ALBERTA PIPING PLOVER PREDATOR EXCLOSURE AND POPULATION MONITORING PROGRAM

2006 Field Season Report

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In cooperation with:

Alberta

Alberta Conservation Association

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EXECUTIVE SUMMARY

Nest predation continues to be a significant limiting factor for the Great Plains piping plover population. Previous studies conducted in east-central Alberta and in the United States have shown that the use of predator exclosures can significantly reduce piping plover nest predation. Since 2002, predator exclosures have been applied to as many nests as possible in Alberta with the goal of increasing nest success and ultimately enhancing fledging success.

As a part of this program, annual surveys are conducted on core breeding lakes to better gauge population numbers and movement. These surveys complement the international census conducted every five years across North America and are designed to monitor changes in populations and distribution. This year marked the fourth international census. Surveys also provide researchers with an opportunity to re-sight piping plovers banded in Alberta in previous years, as well as those banded in other jurisdictions. The information collected from band recoveries assists wildlife managers in determining dispersal patterns as well as adult and juvenile survival and complements the banding program being undertaken in Saskatchewan.

Population inventories were carried out on 74 water bodies. In Alberta, 274 adults were located on 25 different water bodies and an additional 28 adults were seen on adjacent lakes surveyed in Saskatchewan. In total, 127 nests were found in 2006. Of the 107 exclosed nests with known fate, apparent nest success was 86.9% (93/107). Overall, Mayfield nest success was calculated to be 80.8%, fledging success was calculated to be 32.2%, and we calculated that 1.10 chicks per pair were fledged in 2006. In total, 31 young plovers were banded and there were 81 re-sightings of piping plovers banded in previous years.

Activities carried out for this project were done in support of the *Alberta Piping Plover Recovery Plan, 2005-2010*.

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Finally, thank you to those individuals who permitted us access through their land to plover habitat. Our sincere apologies to anyone we have missed.

Please note that the results and recommendations presented in this report do not necessarily represent official positions of our funding agencies.

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1.0 INTRODUCTION

The piping plover is designated as *Endangered* in Canada (COSEWIC 2006), *Threatened* in the United States (United States Fish and Wildlife Service 2006) and *Near Threatened* by The World Conservation Union (IUCN 2006) and is listed as *Endangered* under Alberta's *Wildlife Act* (Prescott 1997). Low productivity, primarily resulting from nest predation, has been identified as a significant limiting factor to piping plover populations in the Great Plains (Whyte 1985, Haig 1992, Heckbert 1994, Richardson 1999). Results from studies carried out in east-central Alberta from 1995 to 1997 showed that, through the use of predator exclosures, piping plover nest predation can be significantly reduced thus increasing productivity (Heckbert and Cantelon 1996, Richardson 1999). Results from other jurisdictions have been similar (Rimmer and Deblinger 1990, Melvin et al. 1992, Larson et al. 2002, Murphy et al. 2003). The Alberta Piping Plover Recovery Team has endorsed the use and continued refinement of predator exclosures as a management technique in the *Alberta Piping Plover Recovery Plan 2005-2010 (*Alberta Piping Plover Recovery Team 2006). This program has been ongoing since 2002 (Engley and Schmelzeisen 2002, Schmelzeisen and Engley 2003, Engley et al. 2004, Schmelzeisen et al. 2005) and in addition to exclosure application, this program includes inventories on many lakes with the potential to support plover populations. These annual surveys will assist wildlife managers in determining the population trends and distribution of Alberta's piping plovers. Field crews have also become increasingly involved with the information and education component of the recovery plan.

2.0 STUDY AREA

The majority of this program was carried out on water bodies in east-central and southeastern Alberta. Four lakes occurring in whole or in part in extreme west-central Saskatchewan were also included in the study because of their proximity to the Alberta lakes in the program. These lakes were South Freshwater Lake (hereafter referred to as Freshwater Lake), North Freshwater Lake, West Reflex Lake (hereafter referred to as Reflex Lake) and East Reflex Lake.

3.0 MATERIALS AND METHODS

Four researchers in two field crews carried out the majority of the work. Fieldwork began 12 May 2006 and was completed by 16 August 2006. One crew was stationed at Dillberry Lake Provincial Park along the Saskatchewan border just north of Provost, Alberta and monitored lakes near Dillberry and in the Provost area. The second crew was stationed on a part-time basis in St. Paul, Alberta from which they monitored

Muriel Lake and Frog Lake. The remainder of their time was spent stationed in Hanna, Alberta where they could monitor lakes in the surrounding area. Additional staff from the Alberta Conservation Association, Alberta Sustainable Resource Development and the Department of National Defence assisted in project activities on lakes outside of the core program area. Field crews contacted landowners whenever it was necessary to cross private land to gain access to a lake.

3.1 Population inventories

Lakes with known or potential piping plover habitat were surveyed for piping plovers, beginning with those lakes that had larger and more recent populations of piping plovers. Adult survey numbers were recorded between 25 May and 7 June, during the peak of breeding activity, and followed guidelines outlined by Goossen (1990). Lakes were surveyed by walking approximately 60-70% of the way from the water's edge to the vegetation line and stopping periodically to scan for plovers. Location of adult plovers and breeding activity were recorded and mapped and all adults were checked closely for leg bands. Complete lake surveys were conducted again in July to assess habitat conditions and look for broods from nests that were never located.

3.2 Exclosure application and monitoring

The locations of nests found during lake surveys were georeferenced using a handheld Global Positioning System (GPS) and recorded in Universal Transverse Mercator (UTM) coordinates (North American Datum 1983). To avoid disturbance to incubating adults, nests were monitored from 50-100 m away using binoculars or spotting scopes. Nests were only approached when exclosures were to be applied, when nest contents needed verification or when no signs of activity were seen from a distance. As a rule, exclosed nests were monitored weekly throughout the incubation period. Unexclosed nests were monitored less frequently, and in some cases were only monitored on the day they were found. Nests were considered to be successful if at least one egg hatched (Murphy et al. 1999).

Exclosure application and monitoring techniques followed the procedures outlined by Richardson (1997). Once located, the majority of nests had predator exclosures applied to them within one day of discovery, regardless of stage of laying or incubation. One researcher carried the exclosure to the nest and secured it to the substrate. After application of an exclosure, each nest was monitored to ensure that adults resumed incubation. Following guidelines outlined by the United States Fish and Wildlife Service (1996), if adults did not resume incubation within 60 minutes (less if the weather turned inclement) the exclosure would be removed.

Predator exclosures used during the 2006 field season (Figure 1) followed the same basic design as has been used since 2002 (Schmelzeisen et al. 2005). They were circular in shape, and made of a single length of 5 cm x 5 cm stucco wire approximately 2 m long and 40 cm high. The two ends of the stucco wire were overlapped by three sections and attached using 10-cm nylon cable ties, forming a circular exclosure 60 cm in diameter. In an effort to prevent predatory birds from perching on the exclosures, the horizontal wire along the top of the exclosure was removed to expose the vertical wires thus creating 5-cm spikes around the top of the exclosure. Each exclosure was anchored with five 25-cm nails with a U-bend at the top. The nails were evenly spaced and inserted through the bottom section of the exclosure in order to secure it to the substrate.

One basic change in exclosure design from previous years was the use of 5 cm x 5 cm stucco wire (the same material used to construct the sides) for the top, in replacement of 2 cm x 2 cm plastic mesh that was used in previous models (see Figure 1). This change was in response to depredations occurring from coyotes that pushed through the plastic mesh (Schmelzeisen et al. 2005). In ten cases exclosures with plastic mesh tops were used by researchers when the other type was not available (see Appendix 1).

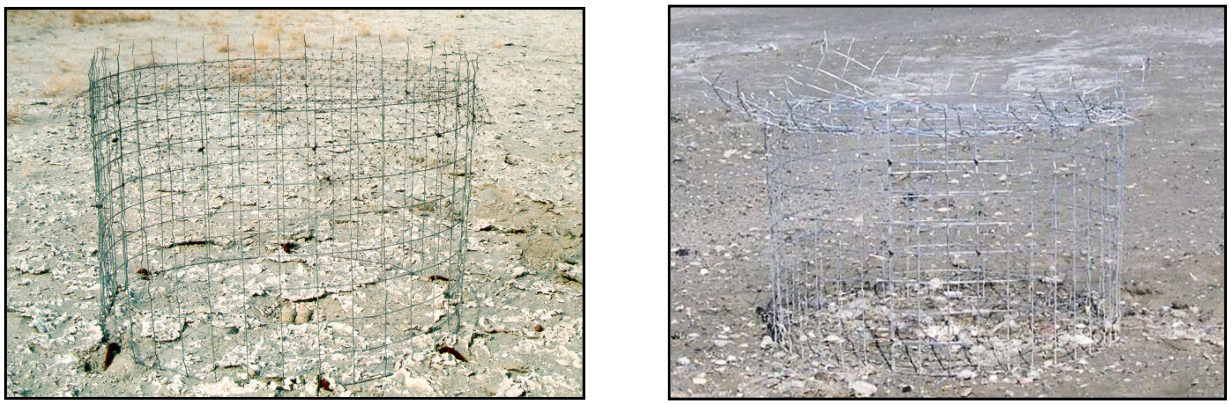

Figure 1. An exclosure with a 2 cm x 2 cm plastic mesh top (left) and an exclosure with a 5cm x 5 cm stucco wire top (right).

The utility of a RECONYX Model: RM30 Silent Image™ recreation camera in documenting exclosure effectiveness, nest threats and nest activity was tested. A single camera was placed 5 m from an exclosed nest on Akasu Lake. The motion sensor in the camera was set to its maximum sensitivity. It was set to take ten successive images after it was triggered by a motion event. A 1-Gb Compact Flash card was used to store the images. To conceal the camera from obvious detection, the camera was fitted inside a

concrete moulding which was made to resemble a rock (Figure 2). Images were downloaded from the camera once every two weeks.

Figure 2. Silent Image™ recreational camera.

3.3 Band application and tracking

Young plovers were opportunistically captured using hand nets and marked with a combination of one metal, one black-and-white striped plastic band and one coloured Darvic™ plastic band (orange for birds banded in Alberta, white for birds banded on Freshwater lake). Bands were applied in combinations that allow band re-sightings to be traced back to the lake and year that the bird was banded. Researchers also weighed and photographed captured young to build a reference dataset linking age with weight and development. In order to minimize any compromising effects that bands may have on the young that were banded, young were banded as close to 18 days of age as possible.

3.4 Productivity analyses

Nest success was calculated by two methods:

1. Apparent nest success: calculated by dividing the number of successful nests by the total number of nests with known fate. Apparent nest success usually overestimates nest survival rates because not all nests are found at initiation and some nests are not found at all. Nests found late in incubation are more likely to hatch during the period of observation than are those found on the first day of incubation because

they have a much shorter period of time to survive. To remedy this error, we also calculated Mayfield nest success.

2. Mayfield nest success: calculated by determining daily survival rate (DSR) of a group of nests (1-[#losses/number of exposure days]), raised to the power of 35, which is the number of days in the laying and incubation period of piping plovers (Murphy et al. 1999). Mayfield success is the superior measure of calculating nesting success, as it considers only nests that are actually under observation for a known period of time (exposure days [Exp]; Mayfield 1961, 1975; Johnson 1979). Mayfield nest success was calculated separately for exclosed and unexclosed nests, and for all nests combined. In some cases a single nest may have contributed exposure days to both unexclosed and exclosed nest calculations.

Fledging success was calculated using a modified Mayfield approach following Flint et al. (1995). This method, which has been employed for a variety of species, including piping plovers (Elias et al. 2000), determines daily survival rates of chicks (1-[#chicks lost/total exposure days]) based on periods of time when broods are actually under observation. This method is also useful in that it allows inclusion of broods that were not followed through the entire chick period because either (a) return visits could not be made at a time when fledging (>20 days) should have occurred, or (b) broods were of unknown nest origin, so the specific number of chicks hatched was unknown. Fledging was assumed to occur at 20 days, and fledging success was therefore calculated as DSR^{20} (Schmelzeisen et al. 2005). This calculation yields a conservative value, as calculations are based only on chicks that are actually observed, and some chicks are undoubtedly missed during visits.

Overall production per nesting attempt (OPN) in the province during 2006 was calculated as:

OPN = (Mayfield nesting success) x (mean # eggs laid) x (% eggs in successful nest hatching) x (Mayfield fledging success).

Because productivity goals established in the provincial and national recovery plans (Goossen et al. 2002, Alberta Piping Plover Recovery Team 2006) are expressed as chicks/pair, rather than chicks/nesting attempt, we multiplied OPN by 1.2, based on the observation that the number of nests on well-surveyed Alberta lakes is typically 20% higher than the number of pairs known to occur on those lakes in the same year (Prescott and Engley, unpubl. data).

4.0 RESULTS

4.1 Population inventories

Population inventories were conducted on 71 water bodies in Alberta and three in Saskatchewan (Table 1, Figure 3) as part of the annual monitoring program in Alberta and as part of the 2006 International Piping Plover Census. In total, 274 adults were located on 25 lakes during the course of these surveys. An additional 28 adults were located in Saskatchewan (18 on Freshwater Lake, 2 on North Freshwater Lake and 8 on the Saskatchewan side of Reflex Lake).

Table 1. Alberta piping plover population inventories for 2006.

Lake	Adult Survey	Lake	Adult Survey
Muriel	46	Chain #7	0
Killarney	27	Chappice	0
Reflex[1]	17(8)	Chin Coulee	0
Birch – Main Basin	22	Coleman	0
Freshwater[1]	(18)	Cooking	0
Handhills	17	Dalemead	0
Red Deer	16	Dawson	0
Baxter	15	East Reflex[1]	(0)
Junction	14	Gooseberry	0
Akasu	12	Goosequill	0
Frog	12	Hansman	0
Clark	9	Joseph	0
Beaverhill	8	Keho	0
Dowling	8	Lowden	0
Horseshoe	8	McGregor	0
Chain #4	7	Metiskow	0
Sunken	7	Milk River Reservoir	0
McLaren	6	Miquelon #1	0
NW Killarney	6	Miquelon #2	0
Piper	6	Miquelon #3	0
Little Fish	4	Mott	0
Cipher	2	Neutral Hills A	0
Foster	2	Neutral Hills B1	0
North Freshwater[1]	(2)	Neutral Hills B2	0
Border	1	Neutral Hills C1	0
Plain	1	Oliver	0
Rider	1	Plover	0
Albert	0	Rockeling	0
Birch – North Basin	0	Rutherford	0
Bittern	0	Sam	0
Buffalo	0	Shanks	0
Chain #1	0	Sittingstone	0
Chain #2	0	Spiers	0
Chain #3	0	St. Mary Reservoir	0
Chain #3A	0	Sullivan	0
Chain #5	0	Unnamed (S of Handhills)	0
Chain #6	0	West	0
		Total	**274(28)**

[1] Numbers in parentheses are birds that were counted in Saskatchewan.

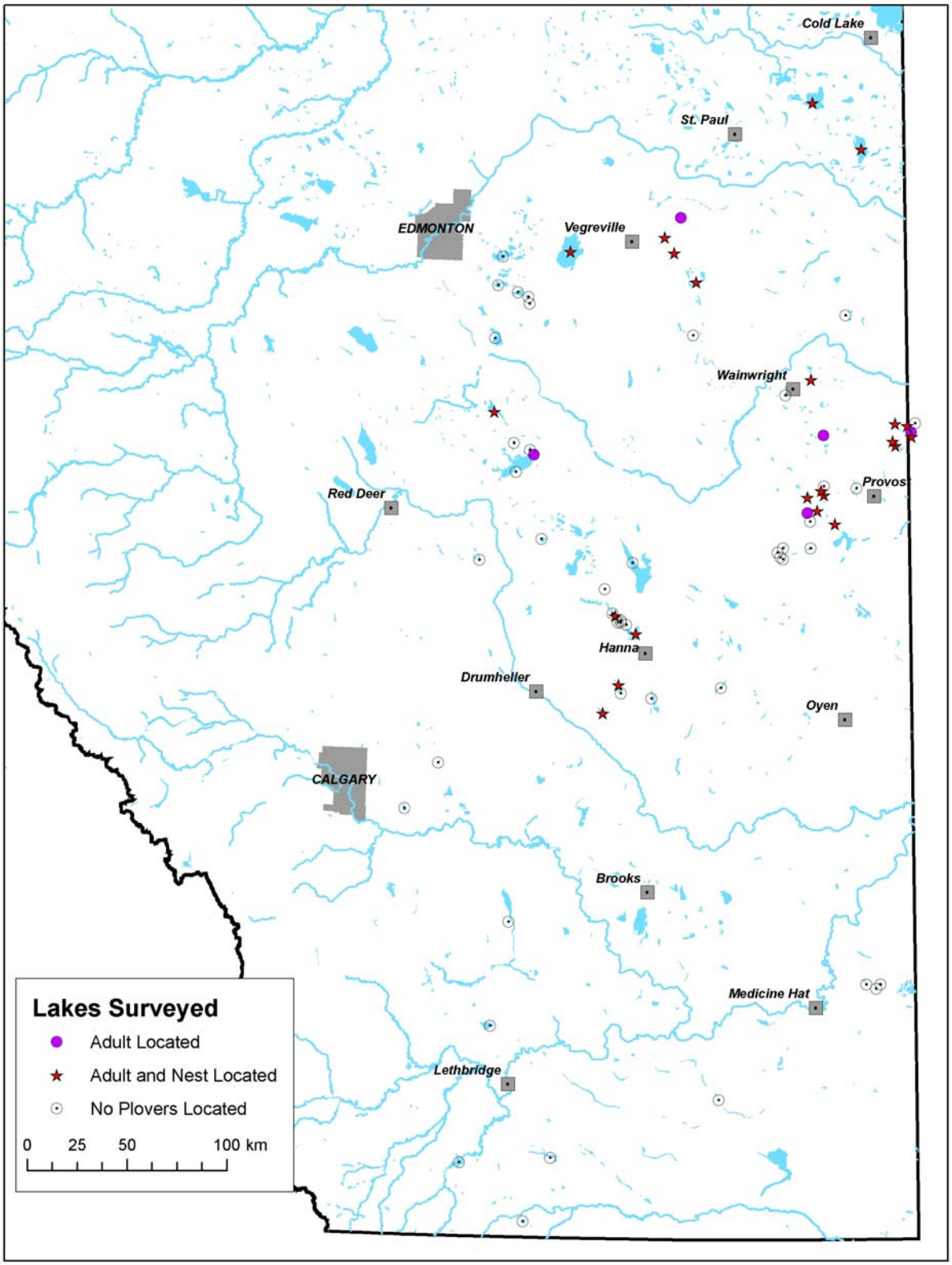

Figure 3. Location of lakes surveyed for piping plovers in 2006.

4.2 Nest summaries

In total, 127 nests were found on 22 water bodies (Figure 2, Table 2). The lake with the highest number of recorded nests was Muriel Lake (n=22) followed by Freshwater Lake (n=11), Handhills Lake (n=11) and Killarney Lake (n=11). For all nests where a full clutch size was known, mean clutch size was 3.84 $\pm$ 0.05 (n=114). Overall, apparent nest success was 86.9% (93/107) for nests with known fate. For nests that were treated with exclosures (exclosed) and the fate was known, 86.7% were successful (85/98). For nests where exclosures were not applied (unexclosed) and the fate was known, 88.8% were successful (8/9). Nest fate was unknown for a total of twenty nests (18 unexclosed and two exclosed). Mayfield nest success was calculated to be 80.6% for exclosed nests (DSR = 0.9939 $\pm$ 0.0018, Exp = 1953) and 83.3% (DSR = 0.9948 $\pm$ 0.0052, Exp = 192) for unexclosed nests. A test of significance was not conducted because of the small number of nests and exposure days for unexclosed nests. Overall, Mayfield nest success for all nests found in 2006 was 80.8% (DSR = 0.9939 $\pm$ 0.0017, Exp = 2145).

A total of 13 exclosed nests failed. Nine exclosed nests were depredated and four exclosed nests were abandoned for a variety of reasons (Table 3). Five nest depredations were on Freshwater, two were on Killarney and two were on Muriel. All nest depredations on Freshwater and Killarney were by coyotes. The coyotes depredated the nests by grabbing onto the exclosure with their teeth and then pulling the exclosure off of the nest. On Muriel, one exclosure was dug under by a domestic dog and the other was preyed upon by an unknown predator.

Signs of coyote activity were observed on 15% (n=15/100) of all exclosed nests and it is very likely that more were approached by coyotes (see Appendix 1). On Handhills Lake a coyote was seen on the beach on almost every visit and tracks to nests were seen on 45% (n=5/11) of exclosed nests. On two of these occasions, signs of digging were observed next to the nest. Despite this, all nests exclosed on Handhills were successful. Similarly, coyote activity was seen on two of five exclosed nests on Akasu. Neither event resulted in a failed nest. In contrast, 45% (n=5/11) of nests on Freshwater were depredated.

Cattle activity was seen on nesting habitat on Horseshoe and Killarney lakes, resulting in the abandonment of two exclosed nests. One exclosure on Horseshoe was partly crushed; however, the bird continued incubation.

All-terrain vehicle (ATV) disturbance resulted in the abandonment of one nest on Muriel. ATV tracks were seen within metres of many of the nests on Muriel despite the

fact that 86.4% of nests (n=19/22) were in the breeding bird sanctuaries (access to the sanctuaries is restricted).

Table 2. Piping plover nest summaries for Alberta and adjacent Saskatchewan lakes in 2006.

Lake[1]	Exclosed nests			Unexclosed nests			Overall		
	No. of Nests	Successful nests[2]	Nest Success	No. of Nests	Successful nests[2]	Nest Success	No. of Nests	Successful nests[2]	Nest Success
Akasu	5	4	0.80	0	0	0.00	5	4	0.80
Baxter	0	0	0.00	8	2 (6 U)	U	8	2 (6 U)	U
Beaverhill	0	0	0.00	2	U	U	2	U	U
Birch	1	1	1.00	9	4 (4 U)	U	10	5 (4 U)	U
Chain #4	6	5 (1 U)	U	0	0	0.00	6	5 (1U)	U
Cipher	1	1	1.00	0	0	0.00	1	1	1.00
Dowling	4	4	1.00	0	0	0.00	4	4	1.00
Foster	0	0	0.00	1	U	U	1	U	U
Freshwater (SK)	11	6	0.55	0	0	0.00	11	6	0.55
Frog	0	0	0.00	2	U	U	2	U	U
Handhills	11	11	1.00	0	0	0.00	11	11	1.00
Horseshoe	4	3	0.75	0	0	0.00	4	3	0.75
Junction	6	6	1.00	0	0	0.00	6	6	1.00
Killarney	10	7	0.70	1	1	1.00	11	8	0.73
Little Fish	1	1	1.00	1	U	U	2	U	U
McLaren	3	3	1.00	0	0	0.00	3	3	1.00
Muriel	20	17	0.85	2	U	U	22	18	0.86
NW Killarney	1	1	1.00	1	1	1.00	2	2	1.00
Piper	3	3	1.00	0	0	0.00	3	3	1.00
Red Deer	3	3	1.00	0	0	0.00	3	3	1.00
Reflex	6	6	1.00	0	0	0.00	6	6	1.00
Reflex (SK)	3	3	1.00	0	0	0.00	3	3	1.00
Sunken	1	U	U	0	0	0.00	1	U	U
TOTALS	**100[3]**	**85**	**0.87**	**27[4]**	**8**	**0.89**	**127[3,4]**	**93**	**0.87**

[1] SK = Lake was in Saskatchewan

[2] U = Unknown fate

[3] The fates of one Chain Lake #4 nest and one Sunken Lake nest are unknown and were therefore left out of nest success calculations. The total number of exclosed nests with a known fate is 98.

[3] The fates of six Baxter Lake nests, four Birch Lake nests, both Beaverhill nests, both Frog Lake nests, both Muriel Lake nests and one Foster Lake nest and one Little Fish Lake nest are unknown and were therefore left out of nest success calculations. The total number of unexclosed nests found with a known fate is nine.

Table 3. Nest fate.

Nest Fate	Exclosed	Unexclosed
Successful	85	8
Unknown	2	18
Nest depredation	9	0
Abandoned due to cattle disturbance	2	0
Abandoned due to ATV disturbance	1	0
Unexplained abandonment	1	1
Totals	**100**	**27**

The Silent Image™ camera recorded a coyote approaching an exclosed nest on three different occasions. On each occasion the coyote was unsuccessful in preying upon the nest. The nest eventually hatched. A second nest that was monitored captured images of an ATV that ran over the nest. This nest also hatched as the ATV did not run over the centre of the exclosure.

4.3 Band application and tracking

Thirty-one young plovers were banded in 2006 (Table 4). This brings the total number of young banded since recovery efforts began in the summer of 1998 to 674 (Schmelzeisen et al. 2005). There were 81 re-sightings of birds banded previously in Alberta, Saskatchewan or on the wintering grounds, and 34 could be traced back to their banding year and lake of origin (Appendix 2).

Table 4. Summary of young banded in 2006.

Lake	Band combination[1]	No. of young banded
Baxter	(--,O:m,B/W)	2
Dowling	(--,--:m,OB/W)	4
Freshwater	(m,W: --,B/W)	2
Handhills	(--,m:--,OB/W)	5
Junction	(O, --:--,B/Wm)	2
Killarney	(--,--:B/W,Om)	3
Little Fish	(--,OB/W:m, --)	1
Muriel	(m,--:B/W,O)	4
Piper	(--,--:m,B/WO)	5
Red Deer	(m,--:--,OB/W)	2
Reflex	(m,O:B/W, --)	1
		Total: 31

1 Band combinations read as follows: upper left, lower left: upper right, lower right. Dashes (--) mean no bands were located on that part of the leg. Consecutive letters mean bands were stacked, where the first letter refers to the band used highest on the leg. Band types include the following: B/W=black-and-white striped plastic band, W=white band, O=orange band, m=uncoloured metal band with serial number.

4.4 Fledging success

Mayfield fledging success was calculated to be 32.2% (DSR = 0.9449 $\pm$ 0.0038, Exp = 3538). Based on the mean clutch size (3.84 eggs), percent of eggs hatching (91.7%), Mayfield nest success (80.8%) and Mayfield fledging success at 20 days (32.2%), overall production per nesting attempt for 2006 was estimated to be 0.92 chicks/nest. Using 1.2 nests/pair, the overall fledging rate was 1.10 chicks/pair.

5.0 DISCUSSION

Activities for this project were undertaken in support of the *Alberta Piping Plover Recovery Plan 2005-2010* (Alberta Piping Plover Recovery Team 2006). Exclosure applications addressed section 8.2 Productivity Enhancement. Landowner liaisons addressed Section 8.3 Information and Outreach. Population inventories and banding of young addressed recovery actions under section 8.4 Population Monitoring and Research.

5.1 Population inventories

The number of piping plovers recorded in Alberta in 2006 was substantially higher than in any other year since large-scale recovery efforts began in 1998. The 274 plovers

recorded is an increase of 82.6% over the number recorded in Alberta during the 2001 International Piping Plover Census, in which 150 birds were counted (Prescott 2001). It is worthwhile to note that population numbers in the U.S. alkali lakes core area increased from 600 adults in 2005 to 674 adults in 2006 and the he population of piping plovers on the Missouri River system increased by 20% from 2001 numbers (Ryba 2006). In addition, population numbers in Saskatchewan increased from 805 adults in 2001 to 1438 adults in 2006 (Cheri Gratto-Trevor, pers. comm.). This is encouraging, as it appears that there is an increase in the entire Great Plains population and not simply a migration of piping plovers from other jurisdictions.

5.2 Nest success

Overall, the current design of the exclosures seems to be working very well. The use of stucco wire tops has proven to be effective in that the wire increases overall stability of the exclosures without increasing the conspicuousness of the exclosures. In fact, the wire tops are less visible than the plastic mesh tops used in previous years. On Reflex Lake, recreational users of the beach were seen within metres of an exclosed nest and appeared oblivious to the presence of the nest, alleviating concerns about people approaching exclosures.

Most nest depredations were on Freshwater and Killarney lakes. Observations from field crew suggest two reasons for the high number of depredations of exclosed nests by coyotes on Freshwater: 1) coyote activity appeared high when compared to other lakes, and 2) the substrate on Freshwater is very soft, making it more difficult to effectively anchor the exclosures and easier for coyotes to remove. Deeper anchors or fences may be needed on lakes with soft muddy or sandy substrates such as Freshwater.

In 2006, Mayfield nest success for unexclosed nests was 83.3%, which is unusually high for unexclosed nests. From 2002–2005, Mayfield nest success for unexclosed nests was just 27.1%. Unexclosed nests are monitored less frequently than exclosed nests. This was particularly true in 2006 as more time was spent on surveys as a part of the international census than on monitoring unexclosed nests. Infrequent monitoring makes it more difficult to determine whether an unexclosed nest was successful and the young were subsequently depredated before being seen, or if the nest failed before hatching. The fate of these types of nests is usually recorded as “unknown fate”. In many cases the only way to determine a fate for infrequently monitored nests is by locating young. Ultimately, this means that almost all nests with known fate are recorded as “successful”, but many nests that likely failed are recorded as “unknown fate”. This creates an artificially high nest success rate for infrequently monitored nests, and in almost all cases the nests that are infrequently monitored are unexclosed.

5.3 Band application and tracking

Banding of young of the year was of a lower priority this year and therefore efforts in this regard were reduced. We continue to band birds to assist with identification of broods for estimating number of fledged young. However, we see a large number of birds banded in previous years where one or more of the coloured plastic bands have fallen off. This often makes it impossible to determine the lake and year in which the bird was banded without recapturing the adult to read the metal band. Thus, marking to determining survival rates and movement patterns is not particularly useful.

5.4 Fledging success

A number of studies have been conducted to try to gauge fledging success of piping plovers, and several different ages are used to consider a young plover fledged. Haig (1992) used 25 days, Larson et al. (2002) used 16 days and Murphy et al. (1999) recommended using 18-20 days. For the purposes of this study, any young seen that were 18 days or older were considered to have fledged. Calculations of chicks per pair were based on mean fledging rates calculated using the modification to the Mayfield method presented by Flint et al. (1995). This method has been shown to be extremely accurate when compared to observed fledging rates for piping plovers (Schmelzeisen et al. 2005).

In 2006, the fledging rate for piping plovers was 32.2%. Historically, fledging rates in Alberta have been approximately 38% (Prescott and Engley, in prep.). A small increase ($\geq$4%) in the fledging rate would have allowed us to achieve our overall goal of 1.25 chicks/pair/year. Low fledging success may be linked to the high water levels seen this year on many of the lakes. High water levels restricted dispersal habitat for young and subsequently may have reduced their ability to escape terrestrial predators such as coyotes. In drier years, young plovers can often be seen dispersed across wide-ranging mud flats with substrate too soft to support many terrestrial predators.

6.0 RECOMMENDATIONS

Participants at the 2003 Northern Great Plains Piping Plover Science Workshop ranked the use of nest enclosures as the most important and the most feasible management technique available to aid in recruitment (Westworth et al. 2004). The application of predator exclosures should continue on as large a scale as funding will allow. However, nest predation is not the only management issue that needs to be addressed with regards to piping plover recovery efforts. We make the following

recommendations (in no order of importance) to those involved with piping plover recovery efforts in Alberta:

- Continue the use of the current exclosure design. However, closely monitor this design and be prepared to make alterations if required.
- Test alternative methods of securing the exclosure to the substrate on Freshwater Lake and on other lakes with soft substrates.
- Leave a number of exclosures on beaches during the winter months as a way to "acclimate" predators to their presence when there is no prey inside. This may deter predators from keying into the exclosures during the breeding season.
- Continue recording brood age and numbers on all Alberta lakes for plover chicks at various ages. This will help to reduce project costs, as fledging success can be accurately calculated from the modified Mayfield method following Flint et al. (1995).
- Ensure all actions carried out through this program are supported by the Alberta Piping Plover Recovery Team. The Alberta Conservation Association is a member of the recovery team and will seek approval for all program actions prior to implementation in 2007.
- Continue to work with landowners and record habitat information. This information should continue to be passed on to the coordinator of the Alberta Piping Plover Habitat Enhancement Program, where efforts can be made to reduce the impacts of livestock and human disturbance.
- Continue to test the utility of Silent Image™ cameras in recording the effectiveness of exclosures for protecting nests. Using a camera on Freshwater Lake, where a high number of exclosed nests were preyed upon, may assist in designing a more effective exclosure for areas with soft substrate.
- Removal of corvid nests during the winter should continue on lakes in areas with high piping plover populations. Experiment with alternative methods of predator deterrence.

7.0 LITERATURE CITED

Alberta Piping Plover Recovery Team. 2006. Alberta Piping Plover Recovery Plan, 2005-2010. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 10. Edmonton, AB. 27 pp.

COSEWIC. 2006. Canadian Species at Risk. Committee on the Status of Endangered Wildlife in Canada. URL: http://www.cosewic.gc.ca/eng/sct0/rpt/rpt_csar_e.cfm [accessed 06 November 2006].

Elias, S. P., J. D. Fraser and P. A. Buckley. 2000. Piping plover brood foraging ecology on New York barrier islands. Journal of Wildlife Management 64: 346-354.

Engley, L., and R. Schmelzeisen. 2002. Alberta Piping Plover Predator Exclosure and Population Monitoring Program. Unpubl. rept., Alberta Conservation Association, Edmonton, AB. 22pp.

Engley, L., D. R. C. Prescott and R. Schmelzeisen. 2004. Alberta Piping Plover Predator Exclosure and Population Monitoring Program. Unpubl. rept., Alberta Conservation Association, Edmonton, AB. 29pp.

Flint, P. L., K. H. Pollock, D. Thomas and J. S. Sedinger. 1995. Estimating prefledging survival: allowing for brood-mixing and dependence among brood mates. Journal of Wildlife Management 59: 448-455.

Goossen, J. P. 1990. Prairie piping plover conservation: second annual report (1989). Unpubl. rept., Canadian Wildlife Service, Edmonton, AB. 20 pp.

Goossen, J.P., D.L. Amirault, S. Richard, R. Bjorge, J. Bazil, S. Brechtel, R. Chiasson, G.N. Corbett, F.R. Curley, M. Elderkin, S.P. Flemming, W. Harris, L. Heyens, D. Hjertaas, M. Huot, R. Jones, W. Koonz, P. Laporte, R.I.G. Morrison, C. Stewart, L. Swanson and E. Wiltse. 2002. National recovery plan for piping plover (*Charadrius melodus*). National Recovery Plan No. 22. Recovery of Nationally Endangered Wildlife. Ottawa, ON. 47 pp.

Haig, S. M. 1992. Piping plover (*Charadrius melodus*). *In* The Birds of North America, No.2 (A. Poole, P. Stettenheim and F. Gill, eds.). Academy of Natural Sciences, Philadelphia, PA. 18 pp.

Heckbert, M. D. 1994. Piping plover (*Charadrius melodus*) ecology and conservation in Alberta (1994): Reflex Lake and Killarney Lake field report. Unpubl. rept. for Alberta Fish and Wildlife Service, Northeast Region, Vermilion, AB. 152 pp.

Heckbert, M. D., and K. D. Cantelon. 1996. Piping plover (*Charadrius melodus*) ecology and conservation in Alberta (1995): east-central Alberta field report. Unpubl. rept. for Alberta Fish and Wildlife Service, Northeast Region, Vermilion, AB. 163 pp.

IUCN. 2006. 2006 IUCN Red List of threatened species. URL: www.iucnredlist.org [downloaded on 06 November 2006].

Johnson, D.H. 1979. Estimating nest success: the Mayfield method and an alternative. Auk 96: 651-661.

Larson, M. A., M. R. Ryan and R.K. Murphy. 2002. Population viability of piping plovers: effects of predator exclusion. Journal of Wildlife Management 66(2): 361-371

Mayfield, H. F. 1961. Nesting success calculated from exposure. Wilson Bulletin 73: 255-261.

Mayfield, H. F. 1975. Suggestions for calculating nest success. Wilson Bulletin 87: 456-466.

Melvin, S. M., L. H. MacIvor and C.R. Griffin. 1992. Predator exclosures: a technique to reduce predation at piping plover nests. Wildlife Society Bulletin 20: 143-148.

Murphy, R. K., R.J. Greenwood, J.S. Ivan and K.A. Smith. 2003. Predator exclusion methods for managing endangered shorebirds: are two barriers better than one? Waterbirds 26: 156-159.

Murphy, R. K., B. G. Root, P. M. Mayer, J. P. Goossen and K. A. Smith. 1999. A draft protocol for assessing piping plover reproductive success on Great Plains alkali lakes. Pages 90-107 in Higgins, K. F., M. R. Brashier and C. D. Kruse (eds.). Proceedings, piping plovers and least terns of the Great Plains and nearby. South Dakota State University, Brookings. Jamestown, ND: Northern Prairie Wildlife Research Center Online. URL: http://www.npwrc.usgs.gov/resource/1999/pplover/pplover.htm [accessed….].

Prescott, D.R.C. 2001. The 2001 International Piping Plover Census in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 27, Edmonton, AB. 15pp.

Prescott, D. R. C. 1997. Status of the piping plover (*Charadrius melodus*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, Wildlife Status Report No. 1, Edmonton, AB. 19 pp.

Prescott, D., and L. Engley. in prep. Productivity of piping plovers in Alberta, 1995-2004. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report.

Richardson, I. M. 1997. Guidelines for the use of predator exclosures to protect piping plover (*Charadrius melodus*) nests. Alberta Environmental Protection, Wildlife Management Division Report, Edmonton, AB. 21 pp.

Richardson, I. M. 1999. Predator exclosures: a management technique to increase piping plover reproductive success in the Canadian prairies. M. Sc. Thesis, University of Alberta, Edmonton, AB. 65 pp.

Rimmer, D. W., and R. D. Deblinger. 1990. Use of predator exclosures to protect piping plover nests. Journal of Field Ornithology 61:217-223

Ryba, A. 2006. Conservation of piping plovers in the U.S. Alkali Lakes Core Area, 2006 field effort: summary report. Publication info? 8 pp.

Schmelzeisen, R., and L. Engley. 2003. Alberta Piping Plover Predator Exclosure and Population Monitoring Program. Unpubl. rept., Alberta Conservation Association, Edmonton, AB. 26 pp.

Schmelzeisen, R., L. Engley, A. Rezansoff and D. Prescott. 2005. Alberta Piping Plover Predator Exclosure and Population Monitoring Program. Unpubl. rept., Alberta Conservation Association, Edmonton, AB. 35 pp.

United States Fish and Wildlife Service. 2006. Division of Endangered Species. United States Fish and Wildlife Service. URL: http://ecos.fws.gov/tess_public/SpeciesReport.do [accessed 06 November 2006].

United States Fish and Wildlife Service. 1996. Piping plover *(Charadnus melodus),* Atlantic Coast Population, Revised Recovery Plan. Hadley, Massachusetts. 258 pp.

Westworth, S. M., D. Martens, C. L. Gratto-Trevor, J. P. Goossen and S. Davis. 2004. Northern Great Plains Piping Plover Science Workshop: 20-23 November 2003, Regina, Saskatchewan. Unpublished Canadian Wildlife Service Report, Edmonton, Alberta. 58 pp.

Whyte, A. J. 1985. Breeding ecology of the piping plover (*Charadrius melodus*) in central Saskatchewan. M. Sc. thesis, Univ. Saskatchewan, Saskatoon, SK. 153 pp.

APPENDIX 1. Nest data from 2006 field season.

Nest Number	Treatment	Eggs Laid	Eggs Hatched	Fate	Comments
AKLA-06-01	Exclosed[1]	4	4	Successful	Coyote pushed in side of exclosure.
AKLA-06-02	Exclosed[1]	4	4	Successful	
AKLA-06-03	Exclosed[1]	4	4	Successful	Silent Image™ camera captured a coyote approaching the exclosure.
AKLA-06-04	Exclosed[1]	4	0	Infertile eggs	Adults incubated for at least 42 days before abandoning.
AKLA-06-05	Exclosed[1]	4	4	Successful	Silent Image™ camera captured a quad crushing the exclosure.
BALA-06-01	Not Exclosed	3	3	Successful	Two broods (7 YOY between 16-21 days old) were seen on July 10 in close proximity to BALA-06-01 and BALA-06-02 and were therefore assigned to these nests though they may have hatched from any of the other nests.
BALA-06-02	Not Exclosed	4	4	Successful	See comments for BALA-06-01.
BALA-06-03	Not Exclosed	4	?	Unknown	See comments for BALA-06-01.
BALA-06-04	Not Exclosed	4	?	Unknown	See comments for BALA-06-01.
BALA-06-05	Not Exclosed	4	?	Unknown	See comments for BALA-06-01.
BALA-06-06	Not Exclosed	4	?	Unknown	See comments for BALA-06-01.
BALA-06-07	Not Exclosed	4	?	Unknown	See comments for BALA-06-01.
BALA-06-08	Not Exclosed	4	?	Unknown	See comments for BALA-06-01.
BELA-06-01	Not Exclosed	?	?	Unknown	
BELA-06-02	Not Exclosed	?	?	Unknown	
BILA-06-01	Exclosed[1]	4	4	Successful	
BILA-06-02	Not Exclosed	4	0	Abandonment	Reason for abandonment unknown.
BILA-06-03	Not Exclosed	4	4	Successful	
BILA-06-04	Not Exclosed	4	?	Unknown	
BILA-06-05	Not Exclosed	4	3	Successful	
BILA-06-06	Not Exclosed	4	?	Unknown	
BILA-06-07	Not Exclosed	4	4	Successful	
BILA-06-08	Not Exclosed	4	3	Successful	
BILA-06-09	Not Exclosed	4	?	Unknown	
BILA-06-10	Not Exclosed	3	?	Unknown	
CHL4-06-01	Exclosed	4	4	Successful	
CHL4-06-02	Exclosed	4	4	Successful	
CHL4-06-03	Exclosed	4	4	Successful	
CHL4-06-04	Exclosed	4	?	Unknown	
CHL4-06-05	Exclosed[2]	4	4	Successful	
CHL4-06-06	Exclosed	4	4	Successful	
CILA-06-01	Exclosed	4	4	Successful	
DOLA-06-01	Exclosed	4	2	Successful	
DOLA-06-02	Exclosed	4	4	Successful	
DOLA-06-03	Exclosed	2	2	Successful	
DOLA-06-04	Exclosed	2	2	Successful	
FOLA-06-01	Not Exclosed	?	?	Unknown	

Nest Number	Treatment	Eggs Laid	Eggs Hatched	Fate	Comments
FRLA-06-01	Exclosed	4	0	Predated	Coyote depredation.
FRLA-06-02	Exclosed	4	4	Successful	
FRLA-06-03	Exclosed	4	0	Predated	Coyote depredation.
FRLA-06-04	Exclosed	3	3	Successful	
FRLA-06-05	Exclosed	4	4	Successful	
FRLA-06-06	Exclosed	4	2	Successful	
FRLA-06-07	Exclosed	5	4	Successful	
FRLA-06-08	Exclosed	3+	0	Predated	Coyote depredation.
FRLA-06-09	Exclosed	2+	0	Predated	Coyote depredation.
FRLA-06-10	Exclosed	4	0	Predated	Coyote depredation.
FRLA-06-11	Exclosed	4	4	Successful	
FROG-06-01	Not Exclosed	?	?	Unknown	
FROG-06-02	Not Exclosed	?	?	Unknown	
HALA-06-01	Exclosed	4	4	Successful	Coyote tracks to nest.
HALA-06-02	Exclosed	4	3	Successful	
HALA-06-03	Exclosed	4	4	Successful	
HALA-06-04	Exclosed	4	4	Successful	Coyote tracks to nest.
HALA-06-05	Exclosed	4	2	Successful	
HALA-06-06	Exclosed	4	4	Successful	Attempted coyote depredation.
HALA-06-07	Exclosed	4	4	Successful	
HALA-06-08	Exclosed	4	4	Successful	Attempted coyote depredation.
HALA-06-09	Exclosed	4	3	Successful	
HALA-06-10	Exclosed	4	4	Successful	Coyote tracks to nest.
HALA-06-11	Exclosed	4	4	Successful	
HOLA-06-01	Exclosed	4	4	Successful	
HOLA-06-02	Exclosed	4	4	Successful	Cattle crushed the exclosure.
HOLA-06-03	Exclosed	4	3	Successful	
HOLA-06-04	Exclosed	1	0	Abandonment	Cattle marks around the exclosure.
JUNC-06-01	Exclosed	3	3	Successful	
JUNC-06-02	Exclosed	4	4	Successful	
JUNC-06-03	Exclosed	4	4	Successful	
JUNC-06-04	Exclosed	4	4	Successful	
JUNC-06-05	Exclosed	4	3	Successful	
JUNC-06-06	Exclosed	4	4	Successful	
KILA-06-01	Exclosed	4	4	Successful	
KILA-06-02	Exclosed	4	4	Successful	
KILA-06-03	Exclosed	4	4	Successful	
KILA-06-04	Exclosed	4	4	Successful	
KILA-06-05	Exclosed	4	3	Successful	
KILA-06-06	Not Exclosed	4	2+	Successful	
KILA-06-07	Exclosed	4	0	Predated	Coyote depredation.
KILA-06-08	Exclosed	4	0	Predated	Coyote depredation.
KILA-06-09	Exclosed	4	0	Abandonment	Cattle marks around the exclosure.
KILA-06-10	Exclosed	3	3	Successful	
KILA-06-11	Exclosed	4	3	Successful	
LFLA-06-01	Exclosed	4	4	Successful	
LFLA-06-02	Not Exclosed	4	?	Unknown	There was no activity near the nest when last visited.
MCLA-06-01	Exclosed	4	4	Successful	

Nest Number	Treatment	Eggs Laid	Eggs Hatched	Fate	Comments
MCLA-06-02	Exclosed	4	4	Successful	
MCLA-06-03	Exclosed	4	2	Successful	
MULA-06-01	Exclosed	4	4	Successful	
MULA-06-02	Exclosed	2	2	Successful	California gull colony.
MULA-06-03	Exclosed	4	4	Successful	California gull colony.
MULA-06-04	Exclosed	4	0	Abandonment	ATV tracks near the exclosure.
MULA-06-05	Exclosed	4	3	Successful	
MULA-06-06	Exclosed	4	0	Predated	Gull marks around the exclosure.
MULA-06-07	Exclosed	4	4	Successful	
MULA-06-08	Exclosed	4	0	Predated	Dog tracks around the exclosure.
MULA-06-09	Exclosed	4	4	Successful	
MULA-06-10	Exclosed	4	4	Successful	
MULA-06-11	Exclosed	4	3	Successful	
MULA-06-12	Exclosed	4	4	Successful	
MULA-06-13	Exclosed	4	3	Successful	
MULA-06-14	Exclosed	4	4	Successful	
MULA-06-15	Exclosed	4	4	Successful	
MULA-06-16	Exclosed	?	?	Successful	
MULA-06-17	Exclosed	4	4	Successful	
MULA-06-18	Exclosed	4	2	Successful	
MULA-06-19	Exclosed	4	3	Successful	
MULA-06-20	Not Exclosed	4	?	Unknown	
MULA-06-21	Exclosed	4	4	Successful	
MULA-06-22	Not Exclosed	?	?	Unknown	
NWKI-06-01	Not Exclosed	4	4	Successful	
NWKI-06-02	Exclosed	3	1	Successful	
PILA-06-01	Exclosed	4	4	Successful	
PILA-06-02	Exclosed	4	4	Successful	
PILA-06-03	Exclosed	4	4	Successful	
RDLA-06-01	Exclosed[1]	4	3	Successful	
RDLA-06-02	Exclosed[1]	4	4	Successful	
RDLA-06-03	Exclosed[1]	4	4	Successful	
RELA-06-01	Exclosed	3	3	Successful	Attempted coyote depredation.
RELA-06-02	Exclosed	4	4	Successful	
RELA-06-03	Exclosed	4	4	Successful	
RELA-06-04	Exclosed	4	4	Successful	
RELA-06-05	Exclosed	4	4	Successful	
RELA-06-06	Exclosed	4	3	Successful	
RELA-06-07	Exclosed	3	1	Successful	
RELA-06-08	Exclosed	3	3	Successful	
RELA-06-09	Exclosed	2	2	Successful	
SULA-06-01	Exclosed	4	?	Unknown	Nest was active on June 7 but wasn't revisited until July 8. No eggs were in the nest and no YOY were seen when revisited.

[1] Exclosure used had a 2 cm x 2 cm plastic mesh cover instead of a stucco wire cover.

[2] Exclosure used had a 4 cm x 4 cm plastic mesh cover instead of a stucco wire cover.

APPENDIX 2. Adult plover band recoveries in 2006**.**

Band combinations read as follows: upper left, lower left: upper right, lower right. Dashes (--) mean no bands were located on that part of the leg. Question marks (?) mean that it is not known whether a band was on that part of the leg or not. Consecutive letters mean bands were stacked, where the first letter refers to the band used highest on the leg. Letters divided by a slash ("/") indicate a striped band of two colours (e.g., B/W = a black-and-white striped band). Uncoloured metal bands are indicated by a lower case "m". Bands with flags are abbreviated with a lower case "f" after the colour (e.g., Wf=white band with a flag). The following abbreviations are used for plastic band colours: W=white, Y=yellow, O=orange, R=red, G=green, dG=dark green, pG=pale green, dB=dark blue, pB=pale blue, B=black, S=silver(grey).

Example: (m,SY:Wf,pG) reads metal band on the upper left leg, a silver band over a yellow band on the lower left leg, a flagged white band on the upper right leg, and a pale green band on the lower right leg.

Lake	Band combination[1]	Apparent sex	Dates observed	Original banding location
Akasu*	(--,m:B/W,Y)	M	May 26–June 29	Reflex, AB 2002
Akasu*	(--,--:B/W,m)	M	June 2–July 7	AB
Birch*	(m,--:B/W,--)	M	June 13	AB
Birch*	(m,--:--,--)	F	June 13	?
Birch*	(m,--:--,Y)	M	June 13	AB
Clark	(m,RB:Wf,O)	M	June 1–June 18	Baxter, AB 2000. Rebanded on Diefenbaker, SK 2002
Clark	(m,pG:--,B/W)	F	June 1–June 18	Chain #4, AB 2005
Dowling	(--,--:B/W,pGm)	F	June 2–June 6	Killarney, AB 2005
Dowling*	(B/W,m:--,--)	M	June 2–June 17	AB
Freshwater	(m,Y:B/W,--)	U	May 14	Reflex, AB 2004
Freshwater	(m,RpG:Wf,--)	F	May 14	Last Mt. Lake, SK 2002
Freshwater	(O,m:--,--)	M	May 14	AB
Freshwater	(--,m:pB,--)	F	May 14	?
Freshwater	(--,--:Wf:pB)	U	May 14–Jun 17	?
Freshwater*	(--,--:B/W,pGm)	U	June 27–July 16	Killarney, AB 2005
Freshwater	(m,B:Bf,dBR)	U	June 27–July 19	Diefenbaker, SK 2005
Freshwater	(--,m:B/W,--)	M	June 27–July 16	AB
Freshwater	(B/W,--:O,m)	U	June 27	Cipher, AB 2003
Freshwater	(--,Y:--,m)	M	June 27–July 5	Baxter, AB 1999 or Diefenbaker, SK
Freshwater*	(W,Y:--,m)	M	June 27	Diefenbaker, SK

Lake	Band combination[1]	Apparent sex	Dates observed	Original banding location
Freshwater	(m,RB:Wf,O)	F	June 27	Baxter, AB 2000. Rebanded on Diefenbaker, SK 2002
Freshwater	(R,m:--,--)	U	July 5	?
Freshwater	(m,--:B/W,--)	U	July 5	AB
Freshwater	(W,Bf:--,--)	U	July 16	?
Freshwater	(--,--:pG,B/Wm)	F	July 19	McLaren, AB 2005
Freshwater	(m,?:--,--)	U	July 19	?
Handhills	(--,m:--,--)	F	June 3	?
Handhills	(m,pG:--,B/W)	M	June 3	Chain #4, AB 2005
Handhills	(--,--:m,--)	F	June 16	?
Handhills	(--,pGB/W::m,--)	M	June 21	Little Fish, AB 2005
Handhills	(--,mB/W:--,--)	M	July 5	AB
Horseshoe	(m,OR:Bf,B)	M	June 26	Diefenbaker, SK 2005
Horseshoe*	(--,--:--,m)	F	June 24	?
Killarney	(--,S:--,--)	M	May 15	?
Killarney	(B/W,--:--,m)	M	May 15	AB
Killarney*	(--,m:B/W,--)	F	May 15–July 10	AB
Killarney*	(--,--:--,m)	M	May 15–July 18	?
Killarney*	(--,m:B/W,--)	M	June 8	AB
Killarney	(m,--:--,YB/W)	F	June 25	Red Deer, AB 2004
Killarney	(--,?:--,B/W?)	F	June 25	?
Killarney*	(B/W,--:m,--)	F	June 25–July 10	AB
Killarney	(--,m:--,Y)	M	July 5	AB
Killarney	(m,Y:B/W,--)	F	June 8	Reflex, AB 2004
Killarney*	(m,--:B/W,W)	M	June 8–June 29	Freshwater, SK 2004
Killarney*	(--,m:B/W,--)	F	June 8–June 29	AB
Killarney	(--,pGB/W:m,--)	U	June 29	Little Fish, AB 2005
Killarney	(B/W,?:--,m)	M	June 29	AB
Killarney	(O,m:B/W,--)	U	June 29	Chain #4, AB 2002
Little Fish*	(m,pG:Wf,SO)	F	June 5–June 27	Dryboro, southern SK
Little Fish	(--,m:--,B/W)	M	June 27	AB
McLaren*	(m,--:B/W,--)	F	May 16–June 18	AB
McLaren	(?,?:Wf,m)	M	May 16	?
McLaren*	(W,Y:--,m)	M	May 26	Diefenbaker, SK
McLaren	(m,?:--,--)	M	June 26	?
McLaren	(B/W,m:--,--)	M	July 6	AB
McLaren	(B/W,--:--,m)	U	July 6	AB
Muriel	(--,--:B/W,m)	F	May 17–June 10	AB
Muriel	(--,--:B/W,m)	F	May 17–June 10	AB
Muriel	(m,--:B/W,Y)	F	May 17–June 10	Muriel, AB 2004
Muriel	(--,m:W/B,--)	U	May 17–June 10	AB or SK
Muriel	(m,--:--B/WY)	U	May 18	Frog, AB 2004
Muriel*	(Bf,RdG:m,--)	M	May 18–31	Diefenbaker, SK 2004

Lake	Band combination[1]	Apparent sex	Dates observed	Original banding location
Muriel	(m,--:--,W/BY)	F	May 18–July 12	Frog, AB 2004
Muriel*	(--,m:W/B,--)	M	June 10–July 12	AB
Muriel	(--,m:W/B,pG)	M	June 10	Muriel, AB 2002
Muriel	(m,--:B/W,--)	M	June 10–July 12	AB
NW Killarney*	(m,--:--,B/WY)	F	June 28–July 9	Frog, AB 2004
NW Killarney*	(--,m:B/W,--)	F	June 28–July 16	AB
Piper*	(--,m:B/W,--)	F	June 4–July 25	AB
Piper*	(--,B/Wm:--,--)	M	June 4–July 25	AB
Reflex	(m,SO:Wf,R)	F	May 15–May 17	Big Quill, SK 2003
Reflex	(--,--:--,m)	F	May 17–June 23	?
Reflex	(m,R/B:Wf,O)	M	May 17	Baxter, AB 2000. Rebanded on Diefenbaker, SK 2002
Reflex	(--,m:B/W,O)	F	June 6	Dowling, AB 2002
Reflex*	(m,--:B/W,--)	M	June 6	AB
Reflex*	(--,--:B/W,pGm)	F	June 23–June 28	Killarney, AB 2005
Reflex	(m,pG:--,B/W)	M	June 23	Chain #4, AB 2005
Reflex*	(W,m:--,OO)	M	June 11–July 15	Manitou, SK 1998. Rebanded on Manitou, SK 2002
Reflex*	(--,m:--,--)	M	June 23–July 15	?
Reflex*	(--,m:--,--)	M	June 6–July 15	?
Red Deer*	(m,--:B/W,--)	M	June 19–July 5	AB

* These birds nested in Alberta in 2006.