USE OF PREDATOR EXCLOSURES TO PROTECT PIPING PLOVER NESTS IN ALBERTA AND SASKATCHEWAN

1999 Field Season Report

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In cooperation with:

North American Waterfowl Management Plan
Alberta Environment, Fisheries and Wildlife Management Division
Alberta Sport, Recreation, Parks and Wildlife Foundation
World Wildlife Fund
Ducks Unlimited Canada

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INTRODUCTION

The Piping Plover is designated as 'endangered' in Canada, 'threatened' in the U.S. (COSEWIC 1999, U. S. Fish and Wildlife Service 1998) and is listed as 'endangered' under the Alberta Wildlife Act. Nest predation has been identified as a significant limiting factor to Piping Plover reproductive success 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). Consequently, a management project implementing the use of predator exclosures on a large-scale basis in Alberta was initiated in 1998 and is ongoing.

STUDY AREA AND METHODS

The predator exclosures used are square-pyramidal in shape, made of four stucco wire panels with bottom width of 1.2 m and top width of 60 cm. The four panels were attached together with hog clips at the nest sites. One re-bar, approximately 1.5 m in height, was attached to each corner and inserted in the substrate for stabilization. The bottom of each exclosure was secured in place by inserting two-10 cm nails, bent at the top, into the ground on each of the four sides. Finally, to protect against aerial predators, the top was woven with bailing twine at 10 to 15 cm intervals. Two larger exclosures were applied at Freshwater Lake. These exclosures were constructed of the same stucco wire and were circular in shape with a diameter of 3 m. The sides were held up with 5-1.5 m re-bars. The open tops were covered with 5 cm x 5 cm mesh netting ("blueberry netting").

Beginning in late April, potential breeding lakes were surveyed for returning Piping Plovers. In order to maximize the efforts of the researchers, only lakes with a relatively large Piping Plover population and easy access were chosen to be included in the management initiative. Eleven waterbodies were divided into two study areas based on geographic location. In the east-central part of the province (Figure 1): the westernmost of the Reflex Lakes (hereafter called Reflex Lake), 'East Reflex Lake', Killarney Lake including the pond at the north end of the lake, Freshwater Lake, Cipher Lake, 'Piper Lake' and Sunken Lake. In the Hanna area: Handhills Lake, Dowling Lake, and 'Chain Lake #4'. Birch Lake near Vermilion was also included.

Pair and brood surveys were carried out on eight lakes: 'Chain Lake #4', Dowling, Handhills, Killarney, Little Fish, Reflex, 'Rider' and Rockeling. Most of these lakes have been surveyed annually since 1989 and some since 1986. Pair surveys were carried out from 25 May to 7 June and brood surveys were carried out from 3 to 11 July. Lakes were surveyed on foot by walking approximately 60 to 70% of the way between the water and the vegetation line and stopping periodically to scan for plovers. Location of adults and juveniles were recorded and mapped.

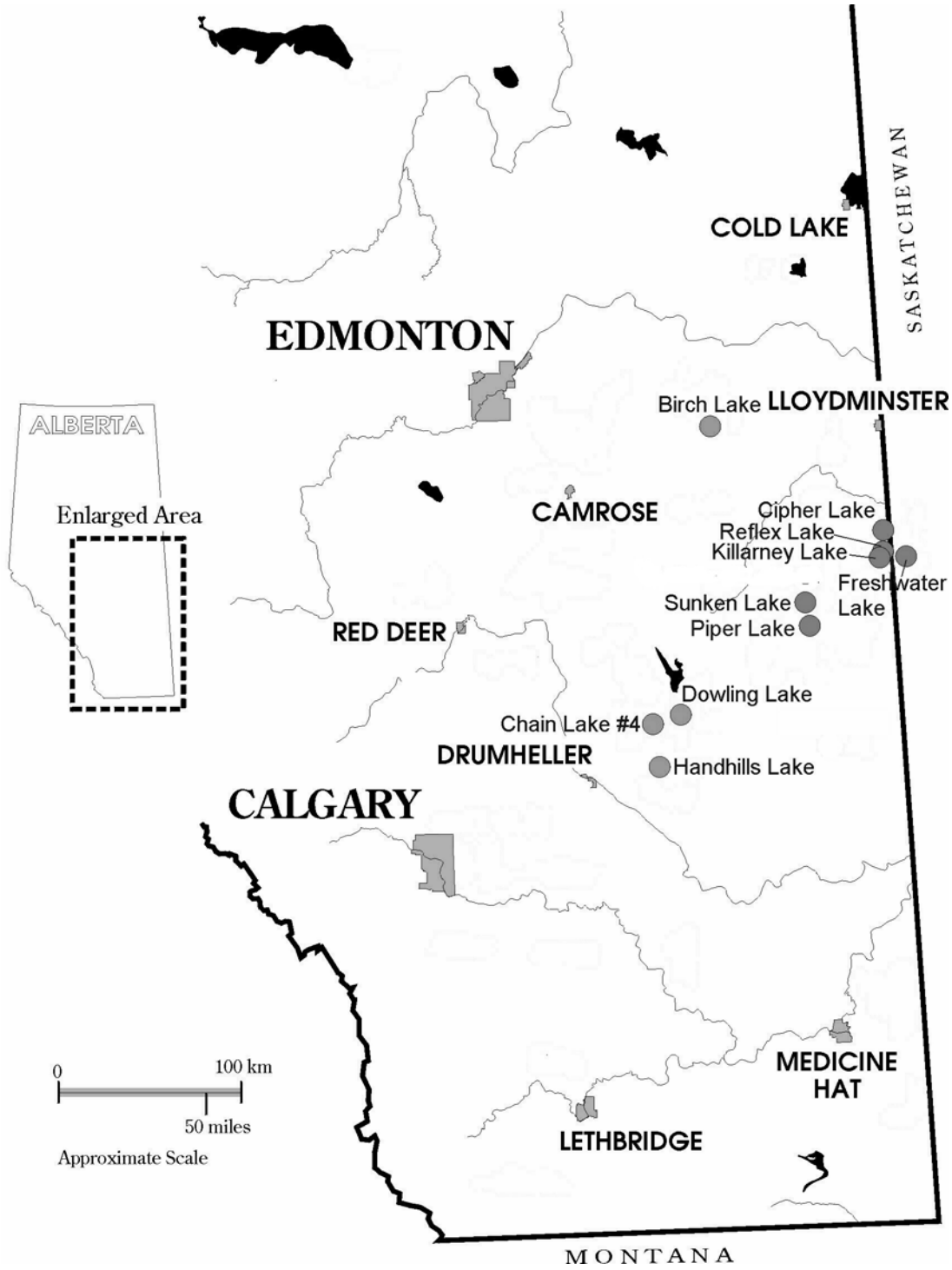

Figure 1. Map of study area, 1999.

Census, exclosure application and monitoring techniques followed the procedures outlined by Richardson (1997). Exclosures were applied to every nest within one day of discovery, regardless of stage of incubation. One or two researchers carried the exclosure to the nest and secured it to the substrate with the four re-bars and the bent nails. After application, each nest was monitored from 70 to 100 m away until the adults resumed incubation. Nests were monitored weekly throughout the incubation period. Changes in nest status were noted including predation of eggs, predation of adult(s), damage to exclosures, unexplained abandonments and hatching.

Traditional nest success was calculated by dividing the number of successful nests (those hatching at least one chick) by the total number of nests for each lake.

RESULTS

A total of 108 nests were found on 12 waterbodies (Table 1). Overall nesting success was 20% (22/108). Sixty-six nests were treated with small predator exclosures; 17% (11/66) hatched successfully. Of the nests where small exclosures were removed or not applied at all, 23% (9/40) hatched successfully.

Table 1. Nest summaries for study lakes

Lake Name	Province	No. of Nests	No. Successful Nests	Crude Nest Success
Birch Lake	AB	3	3	1.00
Chain Lake #4	AB	7	0	0.00
Cipher Lake	AB	2	1	0.50
Dowling Lake	AB	14	3	0.21
East Reflex Lake	SK	1	0	0.00
Freshwater Lake	SK	6	2	0.29
Handhills Lake	AB	23	1	0.04
Killarney Lake	AB	9	3	0.33
Piper Lake	AB	6	0	0.00
Reflex Lake	AB/SK	34	9	0.28*
Sunken Lake	AB	2	0	0.00**
	Total:	108	22	0.19

* 9/32 because the fate of two nests was unknown.
** 0/1 because the fate of one nest was unknown.

Adult plovers were depredated at 34% (23/68) of exclosures. Twenty-one of the losses were 'episodic' (occurred as multiple kills over short spans of time). Specifically, four episodes of kills involving 3, 3, 6 and 9 nests at Freshwater Lake, Handhills Lake, Dowling Lake and Reflex Lake, respectively, spanned over 6 to 7 days each. The remaining two kills involved single nests on Killarney Lake and Chain Lake #4. All 23 losses were recorded between June 2 to 14. The remaining exclosures were removed and nine of those nests were subsequently depredated. Two larger exclosures (3 m diameter) were applied to nests at Freshwater Lake; both hatched successfully.

Evidence of adult kills was typically found directly outside or inside of the exclosures. Remains ranged from a few contour feathers to partial carcasses including combinations of wings,

sternum, head and feathers. Five partial carcasses were found inside exclosures where the eggs remained intact. Bird feces were found on five of the exclosures at kill sites suggesting that birds had been perching on the cages. At Reflex Lake on 8 June a Merlin (*Falco columbarius*) was observed striking an exclosure and capturing the incubating adult as it exited the exclosure. At Handhills Lake on 14 June, a Merlin was observed perching in some trees near the beach. An exclosure was set up (not over a nest) on the beach and the Merlin subsequently flew directly to the exclosure and perched on the top.

The breakdown of the fates of the 68 nests originally treated with small predator exclosures is as follows:

- 9 nests hatched successfully with the exclosures left on until the end of incubation.
- 1 nest failed because of human disturbance
- 4 nests were depredated inside of the exclosures
- 5 nests were abandoned because of cattle disturbance
- 13 nests were abandoned for unknown reasons
- 23 nests failed because adults were depredated
- 2 nests hatched successfully after the exclosures had been removed (see below)
- 9 nests were depredated after the exclosures had been removed
- 2 nests hatched successfully after the small exclosures had been removed and large exclosures were applied

Sixty-five chicks were banded in 1999. Bands were placed in combinations identifying year and lake of origin (Table 2). In addition to observations of newly banded chicks, twenty-four re-sightings of birds banded in Alberta and Saskatchewan from 1996 to 1998 were recorded, plus five observations of birds banded on the wintering grounds or elsewhere.

Table 2. Summary of banding in 1999

Lake	Band Combination[1]	No. of birds banded
Baxter[2]	**B/W, Y:-,m**	**3**
Birch	**B/W ,G m:-,-**	**11**
Chain #4	**B/W,-:-,B/W m**	**3**
Cipher	**B/W,-:-,G m**	**3**
Dowling	**B/W,G:-,m**	**2**
Handhills	**B/W,Y m:-,-**	**2**
Killarney	**B/W,-:-,Y m**	**8**
Piper	**B/W,O:-,m**	**5**
Reflex	**B/W ,O m:-,-**	**27**
Sunken	**B/W ,B/W m:-,-**	**1**
		Total: 65

[1] Leg 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. The lowercase letter 'm' refers to a metal band, uppercase letters refer to the colours of plastic bands, and letters separated by a slash (/) are striped bands. Consecutive letters mean bands were stacked where the first letter refers to the colour of the band highest on the leg.
[2] Not included in predator exclosure study.

Adult and brood surveys were carried out on eight waterbodies (Table 3). No significant population changes were recorded as numbers of Piping Plovers on lakes are within the levels measured since the beginning of the survey (Table 4). However, the trend in the Piping Plover population since 1994 on nine key breeding lakes in the province appears to be downward (Figure 2).

Table 3. Summary of 1999 adult and brood surveys

Lake	Adult Survey	Brood Survey		
	# Adults	#Adults	#Young	Observer
Chain Lake #4	12	10	0	L. Engley & K. Gray
Dowling	18	1	2	L. Engley & K. Gray
Handhills	27	25	2	L. Engley & K. Gray
Killarney	8	3	3	M. Piorecky
Little Fish	0	0	0	L. Engley & K. Gray
Reflex)	37	69	15	M. Piorecky
'Rider'	0	0	0	L. Engley & K. Gray
Rockeling Bay	0	0	0	L. Engley & K. Gray

Table 4. Number of adult Piping Plovers observed on selected lakes in Alberta between 1986 and 1998[a]. Where repeat surveys were conducted in the same year, maximum numbers are given (after Prescott 1997, Richardson 1999).

LAKE	YEAR												
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
'Chain #4'	13	14	13	11	12	5	22	17	23	20	13		1
Chappice	17+	11[b]		15	11	2	5	4	1		1		0
Dowling	18		18	15	13	21	34	39	58	35	54		
Handhills	37	44	71	36	27	20	20	37	52	37	69		44
Killarney				8-10		22		29	48	40	25	14	2
Little Fish		10-17	18	41-49	48	19	18	11	3	2	0		0
'Rider'	15			11	17	7	16	7	12	6	0	0	0
Rockeling Bay	18			30	22	6	9	12	17	13	0	0	0
Reflex	46+	35+		20	21	12	11	16	28	37	19	33	27

[a] sources: Bjorge (1996), Goossen (1991, 1994, unpubl. data), Heckbert (1994), Heckbert and Cantelon (1996), Hofman (1990, 1991, 1992, 1993, 1994 and unpubl. data), Lord (1989), Richardson (1998a); Wershler (1988, 1992), Wershler and Wallis (1987).

[b] partial survey

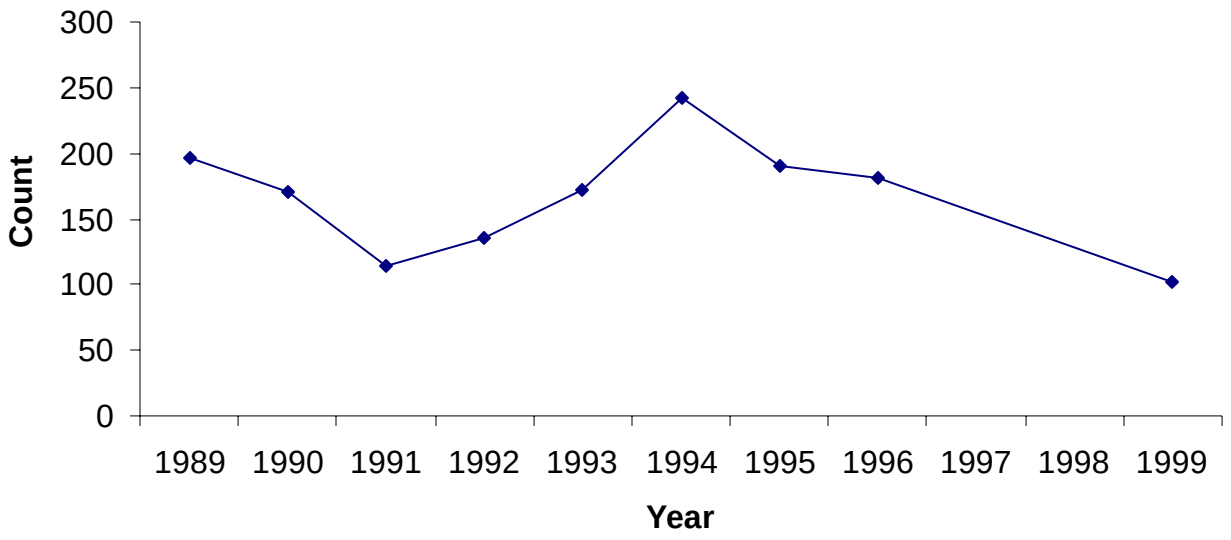

Figure 2. Trend in the population of Piping Plovers on nine key breeding lakes in Alberta (see Table 4), 1989-1999. Years where surveys were largely incomplete were omitted from the analysis.

DISCUSSION

Depredation of adults at predator exclosures increased substantially in 1999. Between 1995–1998, adult kills were recorded at 0-7.5% of exclosures (range 0-3) compared to 33.8% (23/68) of exclosures in 1999. It is unknown what caused this drastic increase, however, we suspect that Merlins were responsible for the majority of the losses.

In the Reflex Lake area, where exclosures have been used since 1995, it is possible that Merlins learned that exclosures mean an 'easy meal'. However, exclosures were used for the first time on Dowling and Chain Lake #4 in 1999 and adults were killed at those lakes. We speculate that the large number of trees surrounding some lakes contributed to the adult kills by supplying nesting sites for raptorial birds. But, again, the prairie landscape surrounding Dowling and 'Chain Lake #4' contains almost no trees.

Hatching success at natural nests between 1994-1997 was reported as 37% (Richardson 1998). The use of predator exclosures in 1998 increased the hatching success to 70% and even with the low (<7.5%) occurrence of adult predation, the projected increase in the breeding population supported the continued use of exclosures (see Richardson 1998). However, the high levels of adult mortality recorded in 1999 negate any benefits attained from using exclosures during that year. Nevertheless, nest predation is still a limiting factor; therefore research on this management technique must continue in order to maximize increases in productivity. Specifically,

1. The effects of large versus small exclosures on adult predation should be examined. Adult predation at exclosures has been observed in other areas of the Great Plains (B. Murphy,

pers. comm.). Preliminary results in some areas show that adult losses are much lower at large (>3 m diameter) exclosures (B. Murphy, pers. comm.). Other alternative exclosure designs should be studied as to their effects on cattle damage and adult predation. For instance, exclosures smaller than the present design, without tall rigid sides, may be less attractive to cattle. However, smaller exclosures would likely still be used by raptors as perching sites (G. Court, pers. comm.). According to G. Court (pers. comm.), an expert on raptor behaviour, the exclosures should be modified so the top is designed to make it impossible for birds of prey to land. It is recommended that large exclosures with sharp spikes along the top be used and closely monitored in 2000.

2. Efforts should continue to minimize damage to exclosures in areas where nesting beaches are accessed by livestock. It is likely that the size and mere presence of exclosures on beaches entices cattle to use the structures as 'scratching posts'. Restricting cattle from nesting areas during the nesting period (i.e., May to July) would eliminate this as well as lessening degradation of soft nesting substrate by deep footprints. Alternatively, the use of the larger design of exclosures may alleviate some of the impacts of cattle on exclosed nests by increasing the buffer between the exclosure edge and the nest.

3. Banding Piping Plover chicks should continue as recoveries and sightings of banded birds are important to increase the knowledge base for the species. The International Piping Plover Census planned in the year 2001 will provide increased opportunity for observations of banded birds across the Piping Plover's winter and summer range.

4. Since predator exclosures are only a partial solution to increasing Piping Plover reproductive success, efforts to address other limiting factors should continue. For example, securing the nesting habitat on the Alberta portion of Reflex Lake means that cattle no longer have access to that area. Exploring ways to improve existing habitat, such as reducing vegetation encroachment or reducing human disturbance, should also be examined.

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APPENDIX 1. Original data from 1999 field season.

Nest No. (1)	Treated=1	Eggs Laid	Eggs Hatched	Exposure Days (2)	Comments
BILA-99-01	1	4	4	20	successful
BILA-99-02	1	4	4	22	successful
BILA-99-03	1	4	4	20	successful
CHL4-99-01	1	3	0	8	nest failure caused by cattle
CHL4-99-02	1	4	0	16	nest failure directly a result of adult depredation
CHL4-99-03	0	2	0	9	nest failure caused by nest depredation
CHL4-99-04	0	4	0	9	nest failure caused by nest depredation
CHL4-99-05	0	4	0	9	nest failure caused by flooding
CHL4-99-06	0	4 (?)	0	15	nest failure caused by flooding
CHL4-99-07	0	4 (?)	0	6	no data
CILA-99-01	0	4	4	10	successful
CILA-99-02	0	4	0	10	nest failure caused by nest depredation
DOLA-99-01	1	4	0	4	nest failure directly a result of adult depredation
DOLA-99-02	1	4	0	11	nest failure directly a result of adult depredation
DOLA-99-03	1	4	0	16	nest failure directly a result of adult depredation
DOLA-99-04	1	4	0	11	nest failure directly a result of adult depredation
DOLA-99-05	1	4	0	11	nest depredated inside exclosure
DOLA-99-06	1	4	0	11	nest failure directly a result of adult depredation
DOLA-99-07	1	4	4	25	successful
DOLA-99-08	1	3	4	11	successful
DOLA-99-09	1	4	0	11	nest failure directly a result of adult depredation
DOLA-99-10	1	4	0	5	egg predation inside exclosure
DOLA-99-11	1	4	0	10	nest failure directly a result of adult depredation
DOLA-99-12	0	4	4	19	successful
DOLA-99-13	0	4	0	19	nest depredated
DOLA-99-14	0	4	0	4	nest depredated
ERLA-99-01	0	2	0	17	nest depredated
FRLA-99-01	1	4	0	11	nest failure directly a result of adult depredation
FRLA-99-02	1	4	0	11	nest failure directly a result of adult depredation
FRLA-99-03	1	4	0	8	nest failure directly a result of adult depredation
FRLA-99-04	1	4	2	29	successful after application of large exclosure
FRLA-99-05	1	4	0	13	nest depredated after removal of exclosure
FRLA-99-06	1	3	2	25	successful after application of large exclosure

FRLA-99-07	0	1	0	7	nest depredation
HALA-99-01	1	4	0	24	nest depredated after removal of exclosure
HALA-99-02	1	4	0	24	nest depredated after removal of exclosure
HALA-99-03	1	4	0	16	nest failure directly a result of adult depredation
HALA-99-04	1	4	0	16	unexplained abandonment
HALA-99-05	1	4	0	28	nest depredated after removal of exclosure
HALA-99-06	1	4	4	19	successful
HALA-99-07	1	4	0	14	nest depredated inside exclosure
HALA-99-08	1	4	0	19	nest depredated after removal of exclosure
HALA-99-09	1	4	0	16	nest failure directly a result of adult depredation
HALA-99-10	1	4	0	16	nest failure as a result of cattle damage
HALA-99-11	1	4	0	11	nest failure directly a result of adult depredation
HALA-99-12	1	4	0	12	nest depredated after removal of exclosure
HALA-99-13	1	4	0	5	nest depredated after removal of exclosure
HALA-99-14	1	4	0	5	nest depredated inside exclosure
HALA-99-15	0	4	0	2	nest depredated
HALA-99-16	0	3	0	6	nest depredated
HALA-99-17	0	4	0	4	nest depredated
HALA-99-18	0	4	0	17	nest depredated
HALA-99-19	0	4	0	28	no data
HALA-99-20	0	4	0	28	no data
HALA-99-21	0	2	0	17	nest depredated
HALA-99-22	0	4	0	20	no data
HALA-99-23	0	4	0	7	nest depredated
KILA-99-01	1	4	0	13	nest failure directly a result of adult depredation
KILA-99-02	1	4	4	27	successful after removal of exclosure
KILA-99-03	1	4	4	23	successful after removal of exclosure
KILA-99-04	1	4	0	20	nest failure directly a result of adult depredation
KILA-99-05	1	4	0	12	abandonment early in incubation – merlin harrassment
KILA-99-06	1	4	0	5	nest failure directly a result of adult depredation
KILA-99-07	0	4	0	30	unexplained abandonment
KILA-99-08	0	4	0	25	nest predation
KILA-99-09	0	4	4	5	successful
NKPO-99-01	1	4	0	9	unexplained abandonment late in incubation
PILA-99-01	0	4	0	13	nest failure caused by nest

					depredation
PILA-99-02	0	4	0	13	nest failure caused by nest depredation
PILA-99-03	0	4	0	13	weather related abandonment-flooded nest- eggs depredated
PILA-99-04	0	4	0	13	weather related abandonment-flooded nest- eggs depredated
PILA-99-05	0	4	0	13	weather related abandonment-flooded nest- eggs depredated
PILA-99-06	0	4	0	13	weather related abandonment-flooded nest- eggs depredated
RELA-99-01	1	4	0	17	nest failure directly a result of adult depredation
RELA-99-02	1	4	0	26	unexplained abandonment late in incubation
RELA-99-03	1	4	0	10	nest failure directly a result of adult depredation
RELA-99-04	1	2	0	6	unexplained abandonment late in incubation
RELA-99-05	1	4	0	16	nest failure caused by cattle
RELA-99-06	1	4	0	16	nest failure directly a result of adult depredation
RELA-99-07	1	4	0	21	abandonment early in incubation, possibly caused by human disturbance
RELA-99-08	1	4	0	16	nest failure directly a result of adult depredation
RELA-99-09	1	4	0	21	nest failure directly a result of adult depredation
RELA-99-10	1	4	4	24	successful
RELA-99-11	1	4	0	21	nest failure directly a result of adult depredation
RELA-99-12	1	4	0	24	nest failure caused by cattle
RELA-99-13	1	4	4	24	successful
RELA-99-14	1	4	0	4	nest failure directly a result of adult depredation
RELA-99-15	1	3	0	4	unexplained abandonment late in incubation
RELA-99-16	1	4	0	9	nest failure directly a result of adult depredation
RELA-99-17	1	4	0	4	nest failure directly a result of adult depredation
RELA-99-18	1	4	0	13	unexplained abandonment late in incubation
RELA-99-19	1	4	0	13	unexplained abandonment late in incubation
RELA-99-20	1	4	0	13	nest depredated after removal of exclosure
RELA-99-21	1	4	0	13	nest depredated after removal of exclosure
RELA-99-22	1	4	0	4	abandonment early in incubation
RELA-99-23	1	4	4	10	successful
RELA-99-24	1	4	0	2	nest failure directly a result of adult depredation
RELA-99-25	0	4	4	9	successful

RELA-99-26	0	4	4	6	successful
RELA-99-27	0	4	4	3	successful
RELA-99-28	0	4	4	3	successful
RELA-99-29	0	4	4	5	successful
RELA-99-30	0	3	3	28	successful
RELA-99-31	0	2	0	10	depredated nest
RELA-99-32	0	4	0	25	no data
RELA-99-33	0	4	?	21	unknown fate
RELA-99-34	0	4	0	9	depredated nest
SULA-99-01	1	4	0	13	nest failure caused by cattle
SULA-99-02	0	4	?	18	Unknown fate

(1) Lake codes: BILA- Birch, CILA- Cipher, CHL4- Chain Lake #4, DOLA- Dowling Lake, ERLA- East Reflex Lake, FRLA- Freshwater, HALA- Handhills, KILA- Killarney Lake, NKPO- North Killarney Pond, PILA- Piper Lake, RELA- Reflex, SULA- Sunken

(2) Refers to the number of days from the day the nest was found until it hatched or was confirmed unsuccessful (see Mayfield 1961, 1975).