benefit include co-habiting shorebirds, such as the American Avocet (*Recurvirostra americana*), Killdeer, Marbled Godwit (*Limosa fedoa*), Spotted Sandpiper (*Actitis macularius*), Willet (*Catoptrophorus semipalmatus*), and Wilson's Phalarope (*Phalaropus tricolor*). Numerous other migrant shorebird species also utilize this habitat and will likely benefit from management.

Discouraging predators (American Crows, coyotes , gulls, and raptors) near Piping Plover nesting sites may lower predator reproductive success locally; however, it is highly unlikely to have any adverse effect on their populations overall.

2.7 Action Plan schedule

There are several action plans that will support and aid the implementation of the recovery strategy for *C. m. circumcinctus*.

The Alberta Piping Plover Recovery Plan (Alberta Piping Plover Recovery Team 2002) is an action-oriented strategy that is currently being updated to cover the period 2005–2010. The recovery goal for the Alberta plan "is to achieve a well-distributed, long-term average population of 300 individual Piping Plovers within their historical range in Alberta"(Alberta Piping Plover Recovery Team 2005. This plan is expected to get provincial approval in 2006 and will be considered for adoption under the *Species at Risk Act*.

Manitoba is in the process of preparing a Piping Plover action plan. This plan, anticipated to be completed by 2007, will aid the implementation of a much-needed strategy for the small population of plovers in that province. The focus will be on evaluating the status of the breeding population and its habitat; providing protection from predation and human disturbance; and maintaining, improving, and securing the quality and quantity of habitat needed for recovery. This plan will be considered for adoption under the *Species at Risk Act* and will include proposed critical habitat.

An action plan will be developed for the Piping Plover's range in Saskatchewan by December 2007 and will include proposed critical habitat.

Although Piping Plovers are extirpated as a breeding species from the Canadian Great Lakes region, the U.S. Great Lakes population has increased by five-fold from 1990 to 2005. Implementation of the U.S. Great Lakes Recovery Plan (U.S. Fish and Wildlife Service 2003) will increase the likelihood of plovers breeding once again on Canada's Great Lakes beaches. Canadian agencies have begun to plan for this eventuality, and an Ontario action plan has been initiated and is anticipated to be completed by 2007. The Great Lakes Action Plan is pending an identification of Critical Habitat.

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Appendix A. Management techniques used to augment Piping Plover reproductive success in the Northern Great Plains and Great Lakes regions

Management tool	Objectives	Source
Predator exclosure	Reduce egg predation	Richardson 1997; Murphy *et al*. 2003b; U.S. Fish and Wildlife Service 2003; Alberta Piping Plover Recovery Team 2005
Predator removal	Reduce local predator numbers	Maxson and Haws 1995
Predator nest removal	Reduce raptor nesting, thereby reducing adult plover mortality	Alberta Piping Plover Recovery Team 2002, 2005; Schmelzeisen *et al*. 2004
Predator deterrent – nylon string	Reduce or eliminate presence of breeding gulls	Maxson *et al*. 1996
Clutch/nest translocation	Protect clutches from flooding	Prellwitz *et al*. 1995; Gordon and Kruse 1999
Electric predator fence	Reduce egg and chick predation	Mayer and Ryan 1991b; Murphy *et al*. 2003b
Strobe lights	Reduce egg predation	Kruse *et al*. 1993
Symbolic fencing	Reduce human disturbance	U.S. Fish and Wildlife Service 2003
Guardian program	Reduce human disturbance, provide education, conservation	Jacobson 2003; Maconachie 2003; Alberta Piping Plover Recovery Team 2005
Signage	Reduce human disturbance	Alberta Piping Plover Recovery Team 2005; Heyens 2005a
Landowner cooperation	Reduce human disturbance, encourage habitat management, provide education	Prescott 1997; Alberta Piping Plover Recovery Team 2005
Habitat creation	Augment nesting habitat	Asmundson and Jones 2004; Alberta Piping Plover Recovery Team 2005
Captive chick release	Mitigate productivity losses from water management projects	Kruse and Pavelka 1999; U.S. Fish and Wildlife Service 2003
Water management	Control spring inflows on managed rivers to reduce egg, chick, and habitat losses	Canadian Wildlife Service *et al*. in prep.