ALBERTA PIPING PLOVER PREDATOR EXCLOSURE AND POPULATION MONITORING PROGRAM

2007 Field Season Report

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In cooperation with:

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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. 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, adult and juvenile survival, and complements the banding program being undertaken in Saskatchewan.

Predator exclosures used during the 2007 field season followed the same specifications as the Type I exclosure model from 2006 with the 5 cm x 5 cm stucco wire cover.

We carried out population inventories on 28 water bodies in 2007. In Alberta, 273 adults were located on 21 different water bodies and an additional 35 adults were seen on adjacent lakes surveyed in Saskatchewan. In total, 109 nests were found, of which 104 had exclosures applied to them. Overall, Mayfield nest success was calculated to be 88.0%, fledging success was calculated to be 52.8%, and we calculated that 2.02 chicks per pair were fledged in 2007. We banded 38 young plovers and spotted 58 piping plovers banded in previous years.

All activities carried out during the course of this project were done in support of the *Alberta Piping Plover Recovery Plan, 2005-2010* (Alberta Piping Plover Recovery Team 2006). In particular, these activities were conducted to address Section 8.2 Productivity Enhancement, Section 8.3 Information and Outreach and Section 8.4 Population Monitoring and Research of the Recovery Plan.

ACKNOWLEDGEMENTS

Thank you to the agencies whose generous funding made this project possible: Alberta Conservation Association; Alberta Tourism, Parks, Recreation and Culture; Alberta Employment, Immigration and Industry; Alberta Sustainable Resource Development (ASRD); Environment Canada; Mountain Equipment Co-op, and the World Wildlife Fund.

Thank you to members of the Alberta Piping Plover Recovery Team for their guidance, suggestions and assistance with field work: Paul Goossen (Canadian Wildlife Service), Gerry Haekel (ASRD), Ed Hofman (ASRD), Craig Horner (Alberta Beef Producers), Dug Major (Special Areas Board), Dave Moore (ASRD), Juanna Thompson (Nature Conservancy of Canada) and Michael Barr (Ducks Unlimited Canada).

Thank you to those individuals that contributed time in the field, attended planning meetings, provided equipment or accommodations, shared ideas or contributed data: Ken Baker, Gerry Bennett, Michelle Gordon, Cheri Gratto-Trevor, Stephen Hamilton, Glenn Harvey, Velma Hudson, Floyd Kunnas, Bob Machum, Barb Maile, Doug Manzer, Shane Mascarin, Ken Porteous, Amanda Rezansoff, Scott Stevens, Dan Sturgess, Kelly Sturgess and all staff at Dillberry Lake Provincial Park.

Special thanks to our primary field crew members: Adam Lemay-Gaudet, Christine Kent and Kathryn Romanchuk.

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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INTRODUCTION

The piping plover is designated as *Endangered* in Canada (COSEWIC 2007), *Threatened* in the United States (United States Fish and Wildlife Service 2007) and *Near Threatened* by The World Conservation Union (IUCN 2007) 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, Rezansoff 2006) 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.

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2.0 STUDY AREA

The majority of this program was carried out on water bodies in east-central and southeastern Alberta. Two 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) and West Reflex Lake (hereafter referred to as Reflex Lake).

3.0 MATERIALS AND METHODS

Four researchers in two field crews carried out the majority of the work. Fieldwork began 11 May 2007 and was completed by 10 August 2007. One crew was stationed at Dillberry Lake Provincial Park along the Saskatchewan border and monitored lakes near Dillberry and in the Provost area. The second crew was stationed on a part-time basis in St. Paul, from which they monitored Muriel Lake and Frog Lake. The remainder of their time was spent stationed in Hanna, 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

We surveyed lakes with known or potential piping plover habitat for piping plovers, beginning with those lakes that had larger and more recent populations of piping plovers. Most adult survey numbers were recorded between 25 May and 7 June, during the peak of breeding activity, and followed guidelines outlined by Goossen (1990). Due to surveying constraints, we surveyed some lakes outside of the peak breeding window. Birch and Red Deer Lakes were surveyed prior to 25 May, while McLaren, Akasu, Junction and Frog Lakes were surveyed after 7 June. We surveyed lakes 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. We conducted complete lake surveys again in July to assess habitat conditions and look for broods.

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, we monitored nests from 50-100 m away using binoculars or spotting scopes. Nests were only approached to apply exclosures, to check maximum clutch size or if nest abandonment was suspected. The majority of nests were monitored every 5-10 days throughout the incubation period when possible. We considered nests "successful" if at least one egg hatched, as described in Murphy et al. (1999).

Exclosure application and monitoring techniques followed the procedures outlined by Richardson (1997). Once located, we applied exclosures to the majority of nests within one day of discovery, regardless of stage of laying or incubation. One researcher would carry the exclosure to the nest and secure it to the substrate. After application of an exclosure, each nest was monitored to ensure the adults resumed incubation. Following guidelines outlined by the United States Fish and Wildlife Service (1996), we removed

exclosures if adults did not resume incubation within 60 minutes of application (less if the weather turned inclement).

Predator exclosures used during the 2007 field season followed the same basic design used since 2002 and included the modification of a stucco wire top used in 2006 (Engley and Schmelzeisen 2002, Rezansoff et al. 2006). Exclosures 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. 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. Exclosures were anchored with 25 cm nails (with a U-bend at the top) or with steel tent spikes. The number of anchors used on an exclosure varied between four and twelve anchors (depending on the firmness of the substrate) with most exclosures having six anchors.

Most exclosures were topped with 5 cm x 5 cm stucco wire (the same material used to construct the sides). In eight cases, exclosures were topped with 2 cm x 2 cm plastic mesh as they were readily available and the stucco wire tops were not (Figure 1, Appendix 1).

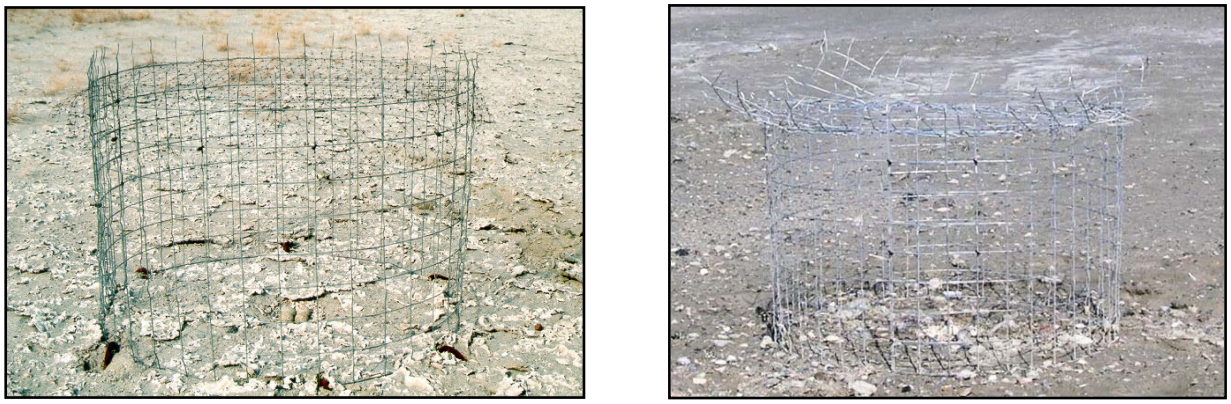

Figure 1. An exclosure with a 2 cm x 2 cm plastic mesh top (left) and an exclosure with a 5 cm x 5 cm stucco wire top (right).

3.3 Band application and tracking

We opportunistically captured young plovers using hand nets and marked them with a combination of one metal and two black-and-white striped plastic bands (one applied black-over-white and the other applied white-over-black). Freshwater Lake young-of-year were banded with one white Darvic™ plastic band instead of a white-over-black

striped band to indicate that they were born in Saskatchewan. Bands were applied in combinations that allow banded birds to be traced back to the lake and year of banding. We weighed and photographed captured young to build a reference dataset linking age with weight and development. Young were banded as close to fledgling age as possible to minimize any potentially adverse affects bands may have to chick survival.

3.4 Productivity analyses

We used Mayfield nest success (Mayfield 1961, 1975; Johnson 1979) with a 35 day laying and incubation period (Murphy et al. 1999). We calculated Mayfield nest success separately for exclosed and unexclosed nests and for all nests combined. In cases where a nest was monitored both with and without an exclosure applied, exposure days were added to the appropriate nest calculations.

We calculated fledging success using a modified Mayfield approach (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. Fledging was assumed to occur at 20 days after hatching, and fledging success was therefore calculated as DSR^{20} (Engley et al. 2004). This method 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 2007 was calculated as:

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

Because productivity goals established in the provincial and national recovery plans (Alberta Piping Plover Recovery Team 2006, Goossen et al. 2002) are expressed as chicks/pair, rather than chicks/nesting attempt, we multiplied OPN by 1.20, 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, in prep.).

4.0 RESULTS

4.1 Population inventories

We conducted population inventories on 28 water bodies in Alberta and one in Saskatchewan (Table 1, Figure 2) as part of the annual monitoring program in Alberta. In total, 273 adults were located on 21 lakes in Alberta during the course of these surveys. An additional 35 adults were located in Saskatchewan (19 on Freshwater Lake and 16 on the Saskatchewan side of Reflex Lake).

Table 1. Alberta piping plover population inventories for 2007.

Lake	Adult Survey	Lake	Adult Survey
Dowling	38	Frog	4
Muriel	36	Red Deer	4
Killarney	30	Sunken	4
Reflex [1]	13 (16)	Clark	3
Handhills	23	Little Fish	2
Birch – Main Basin	23	Cipher	2
Freshwater [1]	(19)	Border	1
Akasu	15	Albert	0
Baxter	14	Chappice	0
Chain #4	14	Foster	0
Horseshoe	14	Leane	0
Junction	11	Mott	0
NW Killarney	9	Rider	0
McLaren	8	Rockeling	0
Piper	5	**Total**	**273 (35)**

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

4.2 Nest summaries

In total, we found 109 nests on 20 water bodies (Figure 2, Table 2). The lake with the highest number of recorded nests was Dowling Lake (n=17) followed by Killarney Lake (n=14), Handhills Lake (n=12) and Birch Lake (n=11). For all nests where a full clutch size was known, mean clutch size was 3.98 $\pm$ 0.0204 (n=49). Nest fate was unknown for a total of eight nests (three unexclosed and five exclosed). Mayfield nest success was

calculated to be 87.8% for exclosed nests (DSR = 0.9963 ± 0.0013, Exp = 2160) and 100.0% (DSR = 1.0000, Exp = 27) 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 2007 was 88.0% (DSR = 0.9963 ± 0.0013, Exp = 2187).

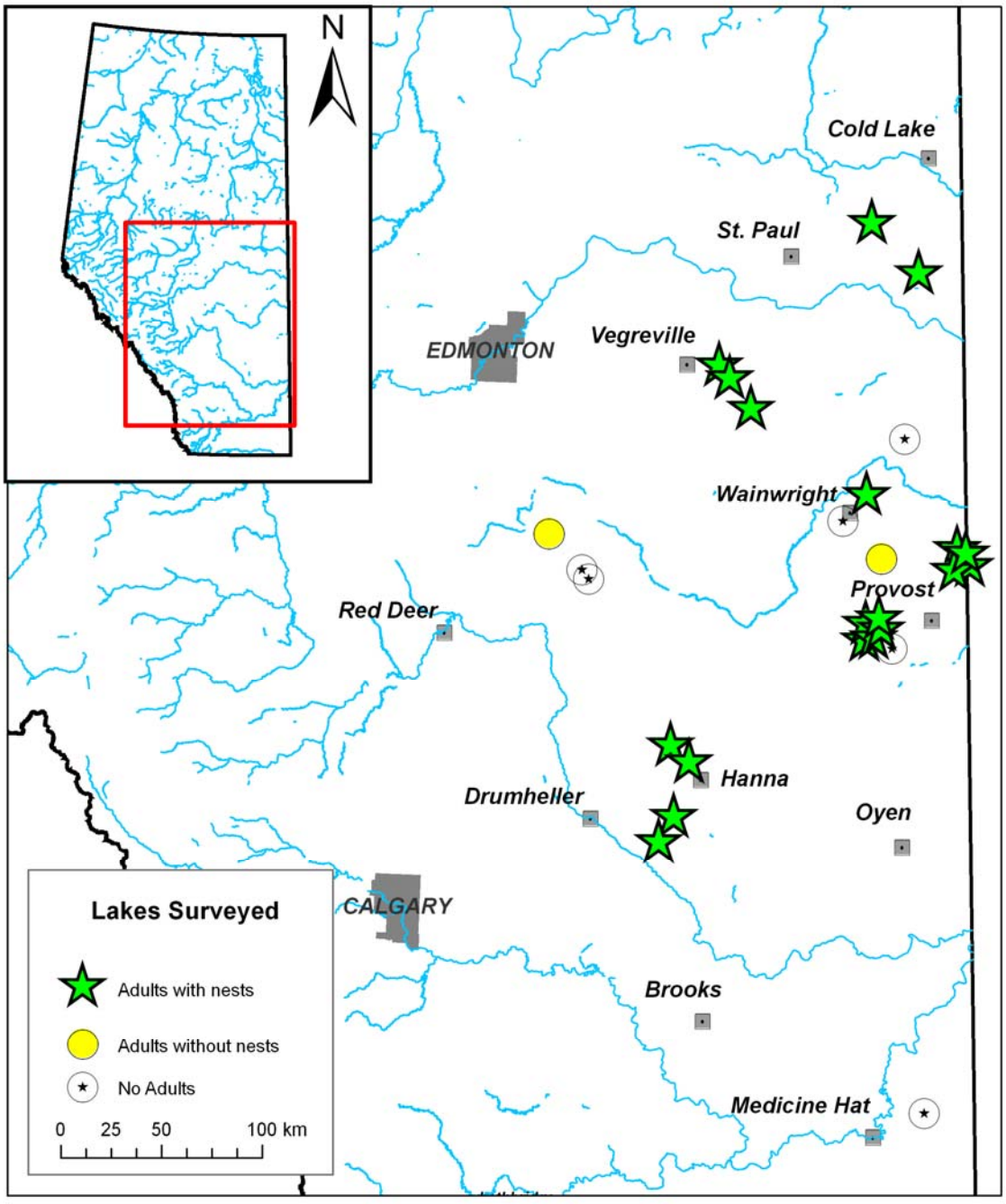

Figure 2. Location of lakes surveyed for piping plovers in 2007.

Table 2. Piping plover nest summaries for Alberta and adjacent Saskatchewan lakes in 2007.

Lake	Total # of Nests	# of Nests Exclosed	# of Nests not Exclosed	Successful Nests	Failed Nests	Nests with Unknown Fate	Exposure Days [1]	
							Exclosed	Unexclosed
Akasu	8	8	0	7	0	1	154	0
Baxter [2]	7	4	3	4	1	2	60	25
Birch [2]	11	9	2	9	1	1	126	0
Chain #4	6	6	0	6	0	0	129	0
Cipher	1	1	0	1	0	0	25	0
Clark	2	2	0	2	0	0	45	0
Dowling	17	17	0	14	2	1	339	1
Freshwater (SK)	3	3	0	2	1	0	53	0
Frog	1	1	0	0	0	1	1	0
Handhills	12	12	0	12	0	0	307	0
Horseshoe	4	4	0	2	2	0	92	0
Junction	5	5	0	4	1	0	93	0
Killarney	14	14	0	13	1	0	293	1
Little Fish	1	1	0	1	0	0	30	0
McLaren	2	2	0	1	0	1	51	0
Muriel	7	7	0	6	0	1	178	0
NW Killarney	1	1	0	1	0	0	8	0
Piper	1	1	0	1	0	0	33	0
Reflex (AB)	1	1	0	1	0	0	29	0
Reflex (SK)	3	3	0	3	0	0	75	0
Sunken	2	2	0	2	0	0	39	0
TOTALS	**109**	**104**	**5**	**92**	**9**	**8**	**2160**	**27**

[1] Exclosed exposure days are the number of days a nest is observed while an exclosure is applied. Unexclosed exposure days are the number of days a nest is observed while an exclosure is not applied.

[2] Data from 11 nests on Baxter and Birch Lakes were not included in Mayfield nest success calculations because the number of exclosed and unexclosed exposure days could not be determined. Therefore, the number of failed nests used to calculate Mayfield nest success was eight.

A total of nine exclosed nests failed (Table 3). Eight exclosed nests were abandoned for unknown reasons, one of which may have been abandoned due to a severe weather event on 29 June. A coyote depredated one exclosed nest on Freshwater Lake by grabbing the exclosure with its teeth and pulling it off the nest. Due to concerns that the substrate on this lake may be too soft for the traditional anchors used, an exclosure on a different nest at Freshwater Lake was reinforced with three, 1 m long pieces of rebar bent into a 'U' shape and driven into the ground.

Table 3. Nest fate.

Nest Fate	Exclosed	Unexclosed
Successful	90	2
Unknown	5	3
Nest Depredation	1	0
Unexplained abandonment	8	0
Totals	**104**	**5**

We observed signs of coyote activity at 24% (n=25/104) of all exclosed nests and it is very likely that more were approached by coyotes. Evidence of coyote attempts to dig up anchors and exclosures was observed at six nests on five lakes.

Cattle activity was observed in the vicinity of 25% (n=26/104) of all exclosed nests. Observations of cattle activity on Killarney and NW Killarney Lakes account for 14% (n=15/104) of total observations made. This included a record of cattle damage to the nesting habitat and to the sides of an exclosure on a nest that did hatch despite this disturbance. Similarly, we found a partly crushed exclosure on a nest at Horseshoe Lake, but it is unknown whether the damage occurred during the incubation period or after the eggs hatched.

We observed evidence of all-terrain vehicle (ATV) disturbance near 18% (n=19/104) of exclosed nests and at 20% (n=1/5) of unexclosed nests. ATV tracks were found within 3 m of an exclosed nest on Reflex Lake. In one case on Birch Lake, an exclosure was found crushed by an ATV, though the eggs did hatch first. In addition, the only two nests on Muriel Lake where ATV activity was recorded were located in breeding bird sanctuaries where access is prohibited during breeding season.

4.3 Band application and tracking

We banded 38 young plovers in 2007 (Table 4). This brings the total number of young banded since recovery efforts began in the summer of 1998 to 712. We identified 58 birds banded in previous years from Alberta, Saskatchewan or on the wintering grounds. We traced 15 birds back to their banding year and lake of origin (Appendix 2).

Table 4. Summary of young banded in 2007.

Lake	Band Combination [1]	No. of Young Banded
Akasu	(--,B/W:m,W/B)	3
Chain #4	(m,W/B:--,B/W)	3
Freshwater	(B/W,--:m,W)	3
Handhills	(--,m:--,W/BB/W)	15
Junction	(m,B/WW/B:--,--)	1
Killarney	(--,--:B/W,W/Bm)	8
Reflex	(m,W/B:B/W,--)	2
Sunken	(--,B/WW/B:m,--)	3
		Total: 38

[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 over white striped plastic band, W/B=white over black striped plastic band, W=white Darvic™ band, O=orange Darvic™ band, m=silver metal band with serial number.

4.4 Fledging success

We calculated Mayfield fledging success to be 52.8% (DSR = 0.9685 $\pm$ 0.0029, Exp = 3624.5). Based on the mean clutch size (3.98 eggs), percent of eggs hatching (91.1%), Mayfield nest success (88.0%) and Mayfield fledging success at 20 days (52.8%), overall production per nesting attempt for 2007 was estimated to be 1.68 chicks/nest. Using 1.2 nests/pair, the overall fledging rate was 2.02 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

Despite the fact that fewer lakes were surveyed, the number of piping plovers that we recorded in 2007 in Alberta is only one less than recorded in 2006. Those numbers being 273 piping plovers on 21 of 28 lakes surveyed and 274 plovers on 26 of 71 lakes

respectfully (Rezansoff et al. 2006). This appears to show that piping plover numbers in Alberta are at the very least stable and most likely are continuing to increase. Far fewer lakes were surveyed in Saskatchewan in 2007 than in 2006, but it did not appear that a substantial increase or decrease in population occurred (P. Goossen, pers. comm.). The population of piping plovers increased in Manitoba from eight plovers in 2006 to 14 plovers recorded in 2007 (K. Porteous, pers. comm.). It is also worthwhile to note that population numbers in the U.S. alkali lakes core area increased from 674 adults in 2006 to 822 adults in 2007 (Mueller 2007).

5.2 Nest success

We made far more effort this year to secure exclosures with stucco wire tops than previously and, as a result, only eight of 104 exclosed nests had plastic mesh tops and nest success for exclosed nests increased by 8.9% over 2006. The use of stucco wire tops has proven to be effective in that the wire increases overall stability of the exclosures and they are less conspicuous than the plastic mesh tops. The mesh tops were also more susceptible to damage by coyotes.

We recorded one nest depredation on an exclosed nest at Freshwater Lake in 2007. The remaining eight exclosed nests that failed were all abandoned for unknown reasons.

Mayfield nest success for unexclosed nests in 2007 (100.0%) was unusually high. This value is not particularly meaningful given the small sample size of unexclosed nests with known fate (n=2). From 1998 - 2007, Mayfield nest success for unexclosed nests was just 33.5% (n=203). Additionally, we typically monitor unexclosed nests less frequently than exclosed nests as these nests are often located on locations that can not be frequently visited. In many cases, the only way to determine the fate for infrequently monitored unexclosed nests is by finding young from the nest. Ultimately, this means that almost all such nests with found broods are recorded as "successful", but many nests that likely failed are recorded as "unknown fate". This creates an artificially high nest success rate for unexclosed nests.

5.3 Band application and tracking

We continue to band birds to assist with identification of broods for estimating number of fledged young. Observation of banded young through this program assists researchers in other jurisdictions, particularly Saskatchewan, with their comprehensive banding programs designed to estimate adult and fledging survival rates.

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 20 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 very accurate when compared to observed fledging rates for piping plovers (Engley et al. 2004).

In 2007, the fledging rate for piping plovers was 52.8% (2.02 chicks/pair/year) compared to 32.2% (1.10 chicks/pair/year) in 2006. Historically, fledging rates in Alberta have been approximately 38% (Prescott and Engley, in prep.). The increase in fledging success in 2007 allowed us to surpass the recovery team goal of 1.25 chick/pair/year.

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. Deploy a Silent Image™ camera on Freshwater Lake, where a high number of exclosed nests have historically been preyed upon. This may assist in designing a more effective exclosure for areas with soft substrate.
- 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 2008.
- 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.

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APPENDIX 1. Original Nest data from 2007 field season.

Nest Number	Treatment [1]	Eggs Laid	Eggs Hatched	Fate	Comments
AKLA-07-01	2 cm² Plastic	4	4	Successful	
AKLA-07-02	2 cm² Plastic	4	3	Successful	
AKLA-07-03	Stucco	4	4	Successful	
AKLA-07-04	2 cm² Plastic	4	4	Successful	
AKLA-07-05	2 cm² Plastic	4	4	Successful	
AKLA-07-06	Stucco	4	3	Successful	
AKLA-07-07	2 cm² Plastic	3	Unknown	Unknown	
AKLA-07-08	2 cm² Plastic	4	4	Successful	Attempted depredation: wall of exclosure pushed in by coyote, but exclosure intact
BALA-07-01	Stucco	4	4	Successful	
BALA-07-02	Stucco	4	0	Abandonment	Unknown cause.
BALA-07-03	Stucco	4	4	Successful	
BALA-07-04	Not Exclosed	4	3	Successful	
BALA-07-05	Stucco	4	3	Successful	
BALA-07-06	Not Exclosed	4	Unknown	Unknown	
BALA-07-07	Not Exclosed	4	Unknown	Unknown	
BILA-07-01	Stucco	4	4	Successful	
BILA-07-02	Stucco	1+	Unknown	Successful	
BILA-07-03	Stucco	4	4	Successful	
BILA-07-04	Stucco	4	1	Abandonment	Unknown cause.
BILA-07-05	Stucco	4	2	Successful	
BILA-07-06	Stucco	1	1	Successful	
BILA-07-07	Stucco	3+	3+	Successful	Hatched, and exclosure later crushed by quad. Tracks from three vehicles along shoreline.
BILA-07-08	Stucco	2+	2+	Successful	
BILA-07-09	Stucco	4	1	Successful	
BILA-07-10	Not Exclosed	4	Unknown	Unknown	
BILA-07-11	Not Exclosed	1+	1+	Successful	
CHL4-07-01	Stucco	4	4	Successful	
CHL4-07-02	Stucco	4	4	Successful	
CHL4-07-03	Stucco	4	4	Successful	
CHL4-07-04	Stucco	4	4	Successful	
CHL4-07-05	Stucco	4	3	Successful	
CHL4-07-06	Stucco	4	3	Successful	
CILA-07-01	Stucco	4	4	Successful	
CLAR-07-01	Stucco	4	4	Successful	
CLAR-07-02	Stucco	4	4	Successful	
DOLA-07-01	Stucco	4	1	Successful	

Nest Number	Treatment [1]	Eggs Laid	Eggs Hatched	Fate	Comments
DOLA-07-02	Stucco	4	4	Successful	Attempted depredation: coyote tried digging under exclosure.
DOLA-07-03	Stucco	4	4	Successful	
DOLA-07-04	Stucco	4	4	Successful	
DOLA-07-05	Stucco	4	4	Successful	
DOLA-07-06	Stucco	4	4	Successful	
DOLA-07-07	Stucco	4	3	Successful	
DOLA-07-08	Stucco	4	4	Successful	
DOLA-07-09	Stucco	4	4	Successful	
DOLA-07-10	Stucco	4	2	Successful	
DOLA-07-11	Stucco	4	4	Successful	
DOLA-07-12	Stucco	4	4	Successful	
DOLA-07-13	Stucco	4	4	Successful	
DOLA-07-14	Stucco	4	0	Abandonment	Unknown cause.
DOLA-07-15	Stucco	4	Unknown	Unknown	3 eggs not hatched, but fate of 4th egg unknown.
DOLA-07-16	Stucco	4	4	Successful	
DOLA-07-17	Stucco	4	0	Abandonment	Unknown cause.
FRLA-07-01	Stucco	4	4	Successful	
FRLA-07-02	Stucco	4	0	Predated	Coyote depredation on nest.
FRLA-07-03	Stucco	4	4	Successful	Used 4′ long bent rebar to anchor exclosure.
FROG-07-01	Stucco	4	Unknown	Unknown	Nest was exclosed June 22 and not revisited until July 25. No adults or YOY were observed.
HALA-07-01	Stucco	4	4	Successful	
HALA-07-02	Stucco	4	4	Successful	
HALA-07-03	Stucco	4	3	Successful	
HALA-07-04	Stucco	4	4	Successful	
HALA-07-05	Stucco	4	3	Successful	
HALA-07-06	Stucco	4	2	Successful	
HALA-07-07	Stucco	4	4	Successful	
HALA-07-08	Stucco	4	3	Successful	
HALA-07-09	Stucco	4	4	Successful	
HALA-07-10	Stucco	4	4	Successful	
HALA-07-11	Stucco	4	4	Successful	
HALA-07-12	Stucco	4	4	Successful	
HOLA-07-01	Stucco	4	4	Successful	June 29 – exclosure damaged by cattle.
HOLA-07-02	Stucco	4	2	Successful	
HOLA-07-03	Stucco	1	0	Abandonment	Unknown cause.
HOLA-07-04	Stucco	4	0	Abandonment	Unknown cause. Possibly severe weather event.
JUNC-07-01	Stucco	4	4	Successful	
JUNC-07-02	2 cm^2 Plastic	4	4	Successful	
JUNC-07-03	2 cm^2 Plastic	4	3	Successful	
JUNC-07-04	Stucco	4	0	Abandonment	Unknown cause.

Nest Number	Treatment [1]	Eggs Laid	Eggs Hatched	Fate	Comments
JUNC-07-05	Stucco	3	2	Successful	
KILA-07-01	Stucco	4	4	Successful	
KILA-07-02	Stucco	4	4	Successful	
KILA-07-03	Stucco	4	4	Successful	
KILA-07-04	Stucco	4	4	Successful	
KILA-07-05	Stucco	4	3	Successful	Attempted depredation: digging marks at 2 stakes from coyote.
KILA-07-06	Stucco	4	4	Successful	Exclosure bent in on one side from cattle or coyote
KILA-07-07	Stucco	3	2	Successful	
KILA-07-08	Stucco	4	3	Successful	
KILA-07-09	Stucco	4	4	Successful	
KILA-07-10	Stucco	4	4	Successful	
KILA-07-11	Stucco	4	4	Successful	
KILA-07-12	Stucco	4	3	Successful	
KILA-07-13	Stucco	4	0	Abandonment	Unknown cause. Possibly heavy presence of cattle.
KILA-07-14	Stucco	3	3	Successful	
LFLA-07-01	Stucco	4	4	Successful	
MCLA-07-01	Stucco	4	4	Successful	
MCLA-07-02	Stucco	4	Unknown	Unknown	Nest not visited after July 23 when adult was still incubating and exclosure was removed. Unknown whether eggs hatched.
MULA-07-01	Stucco	4	4	Successful	
MULA-07-02	Stucco	4	3	Successful	
MULA-07-03	Stucco	3	Unknown	Unknown	Exclosure removed during incubation and no eggs or birds found during following two visits.
MULA-07-04	Stucco	4	3	Successful	
MULA-07-05	Stucco	4	2	Successful	
MULA-07-06	Stucco	3	1	Successful	Animal tried digging under exclosure.
MULA-07-07	Stucco	4	4	Successful	
NWKI-07-01	Stucco	4	4	Successful	
PILA-07-01	Stucco	4	4	Successful	
RELA-07-01	Stucco	4	4	Successful	
RELA-07-02	Stucco	4	4	Successful	May 30 – ATV tracks within 3 m of nest.
RELA-07-03	Stucco	4	4	Successful	Attempted depredation: major digging all around exclosure.
RELA-07-04	Stucco	3	3	Successful	
SULA-07-01	Stucco	4	4	Successful	
SULA-07-02	Stucco	4	3	Successful	

[1] Treatments consisted of enclosing, or not enclosing the nest. Predator exclosures were made of 5 cm x 5 cm stucco wire with either a 2 cm x 2 cm plastic mesh cover, or a cover made of the same 5 cm x 5 cm stucco material.

APPENDIX 2. Adult plover band recoveries in 2007**.**

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 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 colors: B=black W=white, Y=yellow, O=orange, R=red, G=green, dG=dark green, pG=pale green, dB=dark blue, pB=pale blue, 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	(--,GB/W:--,m)	U	July 11	Birch, AB 2005
Birch	(--,Y:m,--)	M	May 11 – 23	AB
Birch*	(m,--:B/W,--)	F	May 17	AB
Birch	(m,--:Wf,--)	F	May 17	SK
Birch	(--,m:B/W,--)	F	July 13	AB
Birch	(--,--:B/W,m)	U	July 13	AB
Chain #4*	(--,--:--,m)	M	June 1 – 24	?
Clark	(W,Y:--,m)	M	May 14	Diefenbaker, SK
Clark*	(m,O:Bf,dBR)	F	June 7 – July 4	Diefenbaker, SK 2006
Clark*	(--,GB/W:--,m)	M	July 15 – 23	Birch, AB 2005
Dowling	(m,--:B/W,--)	U	May 11	AB
Dowling*	(m,dBR:Wf,R)	F	June 7 – Jul 10	Big Quill, SK 2002
Dowling*	(--,--:--,m)	M	June 7	?
Dowling	(--,--:B/W,Wm)	F	June 7	Freshwater, SK 1998
Dowling*	(m,Y:B/W,--)	M	June 7	Reflex, AB 2004
Freshwater	(-,W/Bm:-,Y) or (-,W/Bm:-,G)	U	May 26	Horseshoe, AB 2004 or 2005
Freshwater	(--,--:--,dG)	F	May 26	AB
Handhills	(B/W,m:--,--)	M	May 12 – 27	AB
Handhills	(m,--:--,--)	M	May 27 – July 18	?
Horseshoe*	(--,--:--,m)	F	June 16 – July 23	?
Horseshoe	(m,--:B/W,--)	F	July 15	AB
Junction*	(m,--:--,Y)	M	May 25	AB 2004
Junction	(m,--:--,GW/B)	U	June 12	Red Deer, AB 2005
Killarney	(--,m:B/W,--)	F	May 13 – July 2	AB
Killarney	(--,m:--,W/B)	F	May 24	AB

Lake	Band combination[1]	Apparent sex	Dates observed	Original banding location
Killarney	(--,W:--,--)	U	May 24 – 25	Freshwater, SK
Killarney	(--,--:--,m)	U	May 25	?
Killarney	(--,--:B/W,--)	M	May 29	AB
Killarney*	(--,--:B/W,pGm)	F	May 29 – June 29	Killarney, AB 2005
Killarney*	(--,m:--,W/B)	M	May 29	AB
Killarney	(m,O:B,dGR)	F	May 29	Diefenbaker, SK 2006
Killarney	(m,O:Bf,OR)	U	May 29	Reflex, AB 2004. Rebanded at Diefenbaker, SK 2006
Killarney*	(?,?:B,?)	U	May 29	SK
Killarney*	(m,--:B/W,--)	F	May 29 – July 24	AB
Killarney*	(m,--:--,Y)	M	May 29	AB 2004
Killarney	(W,--:--m)	M	May 29	SK
Killarney*	(--,m:--,--)	M	May 29	?
Killarney	(--,-:B,--)	U	June 21	SK
Killarney	(--,m:--,--)	F	June 30	?
Killarney	(m,--:--,B/W)	M	July 2	AB
McLaren	(W,Y:--,m)	M	July 11	Diefenbaker, SK
Muriel	(--,m:W/B,--)	M	May 16	AB
Muriel	(--,pG:--,m)	M	June 5	AB
Muriel	(--,--:B/W,m)	M	June 5	AB
Muriel *	(m,--:--,--)	F	June 21	?
Muriel *	(W,Om:--,--)	F	June 21	AB
Muriel	(--,m:W/B,--)	F	July 7	AB
Muriel	(--,m:--,--)	F	July 7	?
NW Killarney	(--,m:--,Y)	F	May 30	AB
Piper	(--,--:B/W,Om)	F	June 7 – 27	Killarney, AB 2006
Reflex*	(--,G:--,m)	M	May 15 – Jul 2	AB or SK
Reflex	(--,G:--,?)	F	May 23	AB
Reflex	(--,m:Y,--)	F	May 30	Handhills, AB 2003 or West, AB 2004
Reflex*	(m,--:B/W,--)	M	May 30 – July 16	AB
Reflex	(m,--:Bf,--)	M	May 30	Diefenbaker, SK 2005 or 2006
Reflex*	(--,m:--,--)	F	July 16	?
Reflex*	(--,m:--,--)	M	June 19 – July 24	?
Sunken	(pB,--:--,Y)	F	June 20	Reflex, AB 2003

* These birds nested in Alberta in 2007.