The Manitoba Piping Plover Stewardship Project: a provincial strategy for the management of the endangered Piping Plover (*Charadrius melodus circumcinctus*)

by

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Abstract

The Manitoba Piping Plover Stewardship Project was initiated in 2002 to determine the status of Piping Plovers (*Charadrius melodus*) in Manitoba and to develop a provincial management strategy that outlined provincial management goals and necessary stewardship actions. In 2002 and 2003, intensive surveys of historical and potential sites across Manitoba were conducted and measures taken to protect eggs and chicks from predation and human disturbance. With the use of fencing, signs, predator exclosures and guardian volunteers, predation and recreational disturbance were minimized sufficiently at most sites to allow for increased nest success and fledging rates. An overall apparent nest success rate of 62% and an apparent fledge rate of 1.16 fledglings/pair was achieved during this study. The study concluded that Piping Plover nest success and productivity at the majority of historical nesting sites in Manitoba is being limited by habitat availability, medium to high predation rates and recreational pressures.

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1. Introduction

1.1. Issue

The Piping Plover (*Charadrius melodus*) is a small migratory shorebird that inhabits open beaches, alkali flats and sand flats in North America. There are two populations delineated by subspecies, the Atlantic *C. m. melodus* and the inland *C. m. circumcinctus* located in the Great Plains and Great Lakes regions (Environment Canada 2006a). The Piping Plover is protected as an endangered species under the Manitoba Endangered Species Act (1990) and both subspecies are recognized and listed as endangered under the federal Species at Risk Act (2002) (Manitoba Government 1990; Government of Canada 2002).

Since 1991, international censuses have occurred every five years in an effort to monitor population changes across its breeding range (Goossen et al. 2002). Based on 2001 census data, the Canadian prairie Piping Plover population has declined 42% since 1996 and 32% since 1991 (Boyne 2001; Goossen et al. 2002). Overall, the entire North American Great Plains population has been declining at a rate of 5-12% annually (Ivan 2001). As part of Canadian recovery efforts, two national recovery teams (Prairie and Atlantic) were formed and a draft recovery strategy for the *circumcinctus* subspecies prepared (Environment Canada 2006a).

In Manitoba, population estimates have ranged as high as 130+ adults in the early 1980s (Haig 1986), but have steadily declined since the early 1990s to 16 adults counted in 2001 (De Smet 2001). As not all Piping Plover sites were

annually surveyed, it is not known what percentage of Manitoba's population was sampled annually, if Piping Plovers were utilizing other suitable areas in Manitoba during high water years, if emigration due to habitat loss was part of the cause of decline, or if irreversible declines have indeed occurred. In addition, natural recruitment into Manitoba may be hampered by peripheral population changes, years of apparent low productivity in Manitoba, and/or possible short-stopping due to favorable habitat conditions elsewhere in their nesting range. Threats to Piping Plover populations and productivity in Manitoba include predation, habitat loss due to stabilized water levels, nest flooding during storms, human disturbance, and vegetation encroachment (Haig 1985; Asmundson and Jones 1996b; Jones and Koonz 1999; De Smet 2001).

The recovery potential of Piping Plovers in Manitoba is dependent upon gaining a better understanding of seasonal productivity, the amount of dispersal occurring during high water years, habitat conditions at historical nesting sites, population distribution and abundance, and the level of immigration and emigration occurring. In order for Manitoba to understand and possibly reverse the declining population trend, concerted emphasis needs to be placed on intensive management of the species and its habitat. Prior to 2002, management efforts in Manitoba have been hampered by the lack of clear management objectives and inconsistent application of conservation efforts across the province caused by reduced manpower and lack of funds. To effectively focus provincial efforts and resources on Piping Plover recovery, a framework that identifies provincial management objectives and outlines specific stewardship actions was

needed. This framework needed to bring together all the essential players, integrate already established national recovery goals, and direct regional stewardship actions.

1.2. Study Goals and Objectives

The two goals for this stewardship project were: (1) to establish a framework by which stewardship efforts in Manitoba could be linked with national recovery goals and objectives, and (2) to initiate stewardship efforts at select nesting sites in Manitoba during the 2002 and 2003 breeding seasons.

To accomplish these goals, five objectives were outlined:

1. Develop a management strategy for Manitoba that identified management objectives and coordinated stewardship activities;
2. Prioritize historical nesting areas for management initiatives;
3. Implement select stewardship activities designed to maximize productivity and protect breeding areas;
4. Increase public and stakeholder awareness and participation on managed sites; and
5. Evaluate stewardship activities implemented in 2002 and 2003, and make recommendations for future stewardship efforts in Manitoba.

1.3. Organization and Limitations of the Study

The stewardship project was organized into three phases based on the specific needs and requirements set by Manitoba Conservation and the Canadian Wildlife Service (CWS). In Phase 1, an evaluation and summary of Manitoba's Piping Plover data and conservation efforts were undertaken. This included identifying potential limiting factors and threats, prioritizing current and historical breeding areas, and developing site-specific management recommendations.

Phase 2 implemented specific management actions during the 2002 and 2003 breeding seasons, including surveying historical and potential nesting sites, mitigating human disturbance at priority sites, monitoring nest success and productivity, increasing public awareness, and establishing partnerships to facilitate in the protection of breeding areas. The selection and implementation of management activities were based on feasibility, time limitations, and funding constraints. Finally, the evaluation of management activities and the development of a provincial management strategy completed Phase 3 of the project.

In this thesis, the stewardship project is presented in seven sections. Section 1 outlines the project's goals and limitations. Section 2 summarizes the status of Piping Plovers in Manitoba including the conservation history, limiting factors, and recovery potential. A brief literature review on current conservation techniques used across North America for the recovery of Piping Plover is found in Section 3. Priority site designations and site specific management recommendations for high and medium priority sites are located in Section 4. Section 5 outlines and discusses the implementation of specific management actions during the 2002 and 2003 breeding seasons. The proposed management strategy and implementation outline is located in Section 6. Finally, management priorities and specific recommendations for future stewardship efforts are presented in Section 7.

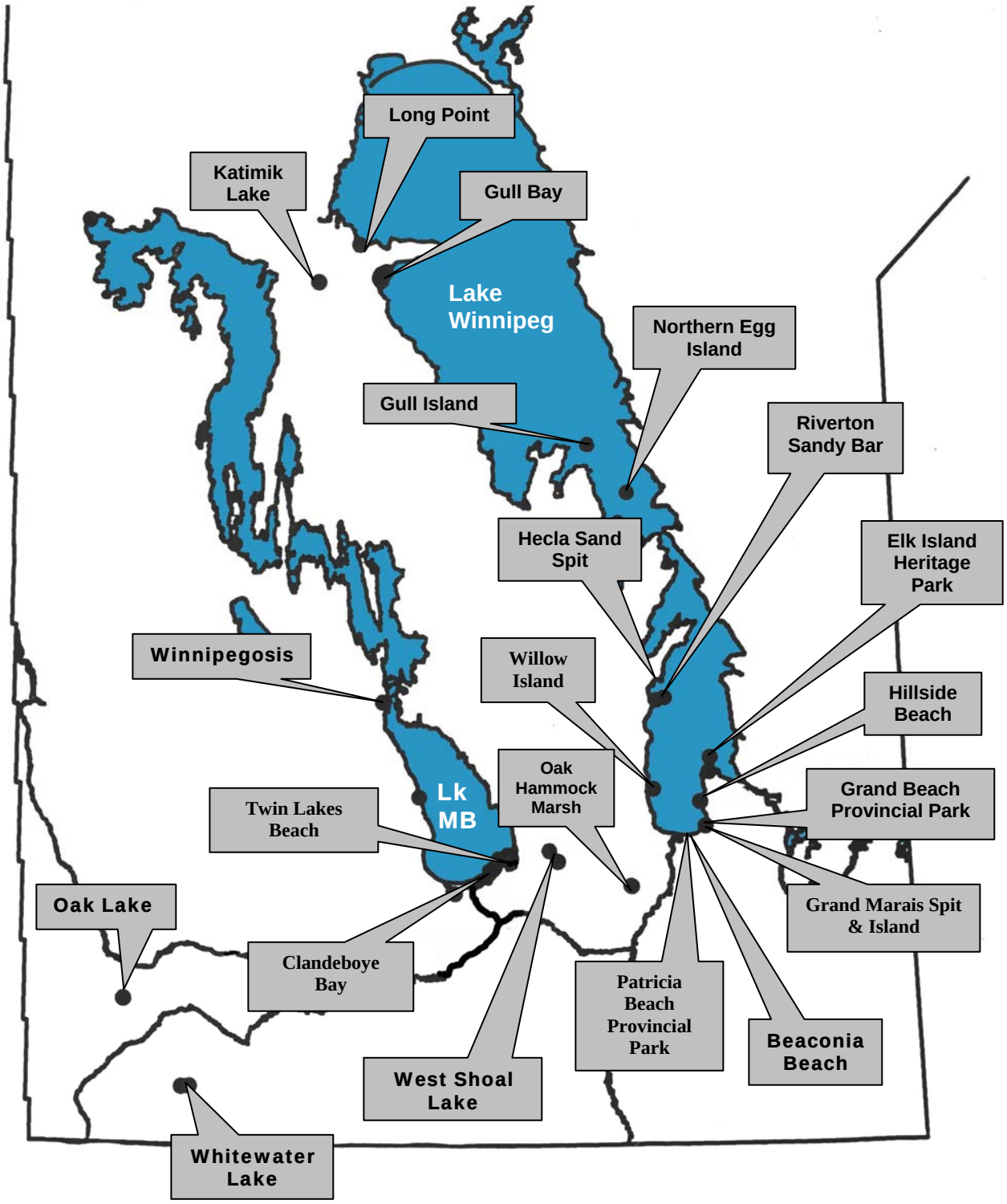
2. Status of Piping Plovers in Manitoba

2.1. Conservation History and Nesting Locations

Manitoba lies within the northeastern range of the Great Plains distribution of Piping Plovers. The earliest recorded nesting site in Manitoba documented in provincial records was in 1921 near the town of Gimli, although Piping Plover observations date back to 1860 (Goossen et al. 2000; Haig 1987). Population surveys in Manitoba were first initiated by Haig (1986) during a five-year study on productivity, limiting factors, movements and distribution of Piping Plovers on West Shoal Lake, and parts of Lake Manitoba and Lake Winnipeg (1981-1985). Since then, Manitoba Conservation (formally known as the Manitoba Department of Natural Resources) has surveyed Piping Plover breeding sites in Manitoba on an annual basis, but the intensity of these efforts and the number of historical sites checked each year has varied. In 1986 and 1987, extensive surveys were undertaken to identify new breeding areas in the province (Haig 1986; Moszynski et al. 1988). Of over 100 sites identified as potential breeding locations during aerial surveys, 77 sites were ground surveyed. In 1991 and 1992, searches for Piping Plovers were made during colonial nesting waterbird surveys of over 80 islands on lakes Winnipeg, Manitoba and Winnipegosis (Koonz 1991b, 1992).

Historical breeding locations have been concentrated on Lake Manitoba, Lake Winnipeg and West Shoal Lake. From 1986-2001, a total of 23 breeding locations in Manitoba were identified as being occupied at least once (Figure 1).

Figure 1. Historical nesting locations in Manitoba from 1986-2001 (based on unpublished Manitoba Conservation survey records)



Based on occupancy numbers during these years, the most significant breeding locations are Gull Bay (south-side of Long Point, southeast of Grand Rapids), West Shoal Lake (north of Woodlands), Clandeboye Bay (southwest of St. Ambroise on Lake Manitoba), and various beaches and islands located on the southeast shores of Lake Winnipeg (Grand Marais, Grand Beach, Patricia Beach, Elk Island, Riverton and Hecla) (unpublished Manitoba Conservation survey records 1986 – 2001; Goossen et al. 2000).

Two Special Conservation Areas have been designated by the Manitoba Government to protect breeding Piping Plovers from human disturbance. The Clandeboye Bay Special Conservation Area was established in 1982 on the south basin of Lake Manitoba and the Walter Cook Special Conservation Area was established in 1994 on Gull Bay in the north portion of Lake Winnipeg (Goossen et al. 2000). Fences, signs and community education have all been deployed to reduce human disturbance in these areas. Additionally, in the Walter Cook Special Conservation Area, fishers' cabins were relocated, boat docks rebuilt, and an agreement was signed between fishers and the Manitoba Government to protect the area (Jones 1994). However, over the past decade both areas have experienced problems with human disturbance, especially with All Terrain Vehicle (ATV) use disrupting and destroying nests and young during the prime-breeding season (Koonz 1991a, 1992, 1993, 2000; Jones and Koonz 1999; De Smet 2001).

During the winters of 1992 and 1993, Manitoba Conservation undertook a habitat enhancement project on West Shoal Lake. Two nesting islands were built

at the south end of the lake to provide a secluded area (away from cattle and land predators) for nesting birds (Jones 1994, 1995; Asmundson and Jones 1996a). Due to the success of the first two islands (both had nesting birds in 1994 and 1995), another island was built in the winter of 1995 on the west side of the lake and portions of the west shoreline were fenced to prevent trampling by cattle (Asmundson and Jones 1996a). All islands were naturally vegetated and held a total of eight nesting pairs in 1996 (Jones 1994, 1995; Asmundson and Jones 1996a). Unfortunately, starting in 1997, rising water flooded these islands and all shoreline nesting areas making them unsuitable for nesting (Jones and Koonz 1997, 1998, 1999; Koonz 2000; De Smet 2001).

In 1998, during the construction of Oak Hammock Marsh Interpretive Centre, birds successfully nested in a gravel parking lot. Ducks Unlimited has also created a large gravel-based nesting island at Oak Hammock Marsh for shorebird species in 1999 - 2000, but it has yet to attract Piping Plovers (Brian Hagglund pers. comm.). Other enhancement projects in Manitoba included a habitat enhancement project on Lake Manitoba (Delta Marsh) in 1983-1984 where gravel was deposited along the shoreline, but was washed away by a late summer storm in 1984 (Haig 1985). In 1986, an attempt to remove encroaching willow (*Salix* spp.) vegetation with a 2 HP tiller at Gull Bay had limited results due to the small size of the tiller (Moszynski et al. 1988).

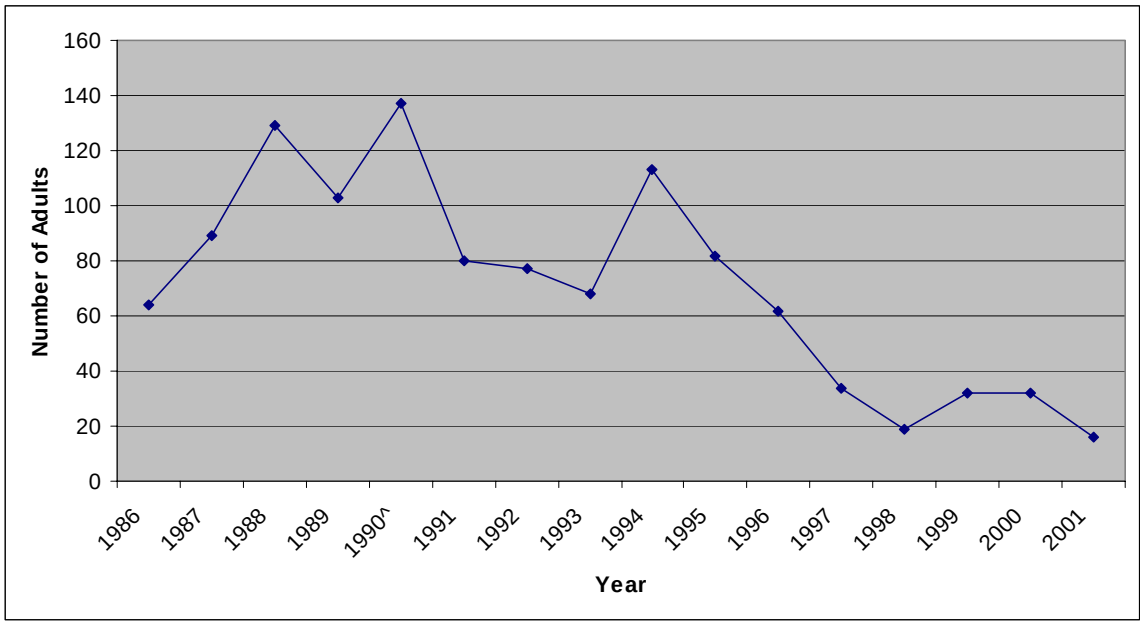
Since the early 1990s, fencing and signs have been installed around Piping Plover nests at Grand Beach Provincial Park to protect them from being destroyed by park visitors (K. Porteous pers. comm.). The Parks' interpretive

program staff have also been instrumental in educating hundreds of cottagers, beach goers, and local school children each year on the plight of the plover through amphitheater programs, school programs and plover spotting opportunities. A volunteer guardian program was initiated from 1993 to 1995 to encourage local involvement in conservation efforts, but the program was dropped in 1996 due to staff changes, poor volunteer numbers and increased time required (Miller 2001). In recognition of the growing importance of Grand Beach as an important nesting area and in cooperation with CWS, the Volunteer Guardian Program was resurrected in 2001 (Miller 2001).

2.2. Population Statistics

Since the first international census in 1991, Manitoba's population of Piping Plovers has seen a steady 80% decline at known nesting sites from 80 individuals in 1991 to 62 in 1996 and down to 16 in 2001 (Figure 2) (Koonz 1991a; Asmundson and Jones 1996a; De Smet 2001). During this period, many historical nesting locations were abandoned or breeding bird numbers declined due to unfavorable habitat conditions (mainly flooding and vegetation encroachment). Some locations have remained suitable but under-utilized (suitability based on observations of apparent habitat conditions and not trophic level changes). Although a population decline is evident, it is unknown what percentage of Manitoba's entire population was being sampled annually and how Piping Plover movements have contributed to the decline at known sites. It is also unknown, what role human disturbance or other conditions may have played in the decrease of nesting birds.

Figure 2. Piping Plover population in Manitoba, 1986-2001 (based on unpublished Manitoba Conservation survey records)



Even though survey efforts were not consistent through all years, it is evident that there is a declining trend in plover populations, as indicated in Figure 2. Drought-like conditions and increased census efforts during the late 1980s accounted for some of the Piping Plover increases seen during that period (Haig 1986; Moszynski et al. 1988). In 1989 and 1994, water levels remained stable throughout the season providing optimal plover habitat at most breeding sites (Koonz 1989; Jones 1994). Low water levels followed by rising water due to spring storms from 1991 to 1993 reduced nesting success in many locations (Koonz 1991a, 1991b, 1992, 1993). Stabilized water levels on Lake Winnipeg and Lake Manitoba from 1995 to the present have reduced available plover habitat (Asmundson and Jones 1996b; De Smet 2001). Flood-like conditions on

West Shoal Lake has prevented nesting there from 1998 to the present (Jones and Koonz 1998, 1999; Koonz 2000; De Smet 2001). Until water levels recede on West Shoal Lake, former nesting areas on this lake will remain unavailable.

Haig (1986) collected the majority of information on Piping Plovers in Manitoba from 1981-1986. Her research showed that from 1981-1984, 44 pairs bred at seven sites in the province. An additional 30-40 non-breeding birds were observed during most years, for a collective population of 118-128 adults. The observed population was distributed as follows: West Shoal Lake (25-35 pair); Lake Winnipeg (Grand Marais and Hecla Island) (10-13 pair); Lake Manitoba (Clandeboye Bay and Hollywood Beach) (3-5 pair); Lake Winnipegosis (Salt Point) (1-4 pair); and Whitewater Lake (1-3 pair) (Haig 1985, 1986). At that time, Clandeboye Bay and West Shoal Lake combined had upwards of 80 adults or about 60% of the known population.

Widespread aerial surveys for unknown breeding areas occurred in 1986 and 1987. Aerial flights over some potential nesting lakes revealed over 100 possible nesting areas in Manitoba; of these, 36 were ground surveyed in 1986 and 41 in 1987 (Haig 1986; Moszynski et al. 1988). The latter surveys confirmed breeding at eight sites in 1987, including three new sites (Gull Bay, Long Point, and Katimik Lake) (Moszynski et al. 1988). Searches for Piping Plovers during colonial waterbird surveys on central Lake Winnipeg in 1990 revealed two new nesting sites - Gull Island and Egg Island (Koonz 1991a). Further colonial waterbird surveys of islands on Lake Manitoba and Lake Winnipeg in 1991 revealed no plovers on over 80 islands that were checked (Koonz 1991a).

Manitoba has participated in the International Census since its inception in 1991 (De Smet 2001). Held every five years, the International Census provides a synopsis of overall population trends occurring across the Prairie and Atlantic breeding regions (Goossen et al. 2002). The 1991 International Census documented 12 active breeding sites out of 45 potential sites that were surveyed in Manitoba (Table 1) (Koonz 1991a). The 1996 International Census recorded 10 of 28 sites having breeding activity (Asmundson and Jones 1996a; 1996b). Finally, the 2001 International Census revealed only four active sites out of 23 surveyed (De Smet 2001). The 2001 census mainly surveyed historical breeding areas with only three potential new areas surveyed for plovers. Areas missed during the 2001 survey, which have had small numbers of nesting plovers at least once during the previous 15 years, included Katimik Lake, Whitewater Lake, Lake Winnipegosis, Gull Island, North Egg Island, Grand Marais Island and Long Point. Surveys of historical breeding sites have occurred annually between censuses, but efforts have varied. In addition, no intensive aerial or ground surveys to locate new breeding areas occurred between 1991 and 2002.

Population statistics from 1986-2001 for all historical nesting locations in Manitoba are indicated in Table 1. Even though survey efforts were not consistent every year, it is apparent that both the number of active sites and the abundance of birds have dramatically decreased in the past 15 years based on observed drops at key sites surveyed every year (i.e. West Shoal Lake, Gull Bay and Grand Marais Spit).

Table 1. Historical nesting locations and population statistics from 1986-2001 (based on unpublished Manitoba Conservation survey records)

Site	1986	1987	1988	1989	1990^	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Lake Winnipeg																
Long Point	?	2 (1)				\										
Gull Bay - North Spit		28(7)	49	31 (14)	17 (6)	15 (6)	16(8)	22 (?)	23 (?)	20 (?)	15(6)	1	6 (3)	14(6)	14(6)	3 (1)
Gull Bay - South Spit	9	4 (2)	3	16 (7)	33 (4)	23(11)	19 (9)	3 (0)	10 (?)	10 (?)	2 (1)	\			\	
Willow Island/Point		?				2 (1)	\	\						\	\	\
Hecla Island (Sandy Point)						2 (1)	\		1 (0)	5 (2)	2 (1)		\		\	\
Riverton Sand Islands		6 (3)	12	8 (3)	5 (2)	2 (1)	1 (0)	\		\	\		\		\	\
Patricia Beach			4			2 (1)					3 (1)	1 (0)			\	2 (1)
Grand Marais Spit	1	5		2 (1)	3 (1)	3 (1)	4 (2)	2 (1)	4 (2)	2 (1)	2 (1)	2 (1)		\	\	\
Grand Marais Island	6 (3)		5	4 (2)	10 (5)	6 (3)	4 (2)	\		2 (1)					\	
Grand Beach			1			2 (1)	2 (1)	2 (1)	2 (1)	6 (5)	5 (2)	8 (4)	6 (3)	8 (4)	8 (4)	5 (2)
Elk Island	{2}	\				2 (1)	4 (2)	4 (2)	2 (1)	4 (2)	2 (1)				\	\
Hillside Beach								2 (1)							\	\
Beaconia Beach											2 (1)					\
Gull Island					3 (1)											
North Egg Island					2 (1)											
Victoria Beach						1*										\
Lake Manitoba																
Clandeboye Bay	6 (2)	4 (2)	5	4 (1)	\	3 (1)	\	\	4 (2)	\	3 (1)	4 (2)	5 (2)	8 (4)	10(5)	6 (3)
Twin Lakes Beach	2 (1)					\					\	4 (2)		1 (0)		\
West Shoal Lake - South	37	26(?)	25	28(11)	34(16)	\	15(7)	13 (4)	14 (?)	33	8 (2)	14(7)	\	\	\	\
West	"	2 (1)	21	10 (5)	30(15)	13 (6)	12(6)	16 (6)	53 (?)	"	18(8)	\	\	1 (0)	\	\
Winnipegosis		3 (1)	4 (2)			\									\	
Salt Point		1*									\					
Whitewater Lake (Sexton's)	3					\										
Katimik Lake		8 (1)									\					
Oak Lake						4 (2)		2 (1)							\	\
Oak Hammock Marsh	3*							2 (1)					2 (1)			\
Beasejour	1*															
Grassmere	1*															
TOTALS	64	89	129	103	137	80	77	68	113	82	62	34	19	32	32	16

KEY: ( ) = Pairs \ = Surveyed but no plovers found * = Migrants " = Combined data { } = Data from 1985, site not surveyed in 1986

^ Data from 1990 combined information from two census (one in early June and one in early July) resulting in max # at each site

The decline at some sites can be attributed to high water levels, namely Hecla Sandy Point, Riverton Sandy Islands, Willow Point, Grand Marais Spit, Whitewater Lake and West Shoal Lake. Other sites were not regularly surveyed or only surveyed once, making it unclear if birds were utilizing these sites or other unidentified sites during high water periods. Since surveys for new breeding areas have not been carried out between 1991-2001 and all of the historic nesting areas have not been checked annually, it is not known if population declines are as steep as recent data suggests or if plovers are utilizing other areas in the province that have yet to be identified.

Since the early 1980s, overall productivity in Manitoba has been below the annual stability rate of 1.25 chicks/pair proposed by the national recovery strategy for this subspecies (Environment Canada 2006a) (Table 2). Between 1987-2000, the number of chicks counted during productivity surveys held in the first week of July was between 1-54 chicks, producing an estimated productivity rate of 0.76 chicks/pair/year (determined using unpublished Manitoba data from 1986-2001). This coincides with Haig's (1987) average of 0.90 chicks fledged/pair/season (n=94) for sites in southern Manitoba between 1981-1986. The productivity numbers in Table 2 are estimates based on the number of chicks observed during the productivity censuses and do not take into consideration unseen chicks or the possible loss of chicks before fledging. It is unknown what effect low productivity may have had on observed declines at historical breeding locations (i.e. are birds nesting elsewhere after repeated failures at one location), on recruitment into the province and on the overall population numbers in

Manitoba.

Table 2. Estimated Piping Plover productivity in Manitoba from 1986-2001 (based on unpublished Manitoba Conservation survey records).

Year	Average # Pair	Min. # of chicks	Estimated Productivity
1986	32	55	1.72
1987	33	39	1.18
1988	56	55	0.98
1989	44	23	0.52
1990	48	9	0.19
1991	36	22	0.61
1992	37	0	0
1993	28	10	0.36
1994	25	33	1.32
1995	39	25	0.64
1996	23	No data	-
1997	16	18	1.13
1998	9	15	1.67
1999	14	10	0.71
2000	15	4	0.27
2001	7	1	0.14
Overall			**0.76**

2.3. Threats to Piping Plover Populations and Productivity

Haig (1985) determined that 59.5% of the nesting efforts on Lake Manitoba and West Shoal Lake from 1982-1984 were unsuccessful (n=32); predation accounted for the majority (55%) of nest losses and the remainder were caused by storms (26%) and human disturbance (19%). Based on her studies and observations in subsequent years, there would appear to be five main threats to Piping Plovers nesting success and productivity in Manitoba: (1) predation of

eggs and chicks; (2) a loss of habitat due to high water levels on West Shoal Lake and seasonal changes on Lake Winnipeg and Lake Manitoba; (3) flooding of nests during storms and prolonged winds; (4) human disturbance by beach visitors, recreationists and ATVs; and (5) vegetation encroachment due to stabilized water levels.

Water Level Management and Vegetation Encroachment

Water levels appear to affect the productivity and suitability of breeding habitat in Manitoba. During low water years, there is an increase in abundance in plover populations as more habitat becomes available. The opposite occurs during high water years. These natural seasonal fluctuations are important since they maintain wide-open beaches by controlling the encroachment of vegetation. However, stabilized water levels have persisted on Lake Winnipeg and Lake Manitoba since the late 1960's allowing vegetation to encroach at some historical sites (Asmundson and Jones 1996b; Jones and Koonz 1997, 1998, 1999; Koonz 2000). Abandonment of sites along the south basin of Lake Manitoba and along Lake Winnipeg can be attributed to habitat deterioration due to stabilized water levels maintained by Manitoba's network of water control structures (Asmundson and Jones 1996a). West Shoal Lake has also experienced flood-like conditions since 1998, placing all breeding areas on this lake under water (Jones and Koonz 1998, 1999; Koonz 2000). Seasonally elevated water levels during years of heavy snow and rainfall and the shallow nature of Lake Winnipeg and Lake Manitoba have also made the remaining habitat susceptible to flooding during summer storms and prolonged periods of strong winds. These factors have

repeatedly caused the loss of nests found along beaches of these large lakes (e.g. Patricia Beach, Grand Beach, Clandeboye Bay, Twin Lakes, and Elk Island).

Human Disturbance

Human disturbance, in the form of motorized and non-motorized recreational activities, has been identified as a serious threat for Piping Plovers across its breeding range (Burger 1991, 1994; Melvin et al. 1994; Prescott 1997; Boyne 2001). Disturbance events can crush eggs, kill chicks, or interfere with territorial establishments, reproductive behaviours or foraging activities. Various studies have documented decreased nest success and fledging success on beaches with human disturbance (Flemming et al. 1988; Burger 1991, 1994; Prescott 1997; Boyne 2001; Goossen et al. 2002). On the Atlantic coast, Cairns (1982 in Prescott 1997) calculated that 0.7-1.6 chicks/pair fledged on human-disturbed beaches, compared to 1.3-2.1 chicks/pair on isolated beaches. Burger (1991), in a study on foraging behaviour and the effects of human disturbance on coastal beaches in New Jersey U.S.A., observed that feeding rates decreased as human disturbance increased. Many authors deducted that reduced fledging success on human disturbed sites is a direct result of reduced time spent foraging and increased time spent avoiding disturbance in areas with frequent human activity (Flemming et al. 1988; Burger 1991, 1994; Cairns 1982 in Prescott 1997; Boyne 2001).

Even when precautions are taken, there are many documented mortality incidents of eggs and chicks due to motorized vehicles (Melvin et al. 1994; U.S.

Fish and Wildlife Service 1994). Unfortunately, the typical foraging behaviours of Piping Plover chicks cause them to be in the direct path of vehicles and, in response to alarm calls form the parents, chicks will often stand motionless or crouch upon the approach of a vehicle resulting in many getting run over. In addition, chicks will often stand in, walk and run along tire ruts and sometimes have difficulty crossing or climbing out of deep ruts. In Manitoba, ATV use has been documented or suspected in destroying nests and killing chicks at Clandeboye Bay, Twin Lake Beach, Gull Bay, Riverton Sand Islands, and Grand Marais Spit (Koonz 1991a, 1992, 1993, 2000; Jones and Koonz 1999; De Smet 2001). Other human activities that may cause disturbance or losses to nesting plovers includes livestock grazing at West Shoal Lake, and activities related to periodic fisher cabin use at Gull Bay and Grand Marais Spit. Recreational and cottage developments along the shorelines of all major lakes in Manitoba will continue to be a concern in the future.

Predation

Across the Northern Great Plains range, predation of eggs and chicks is identified as the greatest threat to Piping Plover productivity (Environment Canada 2006a). Productivity studies across the prairie range have identified predation as the leading cause of Piping Plover nest losses (often resulting in more than half the nest failures) (Haig 1985; Richardson 1997; Schmelzeisen and Engley 2003). Additional predation on unfledged or post-fledged chicks and adults can be substantial and contribute to low annual recruitment (Haig 1992; Schmelzeisen et al. 2004).

Confirmed predators of Piping Plover eggs, chicks and adults include mink (*Mustela vison*), coyote (*Canis latrans*), domestic dog (*Canis familiaris*), raccoon (*Procyon lotor*), Merlin (*Falco columbarius*), Black-billed Magpie (*Pica hudsonia*), American Crow (*Corvus brachyrhynchos*), Common Raven (*Corvus corax*), gulls (*Larus spp*.), Peregrine Falcon (*Falco peregrinus*), Northern Harrier (*Circus cyaneus*), Great Horned Owl (*Bubo virginianus*), and American Kestrel (*Falco sparverius*) (Boyne 2001; Environment Canada 2006a). Potential predators include red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), American badger (*Taxidea taxus*), white-tailed deer (*Odocoileus virginianus*), ground squirrels (*Spermophilus spp*.), blackbirds (*Icteridea*), Red-tailed Hawk (*Buteo jamaicensis*), and Swainson's Hawk (*Buteo swainsoni*) (Environment Canada 2006a). Human activities have increased the abundance of some predators such as gulls, crows, ravens, magpies, raccoons, ground squirrels and skunks (Boyne 2001; Environment Canada 2006a). Garbage left on beaches can also exacerbate the problem by attracting predators to plover habitat.

2.4. Recovery Potential and Limiting Factors

Manitoba's Piping Plover recovery potential is dependent on many factors. The Northern Great Plain's population has declined 15% from the 1991 to the 2001 international census, but in the same period, Manitoba's known nesting population has declined 80% (Ferland and Haig 2002 *in* Environment Canada 2006a). Whether these differing trends are a reflection of the status of these populations or of our incomplete knowledge on their distribution remains to be

determined. It is not clear if seasonally high water conditions during 1995 to 2001 have been a factor in reduced abundance during those years, if plovers have relocated to suitable areas elsewhere in Manitoba (i.e. in the Interlake or along the shores of Lake Manitoba or Lake Winnipeg), or if they have moved out of province to more suitable regions. In addition, pairs cannot recover from constant reproductive failure and may eventually abandon historical sites even though Piping Plovers are relatively site loyal with breeding site fidelity ranging from 25-84% (Haig 1985, 1992). Years of apparently low productivity in Manitoba may have also hampered natural recruitment into the province (based on a natal philopatry rate of 12.2% for Manitoba chicks (Haig 1992).

By controlling human disturbance, especially ATV use, and by implementing a predator management program, nesting success and productivity at current nesting sites in Manitoba would likely increase. These measures may enhance site fidelity and the potential to increase populations in surrounding areas within Manitoba in subsequent years. Essentially, the recovery of Piping Plovers in Manitoba is contingent on the availability of suitable disturbance-free habitat and on the ability to increase nest success and productivity. Manitoba's recovery potential will also be impacted by immigration and emigration, and may be affected by trends in peripheral population, such as the increase or decrease of birds in Ontario and Lake of the Woods. However, if productivity is as low as indicated and disturbances or other limiting factors persist at historical sites, Piping Plover populations in Manitoba are in danger of becoming extirpated.

3. Review of Management Strategies and Techniques

Various management strategies and techniques that focus on nest and chick survival have been deployed across the Piping Plover's breeding range. Recovery efforts for the Great Plains region have focused on population monitoring, enhancement of nesting success and productivity, habitat management, research and communication programs (Environment Canada 2006a). Techniques, such as clutch translocation and egg salvage have also helped mitigate the loss of nests due to flooding. However, intensive management programs, such as egg salvage and captive-rearing programs, are labour intensive, expensive to implement and sustain, and are not conducive to long-term management making them beyond the practical means of most jurisdictions.

This review is not intended to yield an exhaustive compilation of all management strategies and techniques available, but rather to provide an overview of those most applicable to Manitoba's situation. Specifically, of interest are techniques that can mitigate the threats to eggs and chicks caused by human disturbance, predation, flooding and loss of nesting habitat. Ideally, any management strategy for Manitoba would harness current resources and staff, be cost effective, utilize already established conservation programs, would not interfere with the natural behaviour of Piping Plovers, and finally, be socially acceptable. It is likely a combination of various techniques, tailored to specific sites and situations would be the most effective.

3.1. Habitat Protection and Human Disturbance Mitigation

Various strategies have been employed to reduce human disturbance events on Piping Plovers during critical times across the breeding range. In the Atlantic region, active site management and intensive management of people are credited for increasing plover populations in that region (Goossen et al. 2002; Environment Canada 2006a; Environment Canada 2006c). Management activities that focus on reducing human disturbance include utilizing symbolic or barrier fencing to close off part or complete beaches, using signs to educate beach users and restrict access to closed off areas, patrolling and enforcement of no-entry zones and intensive public education campaigns (Goossen et al. 2002; Environment Canada 2006c). In addition, many important breeding areas have been incorporated into provincial or federal protected areas and in some instances, non-governmental organizations have purchased important breeding areas in Nova Scotia and New Brunswick (Boyne 2001). Volunteer-based guardian programs have also played an important role in educating and encouraging compliance to beach closures across the Atlantic coast (Goossen et al. 2002; Environment Canada 2006c).

In the Northern Great Plains region, conservation easements and/or cooperative stewardship activities have provided some protection to nesting birds and their habitat on private land. In Alberta, stewardship agreements with private landowners combined with the fencing of alkali shorelines from cattle disturbance and providing alternative watering sources have been successful in reducing cattle impact on many plover lakes (Prescott 1997; Engley et al. 2004). Other

ongoing activities in Prairie Canada include the designation of sites under protected status, protecting breeding sites with fencing and signage, implementing education programs surrounding sites, utilizing guardian/volunteer monitoring programs, and increasing patrols of 'no entry' area designations by enforcement personnel (Prescott 1997; Goossen et al. 2002; Westworth et al. 2004; Environment Canada 2006b).

In Manitoba, the majority of nesting sites (17 of 23 sites) are found on provincial lands with some degree of human disturbance. In areas with human disturbance, the designation of nesting sites as Special Conservation Areas or Important Bird Areas (IBA) has not proven to be sufficient in itself of preventing recreationists from entering protected areas. Active site management, which includes posting signs, fencing breeding areas, regular monitoring of these sites, and discussions with stakeholders and user groups is also necessary. A combination of designating breeding areas under protected status, utilizing fencing, signs and volunteers to reduce trespassing in sensitive areas, regular patrols and enforcement of no entry areas, and intensive public education is needed. At most sites, community consultation/participation would likely be required to gain cooperation and garner support for the cause.

3.2. Predator Management

Through various studies on both the Atlantic and Great Plains ranges, it has been shown that nest success and productivity rates for Piping Plovers can be significantly increased through the management of predators (Richardson 1997;

Murphy et al. 2003a; Westworth et al. 2004; Environment Canada 2006b, 2006c). A variety of techniques used over the years include predator deterrents (electric fences, predator exclosure cages, chick shelters, repellents, pyrotechnics, effigies), predator removal (trapping, poisoning, shooting) and predator recruitment reduction (nest destruction, den filling, egg sterilization) (Schmelzeisen et al. 2004). However, not all techniques were found to be very effective in increasing productivity (i.e. chick shelters, effigies, repellants), feasible to implement on a large scale (i.e. electric fences), or universally acceptable by the public (i.e. predator removal, poisoning or egg sterilization) (Kruse et al. 2002; Schmelzeisen et al. 2004). Effective mechanisms for predator management have been identified and summarized by Schmelzeisen et al. (2004). The most useful and applicable to Manitoba may include:

- The use of predator exclosure cages to prevent or deter predation on Piping Plover eggs;
- Use of deterrents including effigies, human presence, mobiles, pyrotechnics and suspended lines to scare or deter predators;
- Trapping predators and removing them from an area; and
- Reducing predator recruitment rates including inactive predator nest removal, den destruction and egg sterilization of predators at active plover sites.

The most effective and widely applied predator management technique has been the use of wire-mesh predator exclosure cages. Since the early 1990s, exclosure cages have been used in various jurisdictions to increase nest success

by protecting Piping Plover eggs from avian and mammalian predators (Melvin et al. 1992; Richardson 1997; Kruse et al. 2002; Goossen et al. 2002). In South Dakota, the use of predator exclosure cages increased apparent nest success rates from 35-62% in studies conducted in 1991-1992 (Kruse et al. 2002). In Alberta, widespread use of predator exclosure cages since 2002 (with limited use since 1995) has been effective in increasing apparent nest success for Piping Plovers with success rates as high as 93% on enclosed nests compared to 43% on unprotected nests (Schmelzeisen and Engley 2003; Engley et al. 2004; Schmelzeisen et al. 2005). Findings from studies on exclosure cages and nest success in other jurisdictions have also been similar (Rimmer and Deblinger 1990, Melvin et al. 1992, Larson et al. 2002, Murphy et al. 2003a).

In addition to increasing nest success rates, studies monitoring fledging success on alkali lakes in North Dakota and Montana from 1994 – 2003 saw an increase in apparent fledging rates with the use of exclosure cages or exclosure cages plus electric fencing (unprotected nests 0.98 fledglings/pair; exclosed nests 1.38 fledglings/pair; exclosed nests plus electric fencing 1.64 fledglings/pair; electric fencing only 1.42 fledglings/pair) (Ivan and Murphy 2004). Temporary electric fences appear to be useful in areas with high mammalian pressures, but are relatively expensive and cumbersome to apply (Ivan and Murphy 2004: Schmelzeisen et al. 2005). However, not all jurisdictions saw fledging rates increase with the use of predator exclosures and/or electric fences mainly due to high avian predation pressures in those regions (Schmelzeisen et al. 2005).

As a result of increasing nest success rates and in some areas also increased fledging rates, many jurisdictions have incorporated the use of exclosure cages as part of their overall recovery strategy for this species (Ivan and Murphy 2004; Schmelzeisen et al. 2005). However, caution is required as depredation of adults has occurred at exclosed nests in the past in Alberta, Saskatchewan, Montana and North Dakota (Murphy et al. 2003b). With modifications to cage size and by increasing monitoring, adult depredation has been reduced significantly to less than 1% of applications (Ivan and Murphy 2004). Predator exclosures and other predator management tools are considered a temporary measure until more sustainable landscape based approaches can be employed.

3.3. Habitat Enhancement

At sites where habitat loss has degraded prime nesting areas, some jurisdictions have taken extensive measures to enhance existing habitat or create additional habitat. Various habitat enhancement measures have included clearing trees and vegetation manually, mechanically (using tillers, diskers and heavy machinery) and/or with controlled fires prior to the breeding season (Currier and Lingle 1993; Latka et al.1993; Hultberg 2005; Jenniges 2005; Nelson 2005; Peyton 2005). Annual herbicide treatments are also used to maintain open, vegetation-free habitat at select sites in North Dakota, Nebraska and along the Missouri River (e.g. herbicide Rodeo used in North Dakota) (Latka et al. 1993; Hultberg 2005; Jenniges 2005; Peyton 2005). A series of habitat

enhancement projects conducted along the Missouri River found the most effective method of clearing vegetation was a combination of herbicide treatments (Rodeo and Norosac 10-G) plus mechanical or hand removal of vegetation (Latka et al. 1993). Spring burning (using a drip-torch) of dead vegetation has also been effective at removing any remaining vegetation left after spraying (Latka et al. 1993). In Alberta, management tools used to minimize vegetation encroachment on a 'as need basis' include burning, herbicide use, mechanical ground disturbance and fall/winter grazing (Alberta Piping Plover Recovery Team 2002).

At locations where flooding is a concern, some jurisdictions have elevated at-risk habitat artificially or accelerating natural beach building processes. Along the Missouri River, bulldozers were utilized to reshape island elevations by raising low-elevation sandbars and by leveling high dunes (Latka et al.1993). In addition, snow fencing was erected at some sites to aid in creating dunes to help elevate sandbars at risk for flooding (Latka et al. 1993). Dredging materials have also been successfully used to elevate at risk areas and/or to create vegetation-free islands (Currier and Lingle 1993; Latka et al. 1993; Fischer et al. 2005). Guidelines in creating island habitat have been developed by the U.S. Army Corps of Engineers as part of their Beneficial Uses of Dredged Material Program (see web site for additional information: http://el.erdc.usace.army.mil/dots/budm/budm.cfm) (Fischer et al. 2005).

After vegetation removal and/or creation efforts, most jurisdictions documented Piping Plovers utilizing enhanced areas (Currier and Lingle 1993;

Latka et al. 1993; Plettner 1993; Nelson 2005). In Colorado, habitat enhancement projects have been attributed to preventing the local extinction of Piping Plovers with 74% (43 of 58 total) of Piping Plover fledglings originating from sites created or improved by island creation or vegetation clearing projects since 1996 (Nelson 2005). In one occasion in 1997 when flooding waters threatened to inundate a sandbar with three pre-fledge chicks in Colorado, recovery workers moved the chicks via canoe to the nearest mainland in an attempt to save the young (Nelson 1999). The adults eventually followed the canoe over to the mainland and resumed their parental watch and all three young survived to fledge (Nelson 1999). In cases where the natural water regime can not be reinstated to control encroachment, vegetation clearing may need to occur every year or as necessary to maintain suitability (Currier and Lingle 1993; Latka et al.1993; Hultberg 2005; Jenniges 2005; Nelson 2005; Peyton 2005).

In some situations, birds may need to be discouraged from nesting in areas that are of economic importance, such as in sand and gravel pit operations. In Nebraska, prior to the breeding season, mylar deterrents (five meter long mylar flags erected in a five meter grid pattern over the entire affected area) and the application of gravel in 'safe' areas were used as necessary to move nesting birds away from potential conflict areas (Held et al. 2005). In 2002 and 2003, no nesting was initiated within the six sites where mylar deterrents were used, saving the mining companies up to an estimated $150,000 USD in 2003 (Held et al. 2005).

3.4. Other – Clutch Translocation and Egg Salvage

Clutch Translocation

In areas where rising waters caused by natural (flooding, high winds, rain fall) or artificial means (dams, release of water from control structures) occurs, clutch translocation is a management alternative for nests threatened to be inundated. The technique relocates the nest in a step by step fashion until they have been successfully moved to a higher elevation safe from flooding. The distance nests can be moved in one period is highly variable and dependent on substrate, the degree of elevation change, the stage of incubation, and the behaviour of the tending adult(s) (Prellwitz et al. 1995; Hjertaas 1998; Gordon and Kruse 1999). A successful move results in tending adults finding and resuming incubation at the new location within 15 minutes (or less in inclement weather) (Gordon and Kruse 1999). How quickly this nest-moving process can be repeated is dependent on the behaviour of tending adults, weather conditions, and the urgency (rate at which water levels are rising) (Prellwitz et al. 1995; Hjertaas 1998; Gordon and Kruse 1999). Gordon and Kruse (1999) recommend that Piping Plover nests should not be moved more than 3 m horizontally and 30.5 cm vertically in any single move, with ideally 24 h between moves (though they have moved nests multiple times in a few hours).

Various methods of moving eggs have been deployed (Prellwitz et al. 1995; Hjertaas 1998; Gordon and Kruse 1999):

- Obliterate/re-create: original nest is obliterated and re-created at the new location using the materials (i.e. pebbles lining the nest, debris, landmarks) from the original nest.

- Obliterate/platform: same as above only re-creating the nest on a platform that can be buried and excavated for numerous moves.
- Cylinder/plate/platform: involves excavating the original nest (with eggs not moved) using a bottomless coffee can and plate slide underneath and moving it intact to a new location directly into the ground or on a platform for multiple moves.

Both Gordon and Kruse (1999) and Prellwitz et al. (1995) caution that nest translocation only be attempted as a last resort for saving nests imminently threatened by flooding and that this technique not be used as an alternative to managing water at proper levels for nesting Piping Plovers.

Egg Salvage and Captive-rearing

Egg salvage and captive-rearing and release programs have been utilized over the years in situations where flooding threatened the catastrophic loss of numerous nests at once. Along the Missouri River, the United States Army Corps of Engineers (USACE) have initiated salvage and captive-rearing efforts to save flood-prone Piping Plover nests since 1995 (Kruse and Pavelka 1999). In 2002, 79 flood-prone eggs from Lake Diefenbaker were collected and flown to USACE Gavin's Point captive-rearing facility in Nebraska and 65 surviving chicks were released back on Chaplin Lake in Saskatchewan (Environment Canada 2006b). More recently in 2005, the Saskatchewan Watershed Authority initiated a salvage and captive-rearing and release program when rising waters on Lake Diefenbaker threatened to flood 133 nests within hours (White and McMaster 2006; Environment Canada 2006b). The program saw the collection of 276 eggs, the successful hatching of 247 chicks and the eventual release of 104

plovers at Chaplin Lake, Saskatchewan (White and McMaster 2006; Environment Canada 2006b).

These efforts have shown that Piping Plovers can be successfully reared and released back into the wild. However, the long-term survival and breeding success of released birds still needs to be determined before egg salvage/captive-rearing can be accepted as a viable alternative in periods of catastrophic losses. The USACE first year return rates of banded captive released plovers range between 4.8-12.2%, but survival and breeding success of captive-reared birds have been difficult to assess without unique band combinations (Niver 2000 in White and McMaster 2006). Ongoing studies and unique individual banding combinations will aid in return rate and survival analysis in upcoming years (White and McMaster 2006).

Protocols and a detailed guideline of requirements and activities required to initiate a captive-rearing program have been outlined by White and McMaster (2006) and can be found on the Saskatchewan Watershed Authority's web site under publications and stewardship. However, captive-rearing and release programs are too expensive and labour intensive for most jurisdictions to consider. As with clutch translocation, egg salvage and captive-rearing is not recognized by recovery biologists as an alternative to managing water at proper levels for nesting Piping Plovers.

4. Priority Site Designation and Site Plans

As summarized in Section 3, there are many management strategies that could be employed on the 23 historical sites documented across Manitoba in the past 15 years. However, since landscapes are not stagnant and change over time, some sites are no longer used by Piping Plovers while others continue to be utilized. In order to maximize provincial recovery efforts for the 2002 and 2003 breeding seasons, all historical sites needed to be assessed and prioritized for management activities based on recent activity and past occurrences. By prioritizing sites, resources could be maximized by directing management activities towards sites with recent activity and the highest concentration of breeding pairs.

Historical sites were first prioritized into high, medium and low designations based on known nesting occurrences from 1986-2001. Site plans were then developed for the high and medium sites prior to the 2002 field season and were based on criteria set for the 2002 and 2003 breeding seasons. The data for the priority designations and information contained within each site plan were based on observations and comments noted in unpublished Manitoba Conservation field reports from 1986 –2001. Management recommendations within the site plans implemented some of the strategies outlined in Section 3. Site-specific management activities were designed to improve nest success and productivity at each location by mitigating as many of the outlined concerns as possible. The priority designation and site plan do not reflect a site's current habitat suitability or importance to the recovery of Piping Plovers and should be reassessed and

modified for future needs.

4.1. Priority Site Designation

The designation of historical nesting sites as high, medium and low priority directed management activities for the 2002 and 2003 breeding season. Sites were ranked as high, medium and low priority based on the number of occurrences from 1986-2001, the average number of adults per occurrence at each site, and the current activity at each site (active or non-active). Sites prior to 1986 were not included, as annual surveying of most sites did not commence until 1986. Priority designation was based on the following criteria:

High priority	10 or more nesting occurrences from 1986-2001; population average four or more adults per occurrence; site has had nesting activity in the past five years (since 1997)
Medium priority	Three or more but less than 10 nesting occurrences from 1986-2001; population average less than four individuals per occurrence; no nesting activity since 1997
Low priority	Less than three nesting occurrences from 1986-2001; population average less than four individuals per occurrence; no nesting activity since 1992

The current habitat suitability of historical sites and any new areas that may contain suitable nesting habitat could not be taken into consideration in this designation process as information in this regards was not available for all sites prior to the 2002 season. For the 2002 and 2003 seasons, high and medium priority sites took precedence for management activities over low priority sites.

Table 3. Priority designation of known historical nesting sites in Manitoba from 1986-2001 (compiled from unpublished Manitoba Conservation Piping Plover survey reports from 1986-2001).

Historical sites 1986-2001	Average # adults/ Occurre-nce	Min. # of occur-rence	Activity in past 5 years^	Max – Min # of adults during activity	Priority rank
West Shoal Lake	35	12	Yes	64-13	High
Gull Bay (north & south spits)	25.4	16	Yes	52-1	High
Grand Marais Spit & Island	5.6	12	Yes	13-2	High
Clandeboye Bay	5.2	12	Yes	10-3	High
Grand Beach	4.6	12	Yes	8-1	High
Riverton Sandbar	5.7	6	No	12-1	Medium
Elk Island	2.9	7	No	4-2	Medium
Hecla Sandy Point	2.5	4	No	5-1	Medium
Patricia Beach	2.4	5	Yes	4-1	Medium
Twin Lakes Beach	2.3	3	Yes	4-1	Medium
Lake Winnipegosis	3.5	2	No	4-3	Low
Oak Lake	3	2	No	4-2	Low
Oak Hammock Marsh	2	2	Yes	2-2	Low
Katimik Lake	8*	1	No	8*	Low
Gull Island	3	1	No	3	Low
Whitewater Lake	3	1	No	3	Low
Beaconia Beach	2	1	No	2	Low
Northern Egg Island	2	1	No	2	Low

Historical sites 1986-2001	Average # adults/ Occurre-nce	Min. # of occur-rence	Activity in past 5 years^	Max – Min # of adults during activity	Priority rank
Hillside Beach	2	1	No	2	Low
Long Point	2	1	No	2	Low
Willow Island	2	1	No	2	Low

^ Current till 2002

*Only 1 pair noted and the rest assumed to be migrants

All high priority sites had a long history of occurrences, high average number of nesting adults and had nesting activity in the past five years. Riverton Sandbar and Islands were ranked a medium priority despite its high average number of adults because this area has had no documented nesting activity since 1991. Oak Lake, Oak Hammock, Beaconia and Hillside beaches have all had activity in the past 10 years (a medium priority designation), but low occurrence and averages caused them to be ranked as low priority. It is important to note that Long Point, Gull Island and Northern Egg Island have not been surveyed in the past ten years, and Whitewater and Katimik lakes have not been surveyed in the past five years. If possible, these areas should be reassessed for plover activity in upcoming seasons.

4.2. High and Medium Priority Site Plans

Site plans for high and medium priority sites were developed to aid in the on-going management of each site for Piping Plovers. Each site plan includes a site description, management history, a list of management concerns and threats

to habitat and productivity, and a list of management recommendations. The outlined management recommendations are based on mitigating management concerns and threats in order to improve nest success and productivity in each location.

4.2.1. West Shoal Lake

Location: North of the village of Woodlands, between Lake Manitoba and Lake Winnipeg.
Municipality: Woodlands
Latitude: 50° 17' 47" **Longitude:** 97° 40' 18"
Map #: 62 I/5 St Laurent
Land Ownership: Provincial crown with grazing leases

Conservation Status: IBA and Game Bird Refuge
Management Priority: High

Habitat Description: The area is a catchment basin underlain with limestone. Normally a shallow saline lake with mixed gravel, alkali mudflats and vegetated shoreline. Three nesting islands have been constructed - two in the south end and one on the west end of the lake.

Nesting Locations: Prior to flooding, south section had two man-made islands and immediate shoreline, and west section had one man-made island and a rock ridge.

Population Statistics: Population estimates range from 13-64 adults. Due to high water conditions the last nesting record was in 1997.

History of Management

- Designated as a Game Bird Refuge in 1963 (Game Preserve since 1924)
- Main research area by Sue Haig during 1981-1986.
- Designated by Manitoba Conservation as the second most important breeding area for Piping Plovers in 1991.
- South island #1 created in winter 1992 and was available for nesting in 1993 season. Nesting on island was confirmed in 1994, 1995, and 1996.
- South island #2 created in winter 1994 and was available for nesting in 1995 season. Nesting was confirmed in 1995 and 1996.
- Fencing put up to protect part of shoreline on the south end from cattle grazing in 1995.
- West island was constructed in the winter of 1995 and fencing was erected to protect nesting areas from cattle on the west shore in 1996.

- Suggested as a Western Hemisphere Shorebird Reserve Network (WHSRN) site in 1993 (Koonz 1993).
- A meeting was held in 1999 between Manitoba Conservation, Manitoba Water Stewardship and regional Conservation staff regarding the possible management of water levels on West Shoal Lake to optimize Piping Plover habitat. Negotiations are on-going with Water Resources and the Local Government Districts of Woodlands, St. Laurent and Armstrong regarding the manipulations of water levels on the three Shoal lakes (Koonz 2000).
- In 1998, West Shoal Lake was designated as an IBA for the enormous congregation of migratory waterfowl and high numbers of nesting American White Pelicans (*Pelecanus erythrorhynchos*), Western grebes (*Aechmophorus ocidentalis)*, Eared grebes (*Podiceps nigricollis*) and Piping Plovers.

Management Concerns and Threats

- High water levels, starting in 1997, have flooded islands and mainland nesting areas (W. Koonz pers. comm.).
- Fencing erected to prevent cattle disturbance in 1992 and 1995 have been severely damaged or destroyed by high water levels.
- Before 1997, vegetation encroachment along shorelines and islands were threatening to inundate nesting habitat, especially on south island #1. Vegetation encroachment has a potential to be an issue to habitat availability when water levels recede.

Management Recommendations

- Participate in discussions with the West Interlake Water Management Association, surrounding municipalities, and Manitoba Water Stewardship with regards to the management of water levels on West Shoal Lake.
- Monitor water level conditions annually.
- When water level conditions allow for suitable habitat to be exposed, survey annually for Piping Plovers.
- Repair/improve any remaining nesting islands when water levels recede.
- Notify land owners/leesees if plovers re-establish nesting. Work with and encourage land owners/leesees to protect nesting areas from disturbance.
- Fence off areas prone to cattle disturbance during breeding season. Allow cattle to use area during the non-breeding season to control vegetation encroachment.
- Monitor vegetation encroachment annually, especially on any remaining nesting islands, and remove vegetation with environmentally appropriate methods when necessary.

4.2.2. Gull Bay – Walter Cook Conservation Area

Location: North and south sand spits of Gull Bay located south of Long Point on the northwest shore of Lake Winnipeg, southeast of the town of Grand Rapids.
Municipality: Long Point/Lake Winnipeg
Latitude: 52° 55' 10" **Longitude:** 98° 50' 46"
Map #: 63 B/15
Land Ownership: Provincial crown

Conservation Status: Section of north spit protected through conservation agreement with local fishers. The area was under negotiations with Parks Canada for the development of the proposed Lowlands National Park.
Management Priority: High

Habitat Description: Barrier spits on freshwater lake with gravel substrate up to 10 cm in diameter. During high water, north spit can be breached from mainland creating an island. Centre of spit is vegetated with grasses, shrubs and willow stands. Southeast shoreline of the north spit varies in width from 10-40 m and contains mixed sand and gravel. Northwest shoreline of north spit is narrow (4 m) and consists of gravel and sand. South spit habitat varies with water levels, anywhere from 10-60 m wide, but is considerably smaller then the north spit and normally remains attached to the mainland. Vegetation includes grasses (*Phragmites* spp, *Calamagrostis* spp.), willow (*Salix* spp.) and cattails (*Typha latifolia*) near the south end.

Nesting Locations: North spit along southeast shore and south tip; south spit mainly along east shore and tip

Population Statistics: Population estimates range from 1-52 adults.

Management History

- Considered critical habitat by Manitoba Conservation in 1986.
- Habitat enhancement (removal of willow) attempted in 1987 with a 2 HP tiller (Moszynski et al. 1988). The attempt was unsuccessful because the blades were too small, getting bogged down in sand and caught up in willow roots.
- Considered Manitoba's most important breeding area in 1991 by Manitoba Conservation.
- Designated as the Walter Cook Special Conservation Area in 1994 after a local naturalist. Agreement was signed between Manitoba Conservation and the Grand Rapids Fisherman's Cooperative to protect Piping Plover habitat on the north spit.
- The community participated in moving six fishing cabins, re-building of two docks, building a fence to protect part of the spit from human disturbance, and signage was placed on the fence. A dedication ceremony was held for the Walter Cook Special Conservation Area in 1994.

- Part of fence was broken in winter of 1996 by ice and was never repaired.
- North spit naturally cut from mainland in 1998 by high water, creating an island.
- Vegetation encroachment due to stabilized lake levels.
- Large Common Tern (*Sterna hirundo*) and gull colony noted on south-end of island in 1998. Colony was well established in 1999, 2000, and 2001 (over 1140 tern nests, 3750 Ring-billed Gull (*Larus delawarensis*) nests, and 33 Herring Gull (*Larus argentatus*) nests were counted during 2000 census (Koonz 2000)).
- No active management has taken place on the south spit, which is not accessible by mainland (boat only).

Management Concerns and Threats

- The area is used heavily by locals during the commercial fishing season from May-September. Fishing cabins and docks are located on the northeast shoreline of the north spit.
- Extensive ATV use across the spit and in the conservation area has been noted during several censuses (Koonz 2000; De Smet 2001). Enforcement of no ATV disturbance within the conservation area by regional staff is difficult due to its remoteness.
- Discarded fish and tailings dumped along the shoreline attract predators. Also, rotting fish trapped in nets were found scattered across the shoreline in 2000 (Koonz 2000).
- Large tern and gull colony is thriving on the southern tip of the north spit, which is located within the conservation area.
- Fencing to protect conservation area broken in 1996 and never repaired.
- Piping Plovers are found also nesting outside of the conservation area in close proximity to fishers' cabins.
- Some local resentment to the formation of the Special Conservation Area and methods of protecting Piping Plover nests via fencing.
- Management must be flexible as the spit changes – growing and eroding in approximately a 50-year cycle (W. Koonz pers. comm.).
- In 2002-2003, the area was under negotiations between Parks Canada, Manitoba government and the community of Grand Rapids for the establishment of a proposed national park in this region.

Management Recommendations

- Reestablish communication with the community of Grand Rapids through regional Manitoba Conservation staff, the Band Council, the Grand Rapids Fisherman's Cooperative, the local school, and other appropriate associations.
- Increase awareness of the destructive impact ATVs have on nesting Piping Plovers through public talks, newspaper, radio, local school, etc.
- Re-evaluate the current management of Walter Cook Special Conservation Area and consult with the community of Grand Rapids and the Fishermen's Cooperative to design a strategic plan agreeable to all for

the protection of birds nesting in Gull Bay. Discussions should include mitigating ATV disturbance, the dumping of fish and tailings, reestablishment and position of fencing, and how to protect birds nesting outside of the conservation area.
- Work with regional Manitoba Conservation staff to monitor and protect the conservation area from disturbance.
- Send reminder notices to local fishers with their license renewals to help protect Piping Plovers and to respect the no ATV zone in the conservation area.
- Establish an annual public education and monitoring program through the local school or appropriate group.
- Provide status report to regional Manitoba Conservation staff and the community annually.
- Enhance habitat and mitigate predation where possible.

4.2.3. "Grand Marais Spit and Island"

Alternative names: Fisherman's Wharf, Squaw Beach and Steven's or Pelican Island
Location: Located by Grand Beach Provincial Park and the town of Grand Marais, in the south basin of Lake Winnipeg. The island is located approximately 0.5 km south of the spit.

Municipality: R.M. of St. Clements
Latitude: 50° 32' 32" **Longitude:** 96° 37' 38"
Map #: 62 I/10 Netley Marsh
Land Ownership: Part provincial, part leased to fishers

Conservation Status: None
Management Priority: High

Habitat Description: Sand spit and island located on Lake Winnipeg. Substrate composed of mixed gravel and sandy shorelines with willow, poplar (*Populus* spp.) and shrub along middle of spit and island. Spit is approximately 2 km long and varies in width from 20-60 m. The island is about 1.5 km long with 10-15 m wide beaches and has cliff outcrops along north and east shores.

Nesting Locations: Mainly along east shore near middle and end of spit; on island along south/west shores.

Population Statistics: Population estimates range from 2-13 adults (combined).

Management History
- Considered a critical nesting site by Manitoba Conservation in 1986.

- Recommended as a potential IBA in 1998.

Management Concerns and Threats

- Regular ATV use noted along entire spit.
- Incompatible local use of spit include fishers' cabin and activities (includes ATV for transporting catch), local foot traffic, dog walking, unauthorized parties and camping.
- Accumulation of garbage on spit due to parties and camping groups.
- Nests are prone to flooding during storms.
- Considerable vegetation encroachment along middle of spit and on island.
- Large gull and tern colony on island; roosting gulls, terns and pelicans on north end of spit.

Management Recommendations

- Determine the status and specifications of fishers lease on the spit.
- Increase awareness of the local community on the importance of the sites to Piping Plovers and the current threats.
- Consult with fishers and the community of Grand Marais with regards to the use of area and mitigating threats to Piping Plovers. Perhaps initiate a community clean up of the spit.
- Annually monitor site for Piping Plover activity, habitat suitability, threats and litter.
- Protect nesting areas on the spit and island from disturbance with symbolic fences and signs. Use predator exclosures where gull predation may be a problem (island) and move clutches where flooding is a concern.
- Involve the Guardian Program in Grand Beach and locals in protecting nests and increasing local awareness and support.
- Enhance habitat by removing vegetation with appropriate environmentally friendly methods.
- Pursue legal means to protect the spit and island through a Special Conservation Area, IBA designation or through purchase by an appropriate organization.

4.2.4. Clandeboye Bay Special Conservation Area

Location: South basin of Lake Manitoba, south of St. Ambroise Provincial Recreational Park
Municipality: Portage la Prairie
Latitude: 50° 14' 27" **Longitude:** 98° 07' 10"
Map #: 62 J/1
Land Ownership: Provincial

Conservation Status: Designated as a Special Conservation Area
Management Priority: High

Habitat Description: Barrier beach on freshwater lake with mixed sand and gravel substrate up to 8 cm in diameter. Consists of two sand spits separated by a channel into Clandeboye Bay. The east spit is 400 m long and a beach width of approximately 20-30 m. The west spit is about 95 m long with an average beach width of 10-15 m.

Nesting Locations: Near the opening into Clandeboye Bay on east spit.

Population Statistics: Population estimates range from 3-10 adults.

Management History

- Designated a Special Conservation Area in 1982 by Manitoba Conservation. Signs were posted and area occasionally patrolled by park staff from St. Ambroise Provincial Park.
- Third largest population of breeding Piping Plovers in Manitoba until 1997; thereafter became the second most populated site (1998-2001) when high waters on West Shoal Lake flooded nesting areas.
- Fences and a gate on dike road have been used to control access but vandalized or destroyed by ice in past years (R. Jones pers. comm.).

Management Concerns and Threats

- Whole south basin area prone to ATV activity from Twin Lakes Beach down to Clandeboye Bay. Main ATV access point is along the dyke.
- Foot traffic from St. Ambroise Park from mid June-mid August.
- Stabilized water levels on Lake Manitoba have reduced suitable nesting habitat.
- Minor vegetation encroachment along the eastern and western most sections of Clandeboye Bay.
- Predation of nests has been a problem in previous years.

Management Recommendations

- Increase local awareness through public presentation, posters, and informational pamphlets in the local community and at St. Ambroise Park.
- Work with regional conservation and park staff to monitor and protect the conservation area from disturbance. Provide status report to regional staff annually.
- Increase awareness of the destructive nature ATVs have on nesting Piping Plovers and enforce no ATV zones in the conservation area.
- Use fences and signs where necessary to limit access to plover nesting areas from foot traffic and ATVs.
- Enhance habitat and mitigate predation through the use of exclosure cages where needed.

4.2.5. Grand Beach Provincial Park

Location: Popular recreational beach in the southeast basin of Lake Winnipeg, north of the town of Grand Marais.

Municipality: St. Clements
Latitude: 50° 32' 32" **Longitude:** 96° 37' 38"
Map #: 62 I/10 Netley Marsh
Land Ownership: Provincial

Conservation Status: Protected under the Manitoba Parks Act
Management Priority: High

Habitat Description: Barrier beach on natural freshwater lake with fine sand substrate, bordered by large active sand dunes vegetated with grasses, willow shrubs and poplar. Beach broken into west and east by channel feeding a lagoon.

Main Breeding Locations: East and west beaches (lakeside), parking lot # 5.

Population Statistics: Population estimates range from 1-8 adults.

Management History

- Area was a booming rail resort from 1920-1960. It became a provincial park in 1968.
- Since the early 1990s, park staff provide interpretive programs, fence nest sites and post endangered species signs.
- Volunteer Guardian program started by park staff (Angela Fey) in 1993-1995.
- Guardian program reestablished in 2001 with the support from CWS for a seasonal Piping Plover Guardian Coordinator position. Educational programs and brochures, volunteer guardians, and on-site spotting protect the plovers and educate cottagers and beachgoers.
- Piping Plover management/issues addressed in the Grand Beach Management Plan.

Management Concerns and Threats

- Public beach with upwards of 1000-5000 recreationalists on a hot summer weekend
- Pets regularly occur on beach despite large signs saying 'no pets permitted on beach' at every entrance.
- Predation of nests and chicks by gulls, ravens, ground squirrels, etc.
- Public vehicles with regards to nests and chicks in parking lot # 5.
- Park maintenance vehicles on the beach setting the swim line in late May, regular pick up of garbage and beach sweeping.
- Vegetation encroachment occurring along west beach.

- Nests are prone to flooding during storms and long periods of strong north winds.

Management Recommendations

- Support and continue volunteer guardian program and public education program at Grand Beach and in the surrounding community (Grand Marais and Patricia Beach Provincial Park).
- Work with conservation and park staff to mitigate the effects of maintenance vehicles and beach sweeping to ensure no harm is done to nests and chicks.
- Park staff needs to enforce no pets on East or West beaches at all times.
- Limit access of the public and public vehicles to nesting areas by using fencing, signage and volunteer guardians.
- Monitor areas used by plovers and chicks and during busy weekends maintain disturbance free zones in those areas through symbolic fencing, signage and volunteer guardians.
- Use exclosure cages on all nests and look into other predator management techniques.
- Monitor vegetation encroachment on east beach and identify areas of potential habitat enhancement opportunities.
- Provide conservation and park staff with regular updates to nesting, chick status, threats and successes.

4.2.6. Riverton Sandbar and Islands

Location: Off mainland by Riverton Harbour on Lake Winnipeg, across from Sandy Point (Hecla Island), east of the town Riverton.

Municipality: Bifrost
Latitude: 50° 59’ 56” **Longitude:**96° 54’ 51”
Map #: 62 P/2 and 62 I/15
Land Ownership: Provincial

Conservation Status: Designated an IBA
Management Priority: Medium

Habitat Description: Beach and sandbar located off mainland on freshwater lake. Beach varying 10-20 m wide, consisting of mainly sand and some gravel. Off the north shore, a series of three island extend eastward and consists of sand and gravel with zones of grasses and willows. During low water, islands join to form one bar extending from mainland.

Nesting Locations: Mainly on first and second islands along west shores.

Population Statistics: Population estimates range from 1-12 adults, with last known nesting record in 1991.

Management History

- Designated an IBA in 1999 mainly for its large populations of Ring-billed Gulls and Common Terns.
- The local municipality plans to develop camping facilities and interpretive trail that extends to the sand spit.

Management Concerns and Threats

- Erosion of islands due to stabilized water levels on Lake Winnipeg.
- Predation of eggs and chicks by gulls (large gull and tern colony located on third island).
- ATV use on mainland and on islands when it becomes accessible during low water levels.
- Pedestrian traffic and beach-goers.

Management Recommendations

- Work with regional Manitoba Conservation staff, the municipality and the Riverton and Area Business Association to incorporate Piping Plover protection as part of local development plans and IBA management plans.
- Limit ATV access to first island through the use of fences and signage.
- Mitigate disturbance through public education (signs, posters, informational pamphlets, and school presentations).
- Monitor area annually for Piping Plover activity.
- Use exclosure cages on nests prone to avian predation.

4.2.7. Elk Island Provincial Park

Location: Island north of Victoria Beach in the southeast basin of Lake Winnipeg.

Municipality: Victoria Beach
Latitude: 50° 44’ 13” **Longitude:** 96° 32’ 40”
Map #: 62 I/10 and 62 I/15
Land Ownership: Provincial

Conservation Status: Protected under the Manitoba Parks Act
Management Priority: Medium

Habitat Description: Large island in freshwater lake close to the mainland. Cliffs along north and east sides. West side contains steep dunes and little beach; south side contains sand spit and larger beach with gravel sections. Dunes, shrub, willow and aspen encompass most of island.

Nesting Locations: South side up to and along spit

Population Statistics: Population estimates range from 2-4 adults.

Management History
- Established as a natural park in 1974.
- No management of Piping Plovers or habitat to date.

Management Concerns and Threats
- Roosting gulls and pelicans along entire spit.
- Pedestrian traffic and ATV use during low water as sandbar attaches to mainland in low water years. Difficult to get to during high water.
- Nesting area prone to flooding during high water and storms.

Management Recommendations
- Monitor habitat suitability and Piping Plover activity annually.
- Use symbolic fencing and signage around nesting areas prone to disturbance.
- Monitor predation and utilize appropriate predator control techniques.
- Work with the Victoria Beach Cottage Association to educate cottagers and mitigate disturbance on the island during the breeding season.

4.2.8. Hecla Island Provincial Park – "Sandy Point"

Location: Sand spit located off southwest shore of Hecla Island on Lake Winnipeg (Riverton Harbour).

Municipality: Bifrost
Latitude: 51° 00' 30" **Longitude:** 96° 51' 14"
Map #: 62 P/2
Land Ownership: Provincial

Conservation Status: Protected under Manitoba Parks Act.
Management Priority: Medium

Habitat Description: Natural sand spit located off large island in a freshwater lake. Sand spit currently breached from mainland with willow and shrubs encroaching on habitat.

Nesting Locations: Currently only wider section in middle of spit.

Population Statistics: Population estimates range from 1-5 adults. Last known nesting occurrence was 1996.

Management History

- Monitoring of area by regional Manitoba Conservation staff began in 1991.
- No conservation effort has taken place to date.

Management Concerns and Threats

- Vegetation encroachment (willow) along middle of spit.
- Stabilized water levels on Lake Winnipeg causing erosion of the spit.
- Predation by gulls (colony on Riverton Islands).
- Difficult and sometimes impossible to access off mainland.

Management Recommendations

- Work with regional Manitoba Conservation staff and park staff to monitor area for Piping Plover activity.
- If possible enhance habitat by removing encroaching willow to increase suitability.
- Incorporate Piping Plover education into park programming.

4.2.9. Patricia Beach Provincial Park

Location: Southeast basin of Lake Winnipeg.

Municipality: St. Clements
Latitude: 50° 25’ 55” **Longitude:** 96° 35’ 41”
Map #: 62 I/7
Land Ownership: Provincial

Conservation Status: Protected under Manitoba Parks Act
Management Importance: Medium

Habitat Description: Barrier beach located on large freshwater lake. Large sand dunes covered in willow and shrub surround beach with mainly sand with gravel sections. Storm in 2001 cut dunes, creating steep embankments with beach width varying from 15-30 m wide.

Nesting Locations: Sections along entire beach suitable during years of low water levels, especially the most eastern tip.

Population Statistics: Population estimated range from 0-4 adults.

Management History

- Became a provincial park in 1962.
- Nests fenced off by Grand Beach Park staff in 1996, 1997 and 2001.
- Public program offered during local fair in 1997 by Grand Beach staff.

Management Concerns and Threats

- Recreational beach (foot traffic)
- Nests prone to flooding during storms and strong north winds.

Management Recommendations

- Protect nesting areas with fences and signage.
- Increase public education through onsite posters, pamphlets and interpretive programs.
- Work with locals to support and help protect nesting areas from disturbance.
- Expand volunteer guardian program at Grand Beach to encompass Patricia Beach when there is plover activity.

4.2.10. Twin Lakes Beach

Location: Southeast shore of Lake Manitoba adjacent to Lake Francis, south of the village of St. Laurent.

Municipality: Woodlands
Latitude: 50° 18' 40" **Longitude:** 98° 07' 10"
Map #: 62 I/5
Land Ownership: Mostly private, part provincial crown.

Conservation Status: Provincial land protected as a provincial Wildlife Management Area.
Management Priority: Medium

Habitat Description: Mainland beach on freshwater lake with gravel shoreline approximately 15 m wide in normal water level conditions.

Nesting Locations: Location on private land.

Population Statistics: Population estimates range from 1-4 adults.

Management History

- None to date.

Management Concerns and Threats

- Cottage area with pedestrian traffic, beach-goers, and ATV use along entire south basin shoreline.
- Seasonal high water levels in some year's limits available habitat.
- Nests prone to flooding during storms and strong north winds.

- Various land ownerships in surrounding area makes it difficult to mitigate disturbance and control ATV use.

Management Recommendations

- Identify private landholders and provide information on Piping Plovers and how they can help protect habitat.
- Increase local awareness of Piping Plovers and the destructive impact ATVs have on nests and chicks through public presentation, posters, and informational pamphlets in the local community and at St. Ambroise Park.
- Work with regional Manitoba Conservation staff to monitor and protect the area from disturbance. Provide status report to regional staff annually.
- Use fences and signs where necessary to limit access to plover nesting areas from foot traffic and ATVs.
- Enhance habitat through the removal of select trees and vegetation.
- Mitigate predation through the use of exclosure cages where needed.

5. Selected Field Activities

The second phase of the stewardship project set into motion some of the strategies outlined in Section 3 plus specific actions outlined in the site plans during the 2002 and 2003 breeding seasons. The main goal of the field component was to gain a better understanding of the distribution of nesting Piping Plovers within the province, to maximize nest success and productivity at all active sites, and to increase public awareness and participation on managed sites. Due to limited resources and the large distance between some sites, management actions were focused on active sites located in the southern portions of the province (mainly the south basin of Lake Winnipeg, Lake Manitoba, and West Shoal Lake). Selected management actions included surveying historical and potential nesting sites, mitigating human disturbance at active sites, implementing a predator exclosure program, and assessing nest success and productivity at managed sites. The selection and implementation of specific management activities were based on feasibility, time limitations, and outlined funding requirements. Where possible, activities were coordinated with regional conservation staff, local communities and volunteers to facilitate in the protection of nesting birds.

5.1. Methodology

Distribution and Productivity

Site surveys of historical breeding areas began in early May and continued into mid July. Each site was visited a minimum of three times during each

nesting season to confirm the presence or non-presence of adults and/or nests at the site. Site survey and monitoring methods were consistent with those outlined by Murphy et al. (1999) and Goldin (1994). Key Piping Plover habitat attributes, as outlined in the prairie recovery strategy, may include one or more of the following (Environment Canada 2006a):

- 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 inter-dunal wetlands for feeding
- Alkali deposits present somewhere on beach
- Adjacent upland vegetation from where insect drift occurs
- 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.

Habitat was assessed for suitability based on the above attributes. During travels, potential habitat was also identified and surveyed when the opportunity existed. During surveys and monitoring, adult breeding population, nest fates, nest success and chick survival rates were determined for all active sites within the study zone.

Nests were located by observing adult bird behaviour and using visual cues as outlined in Murphy et al. (1999). Coordinates were taken for all located nests using a hand held Global Positioning System unit. At sites with two or more nests, nests were also identified by a numbered flag placed behind the nest in the vegetation at approximately 3-5 meters from the nest. Numbered flags aided in

nest identification from a distance, thus reducing visiting time and disturbance at each nest. As the majority of nests were located during the laying stage, nest initiation dates were estimated, plus or minus one day, by backdating (average six days based on one egg being laid every other day to a usual four egg clutch). Where possible, nests were checked the following day to increase the reliability of estimations. Hatching dates were estimated for each nest by adding 28 incubation days to the date the 4th egg was laid (or 34 days from nest initiation date for a four egg clutch). For the few nests found during incubation, hatching dates were estimated by adding 28 days from the date found, giving the latest possible hatch date. Nest initiation dates for these nests were estimated by backdating 34 days from hatch date for a four egg clutch or 32 days for a three egg clutch. Where feasible, active nest sites were monitored twice a week to determine nest fates and to search for new nests.

For study purposes, nest fate was assessed as either: hatched, depredated, flooded, destroyed, abandoned, nonviable or undetermined. Hatched nests were determined by the behaviour of adults (alarm calling, broken wing and leading) and the presence of chicks or the possible presence of cap shells in the nest bowl that contained no other traces of predation (i.e. yolk and shell fragments). Any nest incubated less then 23 days was considered a failed attempt (Murphy et al. 1999). Nesting success was calculated using only nests in which final fate could be determined. A successful nest was defined as a clutch in which at least one egg hatched. Where possible, nests were visited two to three days before hatch date and visually checked for the presence of eggs and star pips and on

the estimated hatching date (or day after) to verify nest fate. Estimated nesting success was calculated by dividing the total number of successful nests by the total number of nests in which the final fate was determined.

Where possible, sites that successfully hatched chicks were monitored twice weekly to determine fledgling success. All sites were monitored until they were no longer occupied or when all young were estimated to be fledged. In definition, a chick was considered fledged when it was observed in sustained flight (>15 m) or had reached a minimum of 18-20 days of age (Murphy et al. 1999). The number of fledged chicks per adult pair was determined by dividing the number of chicks fledged (18 days) by the total number of monitored adult pairs. A 'pair' in this study was defined by the observation of two adults engaging in breeding behaviour and/or the presence of a nest (which was corrected for possible re-nest attempts). A re-nesting attempt was recognized when a monitored pair lost a nest and a new nest was found within a few days in the vicinity of the 'lost' nest and when there was no reason to believe that a new pair had entered into the area (i.e. when the total number of adults in area remained the same). In this circumstance the pair was considered to be the original pair and the new nest a re-nesting attempt.

Disturbance Management

During all site visits, efforts were made to reduce disturbance to nesting plovers by surveyors and monitors. When possible, to reduce exposure of eggs and young to excessive heat or cold, nesting areas were not visited during mid-day, during periods of rain, excessive wind (> 40 km/h) or other adverse weather

conditions. Nests were never 'looked for' or approached in the presence of potential predators (namely crows, ravens, gulls or other avian species). In addition, visits within an area were kept as brief as possible, generally less then 30 minutes in duration.

To curb human disturbance at nesting sites, fencing and signs were used to protect nests or nesting area (at sites with a concentration of nests in one area). At sites with high impact disturbance (vehicles, ATV, recreationists), wood slat or plastic fencing was used; in sites with low impact (few walkers or isolated sites) symbolic rope fencing was utilized. 'Do not enter' signs were placed at regular intervals around the fenced area and at places where natural travel would occur (i.e. along a walking trail). Symbolic fencing consisted of yellow 6 mm (1/4 inch) nylon rope, strung at waist and mid calf level (to prevent dogs from entering closed areas). In some instances, both symbolic fencing and snow fencing was used for a stronger visual barrier (i.e. areas prone to ATV use). The number of nests, the behaviour of adults and the type/degree of disturbance determined the size of area fenced. Ideally, nesting areas were fenced from water's edge to upland vegetation. In areas where this was not feasible (i.e. Grand Beach), nests were individually protected at a minimum radius of 6 m from the nest (size based on adults remaining on nest when fencing approached by humans). However, fencing of individual nests does not protect chicks from disturbance once they move away from the nest site to feed.

During each site visit any evidence of disturbance was recorded, including evidence of recreational activity, depredation, flooding and any other adverse

environmental conditions. Any human activity into restricted areas (delineated by fencing and signs) was also documented in order to assess the degree of human-related disturbance during the breeding season and ultimately the successfulness of fencing as a deterrent.

In addition to using fencing and signs, an education campaign to inform the public about Piping Plovers was implemented in areas with nesting birds. The campaign included posters, brochures, informal displays, spotting opportunities at nesting sites, park programs, and school presentations. This was conducted in cooperation with the existing Piping Plover Guardian Program and the Park Interpretive Program at Grand Beach Provincial Park, and was expanded to other nesting areas when opportunities and resources permitted. Permanent interpretive signs describing the Piping Plover and their need for protection already existed at Grand Beach Provincial Park, St. Ambroise Park and the Walter Cook Special Conservation Area.

Predator Exclosures

In order to increase nest success and hopefully productivity, a predator exclosure program was initiated at sites protected with fencing and that could be monitored a minimum of twice a week. Construction and installation guidelines outlined by Richardson (1997) and Melvin et al. (1992) were followed when installing predator exclosures. Exclosure cages were initially constructed from 5 x 5 cm light weight utility wire fence formed into a 0.9 m diameter x 0.6 m tall semi-pyramid structure (base 1.2 m long and top 0.6 m long) with the tapered top left jagged as outlined in Richardson (1997). However, to ease assembly and to

be consistent with other prairie provinces, the design was modified in the second year to a cylindrical exclosure, approximately 0.6 m in diameter x 0.6 m tall, made of 5 x 5 cm galvanized wire fence (J.P. Goossen, personal communication). To discourage perching by avian predators, the tops of both styles were left jagged and capped with white plastic garden mesh. Cage sides were fastened together on site with plastic cable ties allowing for easy transport to and from nesting sites. Each cage was fastened into the substrate approximately 4-5 cm down with 4-6 tent pegs.

Exclosures were placed over a nest by two people during temperate weather conditions (temperatures less then 25°C). In order to reduce the chance of abandonment, exclosures were only placed on nests with a minimum clutch size of three eggs. Nests were monitored at a predetermined non-intrusive distance (min 10 meters) until incubation was resumed by tending adult. If an adult did not resume incubation within 30 minutes of installation, the exclosure was pulled and the nest left unprotected. Data collected during installation included time required to install, time from completion of installation until incubation resumed and the behavioural reaction of the plover to the exclosure. Exclosures were removed after the eggs hatched and chicks had left the immediate vicinity of the nest or upon nest failure and abandonment by adults.

5.2. Results and Discussion

Distribution

Surveys of historical breeding areas began May 10 in 2002 and May 7 in 2003. Water levels on Lake Winnipeg and Manitoba were considered normal to

below normal in 2002 and below normal in 2003 (Manitoba Water Stewardship, pers. comm.). Due to seasonally low water levels, available habitat was above average at these lakes throughout the breeding season. In total, 22 historical and potential sites were surveyed in 2002 (Katimik and Kaweenakumik Lake were only surveyed by air), and 34 sites in 2003 (not all sites were surveyed each year) (Figure 3, Table 4). All sites were surveyed at least once during the breeding season and sites located in the southern portion of the province with suitable nesting habitat were surveyed a minimum of three times during the breeding season (early May, June and mid-July). In 2003, 21 of 34 surveyed sites appeared to have average to above average breeding habitat caused by the below normal water levels experienced that year (evaluation based on physical attributes set out in the recovery strategy for *circumcinctus*; survey summaries located in Appendix A).

The Piping Plover population in Manitoba appeared consistent through the two-year study, though some sites were only active in one year. In total, 27 adults (13 pair) were counted in 2002 and 26 adults (12 pair) in 2003 (Table 5). These totals were up from 16 adults (7 pair) counted in 2001. The apparent population increase from 2001 was attributed to an increase in available habitat and increased survey and monitoring efforts during the study period. Nesting was confirmed at six sites in 2002 and eight sites in 2003 (Table 5). Only one new nesting site (re-nest), Stony Beach on Lake Manitoba, was located in 2003. During the study period, the peak nest initiation period for Piping Plovers in

Figure 3. Manitoba Piping Plover sites surveyed in 2002 and 2003 (see Table 4 for site names)

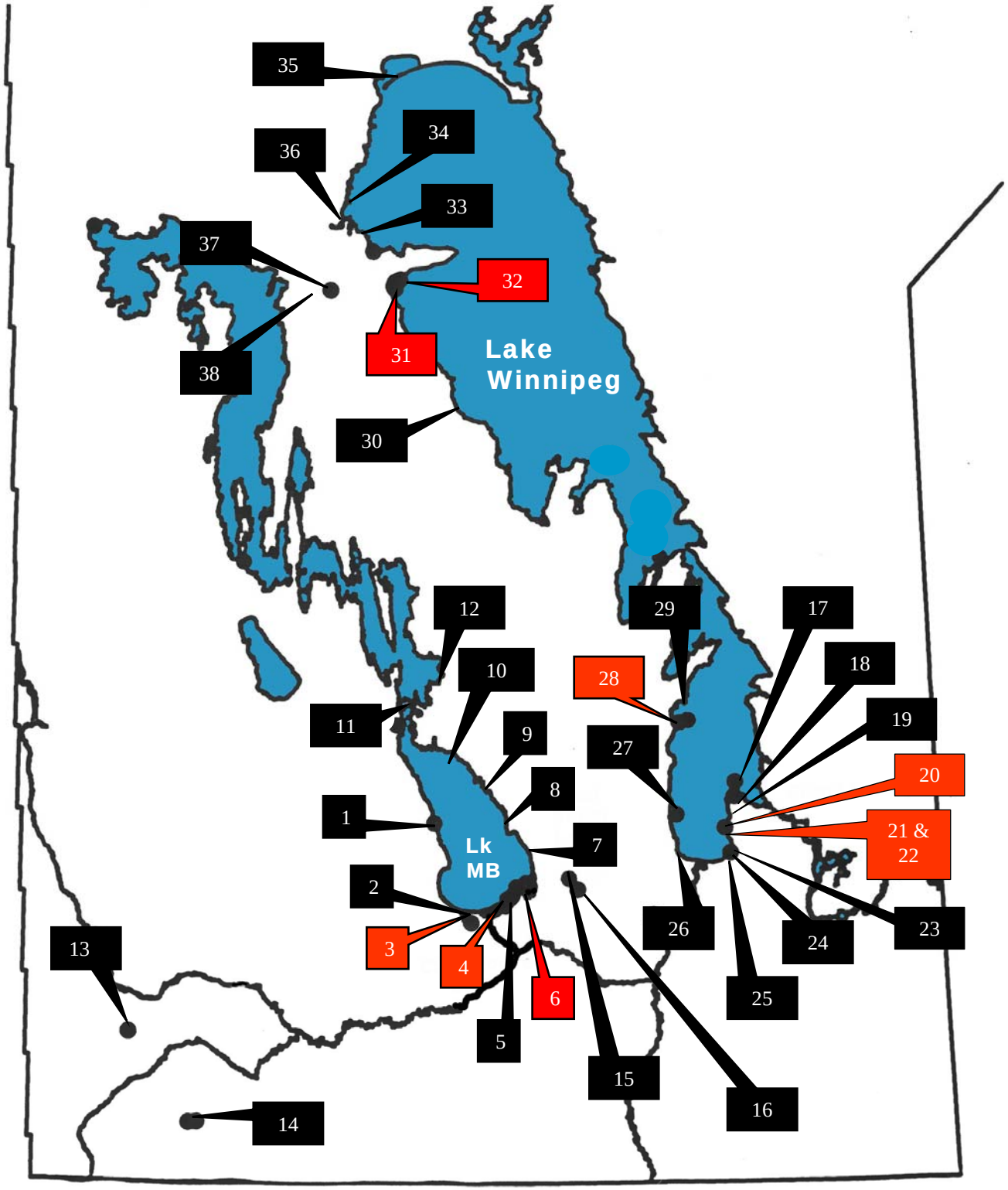


Table 4. Corresponding list of Manitoba Piping Plover sites surveyed in 2002 and 2003 (see Figure 3 for site locations)

Map #	Site Name	Year Surveyed
1	Hollywood Beach	2002/2003
2	Delta Beach (Field Station)	2002
3	Stony Beach (Delta)	2002/2003
4	Clandeboye Bay	2002/2003
5	St. Ambroise Park	2002/2003
6	Twin Lakes	2002/2003
7	Laurentian Beach	2003
8	Shallow Point	2003
9	Lundar Beach	2003
10	Hwy 117 (end of road)	2003
11	The 'Narrows'	2003
12	Watchorn Provincial Park	2003
13	Oak Lake	2002
14	Whitewater Lake	2002/2003
15	North Shoal Lake	2003
16	West Shoal Lake	2002/2003
17	Elk Island Prov. Park	2002/2003
18	Victoria Beach	2002/2003
19	Hillside Beach	2002/2003

Map #	Site Name	Year Surveyed
20	Grand Beach Prov. Park	2002/2003
21	Grand Marais Spit	2002/2003
22	Grand Marais Island	2002/2003
23	Beaconia Beach	2002/2003
24	Whitesands; Sunset Beach; Lakeshore Heights; Balsam Bay; Almsdals Cove; Island Beach	2002/2003
25	Patricia Beach Prov. Park	2002/2003
26	San Sousi Beach	2003
27	Willow Point	2002/2003
28	Riverton Sandy Bar IBA	2002/2003
29	Hecla Sand Spit	2002/2003
30	Warpath River Area	2003
31	South Gull Bay	2002/2003
32	North Gull Bay	2002/2003
33	Willow Point (Grand Rapids)	2003 (aerial)
34	Reef Point	2003
35	Limestone Bay	2003
36	Pebble Beach (Grand Rapids)	2002/2003
37	Katimik Lake	2002 (aerial)
38	Kaweenakumik Lake	2002 (aerial)

Table 5. Manitoba Piping Plover survey and nesting summary for 2002 and 2003

Location	2002					2003				
	# of Adults	# of Pairs	# of Nests	# of Hatched Nests	# of Chicks Fledged	# of Adults	# of Pairs	# of Nests	# of Hatched Nests	# of Fledged Chicks
Lake Manitoba										
Clandeboye Bay	8	4	6	3	7	8	4	4	3	0
Twin Lakes	2	1	1	0	0	-	-	-	-	-
Stony Beach	-	-	-	-	-	[2]*	1	1	0	0
Lake Winnipeg										
Grand Beach	6	3	4	2	4	6	3	4	3	4
Grand Marais Spit	-	-	-	-	-	2	1	1	1	0
Grand Marais Island	3	1	1	1	3	3	1	1	1	4
Riverton Sandy Bar	-	-	-	-	-	3	1	1	0	0
Gull Bay North Spit	6	3	3	2 + 1 unknown	Unknown	2	1	1	Unknown	Unknown
Gull Bay South Spit	2	1	1	unknown	Unknown	2	1	1	Unknown	Unknown
Totals	27	13	16	8	14	26	12	14	8	8

*[Stony Beach pair assumed from Clandeboye Bay after failed nest]

Manitoba ranged from May 14-31 (n=26; 70%); with the earliest initiation occurring in May 12 and the latest nest initiation between June 24-30. Due to lower then average water levels on Lake Winnipeg, Riverton Sandy Bar had nesting birds in 2003 for the first time since 1991. High (though receding in 2003) water levels at West Shoal Lake precluded nesting at that site during the study. Aerial surveys, provided by Grand Rapids District Office, were conducted over the west shore of Lake Winnipeg by Long Point and over Katimik and Kaweenakumik lakes in 2002. Potential areas were noted along the northeastern shoreline of Katimik Lake and two islands on Kaweenakumik Lake, but because of their remoteness and, in the case of the islands, protected status for American White Pelicans, they were not surveyed by foot. Nineteen other sites were also identified and checked during field activities, but yielded no additional adults or nesting areas. Other sites that have been used at least once in the past 15 years that were not checked during the study due to their remote location include Winnipegosis (2 km NW of town) (1987-88), Long Point (1987), Gull Island (Lake Winnipeg) (1990), and North Egg Island (Lake Winnipeg)(1990).

Based on increased survey and monitoring efforts combined with a number of suitable historical nesting areas not utilized during the study, it appears that the population of Piping Plovers would not be significantly larger than what was observed. However few non-paired adults were observed during this study (compared to considerable numbers observed by Haig in studies conducted between 1981-1986) and it is not known if non-paired individuals maybe using

areas considered unsuitable for nesting (i.e. areas with little shoreline or with gull colonies) and are being missed in current survey methods. Though this segment of the population would be highly transient, attention to non-traditional nesting habitat during regular surveys may facilitate in locating additional non-paired individuals and perhaps some outlying nesting pairs. Based on comments from regional conservation staff and local fishers, future surveys should focus on identifying and surveying sites in the Interlake region and on Lake Winnipegosis.

Disturbance Mitigation

Recreational activities occurring at Piping Plover nesting areas during the study consisted of beach goers, ATVs, walkers, boaters, cottagers and commercial fishers. During the study, of the 23 surveyed sites deemed suitable for nesting (based on national recovery strategy criteria), only seven had little or no human conflict issues (Grand Marais Island, Hecla Sand spit, Warpath River area, Gull Bay South Spit, Limestone Bay, Katimik Lake, and Kaweenakumik Lake) (Appendix A). Further, seven out of nine active nesting sites in 2002 and 2003 had conflicting human activities occurring in or around nesting areas (Table 6).

Disturbance severity was assessed for all active sites and low, medium, and high designation was based on disturbance type, frequency of disturbance and the potential for nesting success if not protected with fencing (Table 6). Depending on the site's topography, accessibility and the degree of disturbance, different protective measures were taken. Areas with low recreational disturbance or sites that could not be monitored on a regular basis (i.e. minimum

once a week) were not protected. In 2002, three of the six active sites (Grand Beach, Twin Lakes and Clandeboye Bay) had fencing and signs posted to protect nesting birds, and in 2003 four of the eight (Grand Beach, Grand Marais Spit, Riverton Sandy Bar and Clandeboye Bay) had fencing and signs.

Table 6. Protective measures and severity of disturbance occurrences at active Piping Plover sites in Manitoba during 2002 and 2003

SITE	YEAR OCCUP-IED	PROTECTIVE MEASURES	TYPE OF DISTURBANCE	NUMBER OF OCCURRENCES	SEVERITY*
Grand Beach	2002 2003	Nests individually fenced with signs Volunteer guardians protected chicks on busy weekends	Sunbathers, wind surfers, vehicles (parking lot nests); park maintenance vehicles	Constant foot traffic; three incidences of fencing torn down; dogs regularly on beach by nests/chicks; park safety and maintenance vehicles on beach daily	High - Intense use on warm weekends from June - August
Grand Marais Spit	2003	Nest fenced with rope and signs posted Snow fencing used across spit, but not completely restricting access into area, signs posted	ATV, vehicles, dog walkers, party goers; commercial fishers	Daily occurrences of ATVs, dogs and/or foot traffic; three incidences of fencing breeched; one incident of a truck and tow truck stuck on spit (requiring a third larger tow truck to get them out); evidence of parties/camping occurring on spit	High
Grand Marais Island	2002 2003	None	Boaters, few walkers during low water	One set of ATV tracks noted during low water; some foot traffic	Low
Riverton Sandy Bar	2003	Spit completely fenced off and signs posted	ATV, vehicles, walkers, party goers	Regular ATV traffic; fence torn down three times; foot traffic within fenced	Medium - High

SITE	YEAR OCCUP-IED	PROTECTIVE MEASURES	TYPE OF DISTURBANCE	NUMBER OF OCCURRENCES	SEVERITY*
				area; evidence of one large party	
Gull Bay North	2002 2003	None	ATV, vehicles, fisher cabins	ATV and vehicle traffic by fishers along entire spit	High during fishing season (May-July)
Gull Bay South	2002 2003	None	Relatively inaccessible; few fishers' cabins	Little traffic, ATV tracks apparent in 2002	Low
Clande-boye Bay	2002 2003	Total nesting area from water to vegetation fenced off with signs posted	ATV, walkers, party goers	Regular ATV traffic and some foot traffic; fencing breeched five+ times; fencing torn down twice	Medium - High (ATV activity intense)
Twin Lakes	2002	Nest fenced with rope and signs posted	ATV, vehicles, sunbathers, dogs, walkers, beach sweeping	Vehicle tracks on entire beach; evidence of beach sweeping	Medium – High (cottage area)
Stony Beach	2003	None	Relatively inaccessible; ATV	Evidence of ATV traffic along shoreline	Medium

Some level of recreational disturbance occurred on all sites during the time that these sites had active nests or chicks. On numerous occasions throughout the season, disturbance occurred within fenced areas. In eight of these occasions, recreationists actually removed fence posts or destroyed fencing to gain access to restricted areas at Grand Beach, Riverton Sand Spit and Clandeboye Bay. On six separate occasions in 2003, trucks were also seen parked or driving along the beach in unrestricted areas during regular surveys of Twin Lakes and Grand Marais Spit. The potential loss of two nests in 2002 and one in 2003 at Clandeboye Bay, and two 16-day-old chicks in 2003 at Grand

Marais Spit are all attributed to intense ATV activity that occurred prior to the observed losses.

Additional concerns about nest and chick safety include the daily park maintenance activities occurring near or in nesting areas at Grand Beach throughout the entire breeding season. Though efforts are made by park staff to reduce disturbance to Piping Plovers, activities of concern spotted during the study include a front end loader repeatedly driving through the West Beach blowout area where one plover establishing a territory was being monitored during mid May, the placement of garbage cans beside protected areas (concern as a predator attractant), and the regular presence of maintenance vehicles driving on the beach (particularly on West Beach by parking lot # 5) where chicks normally spent time feeding. Some of these concerns were immediately mitigated by park staff once they were brought to their attention. Others, such as the effects of regular beach maintenance activities and vehicle disturbance in parking lot # 5, still need to be addressed.

An educational campaign to increase awareness and compliance to restricted areas was initiated at all sites protected with fencing and signs. The campaign included informational posters located at campgrounds and local stores, distribution of informational brochures to cottagers and park visitors, interpretive programming at Grand Beach Provincial Park and St. Ambroise Park, school programs in communities adjacent to nesting areas (Grand Marais and Grand Rapids) and the volunteer-based Grand Beach Guardian Program. Overall the program distributed 2500 informational brochures and delivered 27

programs to approximately 1380 park visitors and school children (Miller 2002; Dufour 2003). In addition, the Grand Beach Volunteer Guardian Program made over 1850 personal contacts with beach visitors during daily monitoring duties and scheduled plover spotting programs (Miller 2002; Dufour 2003).

Though human disturbance was not eliminated at all posted and fenced sites, it was reduced sufficiently at protected sites to allow the majority of those nests to proceed uninhibited. Based on finding from other studies (see Section 3) and the degree of disturbance observed at unprotected sites in Manitoba, it is believed that many of the nests located in medium and high use areas would not have been successful if access to nesting sites was not restricted or impeded with fencing and signs. Due to low visibility and safety issues, symbolic fencing should only be used in low traffic areas with no ATV activity. It is also necessary that protected areas be monitored and fencing maintained in good condition for beach users to respect restricted areas. More work needs to be done to educate local users on the effects that recreational activities have on nesting birds and on chick survival, specifically in the communities of Grand Marais, Riverton, Grand Rapids and St. Ambroise.

Exclosure Program

During the study, an exclosure program was implemented at three protected sites that could be monitored a minimum of two times a week (Grand Beach, Grand Marais Spit and Clandeboye Bay). As a result, five of the 16 nests located in 2002 and seven of the 14 nests in 2003 were protected with exclosure cages. Ten of the twelve exclosed nests hatched successfully (83%), with one nest

depredated in 2002 and one nest abandoned in mid-incubation for unknown reasons in 2003. Exclosure cages were installed on clutches with a minimum three eggs with average installation time ranging from 2 min 5 s to 5 min 0 s (average being 3 min 17 s per cage). Installation time decreased with practice, but varied with substrate (i.e. harder substrate had longer installation times).

In most cases, Piping Plovers adapted to exclosure cages with few problems noted during post-installation observations of the adults. For example, nesting plovers with incomplete clutches or those that had just completed their clutch often circled the cage before entering and resuming incubation. Adults further into incubation usually entered the cage and resumed incubation immediately. Time between final installation of the exclosure (once installers retreated to a predetermined non-invasive distance – min 10 meters) and when the incubating adult returned varied from 1 min 30 s to 12 min 10 s, with the average being 3 min 51 s (n=12).

The pyramid style cages used in the first year of the study had a few issues in their design - mainly that they were cumbersome to assemble and prone to collapsing. In one occurrence during a severe thunderstorm, the pyramid cage collapsed into itself directly on top of the eggs preventing an adult from incubating. The eggs were found the following day being incubated in a shallow nest in the corner of the cage (the nest hatched five days later). Since reinforcement of the pyramid style cages would make them more cumbersome to transport and assemble, a simpler cylindrical style being used elsewhere in the prairie region was adopted in the second year of the study. The cylindrical cages

were easier to transport and assemble, left little waste material and were more stable then the previous design. Overall, little difference in nesting success was observed between each season, even though the cage style changed.

Three noteworthy occurrences were documented in 2003 with the cylindrical exclosures, though it is suspected that the design change had little to do with the occurrences. In one instance, the exclosure was placed over an incomplete clutch (3 eggs) with the tending adult returning promptly. The following day, another shallow nest with one egg was found just outside of the exclosure being incubated. In a subsequent visit later that day, the eggs inside the nest were observed being incubated. Since it appeared that one adult (probably the female) would not enter the exclosure, the decision was made to pull the exclosure and place the one egg with the three in the original nest. Three of the four eggs did hatch successfully. In another instance, an exclosed nest was found abandoned at the 18-20 day incubation stage (no adults were present in the vicinity of the nest during two lengthy visits). It is unknown why the nest was abandoned, but circumstances suggested that one of the adults may have gone missing leading the mate to abandon; all eggs were verified later as not being sterile. The final occurrence included two partial depredation events of a nest where one egg was taken in each occurrence 5-6 days apart (possibly by Franklin's ground squirrels (*Spermophilus franklinii*) in the area). This predation event occurred on a nest which had successfully hatched two of four eggs earlier in the week but where an adult continued incubating the two unhatched eggs (at

least part of the time) (assumed unviable as they were five days overdue prior to the first depredation event).

5.3. Productivity and Discussion

Nest Success

During this study, 30 nests were located, 25 were monitored regularly and 16 were eventually successful (Table 5, Appendix B and C). Nests in the Gull Bay area were not monitored due to the remote nature and difficulty in accessing these sites (one nest was found at hatch and the fates for four nests (two in 2002, two in 2003) were unknown). Five nests were considered re-nesting attempts. Ten of the twelve exclosed nests (83%) and six of the fourteen unexclosed nests (43%) were successful. Of the ten confirmed nest failures, five were believed to have been depredated (one of these exclosed), one flooded, one was abandoned (exclosed), two were potentially destroyed by human disturbance, and one was lost to undetermined reasons (though predation was suspected). The one flooded nest at Stony Beach was lost before clutch relocation could be attempted in 2003.

By protecting nests from human disturbance and with the aid of predator exclosure cages, an overall apparent nest success rate of 62% (n=26) was achieved over the two year study period (excluding unknown nest fates from Gull Bay). Nest success was marginally higher in 2003 (67%; n=12) than in 2002 (57%; n=14), which may be attributable to the use of more exclosure cages during the 2003 season. An apparent nest success rate of 83% was achieved by using exclosure cages (n=12) compared to only 43% apparent success rate for

unexclosed nests (n=14). These rates are comparable to Alberta and other studies conducted in the Great Plains region (see Section 3). As all twelve exclosed nests were also protected with fencing, fencing may have contributed to the success of exclosure cages by reducing human disturbance at these sites. It is also possible that fencing may inadvertently attract or provide perches for predators as four out of seven nests (57%) protected by fencing alone were predated. This was a concern in areas with high number of gulls and other avian predators, especially at Grand Beach where gulls were observed resting within fenced areas when the beach was inundated with sunbathers.

Potential, but unverified predators of eggs, seen near nesting areas includes but were not limited to: Franklin's ground squirrel, thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), American Crow, Common Raven, Ring-bill Gull and Herring Gull. Tracks of gulls and small mammals (ground squirrel suspected) were found around five of the failed nests. In one instance, small mammal tracks were found around and inside an exclosed nest, which had been predated (these were believed to be ground squirrel tracks as the predator had to be small to fit through a 5 x 5 cm wide opening). In another incidence, two eggs went missing from an exclosed nest 5-6 days apart in 2003 (again ground squirrel strongly suspected). Other potential predators and/or tracks seen in the vicinity of nesting sites include raccoon, red-sided garter snake (*Thamnophis sirtalis*), Black-billed Magpie, Northern Harrier, and possibly mink or weasel (*Mustela* spp.).

Even though some incidents and predation of nests occurred with the use of predator exclosure cages, the nest success rates for exclosed nests were higher then those without protection (83% versus 43%). Due to the success during the study and the proven success in other jurisdictions (see Section 3), I recommend that predator exclosure be utilized for all nests that can be monitored on a regular basis and especially on nests individually protected with fencing (such as at Grand Beach).

Fledgling Success

A total of 22 chicks fledged from monitored nests during the study period; 14 in 2002 and 8 in 2003 (Table 5). An overall apparent fledge rate of 1.16 fledglings/pair was achieved during the two-year study (n=19 pairs, excluding Gull Bay pairs). The number of fledged chicks per pair dropped from an apparent fledge success rate of 1.56 in 2002 (n=9 pairs) to 0.80 in 2003 (n=10 pairs). This yearly difference is mainly due to a complete loss of chicks at Clandeboye Bay in 2003 which occurred during a critical one week hatching period when the nesting site was inundated with over 400 Ring-bill and Herring gulls that were attracted by hundreds of common carp (*Cyprinus carpio*) stranded by a sandbar that formed along the shoreline.

Though the number of hatched nests increased with the use of more exclosure cages from 2002 to 2003, fledging rates did not increase in proportion. Low fledging rates despite the increase in nest success rates are opposite to findings on alkali lakes in North Dakota and Montana where fledging rates increased with the use of exclosure cages, but are similar to the occurrences

seen in Alberta (see Section 3). Low fledging rates could be attributed to the overall high predation rates of chicks (which were somewhat protected by volunteer guardians but were not protected by fencing or other predator exclusion or deterrent methods) and by an obvious increase in human disturbance at sites like Grand Beach as the breeding season progressed.

Predation was assumed to be the main cause of chick loss, although human disturbance could not be ruled out as attributing to the undetermined loss of many pre-fledged chicks, especially at sites with medium to high disturbance issues. During the study at Grand Beach, four chicks went missing the same day or the day after the beach was inundated with park visitors. In total, eight chicks were lost at Grand Beach including four from unknown causes, one possibly lost to inclement weather, two presumably predated by ravens, and one confirmed predation by a Ring-bill gull. Although predation could not be ruled out as a factor in the unknown chick losses, increased human disturbance may have contributed as chicks were often observed feeding less and spending more time avoiding vehicles, dogs and other beach users. Possible overexertion and being forced away from the shoreline for extended periods of time during hot weather may have increased the chick's susceptibility to the elements and/or predation. In 2003, the loss of two16 day-old chicks was directly attributed to one episode of ATV activity on Grand Marais Spit. Observed or suspected predation events included one 18 day-old chick being taken by a Ring-bill Gull at Grand Beach and in two separate incidences, four or five Common Ravens were seen in the immediate vicinity prior to and after the loss of day-old chicks. Talon and wing

feather markings (suggesting predation by a hawk or possibly an owl) were also seen on the beach at Clandeboye Bay and at Grand Marais Spit on occasions where single chicks went missing at those sites.

Based on outlined goals in the Prairie recovery strategy, the 1.16 fledglings/pair chick survival rates observed during this study are slightly below the rate (1.25) determined to be needed to sustain a stable. During this study, plover chicks appeared to be most vulnerable to predation and disturbance within the first eight days of hatching (18 chicks disappeared within first eight days) at monitored sites in 2003, although the loss of 16+ day-old chicks was also observed.

More effort needs to be placed on reducing predation and disturbance pressures at active sites in order to increase plover fledging rates in Manitoba. This may necessitate further restricting access to feeding sites (from upland vegetation to waters edge) to protect pre-fledge chicks from human disturbance, plus continuing to work with local communities and cottagers to mitigate the negative effects that recreational activities have on nesting birds and on chick survival. Other techniques not employed during the study, but outlined in Section 3 and the management strategy, include using more intense predator management actions at active sites, such as the trapping of potential predators and/or removal of nests and denning sites. Long-term actions may include the creation of nesting islands (to reduce mammalian predation pressures) and/or the enhancement of nesting habitat away from development and areas with high recreational value.

6. Proposed Management Strategy

In order to address the threats facing Piping Plovers in Manitoba and to focus provincial efforts and resources, I have proposed a management strategy that outlines provincial management goals and stewardship actions that are necessary for the management of the species and its habitat. This provincial strategy brings together essential players, integrates already established national recovery goals and coordinates with stewardship actions occurring in other regions. As the national recovery strategy already sets out population and productivity objectives for *circumcinctus*, this provincial strategy follows the strategic outline set out in that strategy.

The Canadian recovery goal for *circumcinctus* outlined in the national recovery strategy is "to achieve a viable, 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 (Environment Canada 2006a)." Based on historical provincial population estimates, the recovery goal for the Canadian prairie population outlined in the strategy is 1626 adult Piping Plovers, with minimum provincial population targets of: Alberta 300; Saskatchewan 1200; Manitoba 120; Ontario (Lake of the Woods) 6 (Environment Canada 2006a). As of 2001, the above population goals have not been met by the region or any of the provinces; the 2001 International Census numbers for Prairie Canada are: Alberta 150; Saskatchewan 805; Manitoba 16; Ontario 1 (Environment Canada 2006a).

The prairie recovery strategy has also set a productivity objective of "achieving a fledging rate of at least 1.25 fledglings/pair/year for managed sites" (Environment Canada 2006a). Current productivity in the Great Plains region had been estimated to be 0.86 chicks/pair/year on unmanaged sites (Ryan et al. 1993 in Prescott 1997). This is supported by baseline reproductive success rate findings in Larson et al. (2002) of 0.89 fledglings/pair for alkaline wetlands in the Great Plains based on 36 site-years of data. Larson et al. (2002) conducted population viability analysis model research which indicated that a reproductive success rate of 1.25 fledged/pair for the entire Great Plains population was required to stabilize the median population size.

6.1. Management Goals

Based on discussions with provincial wildlife managers and objectives outlined in the national recovery strategy (Environment Canada 2006a), the following goals for Manitoba have been identified:

Population Goal: To achieve a population of 120 adults over three consecutive international censuses and a fledging rate of 1.25 chicks/pair/year.

Habitat Goal: To maintain and protect active breeding sites from disturbance and identify new breeding sites as landscape conditions change over time.

Communication Goal: To promote education and develop a strategy which involves regional staff, stakeholders and other interested parties in the management of Piping Plovers.

Evaluation Goal: To monitor population and productivity changes and evaluate the effectiveness of management activities over time.

These management goals focus provincial efforts and resources and, in conjunction with national efforts, build the framework towards the intended recovery of the species.

6.2. Step-Down Outline

The following actions have been delineated to help answer some of the population unknowns and to help achieve the goals outlined above:

1.0 Assess and monitor population, productivity and habitat suitability

1.1 Conduct annual adult and brood surveys on all historical sites used within the last 20 years and any newly identified breeding areas (once in late May/early June and once in early July).

1.1.1 Continue to participate in the international survey every five years by carrying out intensive surveys of all historical breeding sites and newly identified potential sites in Manitoba.

1.2 Monitor all active breeding sites on a weekly basis to determine productivity and limiting factors.

1.3 Evaluate habitat conditions, suitability, and identify and monitor threats to habitat quality and availability during annual surveys and directed studies.

1.4 Review previous surveys, current aerial maps and use Geographical Information System mapping to identify potential areas and/or new sites, and where feasible, conduct aerial and intensive ground surveys to determine suitability of apparently suitable habitat and/or use.

1.4.1 Involve regional staff, interest groups and the birding community in identifying active sites or potential breeding sites.

1.5 When funding and staffing allows, initiate a banding program in Manitoba, which coordinates with other regions in the Great Plains region, to monitor seasonal and annual movements of plovers

within Manitoba and to determine the rate of return and dispersal to other regions.

2.0 Habitat protection and management

2.1 Apply protective designations on all active sites which do not have current protective designations

2.1.1 Assess land use and ownership of all breeding sites and surrounding areas.

2.1.2 Protect through easements, or other means, privately held parcels of habitat with active Piping Plover use.

2.1.3 Work with communities and non-government organizations to establish IBAs, Special Conservation Areas, and other designated or protected conservation initiatives on identified important breeding sites.

2.2 Protect all active breeding sites from human and human-related disturbance prior to the start and throughout the entire breeding season.

2.2.1 Where necessary, control public access to active breeding sites through public awareness, signage, fencing, beach closures and volunteer guardians.

2.2.2 Where necessary, control ATV and other vehicle access at active sites by installing physical barriers and appropriate signs, and by enforce prohibitions against ATV use within designated areas.

2.2.3 Where necessary, prevent damage by livestock to Piping Plover breeding areas by installing fences.

2.2.4 Control domestic pets by enforcing leash or beach access restrictions at plover sites within Provincial Parks.

2.2.5 Ensure that park maintenance practices/procedures do not harm plover nests, chicks or adults

2.2.6 As required, prevent other human disturbances which may be detrimental to Piping Plovers.

2.3 Where necessary, control beach vegetation by using water control, fire, and other environmentally safe vegetation removal methods to maintain sufficiently open habitat at active sites.

2.4 Work with Manitoba Water Stewardship, Fisheries and Oceans Canada and Manitoba Hydro to maintain and/or restore favourable water regimes at lakes critical to the survival of Piping Plovers in Manitoba.

2.4.1 Identify impacts of non-natural water regime on Piping Plover habitat on a site-by-site basis.

2.4.2 Identify and implement the best options to restore the natural water regime at each basin.

2.5 Work with Manitoba Water Stewardship and Fisheries and Oceans Canada to monitor and maintain water quality at Piping Plover sites.

2.5.1 Report any threats and/or water quality issues to appropriate agencies.

2.6 Participate in and support programs that benefit Piping Plovers and the conservation of critical habitat, such as WHSRN, IBAs, and the designation of Special Conservation Areas.

2.7 Through the federal and provincial Environmental Assessment process, identify potential impacts of all project proposals that may affect Piping Plover breeding habitat and ensure developments do not negatively impact breeding sites.

2.8 When necessary, enforce Manitoba's Endangered Species Act and other legislation and protocols to protect Piping Plover and their breeding areas.

3.0 Productivity Enhancement

3.1 Expand the predator exclosure program to include as many nests as personnel hours and funding allows

3.2 Manage active breeding sites to reduce their attractiveness to predators by maintaining un-vegetated and litter free beaches.

3.3 Monitor predator situations at active sites and utilize specific non-lethal predator deterrence and/or removal measures, such as removal of nests or denning areas during the non-breeding season.

3.4 Where flooding is a concern, use clutch translocation techniques to move threatened nests to higher ground.

3.5 When resources allow, establish nesting islands in remote locations to offer predator-reduced nesting alternatives.

4.0 Information and Education

4.1 Produce and distribute information packages to landowners, stakeholders and recreational groups whose activities affect plover recovery.

4.2 Promote and encourage involvement of private landowners, local communities and other interested individuals and/or groups in voluntary stewardship initiatives or guardianship programs.

4.3 When opportunities exist, conduct presentations on plover-related issues to communities, school groups and park users.

4.4 Prepare and distribute annual reports including progress updates and evaluations to all involved organizations and interested parties.

4.5 Annually recognize and highlight conservation efforts of landowners, communities, interested groups and other non-governmental organizations.

4.6 Participate in the preparation of national and regional recovery plans or strategies, and support and facilitate conservation efforts in other jurisdictions when the opportunity exists.

4.7 Enter accumulated Piping Plover data into the Manitoba Conservation Data Centre (CDC) element occurrence database and update CDC records following each field season.

5.0 Evaluate effectiveness of management actions

5.1 Assess and describe habitat and species responses to management actions through census counts and productivity assessments.

5.2 Monitor compliance by local users and recreationists to protection measures (i.e. ATV use, unleashed pets).

5.3 Compare the percentage of plover habitat managed and/or protected under conservation agreements, easements, IBAs, and Special Conservation Areas versus the percentage of non-protected or non-managed areas.

5.4 Monitor and assess the progress of recovery actions and develop new recovery strategies and actions when needed.

6.0 Administration

6.1 The Manitoba Piping Plover Recovery Implementation Group (RIG) shall oversee the implementation of this strategy and all provincial recovery actions.

6.1.1 The RIG shall maintain provincial and federal representatives and involve local stakeholders and interest groups when feasible.

6.1.2 The RIG shall convene a minimum twice annually to coordinate and review recovery actions.

6.2 Establish annual work plans and determine funding levels required to support monitoring and carry out recovery actions

6.3 Seek and maintain financial support for recovery initiatives from government, non-government and industry.

6.4 Recruit and train field staff to maintain and conduct annual field programs.

6.5 Coordinate provincial activities with those in other jurisdictions through involvement in national recovery team meetings and ventures.

6.3. Implementation Outline

The implementation schedule outlines and prioritizes tasks that are required to achieve the outlined management goals. Priority 1 designation applies to those actions absolutely necessary to prevent extirpation of the species in Manitoba, specifically management actions that will protect the species, its key nesting areas and help increase productivity. Priority 2 designations apply to those actions necessary to maintain the species current population status. Maintaining administrative and public support and evaluation of recovery actions are seen as secondary priority actions. Finally, priority 3 designations apply to all other actions necessary to provide for full recovery of the species.

Table 7. Manitoba Piping Plover management strategy implementation outline

Task No.	Action	Priority	Responsible Agencies*	Frequency
1.0	**Monitoring**			
1.1	Conduct annual nesting adult and brood surveys	1	Province, regional staff, volunteers, stakeholders, NGOs	Annual
1.2	Monitor nest success, productivity and limiting factors	1	Prov., reg. staff	Annual
1.3	Evaluate habitat suitability and monitor threats to habitat	1	Prov., reg. staff	Annual
1.4	Identify and survey other potential nesting areas	2	Prov., reg. staff, volunteers, stakeholders, NGOs	Bi-annual
1.5	Assess initiating a provincial banding program	3	Prov.	Based on resources
2.0	**Habitat Management**			
2.1	Protect active breeding sites through protective status, land easements or purchase	1	Prov., NGOs, stakeholders	On-going
2.2	Protect breeding areas from human-related disturbance	1	Prov., reg. staff, municipalities, volunteers, stakeholders, NGOs	On-going
2.3	Control beach vegetation to maintain open habitat	2	Prov., reg. staff, munic., NGOs, stakeholders,	Bi-annual
2.4, 2.5	Protect and manage watersheds	2	Prov., munic., federal	On-going
2.6	Support other conservation programs	3	Prov.	On-going

Task No.	Action	Priority	Responsible Agencies*	Frequency
2.7	Participate in federal and provincial Environmental Assessment process	3	Prov., federal	On-going
2.8	Protect nesting areas through legislation and enforcement	2	Prov., reg. staff, NGOs	On-going
3.0	**Productivity Enhancement**			
3.1	Continue or expand nest exclosure program	1	Prov., reg. staff	Annual
3.2	Manage sites to reduce predation on plover chicks in problem areas	1	Prov., reg. staff	Annual
3.3	Employ non-lethal predator deterrence measures	1	Prov., reg. staff	Annual
3.4	Relocate nests prone to flooding	1	Prov., reg.staff	Annual
3.5	Establish nesting islands	3	Prov., reg. staff, NGOs, federal	Based on resources
4.0	**Information and Education**			
4.1	Produce and distribute information packages	1	Prov., reg. staff, volunteers, NGOs	On-going
4.2	Involve landowners, communities and other interested individuals in management efforts	1	Prov.	On-going
4.3	Conduct presentations	2	Reg. staff, NGOs	Annual
4.4	Prepare and distribute reports	2	Prov., reg. staff	On-going
4.5	Recognize and highlight conservation efforts	2	Prov.	Annual
4.6	Participate in and support national recovery efforts	2	Prov., fed.	Annual
4.7	Maintain Conservation Data Centre database	3	Prov., Manitoba Conservation Data	On-going

Task No.	Action	Priority	Responsible Agencies*	Frequency
			Centre	
5.0	**Evaluation**			
5.1 – 5.3	Evaluate effectiveness of management actions	2	Prov.	Annual
5.4	Assess actions and develop new strategies	2	Prov.	Annual
6.0	**Administration**			
6.1	Insure that Manitoba Recovery Implementation Group continues to direct and oversee recovery efforts	2	Prov., fed., reg. staff, stakeholders	Annual
6.2	Establish annual work plans	1	Prov., fed., reg. staff, stakeholders	Annual
6.3	Seek enhanced financial support	1	Prov., fed.	Annual
6.4	Recruit and train qualified field staff	1	Prov., fed.	Annual
6.5	Maintain involvement in national recovery ventures	2	Prov., fed.	On-going

*Prov. = Province of Manitoba; Reg. Staff = Regional staff; Munic.= Municipalities; NGOs = Non-governmental organizations; Fed = Federal Dept.

7. Summary, Conclusions and Recommendations

The Piping Plover stewardship project was initiated in 2002 to gain a better understanding of the status of Piping Plovers in Manitoba and to develop a strategy which would facilitate the species recovery. Ideally, any strategy for Manitoba would bring together all the essential players, harness current resources and staff, utilize already established conservation programs, and finally, be cost effective. The strategy outlined in this thesis provides a working framework in which to initiate recovery efforts within Manitoba.

At the onset of the project, it was unknown what percentage of Manitoba's entire population was being surveyed annually, if Piping Plovers were utilizing other suitable areas in Manitoba during high water years, if emigration due to habitat loss was part of the cause of decline, or if irreversible declines had indeed occurred. In 2002 and 2003, intensive surveys of historical and potential sites across Manitoba resulted in the identification of many suitable breeding sites that were not being used by Piping Plovers. However, the above average habitat suitability observed during the study is not considered to be typical as water levels were considered to be below normal. Though not observed during the study, available habitat and vegetation encroachment caused by stabilized water levels has greatly reduced the suitability of most historical nesting sites on Lake Manitoba and Lake Winnipeg (due to the shallow nature of both lakes, a rise in a foot of water greatly reduces the available shoreline at many sites). Based on increased survey and monitoring efforts combined with above average habitat

conditions, it does not appear that the population of Piping Plovers would be significantly larger than what was observed during the study.

In Manitoba, Piping Plover nest success and productivity at the majority of historical nesting sites is being limited by habitat availability (during 'normal' to high water years) , medium to high predation rates and recreational pressures. With the use of fencing, signs, exclosure cages, and volunteer guardians, predation and recreational disturbance were minimized sufficiently during the study period to allow for increased nesting success rates (compared to sites with no protection) and reasonable fledging rates (only slightly below the national target and in excess of the prairie-wide average). However, based on observed disturbance events at unprotected sites as well as some of the protected sites, I strongly believe that the majority of plover nests located in medium and high recreational use areas during this study would have been destroyed if access to nesting sites was not restricted or impeded by fencing, signs and volunteer guardian observers. Though Piping Plover nest success rates were enhanced by the use of nest exclosure cages and fencing during this study, chick survival continues to be suppressed and overall productivity still was below levels determined to be needed to stabilize the population. The chick survival rates witnessed during the study could be attributed to high predation pressures found at nesting areas and an increase in human disturbance as the breeding season progresses. In order to increase Piping Plover productivity in Manitoba more effort needs to be placed on reducing predation and recreational pressures during the plovers pre-fledge stage.

Due to the high degree of disturbance found at historical nesting sites across the province and the resultant increased chance for nest losses, I do not believe that target productivity and population goals can be achieved without proper habitat protection. Habitat protection would need to include some restrictions on public access to breeding areas during nesting and pre-fledge periods. This may necessitate the complete closure (from upland vegetation to the waters' edge) of accessible breeding sites to properly protect nests and pre-fledge chicks from recreational disturbance (e.g. as in Atlantic Canada). It will also be necessary to continue working with local communities and cottagers to mitigate the negative effects that recreational activities have on nesting adults and chick survival. In order to be effective, these restrictions and/or closures would need to be regularly monitored and enforced (especially in areas with current ATV activity). Unfortunately, it is foreseeable that both recreational and predation pressures will only keep increasing and any mitigation of these threats would need to be sustained at active sites for an indefinite period of time or until populations within the entire Great Plains range have recovered.

In addition to implementing the proposed strategy, I recommend to Manitoba Conservation and the Manitoba Piping Plover RIG the following management actions and considerations:

1. Continue annual surveys of all historical sites plus any potential areas in order to identify active nesting sites and monitor population changes. Future work should include identifying potential habitat in the Interlake region and on Lake Winnipegosis. Also, more attention should be paid to

non-traditional nesting habitat during regular surveys to possibly locate additional non-paired individuals and outlying nesting pairs.

2. Restrict recreational activities at all active nesting sites. This may necessitate the complete closure (from the upland vegetation to the waters' edge) of accessible sites to properly protect pre-fledge chicks from human disturbance. In addition, efforts should be made to designate all high priority sites as important or critical nesting areas and be given protected status either through legislation (i.e. as a Special Conservation Area) or under an established conservation program (i.e. IBA, world heritage designation, etc.). It is also necessary that protected areas be monitored regularly, restrictions enforced and fencing erected early enough and maintained in good condition for recreational users to respect restricted areas.

3. Expand the nest exclosure program to encompass as many nests as funding and personnel hours allow. Due to the threat of nest losses associated with fencing of individual nests, such as at Grand Beach, I recommend that exclosures be compulsory in those instances and strongly encouraged for all nests that can be monitored on a regular basis. However, due to the potential risk of predation of adults and nest abandonment, only nests that can be monitored on a regular basis should be exclosed.

4. Continue to work with local communities, cottagers and recreational users to mitigate the negative effects that recreational activities have on nesting birds and on chick survival, specifically in the communities of Grand Marais, Riverton, Grand Rapids and St. Ambroise. The establishment of volunteer guardian programs may provide a sense of community ownership plus aid in the protection and monitoring of nests and chicks. The provincial government should also initiate a public education

campaign that includes media outlets, community groups and school districts.

5. Initiate more intense predator management controls at active sites where predation pressures are strong, such as trapping potential predators and/or removal of stick nests and denning sites. Specifically, the removal of ground squirrels or the use of predator fencing around nesting sites at Grand Beach Provincial Park should be initiated to reduce the possible predation of exclosed nests.

6. Clutch translocation should be used to save eggs that are in eminent danger of being lost to rising water. Where feasible, clutches located below or within one meter of the high water line should be moved prior to any anticipated risk.

7. As the potential to reduce human disturbance at Grand Beach Provincial Park is extremely limited, focus should be placed on protecting and enhancing alternative nesting sites within the vicinity. Doing so may draw the birds away from high disturbance areas to more suitable and possibly less intrusive areas (i.e. areas on East Beach at Grand Beach or on Grand Marais Spit and/or Island). In addition, through habitat manipulation, predator decoys, and/or ground flagging techniques, Piping Plovers should be discouraged from nesting in areas where nesting success and/or the fledging of chicks would be nearly impossible due to the influx of park visitors, for example - West Beach blowout area at Grand Beach Provincial Park. However, these techniques should only be used if other suitable nesting sites within the vicinity are available.

8. To increase the chance of survival of pre-fledge chicks that hatch in parking lot # 5 at Grand Beach Provincial Park, every effort should be made to protect beach-side feeding areas and restrict vehicle access in the parking lot during the first 15 days after hatch. Another possible alternative would be to relocate chicks from West Beach across the

channel to East Beach (see habitat enhancement in Section 3). This relocation would move the chicks to an area with fewer disturbances and eliminate the risk of chicks being run over by vehicles in the parking lot or by maintenance vehicles accessing the beach.

9. Manitoba Conservation should consider participating in banding programs like those occurring in Saskatchewan and Alberta in order to assess and monitor seasonal and annual movements of Piping Plovers within Manitoba and to help determine the rate of return and dispersal to other regions.

10. Long-term management actions should include the creation of nesting islands (to reduce mammalian predation pressures) and/or the enhancement of nesting habitat (i.e. vegetation removal) away from development and areas with high recreational value. Possible areas include Grand Marais Spit, Riverton Sandy Bar, and re-creating nesting islands at historical nesting areas on West Shoal Lake.

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Appendix A: 2002 and 2003 Survey Summary

No.	Location	Year Surveyed	Comments	Survey (comp/part)	KM Surveyed
	Lake Manitoba				
1	Hollywood Beach	2002 2003	Open beach aprox. 30 m wide; human activity	Complete	1.0
2	Delta Beach (University of Manitoba Field Station)	2002	Narrow beach < 6 m wide with tree line to edge; south west holds potential	Complete	1.0
3	Stony Beach (Delta)	2002 2003	< 25 m shore with trees to edge; best habitat by road; ATV activity	Complete	1.5
4	Clandeboye Bay	2002 2003	Aprox. 40-60 m open beach; best habitat at end by channel; ATV activity	Complete	2.0
5	St. Ambroise Park	2002/2003	Narrow beach < 6 m wide; recreation	Complete	1.0
6	Twin Lakes	2002 2003	Open in parts up to 25 m; cottage area with extensive ATV use	Complete	0.5
7	Laurentian Beach	2003	No habitat; beach < 4 m wide	Complete	0.1
8	Shallow Point	2003	Beach <15 m wide with few trees	Complete	0.1
9	Lundar Beach	2003	Beach < 8 m wide with trees to edge; recreation	Complete	0.2
10	Hwy 117 to end	2003	Highly vegetated shoreline < 5 m wide	Part – off road	0.1
11	The ‘Narrows’	2003	No suitable habitat in immediate area (sight)	Part – area surrounding bridge	0.5

No.	Location	Year Surveyed	Comments	Survey (comp/part)	KM Surveyed
12	Watchorn Provincial Park	2003	Beach 30 m wide x 480 m long – suitable habitat; recreation beach	Complete	0.5
13	**Oak Lake**	2002	Shore rocky < 5 m wide, only south and southeast portion scanned; recreational beach aprox. 10 m wide.	Part – south and southeast sections	1.0
14	**Whitewater Lake**	2002 2003	Water levels low, highly vegetated in most spots with grasses/cattails, exposed areas are wet mud, some sections > 25 m.	Part - southwest side and Sexton Island	2.5
15	**North Shoal Lake**	2003	Exposed shoreline muddy and vegetated (Cattails), < 10 m	Part – South east shore off HWY	0.5
16	**West Shoal Lake**	2002 2003	Flooded – lower water in 2003, < 4 m exposed shoreline; silted	Part – Enn's property and northwest side off road	1.5
	Lake Winnipeg				
17	Elk Island Provincial Park	2002 2003	Water levels low exposing new sandbar > 30 m wide from mainland to island in 2003, rest of shore aprox. 10 – 20 m; recreation and ATV use	Part - Northwest shore not surveyed	2.0
18	Victoria Beach	2002 2003	Beach aprox. 15 m wide, most suitable area at point across from Elk Island; recreation and ATV use	Complete	1.0
19	Hillside Beach	2002/2003	Narrow beach < 4 m with tree line to edge	Complete	0.2

No.	Location	Year Surveyed	Comments	Survey (comp/part)	KM Surveyed
20	Grand Beach Provincial Park	2002 2003	West Beach >25 m wide, East Beach < 15 m in some sections; recreation	Complete	3.0
21	Grand Marais Spit	2002 2003	Shore 10-20 m wide, good habitat middle and end, some willow encroachment; recreation and intensive ATV activity noted	Complete	2.0
22	Grand Marais Island	2002 2003	Shore aprox. 1-12 m wide; Good habitat at east end; large gull colony west end, terns on east end	Complete	1.5
23	Beaconia Beach	2002 2003	Shore aprox. 5-30 m in some sections, suitable areas in middle and at end by channel; recreation	Complete	3.0
24	Whitesands; Sunset Beach; Lakeshore Heights; Balsam Bay; Almsdals Cove; Island Beach	2002 2003	Cottage development areas along south basin of Lake Winnipeg between Grand Beach and Patricia Beach, shoreline < 8 m wide	Immediate area scanned	0.2
25	Patricia Beach Provincial Park	2002 2003	Beach aprox. 15 m wide with cut dunes, low water levels exposed new sand/mud flat by channel > 30 m wide; recreation	Complete	2.5
26	San Sousi Beach	2003	Shore < 10 m wide; Cottage area	Complete	0.5
27	Willow Point	2002 2003	Shore 3-15 m, good habitat at end, no trees, island scanned from mainland; roosting gulls and pelicans, some ATV tracks apparent	Part (island not done)	2.0
28	Riverton Sandy Bar IBA	2002 2003	Water levels low, islands attached to mainland, aprox 30-70 m wide, large gull and tern colony on both islands; ATV activity	Complete	2.5

No.	Location	Year Surveyed	Comments	Survey (comp/part)	KM Surveyed
29	Hecla Sand Spit	2002 2003	Suitable mostly on end and area in middle; spit aprox 20-60 m wide; area used for loafing by pelicans, gulls, terns	Complete	1.5
30	Warpath River Area	2003	Mouth of river good; rest < 15 m wide with trees to edge.	Complete around mouth of river	3.0
31	South Gull Bay	2002 2003	East shore 10-30 m wide, best area at north end > 30 m wide, large flat on south end prone to flooding	Complete	6
32	North Gull Bay	2002 2003	East shore 10-40 m wide, best habitat by fence, middle and south end along the east shoreline; fisher cabins along spit with ATV activity	Complete	8
33	Willow Point (Grand Rapids)	2003	Potential habitat, fisher cabin, prone to flooding	Aerial	0.5
34	Reef Point	2003	Spit < 30 m wide, large rock > 10 cm; merganser colony at end	Part	0.5
35	Limestone Bay	2003	Large sand flat southwest end; rest aprox. 15-30 m wide with trees to edge.	Part (26 km long)	22.5
36	Pebble Beach (Grand Rapids)	2003	Rocky shoreline 10-40 m with tree line to edge	Complete	1.0
37	**Katimik Lake**	2002	Best area southeast side with mud flat > 20 m wide, rest of shoreline vegetated < 5 m wide	Aerial	15
38	**Kaweenakumik Lake**	2002	Shoreline vegetated < 5 m wide, two islands with potential (gulls and pelicans observed)	Aerial	10

Appendix B: 2002 Nesting Summary

Location	Nest No.	Protection	Est. Nest Initiation	# Eggs at Hatch	Hatch Date	No. Chicks Hatched	No. Fledge
Clandeboye Bay	1	None	May 19-20	Lost (May 22-30)	---	---	---
	2	Area fenced; nest exclosed	May 22-24	4	June 21-23	3+	2
	3	Area fenced; nest exclosed	May 28	Lost (June 13-19)	---	---	---
	4	Area fenced; nest exclosed	May 28-29	4	June 27-28	3+	3
	5*	Area fenced	June 12-13	Lost (June 13-19)	---	---	---
	6*	Area fenced; nest exclosed	June 23-24	4	July 23-24	2+	2
Twin Lakes	1	Nest fenced	May 21-22	Lost (June 6-13) - predation	---	---	---
Grand Beach Pk lot #5	1	Nest fenced	May 23-24	Lost - predation	---	---	---
East Beach	2	Nest fenced	May 27	4	June 27	3	2
East Beach	3	Nest fenced; nest exclosed	June 10-11		July 13	4	2

Location	Nest No.	Protection	Est. Nest Initiation	# Eggs at Hatch	Hatch Date	No. Chicks Hatched	No. Fledge
Pk lot #5	4*	Nest fenced	Unknown	Lost - predation	---	---	---
Grand Marais Island	1	None	June 9	4	July 9	4	3
Gull Bay North	1	None	June 3	4	July 3	3 (July 3)	Unknown
	2	None	June 6-7	4	Unknown	Unknown	Unknown
	3	None	June 11-12	4	July 15-19	2 (July 23)	Unknown
Gull Bay South	1	None		Unknown	Unknown	Unknown	Unknown

(* re-nest attempt)

Appendix C: 2003 Nesting Summary

Location	Nest No.	Protection	Est. Nest Initiation	# Eggs at Hatch	Hatch Date	No. Chicks Hatched	No. Fledge
Clandeboye Bay	1	Area fenced; nest exclosed	May 12-13	4 (June 11)	June 17-18	4	0
	2	Area fenced; nest exclosed	May 14-15	4 (june 11)	June 16-17	4	0
	3	Area fenced; nest exclosed	May 17-18	Nest abandoned (4 eggs)	---	---	---
	4	Area fenced: nest exclosed	May 17-18	4 (June 17)	June 19-20	4	0
Grand Beach Pk lot #5	1	Nest fenced; nest exclosed	May 14	4	June 17	4	4
East Beach	2	Nest fenced; nest exclosed	May 18	3	June 19	1	0
West Beach	3	Nest fenced	May 20	Lost (May 21) – predation	---	---	---
Pk lot #5	4*	Nest fenced; nest exclosed	May 22	4	June 21/22	3	0
Grand Marais Spit	1	Nest fenced; nest exclosed but removed	June 1-2	4	July 1	3	0

Location	Nest No.	Protection	Est. Nest Initiation	# Eggs at Hatch	Hatch Date	No. Chicks Hatched	No. Fledge
Grand Marais Island	1	None	Before May 29	4 (June 15)	Before June 25	4	4
Gull Bay South	1	None	Before June18	Unknown	Unknown	Unknown	Unknown
Gull Bay North	1	None	Before June 19	Unknown	Unknown	Unknown	Unknown
Stony Beach (Delta)	1*	None	Estimated July 2	Lost – flooding	---	---	---
Riverton Sandy Bar	1	Area fenced	After June 12	3 (July 17 – 1 star pipped)	Unknown	Unknown (nest gone July 21)	0

(* re-nest attempt)