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PIPING PLOVER RESEARCH AND MANAGEMENT  
WITHIN THE CAPE COD NATIONAL SEASHORE, 1985 - 1991

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## INTRODUCTION

We summarize results from 6 years (1985 - 1991) of research and management of piping plovers (Charadrius melodus) nesting within the Cape Cod National Seashore (CCNS) in Massachusetts. The piping plover was listed as endangered and threatened by the U.S. Fish and Wildlife Service in 1986 because of its rarity and declining populations. Piping plovers that nest on sandy beaches and dunes along the Atlantic coast are threatened by cumulative impacts of habitat loss and alteration, human disturbance, and predation. Approximately 16% of the U.S. Atlantic coast population of piping plovers nests on National Park Service (NPS) properties from Massachusetts to North Carolina (Melvin et al. 1991). Research funded by NPS and other cooperators has laid the foundation for a scientifically-based management program that has significantly increased abundance and productivity of piping plovers within the CCNS and has contributed to regional recovery efforts.

## SCOPE OF MANAGEMENT

Our data come from 9 locations within the boundaries of the CCNS: Race Point to High Head (Provincetown and Truro), Long Point (Provincetown), Jeremy Point (Wellfleet), Marconi Beach (Wellfleet), Coast Guard Beach (Eastham), New Island (Orleans), Nauset Spit (Orleans), Nauset Beach-Chatham (Chatham), and South

Beach Island (Chatham). Recreational use by pedestrians is allowed on all these beaches. Off-road vehicles are permitted at Race Point to High Head, Nauset Spit, and Nauset Beach-Chatham, but are prohibited from sections of beaches where unfledged plover chicks are present at Race Point to High Head (1989-1991) and Nauset Spit (1991). Since 1985, symbolic fencing has increasingly been used to protect plover nests, reduce human disturbance to incubating birds, and provide refuge areas for unfledged chicks. Management of piping plovers within the boundaries of the CCNS has involved efforts by the National Park Service, Massachusetts Division of Fisheries and Wildlife, University of Massachusetts-Amherst, Massachusetts Audubon Society, U.S. Fish and Wildlife Service, the towns of Orleans and Chatham, and a private landowner.

#### POPULATION DYNAMICS AND LIMITING FACTORS

We censused breeding piping plovers at all sites in all years except for Nauset Beach-Chatham (not surveyed from 1987 to 1990). We calculated hatching success (% eggs laid that hatched) and fledging success (% chicks hatched that fledged) each year at 3 to 9 sites and for 54 to 98% of all pairs. We calculated mean number of chicks fledged per pair each year at 4 to 9 sites and for 79 to 98% of all pairs. We considered a chick to have fledged if it survived to  $\geq 25$  days of age or flew  $\geq 15$  m, whichever came first.

Number of breeding pairs at all sites declined slightly between 1985 and 1988, remained relatively constant for 2 years, then nearly doubled in 1991 (Table 1). Hatching success was low from 1985 through 1987, ranging between 9 and 23% (Table 1). Hatching success steadily increased from 35% in 1988, when predator exclosures were first used, to 67% in 1991. Predation by red foxes (Vulpes vulpes) and high tide overwashes caused over 60% of nest losses. Other causes of nest loss included predation by American crows (Corvus brachyrhynchos), striped skunks (Mephitis mephitis), and gulls (Larus spp.), blowing sand that buried eggs, and abandonment. We do not believe our nest monitoring or other research activities increased rates of nest predation (MacIvor et al. 1990). Fledging success fluctuated between 38 and 79% annually, and exceeded hatching success every year (Table 1). It was usually impossible to positively confirm causes of chick mortality. Confirmed or probable causes of chick mortality included predation by red foxes, a domestic cat, and an American kestrel (Falco sparverius), and mortality caused by an off-road vehicle.

Largely as a result of poor hatching success, overall productivity during 1985-1987 averaged only 0.44 chicks fledged per pair, well below our estimate of minimum productivity needed to maintain a stationary population (see POPULATION MODELING). However, from 1988 to 1991, productivity steadily increased and averaged 1.93 chicks fledged per pair during that period (range = 0.92 - 2.43).

We believe this high productivity is largely responsible for the substantial population increase recorded in 1991.

#### PREDATOR EXCLOSURES

Use of circular, 3.2 m - diameter, 5 x 10 cm - mesh wire exclosures significantly reduced predation on piping plover nests in our study area beginning in 1988 (MacIvor 1990). In 1988 and 1989, 90% (26/29) of nests protected by exclosures hatched at least 1 egg, compared to 17% (4/24) of unprotected nests (MacIvor et al. in review). Hatching success was 74% (77/104 eggs) for nests protected by exclosures, compared to only 19% (11/59 eggs) for unprotected nests. Installation time averaged 9.5 min per exclosure, and incubating plovers were kept off nests an average of 17.3 min. Cost of materials was about \$15 U.S. per exclosure.

#### POPULATION MODELING

We captured and individually color-marked 103 adult and 61 juvenile (unfledged) piping plovers from 1985 to 1988. We used PROGRAM-JOLLY to estimate mean annual survival rates of 0.74 for adults and 0.48 for juveniles based on re-sightings of color-marked birds between 1986 and 1989. We applied these survival estimates to a stochastic model, RAMAS-AGE, to estimate population trends based on varying levels of productivity. We estimate a mean annual productivity of about 0.9 chicks fledged per pair is necessary to maintain a stationary population. Simulations based on mean annual productivity less than 0.8 or greater than 1.0 chicks fledged per pair resulted in rapidly decreasing or increasing populations, respectively. These results are consistent with population trends observed on the CCNS during our study (Table 1).

#### LITERATURE CITED

- MacIvor, L. H. 1990. Population dynamics, breeding ecology, and management of piping plovers on outer Cape Cod, Massachusetts. M.S. Thesis. University of Massachusetts, Amherst. 100 pp.
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Table 1. Abundance and reproductive success of piping plovers nesting at 9 sites<sup>a</sup> within the Cape Cod National Seashore, Massachusetts, 1985-1991.

| Year | No. pairs | % hatch | % fledge | Mean no. chicks fledged per pair |
|------|-----------|---------|----------|----------------------------------|
| 1985 | 27        | 23      | 65       | 0.70                             |
| 1986 | 28        | 9       | 38       | 0.27                             |
| 1987 | 25        | 12      | 46       | 0.29                             |
| 1988 | 20        | 35      | 50       | 0.92                             |
| 1989 | 23        | 51      | 72       | 1.35                             |
| 1990 | 24        | 66      | 79       | 2.18                             |
| 1991 | 43        | 67      | 74       | 2.43                             |

<sup>a</sup> Sites include Race Point to High Head (Provincetown and Truro), Long Point (Provincetown), Jeremy Point (Wellfleet), Marconi Beach (Wellfleet), Coast Guard Beach (Eastham), New Island (Orleans), Nauset Spit (Orleans), Nauset Beach (Chatham), and South Beach Island (Chatham).