

Introduction

Piping plover monitoring at Cape Lookout National Seashore (CALO) began with a baseline study in 1989. The park was found to be a significant nesting area with about 2/3 of the nesting pairs in the state of North Carolina. Unfortunately nesting success was found to be poor compared to other nesting pairs throughout the bird's range.

Since 1992 monitoring has continued, focusing on factors limiting nesting success and methods that could be used to increase the productivity of the birds.

Methods

All known nesting habitat was posted with signs and/or symbolic fence by April 1. Beginning in late April nesting areas were searched at least three times a week for territorial pairs and nests. The locations of nests were recorded and the nests were monitored until they hatched or were lost.

Nests were protected with predator exclosures if the topography of the location was suitable. Exclosures were circular, 10 feet in diameter, made of four feet high 4"x 2" mesh wire fence anchored with steel rebar. Exclosures were topped with 3/4" mesh bird netting. Because of high rates of losses to raccoons, nest exclosures were constructed as soon as possible after the nest was found regardless of the whether the clutch was complete.

Electric fence was used for the first time in two piping plover nesting areas. The fence was primarily used to attempt to protect chicks from raccoons and feral cats. Solar powered chargers, aluminum wire, 1-inch wide electric fence tape and polypropylene posts were used to construct the fence.

After a nest hatched, the brood was monitored until chicks fledged or were lost. Any ocean beach foraging areas were closed to vehicle traffic while the chicks were present.

Results

Nesting Pairs

A total of 18 pairs of piping plovers nested at CALO in 1999, a decline of nearly 50% from the average number of nesting pairs 1989-1998. 12 pairs nested on North Core Banks (NCB) and 6 pairs on South Core Banks (SCB). Birds held territories in 8 distinct nesting areas (Table 1). Portsmouth Flats contained the highest number of nesting pairs. For the first time a pair nested at Cape Point.

Table 1. Number of Nesting Pairs by Nesting Areas

NESTING AREA	NUMBER OF PAIRS
Ocracoke Inlet	1 non-nesting pair
Portsmouth Flats	9
Kathryn-Jane Flats	1 plus 1 non-nesting pair
Old Drum Inlet	0
New Drum Inlet (NCB)	2 plus 1 non-nesting pair
New Drum Inlet (SCB)	3
Plover Inlet (Mile 23.4)	1
Cape Point	1
Power Squadron Spit	1

Table 2. Piping Plover Nesting Pairs at Cape Lookout National Seashore 1989-1999

	1989	1992	1993	1994	1995	1996	1997	1998	1999
Ocracoke Inlet	0	2	0	2	2		1	0	0
Portsmouth Flats	14	8	9	7	8		17	15	9
Kathryn-Jane Flats	7	11	9	12	11		10	8	1
Old Drum Inlet	3	2	1	1	2	2	1	1	0
New Drum Inlet (NCB)	4	5	9	10	6	2	3	2	2
New Drum Inlet (SCB)	3	3	4	5	4	4	2	3	3
Plover Inlet (Mile 23.6)	0	0	0	0	0	0	1	1	1
Cape Point	0	0	0	0	0	0	0	0	1
Power Squadron Spit	3	2	3	2	2	1	1	2	1
CALO Total	34	33	35	39	35		36	32	18

Nests

22 nesting attempts were made in 1999. 13 nests were found on NCB and 9 on SCB. 9 of the nests hatched and single chicks were fledged from two nests. The average clutch size was 3.0 eggs. The fledge rate for CALO was 0.11 chicks fledged per nesting pair, the lowest ever recorded for the park (Table 3).

Table 3. Piping Plover Nesting Success at CALO 1989-1999

YEAR	NESTING PAIRS	NESTS	CHICKS FLEDGED	FLEDGE RATE
1989	34	56	25	0.74
1992	33	39 (NCB only)	7 (NCB only)	0.25
1993	35	56	26	0.74
1994	39	66	9	0.23
1995	35	43	15	0.43
1997	36	41	7	0.19
1998	32	39	11	0.34
1999	18	22	2	0.11

Predator Exclosures

Predator exclosures were used to protect 18 nests. 50% of the nests with exclosures hatched. None of the four nests without exclosures hatched. Raccoon predation was the greatest threat to nesting success. 5 nests had eggs disappear from inside an exclosure. In one case an egg was found in a ghost crab burrow and in two nests a crab burrow was found on the nest scrape when the eggs disappeared. Since 1997, at least 9 nests protected by exclosures have lost eggs during incubation, presumably to ghost crabs.

Table 4. Suggested Cause of Piping Plover Nest Losses in 1999.

NESTING AREA	# NESTS	# LOST	PREDATORS	STORMS	ABANDONED	UNKNOWN
Ocracoke Inlet	0					
Portsmouth Flats	10	5	1	2	1	1
Kathryn-Jane Flats	1	1	1	0	0	0
Old Drum Inlet	0					
New Drum Inlet (NCB)	2	2	1	0	0	1
New Drum Inlet (SCB)	5	4	3	0	0	1
Plover Inlet (Mile 23.4)	1	0				
Cape Point	1	0				
Power Squadron Spit	2	1	1	0	0	0
Total	22	13	7 (54%)	2 (15%)	1 (8%)	3 (23%)

Nest Elevations

Two nests on North Core Banks (nests #6 and #10) were elevated in an attempt to protect them from flooding. Both nests were in an area of Portsmouth Flats that is subject to flooding during heavy rain or northeast winds. Neither of the nests hatched. One was lost to flooding and the eggs disappeared from the second.

Brood Foraging

Broods foraged on the ocean beach in two locations on South Core Banks. At New Drum Inlet a chick used the ocean beach briefly when soundside foraging habitat was flooded. At Cape Point a pair nested in an area without access to soundside beach. Both areas were closed to vehicles while the chicks were present. All other areas used by chicks were closed to all entry.

Discussion

Nesting Pairs

The decline in the number of nesting pairs at CALO in 1999 may have been related to weather. Strong Northeasters hit the park at the end of April and again in early May. Many traditional nesting areas were flooded when pairs would normally have been establishing territories and initiating nests. The area with the greatest decline over historic numbers was Kathryn-Jane Flats. At this location vegetation has rapidly encroached on what was previously open sand flats.

Nest Success

Predator exclosures have been used at CALO since 1993. The exclosures have been effective in increasing hatch success. Between 1997 and 1999 61% of the nests protected with exclosures have hatched, compared with 8% of the nests left unprotected.

Electric fence has been used at the park to attempt to protect least tern nests from raccoons and feral cats. In 1999 a section of piping plover nesting habitat at Kathryn Jane Flats was enclosed with electric fence. The intention was to exclude raccoons and feral cats from an area that was expected to be a foraging area for chicks. Only one pair nested in the area and the nest failed to hatch. Eggs disappeared from inside the exclosure and ghost crab predation was suspected. The rapid encroachment of vegetation made it difficult to keep the fence operating correctly and storms washed out some posts. The fence did not prove effective in keeping raccoons out of the area.

Another electric fence was set up on the south side of New Drum Inlet. A nesting colony of least and common terns was established at this location. One piping plover nest was found inside the protected area. The nest was on the side of a dune and in vegetation, which prevented the use of a predator exclosure. Despite the electric fence, the nest was lost to predation about 5 days before its expected hatch date.

Fledging Success

Despite the use of exclosures the fledging success for piping plovers at CALO was 0.36 chicks fledged per nesting pair in the period from 1993-1995 and 1997-1999. This is

well below the “Recovery Plan” goal of 1.5 fledged chicks per pair. It is also well below the 1.2 chicks fledged per pair estimated to be required to maintain a stable population.

Conclusions

Clearly the management techniques that have been highly successful in the northern areas of the piping plover nesting range have failed at Cape Lookout. Despite the use of more effective symbolic fence, predator exclosures and electric fence, the nesting success of piping plovers at CALO has continued to decline. There are most likely some unknown environmental factors that limit reproductive success of the birds, despite apparently pristine and undisturbed nesting habitat. In 1999, despite no major storms during nest incubation and intensive monitoring, fledging success fell to its lowest level in 10 years of study.