Monitoring and Management of Piping Plovers and Colonial Waterbirds at Cape Cod National Seashore

2003

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ABSTRACT

This report summarizes the 2003 Piping Plover (*Charadrius melodus*) and waterbird nesting season for Cape Cod National Seashore. Piping Plover nesting and brood-rearing were monitored at 14 beaches in Cape Cod National Seashore from Provincetown to Orleans. Observations of Piping Plovers began mid-March. Egg laying began in the fourth week of April in both the South and the North District. Peak nesting occurred during the second week of June. There were a total of 84 nesting pairs, 38 in the South District and 46 in the North. Hatching success was 49%. Fledging success was 69%. A total of 130 chicks fledged. Productivity was 1.55 chicks fledged/pair. Of 121 nests, 67 (55%) of all nests initiated failed to hatch at least 1 chick. The leading causes of nest loss included predation (58 %), overwash (13 %) and nest abandonment (13 %). Of 57 exclosed nests, 36 (63%) successfully hatched young. Of the 21exclosed nests that did not hatch, 9 (43%) failed due to abandonment, 6 (28%) to overwash, 3 (14%) to being sanded over, 2 (10%) abandoned due to adult mortality and 1 (5%) abandoned due to suspected perching of a Great Horned Owl on the exclosure. Of 58 unexclosed nests, 16 (28%) successfully hatched young. Of the 42 failed unexclosed nests, 36(88%) were lost to predators, 3(7%) were abandoned, 2 (5%) lost to overwash, and 1 (2%) was sanded over. Six nests were exclosed only to later have the exclosure removed once the plovers did not accept it. Of these 6 nests, 2 (33%) successfully hatched young. Of the 4 failed nests, 3 (75%) were lost to predators and 1 (25%) was lost to overwash. This was the sixth year the 1995 negotiated rule for ORV management was in effect. Thirty-two pairs of plovers nested within the ORV corridor. Fourteen of these pairs nested in the 4.9-mile section of Race Point South Beach closed per Negotiated Rule 15 November until at least 21 July, and eight pairs nested between Head of the Meadow and High Head. As a result, all but approximately 0.4 miles of the Race Point South Beach was closed for approximately 47 days. Closures, to some extent, were imposed on Race Point North Beach for a total of 50 days. By 15 August, all ORV corridors that could legally be opened under the negotiated rule were opened.

INTRODUCTION

Cape Cod National Seashore (CACO) was authorized by congress in 1961 as a unit of the National Park Service. The Park preserves approximately 44,600 acres of uplands, wetland and tidal lands located on Outer Cape Cod. As reflected in CACO's enabling legislation (Public Law 87-126), this unit of the National Park System was established, in part, to protect the area's outstanding Natural Resources including Federal and/or State listed rare animals.

The Seashore provides miles of prime feeding, nesting and roosting habitat for beach-nesting birds, including the Piping Plover (*Charadrius melodus*). This species was federally listed in 1986 as threatened (Federal Register 1985). At that time, there were 139 pairs estimated to be nesting in the Commonwealth of Massachusetts.

In 1985, CACO began a Piping Plover monitoring/protection program and 18 pairs nested on beaches managed by the Seashore. Productivity (number of chicks fledged per pair) that year was less than 1 chick fledged per pair (Figure 1). Over the next several years, numbers of plovers nesting in the Seashore decreased while numbers of plovers nesting in the state remained relatively stable. Eventually, numbers of nesting plovers rose significantly, both at CACO and throughout Massachusetts. In 2003, 84 pairs, representing approximately 16% of the state total, nested on CACO beaches. Productivity at CACO rose from 0.3 in 1986 to a high of 2.6 fledged chicks per pair in 1991. This report summarizes the results of the 2003 Piping Plover/Colonial Waterbird monitoring and management program at Cape Cod National Seashore.

STUDY AREA

Piping Plovers were monitored on 14 beaches in CACO from Provincetown to Eastham encompassing approximately 70 km (30 mi.) of beach. These study beaches are divided between two districts. The North District includes all NPS beaches located in Provincetown and Truro (Wood End - Long Point, Race Point Beach North, Race Point Beach South, High Head, and Ballston). The South District includes all NPS beaches located in Eastham and Wellfleet (Great

Island - Jeremy Point, Newcomb Hollow, Cahoon Hollow, White Crest, LeCount Hollow, Marconi Beach, Marconi Station, Nauset, and Coast Guard Beach). A map of all Piping Plover nest sites monitored by the CACO can be found in Appendix A. Appendix B contains maps of South District Piping Plover nest sites. Maps of North District Piping Plover nest sites are located in Appendix C.

PRE-SEASON ACTIVITIES

To ensure protection of nesting Piping Plovers, Coast Guard Beach and Marconi Beach were closed to pets and kite flying on 20 April 2003. Marconi Beach was re-opened to these activities on26 June, when it was determined that there was no plover nesting activity at this site. Kite flying was also prohibited in the North District near any potential plover nesting sites. Large signs were installed to inform beach-goers of these restrictions, and a press release was submitted to the local media.

Historic plover nesting sites in the South District (Coast Guard, Marconi, and Jeremy Point) were closed with symbolic fencing/signs, later than in past years due to the concerns of storms/tides washing fencing away. Posting began on 10-11 April on Coast Guard Beach. Marconi and Great Island were posted the third week of April and Jeremy Point on 25 April. In the North District, historic plover nesting sites on Race Point North were closed with symbolic fencing/signs by 15 April when the ORV corridor becomes open to permit holding visitors. Various plover/tern informational and regulatory signs were posted at the entrance of most beaches and at the nesting site.

METHODS

Daily observations of Piping Plovers began on 1 April, just after the plover's arrival and continued through August when plovers are observed in their southward migration. In March, during the period of arrival and courtship, most beaches were visited three to four times per week.

The exception was Great Island and Wood End/Long Point, monitored every 3 days. Once nests were established, all beaches were visited almost daily (≥5 times per week) except for Great Island/Jeremy Point which was visited 3 times/week.

During the nest location phase, monitors searched the beach for the presence of plovers, nest scrapes and plover tracks in the sand. All active scrapes (potential nests) were marked with a few pieces of driftwood approximately 1 meter (m) away from the nest so that the scrape could easily be found on return visits. A concentrated area of plover tracks often meant a plover nest or potential nesting site was nearby, as did any plover exhibiting the "broken-wing" behavior. Nests were also found by searching for birds sitting low in the sand, incubating a nest. A signed closure was placed around all active scrapes and nests.

To provide accurate predictions of hatching dates, efforts were made to find nests before clutch completion. The ability to predict hatching dates is especially important in managing and protecting the plovers along the ORV corridors. Sections of beach are closed to vehicles in the corridor when chicks hatch out. Nest searching continued through mid-July. Signs and symbolic fence protected each nest or nesting area.

Predator exclosures were installed around nests upon clutch completion, although there were some exceptions. With permission from the State, some incomplete clutches were exclosed if (1) the chance of predation on eggs was imminent or (2) the pair was actively incubating an incomplete clutch.

Nests were not exclosed when they were: (1) located in thick vegetation and adults were prone to fly off the nest when disturbed, creating a potential for entanglement in the exclosure top; (2) located on the side of a dune that precluded us from installing an exclosure due to slope or nest location; or (3) when a group of exclosed nests were abandoned on a single day at a particular site and there were concerns regarding adult plover mortality associated with exclosure use. In 2003, the latter (3) was a concern and Massachusetts and Federal endangered species coordinators recommended not using predator exclosures where this occurred. The decision to

exclose or not was determined on a case by case basis, with consideration of the above factors driving the individual decision.

In the North District, four-wheel-drive (4WD) vehicles and all-terrain vehicles (ATVs) were used to access all sites. Once chicks hatched out, however, ATVs were the preferred conveyance for most beaches, especially Wood End/Long Point. In the South District, ocean beaches from Coast Guard to Newcomb Hollow were accessed by foot, 4WD and ATVs. Bound Brook to Jeremy Point was accessed by 4WD vehicle and on foot.

RESULTS AND DISCUSSION

Seasonal Chronology

Plovers were first observed on CACO beaches on 16 March and most beaches had plovers present by mid-April. Plovers continued to arrive into mid-June. It is likely that some of these later arriving birds may have lost nests at other sites before moving to Seashore beaches.

Egg laying began in the fourth week of April in the South District and the fourth week in the North District. The first nest (with 3 eggs) was found on 5 May at Wood End/Long Point. The first egg was laid on 30 April and the nest was completed on 6 May. The nest was depredated by gull on 26 May. The first nests to hatch chicks occurred on 9 June at High Head and Coast Guard Beach, both nests fledged 3 chicks. Peak nesting for the Seashore occurred during the second week of June (Figure 2). The last nest was initiated on 26 June (1 day earlier than 2002) at Coast Guard Beach. The last nest hatched on 26 July and fledged one chick on 18 August. Based on historical nesting data for CACO, peak nesting fell two weeks later then in past years. This is likely associated with the cooler/wetter spring (Lawimore, 2003).

Hatching dates ranged from 6 June to 26 July. Fledging dates ranged from 4 July to 18 August. These dates are comparable to those reported over the past several years.

Nesting Pairs

Eighty-four pairs of Piping Plovers were monitored at 14 sites in CACO in 2003. This represents approximately 16% (84 of 523 (unofficial state estimate)) of the total breeding population in Massachusetts. Number of nesting pairs at the 14 sites monitored decreased by 13 from 2002 (97 pairs in 2002 to 84 pairs in 2003) (Fig. 1). Most beaches (6 out of 14) saw the same number of nesting pairs in 2003 as in 2002. These beaches were Wood End/Long Point, High Head, Ballston, Cahoon Hollow and Newcomb Hollow. Although CACO had fewer pairs overall then in 2002, some beaches saw an increased number of pairs. The greatest increase in number of nesting pairs occurred at Race Point North, where numbers rose from 8 observed in 2002 to 10 pairs in 2003. Coast Guard, Marconi, LeCount, Great Island/Jeremy Point, and Race Point South all saw a decrease in nesting pairs. For the first time in recent history, no plovers nested on the north side of Marconi Beach proper. This beach has historically supported 3-4 pairs of plovers. Marconi Beach proper was extremely narrow in 2003 due to severe erosion that took place over the winter.

Hatching Success

Hatching success (total number of eggs hatched/total number of eggs laid) for all sites combined was 49% and ranged from 20 to 77% (Table 1). Overall, hatching success was 8% higher than in 2002.

Hatching success was greatest at High Head (79%), Race Point North (76%), Marconi Station (68%), Cahoon Hollow (58%), LeCount (50%), Newcomb Hollow (50%), and Bound Brook/Duck Harbor (44%). The lowest hatching success occurred on Great Island (42%), Race Point South (38%), Ballston (37%), Marconi (33%), Wood End/Long Point (32%) Jeremy Point (23%). Coast Guard (20%) (Table 1).

Fledging Success

Fledging success (total number of chicks fledged/total number of eggs hatched) for all sites combined was 69% and ranged from 25 to 86% (Table 1). Overall, fledging success increased 12% from 2002. The greatest fledging success occurred on Cahoon Hollow (86%), Great Island (85%), and Race Point North (82%), with these sites representing 20 nesting pairs. The sites with the lowest fledging success were Newcomb Hollow (25%), Jeremy Point (29%), and Marconi (33%) (Table 1).

Productivity

Productivity (number of chicks fledged/nesting pair) for all sites was in 2003 was 1.55 (130 chicks fledged from 84 pairs) and ranged from 0.50 to 2.70 (Table 1). This is higher than 2002 when total productivity was 0.91. The North District had higher productivity (1.74 chicks/pair) than the South (1.32chicks/pair). Productivity was greatest at Race Point North (2.70), Marconi Station (2.67), and High Head (2.25), while the lowest productivity occurred at Coast Guard (0.64) and Marconi Beach (0.50), and Jeremy Point (0.50) (Table 1). According to the Atlantic Coast Piping Plover Recovery Plan productivity at a minimum of 1.24 is necessary to maintain the population at current levels (Melvin and Gibbs 1994).

Nest Loss

Fifty-five percent (67 of 121 nests) of all nests initiated failed to hatch at least 1 chick in 2003 (Table 3). This is a decrease from 2002 when 60% (84 of 141) nests were lost. All nine of the South District beaches lost at least one nest and all five North District beaches lost at least one nest in 2003 (Table 2). In the South District, predation of nests that were not exclosed (predation either occur prior to the exclosure being set up or at nests where exclosures were not used based on professional judgement) accounted for 54 % (n=21) of the nest losses (Table 4). In the North District, the main reason for early nest loss was also to predators accounting for 64% of the losses (n=18) (Table 4).

Overall, predation (n= 39), overwash (n= 9) and abandonment after the nest was exclosed (n= 9) were the leading causes of nest loss, accounting for 57 of the 67 (85%) nests lost (Table 2). Of the 67 lost nests, 42 (63%) had not been exclosed, 21 (31%) had been exclosed, and 4 (6%) had been initially exclosed but the exclosure was removed after the plovers did not accept the presence of the exclosure. Predators accounted for 77% (30 of 39) of unexclosed nest failures (Table 4). A total of 151 eggs were lost from unexclosed nests (Table 5). Some of these eggs were lost before the pair was actively incubating the nest and the exclosure installed.

Predator Exclosures

To determine if and when a predator exclosure was going to be used, all nests were evaluated in compliance with guidelines prepared by the Atlantic Coast Piping Plover revised Recovery Plan (1996) for the use of predator exclosures.

Predator exclosures were installed around 57 of the 121 (47%) nests. Of the 57 exclosed nests, 36 (63%) successfully hatched young. Of the 21 exclosed nests that did not hatch, 12 (57%) failed due to abandonment, 6 (29%) were lost to overwash and 3 (14%) to being sanded over (Table 4).

There was a total of 58 unexclosed nests. Of these nests, 42 (72%) failed to hatch (Table 4). Although the number of unexclosed nests seems extremely high, many of these nests were either incomplete clutches (with < 3 eggs), not actively being incubated, or the nest was located where an exclosure could not be used.

The greatest loss of unexclosed nests was to predation (86%) including: 9 (25%) to unknown predators, 5 (14%) to Black-Crowned Night Heron, 5 (14%) to crow, 4 (11%) to canid (sp?), 4 (11%) to coyote (identified by track size), 4(11%) to gull, 4 (11%) to skunk, and 1 (3%) to coyote that also caused an adult mortality. The remaining loss of unexclosed nests were to abandonment 3 (7%), overwash 2 (5%), and sanding over 1 (2%).

Also, early in the season, six exclosures in the South District were taken down immediately after being installed. Pairs were exhibiting distress behavior (running in and out of the exclosure) and did not resume incubation or accept the presence of the exclosure. When the exclosure was removed, the bird resumed normal incubation. Of these 6 nests, 4 (67%) failed to hatch (Table 4.) Three (75%) were lost to predators and 1(25%) was lost to overwash after the exclosure was removed.

Abandonment of Exclosed Nests

A review of eight years of data from 1993 to 2000, shows 32% of exclosed nests (175 of 549) failed to hatch and 8% of these exclosed nests (44 of 549) failed due to abandonment. Of the 175 failed nests in eight years, 44 failed due to abandonment, identifying 25% of CACO's exclosed nest failures due to abandonment. In 1999, there was a high of 50% (5 of 10 failed nests) failure due to abandonment and a low of 7% (2 of 44 failed nests) in 2000.

In 2001 in, 17% of exclosed nests (12 of 70) failed to hatch with 14% of these exclosed nests (10 of 70) having failed due to abandonment. Of the 12 failed nests in 2001, 10 were due to abandonment, identifying 83% of the exclosed failures due to abandonment. Nine of these abandoned nests occurred in the South District. This year had the highest percentage of failures due to abandonment since 1993 and indicated the need to further watch for an increase in abandonment rates in exclosed nests.

In 2002, 36% of exclosed nests (28 of 78) failed to hatch with 18% of the exclosed nests (14 of 78) failing due to abandonment. Of the 28 failed nests, 14 were due to abandonment, identifying 50% of our exclosed failures due to abandonment. All 14 abandoned nests occurred in the South District.

In 2003 in both districts, 37% of exclosed nests (21 of 57) failed to hatch with 21% of all exclosed nests (12 of 57) having failed due to abandonment. Of the 21 failed nests, 12 were due to abandonment, identifying 57% of our exclosed failures due to abandonment.

South District - Although there were concerns with the use of exclosures, all nests that were actively being incubated at the beginning of the nesting season were exclosed and monitored no less than every other day. By the end of May, the South District began to see the same pattern of unexplained abandoned nests as seen in 2002.

In 2003, 47% of exclosed nests (14 of 30) failed to hatch. 27% of all exclosed nests (8 of 30) failed due to abandonment. Of the 14 failed nests, 8 were due to abandonment, identifying 57% of the South Districts exclosed failures due to abandonment. Great effort was taken to account for the nesting pairs that abandoned their nests at all sites.

North District - In 2003, 26% of exclosed nests (7 of 27) failed to hatch. 15% of all exclosed nests (4 of 27) failed due to abandonment. Of the 7 failed nests, 4 were due to abandonment, identifying 57% of the North Districts exclosed failures due to abandonment. Three of the four pairs that abandoned their nests were identified as having renested. One pair was not observed again in the area of its abandoned nest.

In an attempt to identify what predator(s) could be the source of these abandonments, nocturnal field observations were conducted on two evenings from 1830-0100 at Coast Guard Beach in Eastham. A mock exclosure was set up and monitored with binoculars until dark. After sunset, a video camera with night vision capabilities was installed near the exclosure to observe any predator that investigated the exclosure. No predators were observed near the mock exclosure on these nights.

Chick Mortality

Chick mortality factors are extremely difficult to assess. In the majority of cases when chicks are lost, there is no evidence as to why. A chick was presumed dead when it was never seen again before the remainder of the chicks in the brood fledged. A brood was considered lost when there was no sign of the chicks after five consecutive days of searching. As in years past, most chick mortality occurred within the first 10 days after hatching, which was consistent with

data from previous studies (MacIvor 1990, Brown and Hoopes 1993). We could not directly attribute chick mortality to any specific factor, although shorebird personnel did note an increase in coyote (*Canis latrans*), red fox (Vulpes fulva), and skunk (Mephitis mephitis) sightings since 2001 (unpublished data) in the areas where mortality occurred; however this information is speculative. It is possible that these species, along with gulls and crows (which congregate in large groups on the beachfront), and domestic dogs and feral cats may have contributed to chick mortality.

Adult Mortality

South District - On 28 May at Coast Guard Beach, plover feathers were found scattered inside an exclosure. Upon further investigation, a plover wing bone with some feathers and flesh attached was found approximately ten feet outside the exclosure. It had rained the previous night making it hard to identify any predator tracks in the sand. There were no tracks other than plover tracks inside the exclosure.

Massachusetts and Federal endangered species coordinators were contacted by the park's Chief Natural Resource Management Specialist on 28 May and informed of this mortality. A decision was made by all agencies to stop exclosing any more nests at Coast Guard Beach and Jeremy Point and to remove all existing exclosures on these beaches to prevent any additional exclosure related deaths to plovers. All exclosures were removed on Coast Guard Beach and Jeremy Point on 29 May.

On 7 July, another adult mortality was discovered at Great Island (Middle Meadow). Small piles of plover feathers were found 6 inches outside the exclosure. There were also crow tracks outside the exclosure and small mammal tracks inside the exclosure.

On 10 July, no bird was seen incubating or near a nest located between Nauset and Marconi Beach and is thought to have been depredated. After this date, no bird was seen again at this nest.

North District - On June 2nd, a nest at Peaked Hill, Race Point South, was sanded over after a nor'easter storm and several days of heavy rain. The nest was buried under approximately 6" of sand. To check the number of eggs lost, shorebird personnel dug out the nest only to discover an adult bird, buried beneath the sand, still incubating the nest. This incident was reported to Anne Hecht, Endangered Species Biologist, U.S. Fish and Wildlife Service. The bird was transported to Tufts Veterinary School in Boston, Massachusetts. The bird died three days later at the medical facilities.

On June 24th, a nest on Race Point South was discovered depredated by coyote. Two sets of coyote tracks paralleled the dune face and lead up to and around the nest bowl. Located approximately 4.5 feet southeast of the nest bowl, a dead adult plover was found. The bird had a dislocated shoulder but no apparent puncture wounds.

The North District also had two suspected plover deaths. On Race Point North, a nest was completed on May 20th. On June 10th and June 11th , no bird was incubating or seen near the nest. The nest hatched on June 15th with only a single bird in attendance to the hatching brood. Only the male (sex based on observed plumage differences) was seen attending the brood until fledging three chicks and leaving the area.

The second suspected adult mortality occurred at Wood End/Long Point and is similar to the above scenario. This nest was completed on May 18th. A bird was observed incubating the nest until June 4th. Between June 6th and June 20th, a bird was observed incubating the nest once. On June 20th a single adult male was observed brooding 2 eggs and 2 chicks. It is interesting to note that the second adult disappeared during the same time as a nor'easter storm and several days of heavy rainfall.

Dogs Off Leash

Dogs off leash continue to be a chronic problem in the South District. These unleashed dogs not only pose health and safety concerns to the visitor, they also can harass and potentially kill native wildlife. Ground nesting birds like the plovers and terns are extremely vulnerable to unleashed pets.

A total of 234 dogs were observed off leash from 18 May to 17 August in the South District. Unleashed dogs were encountered most frequently on the oceanside at LeCount Hollow and on the bayside at Duck Harbor. Most owners put their dogs on a leash when informed of the National Park Services pet regulations.

A total of 61 dogs were observed off leash from 13 April to 15 August in the North District. Unleashed dogs were encountered most frequently on Race Point North and Race Point South. Most owners put their dogs on a leash when informed of the National Park Services pet regulations.

Implementation of the Negotiated Rule

ORV Management - ORV management, as it relates to plover management at CACO, is a dynamic process. This was the sixth year of the negotiated rule of 1995. We observed no direct negative impacts to Piping Plover adults or chicks in 2003.

The presence of Piping Plover chicks caused the closure to ORV traffic on portions of Race Point North beach for a total of 47 days (11 days less than 2002). On 14 July (19 days earlier than 2002) the entire Race Point North oversand route was opened to ORV traffic due to the absence of Piping Plover chicks. Race Point South beach was closed to some extent between Exit 8 and Race Point South Self-contained Vehicle (SCV) Area for 47 days (8 days less than 2002). The night fishing corridor located at Coast Guard beach (Truro) was not effected due to lack of Piping Plover nesting. The stretch of beach between Head of the Meadow and High Head

was completely open (8 August) for 3 weeks and 4 days, in comparison with the 11 days it was open in 2002. As of 15 August, the entire ORV corridor was opened to vehicles.

Plover Management - Thirty-two of 46 (70%) North District pairs nested within the ORV corridor (5 more than in 2002). Eighteen pairs of these pairs (22 nests) nested in areas seasonally closed to ORV traffic (opening/closure mandated by the Negotiated Rule). Fourteen pairs (17 nests) nested in the area open to ORV traffic. As these nests hatched, affected sections of the ORV corridor were closed to vehicles. Closures were imposed only when eggs hatched and were kept in effect through the chick-rearing stage until fledging.

The following is a chronological discussion of the principal events and responses. This information is summarized in Table 7, written in fulfillment of requirements of the Negotiated Rule.

The anticipated hatching of two nests in close proximity to ORV corridor entrances prompted several actions to be initiated to best accommodate both visitors and breeding pairs. In coming years, different management actions may be undertaken to what appears to be similar scenarios.

At Race Point North the location of a Piping Plover nest made it inevitable that upon hatching (expected 13 June) the area in which the Race Point North SCV Area occupied would be closed. Likewise on Race Point South, the location of another Piping Plover nest would restrict travel to 0.9 miles south of the Race Point South entrance upon hatching (expected 29 June).

On 9 June, a single-track lane for ORV passage was laid as high as possible across the Race Point North protected beach. This would enable large SCVs that could not navigate the Race Point South entrance to access the Race Point South SCV Area and the available corridor. The single-track corridor was posted with informational signs to Race Point North Protected Beach-goers warning that vehicles may be passing through from 1830-0800 and during

emergency situations. Signs were also posted at either end of the single-track lane restricting travel to designated hours and emergency situations.

To prepare for the increased number of SCVs on Race Point South, 0.2 miles were added to Race Point South SCV Area south of the Race Point South entrance on 10 June. This allowed the Race Point South SCV Area to be extended to the greatest extent it could, given foresight into future corridor availability. On the evening of 10 June (three days prior to the estimated hatch date of the Piping Plover nest) the remaining Race Point North SCVs were escorted to the Race Point South SCV Area and the Race Point North SCV Area was closed. The Race Point North corridor remained open until the nest hatched, as usual.

Three days later, 13 June, the Race Point North Piping Plover nest began to hatch and Race Point North corridor was closed. The Race Point North entrance remained open for vehicles to enter Race Point North beach and park, as well as for SCVs to access the single-track corridor to Race Point South SCV Area. In accordance with state and federal guidelines the brood was scrupulously monitored to insure it did not wander proximal the open Race Point North entrance parking area. On June 29, the Race Point South Piping Plover nest began to hatch and the Race Point South corridor was reduced to 0.9 miles.

A Piping Plover nest along the pole-line route began to hatch late afternoon 15 June. North District Rangers and shorebird personnel worked together to monitor the brood continually until it safely moved into Hatches Harbor at 1545 on 16 June. At this time, the brood began foraging in a section of Hatches Harbor approximately 50 feet from the pole-line route. Due to the proximity to the pole-line route and the potential of the brood moving into the road due to high tides, Rangers and shorebird personnel continued to monitor the brood until 17 June at 1200 allowing the pole-line route to remain open. If not for this effort the pole-line route would have been closed and all visitors removed from the Hatches Harbor area.

A Piping Plover nest in Hatches Harbor began hatching on the morning of 14 July. North District Rangers and shorebird personnel worked together to monitor the brood continually until

it safely moved into Hatches Harbor at 1700 of the same day. If not for this effort, Hatches Harbor would have been closed and all visitors removed from the area.

All of Race Point North opened on 14 July due to the fledging of all chicks from the Race Point North ORV corridor. This allowed the Race Point North SCV Area to be reestablished. All SCVs present in Race Point South SCV Area were notified that the single-track corridor would be closed and removed at 0800 hours 14 July. All vehicles that could not navigate the Race Point South entrance must move to the Race Point North SCV Area prior to that date. On 15 July the single-track corridor was closed and removed.

On July 29, 0.9 miles of corridor opened on Race Point South following the fledging of two chicks from the two Piping Plover nests. The remainder of Race Point South beach was open on 15 August.

COLONIAL WATERBIRDS

Least Terns

Least Terns returned to CACO during the second week of May. Egg laying began the first week in June, with most Least Terns on eggs by 15 June. Renesting attempts continued through late August. The first chicks that hatched this year were not observed until 18 July. This late hatching date can be contributed to renesting due to both predation and overwash.

An aerial estimate of 245 pairs nested on four beaches in the South District (Table 8). Approximately 95% of the first nesting attempts on all beaches were depredated by 20 June. Tracks indicated canid (sp.?) and skunk to be the major predators. Some nests were lost to overwash. Most pairs renested with some shifting of nesting locations including two new nesting locations at Marconi Station and Cahoon Hollow Beach. Egg predation continued for the duration of the breeding season. It was not uncommon to walk through colonies at Coast Guard Beach, Great Island and Jeremy Point and observe a moderate number of nests, only to return a week later to find empty scrapes. No chicks were observed on any of these three beaches. In early July, small colonies appeared on Marconi Station and Cahoon Hollow and faired somewhat better. A high count of seven chicks was observed in each of these locations. A total of less than ten chicks fledged from these two sites. Although an increase from 2002, when only one chick was observed in the entire district, productivity of the Least Tern is extremely low.

The North District did not fare any better. A total of 125 pairs nested on four beaches (Table 8). Moderate egg predation by coyote and other unidentified predators occurred at all sites. In all colonies predator tracks were observed, usually cast in long linear transects. Only nests within the direct path of the tracks were affected, it is noteworthy that nests adjacent to the track transect (sometimes within 12 inches of a track) were undisturbed. Such evidence suggests that eggs were taken opportunistically. At Wood End and Long Point this year, in addition to coyote predation pressures, Black-Crowned Night Herons (BCNH) were consistently seen

through the month of June. Black-Crowned Night Herons were frequently seen sitting among Rosa rugosa bushes within 300 feet of the Least Tern colony. Overall, depredation combined with overwash led to Least Terns having to renest throughout the season and accounted for their very low productivity; less then a dozen chicks are believed to have fledged from all sites in the North District.

Common Terns

Common Terns were first sighted on 2 May. For the first time in over 20 years, no Common Terns nested in the South District. One pair was observed at Coast Guard Beach on 5 June. The pair was acting territorial (dive-bombing) but no nest was found.

For the past three years, historic nesting sites in this district (New Island, Coast Guard Beach and Jeremy Point) experienced a steady decline in nesting birds and extremely low to no productivity due to intense predator pressure from gull, skunk and coyote.

In mid-August, a conservative estimate of 1000 immature and post-breeding Common Terns were observed on the mudflats of Nauset Marsh.

A single pair attempted to breed on Race Point North Beach in the North District, however, the nest is speculated to have been depredated by coyote.

Roseate Terns

For the second consecutive year, no Roseate Terns nested on New Island. Since 1999, this island supported 3-4 nesting pairs. The Roseate Terns first nested at this site in 1999 when close to 2200 pairs of Common Terns nested on this small island. In 2001, when Common Terns failed to use New Island as a nesting site, so did the Roseate Terns. This loss, although relatively small, is a set back in the recovery efforts. Almost 100% of the state's nesting Roseate Terns are found in two locations (Bird and Ram Island in Buzzards Bay). Because this species nests in only a few concentrated areas, it is vulnerable to losing a large percentage of the population if a

catastrophic event occurred. New Island was one of only a few alternative population sites in the state with nesting birds that ensured a few Roseate Terns would survive if the Buzzard Bay colonies were hit hard by some disaster.

In mid-August, approximately 75 immature and post-breeding Roseate Terns were observed on the mudflat of Nauset Marsh.

Arctic Terns

There was one confirmed nesting pair of Arctic Terns on Coast Guard Beach, Eastham in 2003. Prior to finding the nest, a pair was observed calling along the southwest corner of New Island (historic nesting location on the island) on 19 June. Pair was acting territorial (dive-bombing) but staying high in the sky and is not known to have landed on the island. On 20 June, one Arctic Tern was observed calling on the southern tip of Coast Guard Beach. This bird is theorized as being from the same pair observed on New Island on 19 June. On 25 June, a one-egg nest was found on the southern tip of Coast Guard Beach. On 28 June, the nest had two eggs and was being incubated. On 7 July, days before the eggs were due to hatch, the nest was depredated by a skunk (tracks leading up to nest bowl).

Black Skimmers

A total of 9 Black Skimmers were observed on the southeast corner of New Island on 21 May. These birds were never seen again.

Laughing Gulls

One pair of Laughing Gulls nested on New Island this year. Historically, this island supported the largest Laughing Gull colony in the state. Over the past five years, the number of nesting pairs has slowly declined to one pair and productivity has been low to none (Table 9).

American Oystercatchers

Two pairs of American Oystercatchers nested unsuccessfully on Jeremy Point. One pair nested on the southern tip and lost three nests to predation, two nests to unknown predator, one to canid (sp?). The second pair was seen regularly in the northern section of Jeremy Point exhibiting territorial behavior and several active scrapes were identified. No eggs were ever found.

MANAGEMENT RECOMMENDATIONS

1. Dogs off leash continue to be a chronic problem in the park. Ground nesting birds like the plovers and terns are extremely vulnerable to disturbance by unleashed pets. Many violations appear to be associated with people accessing seashore property from town beaches where signage and enforcement are less prevalent. The Seashore will continue to record incidences of dogs off leash formally in 2004 to determine usage trends.

2. Loss of exclosed nests to abandonment in the South needs to be evaluated both by the park and Massachusetts and Federal endangered species coordinators. The reason(s) for abandonment also needs to be better understood. Changes in exclosure design should be explored.

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Figure 1. Number of Piping Plover breeding pairs and nest productivity on beaches managed by the National Park Service, Cape Cod National Seashore, 1985 - 2003

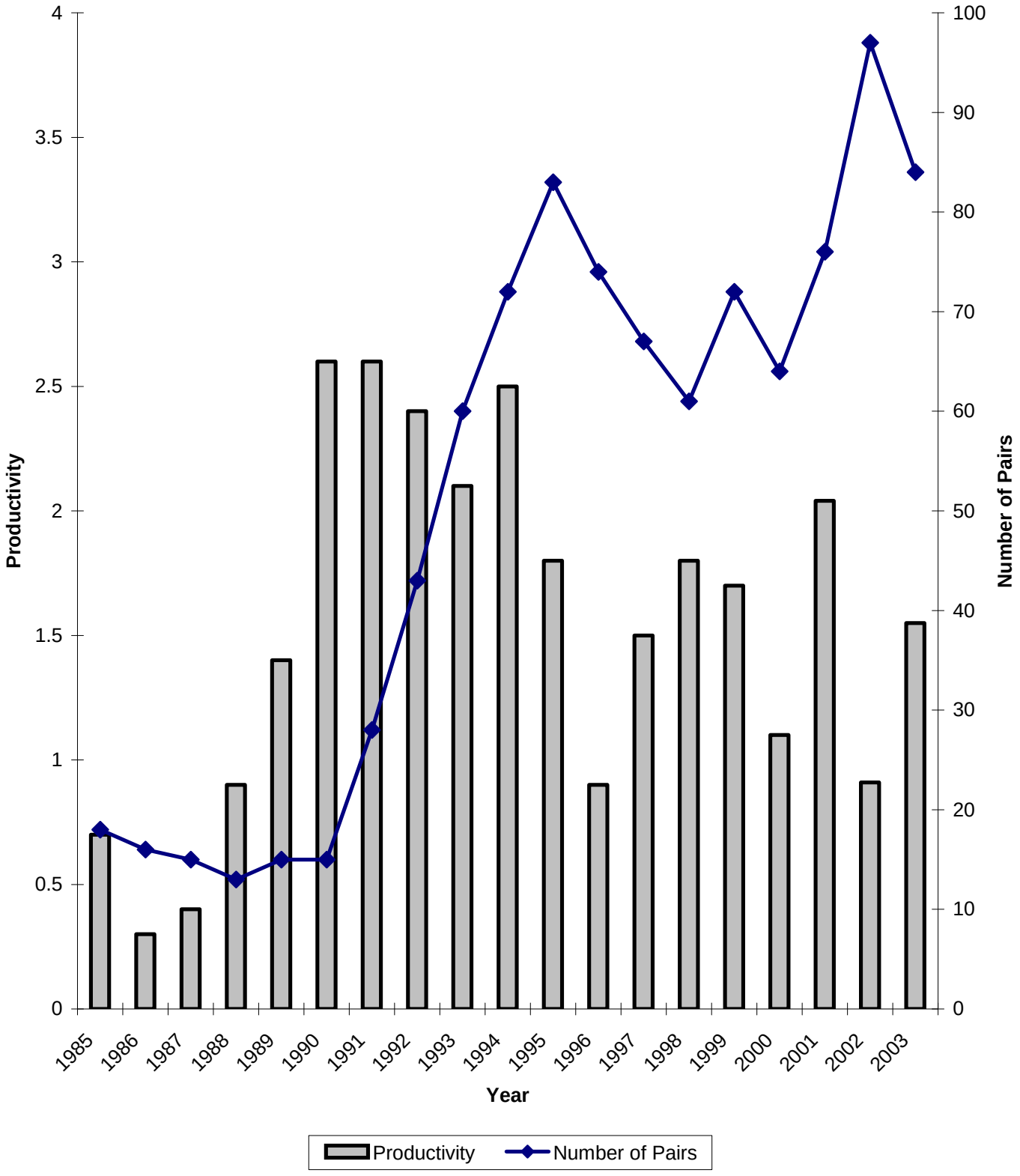


Figure 2. Weely Active Piping Plover Nests at Cape Cod National Seashore 2003

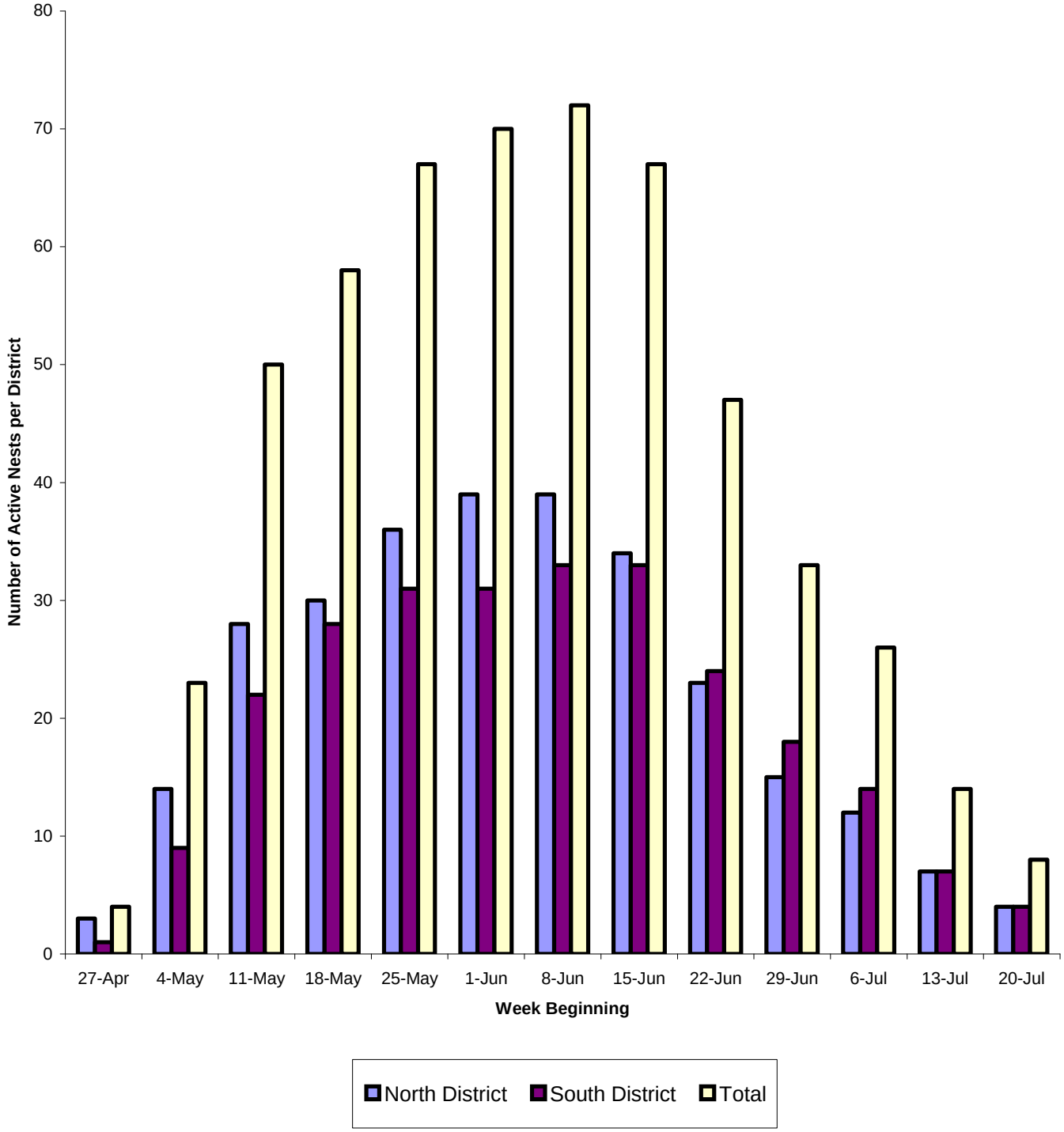


Table 1. Summary of Piping Plover Breeding Success, Cape Cod National Seashore, 2003

Site	No. Pairs	No. Nests [1]	No. eggs Laid	No. eggs Hatched	No. Fledged per site	Hatching Success [2]	Fledging Success [3]	Productivity [4]
Coast Guard	11	20	71	14	7	0.20	0.50	0.64
Marconi	4	6	18	6	2	0.33	0.33	0.50
Marconi Station	3	4	16	11	8	0.68	0.66	2.67
LeCount	1	2	8	4	3	0.50	0.75	3.00
Cahoon Hollow	2	3	12	7	6	0.58	0.86	3.00
Newcomb Hollow	1	2	8	4	1	0.50	0.25	1.00
Great Island	8	12	47	20	17	0.42	0.85	2.10
Jeremy Point	4	8	30	7	2	0.23	0.29	0.50
Bound Brook - Duck Harbor	4	4	16	7	4	0.44	0.57	1.00
Wood End / Long Point	10	16	61	19	12	0.32	0.63	1.20
Race Point North	10	11	42	32	27	0.76	0.82	2.70
Race Point South	14	20	73	28	19	0.38	0.68	1.36
High Head	8	8	29	23	18	0.79	0.78	2.25
Ballston Beach	4	5	19	7	4	0.37	0.66	1.00
TOTAL	84	121	450	189	130	0.49	0.69	1.55

[1] Includes renests
[2] Total number of eggs hatched/total number of eggs laid
[3] Total number of chicks fledged/total number of eggs hatched
[4] Total number of chicks fledged/total number of nesting pairs

Table 2. Causes of Piping Plover Nest Failures, Cape Cod National Seashore, 2003 (page 1 of 2)

Site	NESTS			Cause	PER SITE	
	Total No.	No. Lost	% Lost		No. Lost	% Lost
Coast Guard	20	16	80%			
				Predation (Net)	14	88%
				Abandoned (excl)	1	6%
				Abandoned - adult mortality	1	6%
				Predation types		
				Unknown predator (not excl)	7	50%
				Skunk (not excl)	5	36%
				Canid (sp.?) (not excl)	2	14%
Marconi	6	4	66%			
				Overwashed	2	50%
				Abandoned (excl)	1	25%
				Crow (not excl)	1	25%
Marconi Station	4	1	25%			
				Overwashed	1	100%
LeCount	2	1	50%			
				Overwashed	1	100%
Cahoon Hollow	3	1	33%			
				Sanded over	1	100%
Newcomb Hollow	2	1	50%			
				Sanded over	1	100%
Great Island	12	7	58%			
				Predation (Net)	3	43%
				Overwashed	2	29%
				Abandoned (excl)	1	14%
				Abandoned - adult mortality	1	14%
				Predation types		
				Crow (not excl)	2	67%
				Unknown predator (not excl)	1	33%
Jeremy Point	8	6	75%			
				Canid (sp.?) (not excl)	3	49%
				Abandoned - GRHO[1]	1	17%
				Abandoned (not excl)	1	17%
				Overwashed	1	17%
Bound Brook - Duck Harbor	4	2	50%			
				Abandoned (excl)	2	100%

[1] Suspected Great Horned Owl perching on exclosure

Table 2. Causes of Piping Plover Nest Failures, Cape Cod National Seashore, 2003 (page 2 of 2)

Site	NESTS			Cause	PER SITE	
	Total No.	No. Lost	% Lost		No. Lost	% Lost
Wood End/Long Point	16	10	73%			
				Predation (Net)	6	60%
				Abandoned (excl)	3	30%
				Overwashed	1	10%
				Predation types		
				BCNH[1] (not excl)	4	66%
				Coyote (not-excl)	1	17%
				Gull (not excl)	1	17%
Race Point Beach North	11	2	18%			
				Abandoned (not excl)	1	50%
				Coyote (not excl)	1	50%
Race Point Beach South	20	12	65%			
				Predation (Net)	7	60%
				Abandoned (excl)	1	8%
				Abandoned (not excl)	1	8%
				Overwashed	1	8%
				Sanded over	1	8%
				Sanded over - adult mortality	1	8%
				Predation types		
				Gull (not excl)	3	43%
				Crow (not excl)	2	29%
				Coyote - adult mortality	1	14%
				Coyote (not excl)	1	14%
High Head	8	1	12%			
				BCNH[1] (not excl)	1	100%
Ballston Beach	5	3	60%			
				Unknown predator (not excl)	2	67%
				Coyote (not excl)	1	33%

[1] Black-crowned Night Heron

Table 3. Nest Loss Totals, Cape Cod National Seashore, 2003

Nests					Per Cause	
No. Nests	No. Hatched	No. Lost	% Lost	Cause	No. Lost	% Lost
121	54	67	55%			
				Predation (Net)	39	58%
				Abandoned (excl)	9	13%
				Overwash	9	13%
				Sanded over	4	6%
				Abandoned (not excl)	3	5%
				Abandoned - adult mortality	2	3%
				Sanded over - adult mortality	1	2%
				Predation types		
				Unknown predator (not excl)	10	26%
				Black-crowned Night Heron (not excl)	5	13%
				Canid (sp?)	5	13%
				Skunk (not excl)	5	13%
				Crow (not excl)	5	13%
				Coyote (not excl)	4	10%
				Gull (not excl)	4	10%
				Coyote - adult mortality	1	2%

Table 4. Fates of Exclosed and Unexclosed Piping Plover Nests, Cape Cod National Seashore, 2003

Nest	Total	No. Successful	No. Not Successful	% Successful	% Not-successful	Cause of Failure	No. Lost	% Lost
Exclosed	57	36	21	63%	37%			
						Predation (Net)	0	0
						Abandoned	12	57%
						Overwash	6	29%
						Sanded over	3	14%
						Abandonment types		
						Abandoned - unknown reasons	9	75%
						Abandoned - adult mortality	2	17%
						Abandoned - GRHO[1]	1	8%
Unexclosed	58	16	42	28%	72%	Predation (Net)	36	86%
						Abandoned - unknown reasons	3	7%
						Overwash	2	5%
						Sanded over - adult mortality	1	2%
						Predation types		
						Unknown predator	9	25%
						BCNH	5	14%
						Crow	5	14%
						Canid (sp.?)	4	11%
						Coyote	4	11%
						Gull	4	11%
						Skunk	4	11%
						Coyote - adult mortality	1	3%
Exclosed initially then removed								
	6	2	4	33%	67%			
						Predation (Net)	3	75%
						Overwash	1	25%
						Predation types		
						Canid (sp.?)	1	33%
						Skunk	1	33%
						Unknown Predator	1	33%

[1] Suspected Great Horned Owl perching on exclosure

Table 5. Fate of Piping Plover Eggs, Cape Cod National Seashore, 2003 (page 1 of 2)

SITE	No. Nests	Net Laid	No. Hatched	No. Lost	% Lost Per Site	CAUSE	# Eggs Lost	% Lost Per Cause
Coast Guard	20	71	14	57	80%			
						Predation (net)	49	86%
						Abandoned (excl)	4	7%
						Abandoned - adult mortality	4	7%
						Predation types		
						Unknown predator (not excl)	24	49%
						Skunk (not excl)	17	35%
						Canid (sp.?) (not excl)	8	16%
Marconi	6	18	6	12	67%	Abandoned (excl)	4	33%
						Overwashed	4	33%
						Crow (not excl)	2	17%
						Non-viable	2	17%
Marconi Station	4	16	11	5	31%	Overwashed	4	80%
						Non-viable	1	20%
LeCount	2	8	4	4	50%	Overwashed	4	100%
Cahoon Hollow	3	12	7	5	42%	Sanded over	4	80%
						Non-viable	1	20%
Newcomb Hollow	2	8	4	4	50%	Sanded over	4	100%
Great Island	12	47	20	27	57%	Predation (net)	11	40%
						Overwashed	8	30%
						Abandoned (excl)	4	15%
						Abandoned - adult mortality	4	15%
Jeremy Point	8	30	7	23	76%	Canid (sp?) (not excl)	10	43%
						Overwashed	4	17%
						Abandoned (excl)	4	17%
						Abandoned (GRHO[1])	4	17%
						Non-viable	1	6%
Bound Brk-Duck Hrbr	4	16	7	9	56%	Abandoned (excl)	8	89%
						Non-viable	1	11%

[1] Suspected Great Horned Owl perching on exclosure

Table 5. Fate of Piping Plover Eggs, Cape Cod National Seashore, 2003 (page 2 of 2)

SITE	No. Nests	Net Laid	No. Hatched	No. Lost	% Lost Per Site	CAUSE	# Eggs Lost	% Lost Per Cause
Wood End-Long Point	16	61	19	42	68%	Predation (Net)	24	57%
						Abandoned (excl)	12	29%
						Overwashed	4	9%
						Non-viable	2	5%
						Predation types		
						BCNH (not excl)	16	66%
						Coyote (not excl)	4	17%
						Gull (not excl)	4	17%
Race Point North	11	42	32	10	19%	Abandonment (not excl)	4	40%
						Predation (Net)	4	40%
						Non-viable	2	20%
						Predation types		
						Coyote (not excl)	4	100%
Race Point South	20	73	28	44	62%	Predation (Net)	25	57%
						Overwashed	5	11%
						Abandoned (excl)	4	9%
						Sanded over	4	9%
						Sanded over, adult mortality	3	7%
						Abandoned (not excl)	2	5%
						Non-viable	1	2%
						Predation types		
						Gull (not excl)	11	44%
						Crow (not excl)	6	24%
						Coyote (not excl)	4	16%
						Coyote, adult mortality	4	16%
High Head	8	29	23	7	13%	Predation (Net)	4	57%
						Non-viable	3	43%
						Predation types		
						BCNH (not excl)	4	100%
Ballston	5	19	7	12	39%	Predation (Net)	11	92%
						Non-viable	1	8%
						Predation types		
						Unknown predator (not excl)	7	64%
						Coyote (not excl)	4	36%

Table 6. Egg Loss Totals, Cape Cod National Seashore, 2003

No. Nests	Eggs: No. Total	Eggs: No. Lost	Eggs: % Lost	Cause	Per Cause: No. Eggs Lost	Per Cause: % Lost
121	450	261	58%			
				Predation (Net)	140	53%
				Abandoned (excl)	40	15%
				Overwash	33	13%
				Non-viable	15	6%
				Sanded over	12	5%
				Abandoned (not excl)	10	4%
				Abandoned - adult mortality	8	3%
				Sanded over - adult mortality	3	1%
				Predation types		
				Unknown predator (not excl)	35	25%
				Black-crowned Night Heron (not excl)	20	15%
				Canid (sp.?)	18	13%
				Skunk (not excl)	17	12%
				Coyote (not excl)	16	11%
				Crow (not excl)	15	10%
				Gull (not excl)	15	10%
				Coyote - adult mortality	4	4%

Table 7. North District Off-Road Vehicle Corridor Openings and Closures, Cape Cod National Seashore, 2003

Date	Beach	Change	Net Mileage Open	Net Closed	Reason
15-Apr	PRN	0.2	2	0.2	Corner at Race Point too narrow for vehicle passage
5-May	RPS	5 meters	1.8	0	PIPL pair scraping 10 meters from No Vehicle signs, moved signs to allow larger courtship area
9-May	RPN	0.1	1.9	0.3	N. No. 1 located along narrow part of beach, once signed, no room for vehicles to pass at high tide
25-May	RPN	0.1	1.8	0.4	N. No. 8 located along narrow part of beach, once signed, no room for vehicles to pass at high tide
9-Jun	RPN	NA	NA	NA	Laid single track through Protected Beach for SCV access[1]
10-Jun	RPN - RPS	NA	NA	NA	Closed RPN SCV Area, escorted vehicles to RPS SCV Area
10-Jun	RPS	NA	NA	NA	SCV Area increased to 0.4 miles wide
11-Jun	RPN	0.2	1.6	0.6	N. No.1 hatched, closed RPN Lighthouse cut-off
13-Jun	RPN	0.6	1	1.2	N. No. 3 hatched
17-Jun	RPN	0.45	0.55	1.8	N. No 6 hatched - RPN Entrance open for fisherman parking
17-Jun	RPN	NA	NA	NA	Pole Line Route Opened to allow access to Hatches Harbor
29-Jun	RPS	0.4	0.9	0.9	N.No 10 hatched - Closed 0.4 around nest, but only 0.2 effects the public use[2]
29-Jun	RPS	NA	NA	NA	0.5 Opened for Commercial Dune Tours[2]
30-Jun	RPS	NA	NA	NA	N.No 15 hatched
30-Jun	RPS	NA	NA	NA	N.No. 15 moved into open area for Commercial Dune Tour turnaround, closed additional 0.2 - total open 0.1for CDT[2]
Jun-31	RPS	NA	NA	NA	N.No. 15 moved into open area for Commercial Dune Tour turnaround, closed turnaround[2]
14-Jul	RPN	1.5	2.2	0	Chicks on RPN fledged
14-Jul	RPN	NA	NA	NA	SCV Area reestablished on RPN - 0.3 wide
15-Jul	RPN	NA	NA	NA	Removed single track through Protected Beach laid for SCV access[1]
21-Jul	HH	0.5	0.5	0	Opened exit and 0.3 miles north per Negotiated Rule
22-Jul	HOM	0.5	0.5	0.3	Opened exit and 0.5 Miles north per Negotiated Rule
28-Jul	RPS	NA	NA	NA	0.15 Opened for Commercial Dune Tour turn around[2]
29-Jul	RPS	0.8	1.8	3.1	Chicks on RPS fledged
29-Jul	RPS	0.4	2.2	2.7	Opened south of Exit 8 per Negotiated Rule
7-Aug	RPS	1.3	3.5	1.4	Chicks on Peaked Hill fledged
8-Aug	HOM	0.3	0.8	0	Chicks south of High Head entrance fledged
15-Aug	RPS	1.4	4.9	0	Chicks on Armstrong fledged
1-Sep	HOM	0.8	0	0.8	Closed for season between HH & HOM per Negotiated Rule

** All mileage of RPN includes Hatches Harbor

RPN = Race Point North
RPS = Race Point South
HH = High Head
HOM = Head of the Meadow

[1] = See Implementation of the Negotiated Rule in Results/Discussion
[2] = Corridor open from Exit 8 for Commerical Dune Tours

Table 8. Number of Pairs of Other Waterbirds Nesting at Cape Cod National Seashore, 2003

SITE	LETE	COTE	ROST	ARTE	BLSK	LAGU	AMOY	WILL
Coast Guard	110	0	0	1	0	0	0	1 [1]
Marconi	8	0	0	0	0	0	0	0
Marconi Station	0	0	0	0	0	0	0	0
Cahoon Hollow	0	0	0	0	0	0	0	0
Newcomb Hollow	0	0	0	0	0	0	0	0
Great Island/Jeremy Point	128	0	0	0	0	0	2	0
New Island	0	0	0	0	0	1	0	1 [1]
Bound Brook - Duck Harbor	0	0	0	0	0	0	0	0
Ballston Beach	0	0	0	0	0	0	0	0
High Head	19	0	0	0	0	0	0	0
Race Point South	21	0	0	0	0	0	0	0
Race Point North	44	1	0	0	0	0	0	0
Wood End/Long Pt.	41	0	0	0	0	0	0	0
Total	371	1	0	1	0	1	2	2

[1] Probably breeding in abundance

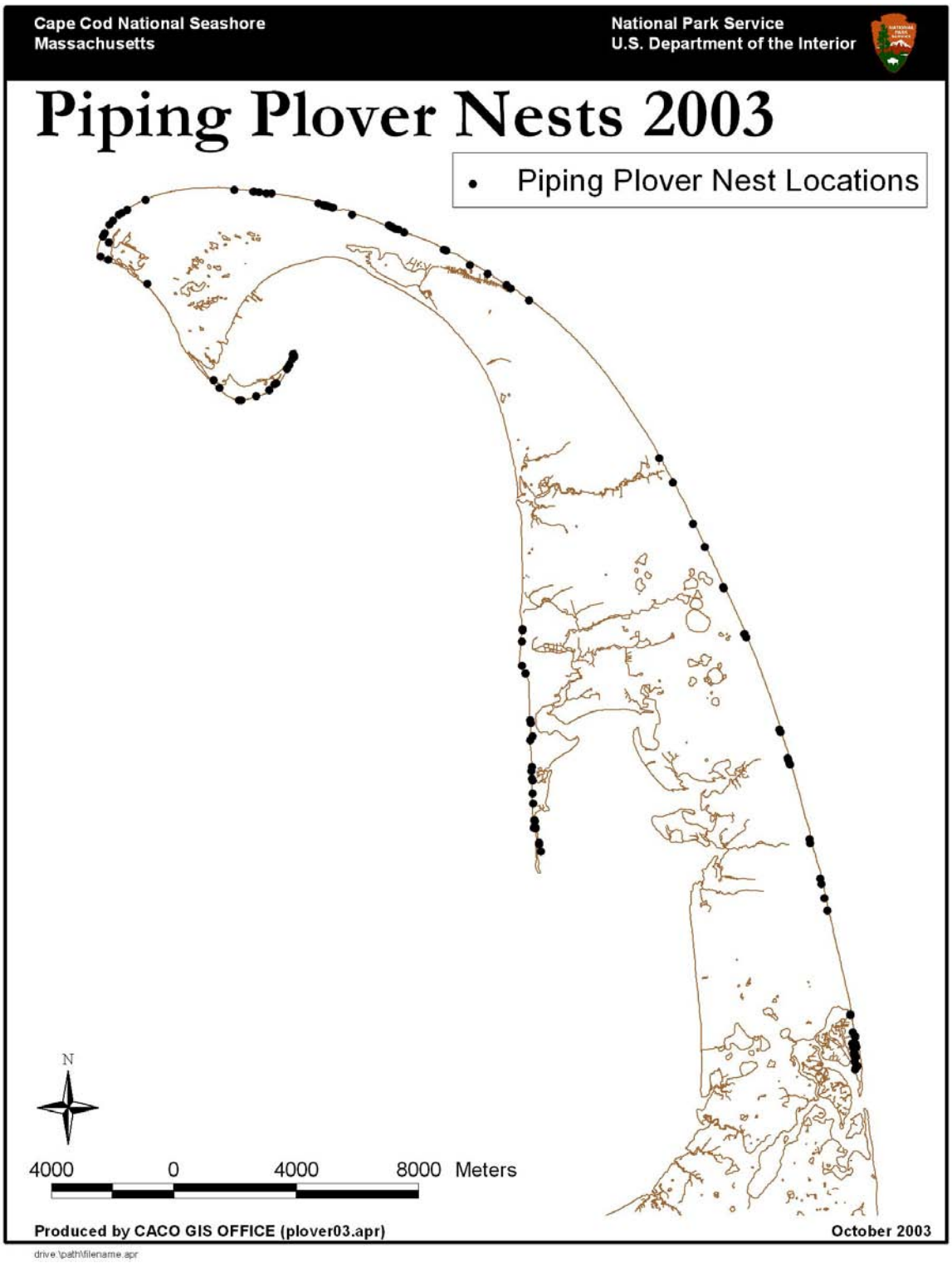
Table 9. Pairs of Colonial Waterbirds on New Island - Orleans, MA, 2000 - 2003

	YEAR				TREND		
Species	2000	2001	2002	2003	2000 - 2001	2001 - 2002	2002 - 2003
Common Tern	1073	493	0	0	-54%	-100%	0%
Roseate Tern	4	4	0	0	0%	-100%	0%
Artic Tern	3	3	2*	1	0%	-67%	-50%
Black Skimmer	5	3	0	0	-40%	-100%	0%
Laughing Gull	721	517	0	1	-28%	-100%	NA

* Probable breeding attempt

Appendix A

Maps of Cape Cod National Seashore 2003 Piping Plover Nest Sites


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nests 2003
Piping Plover Nest Locations
N
4000
0
4000
8000 Meters
Produced by CACO GIS OFFICE (plover03.apr)
October 2003
drive:\path\filename.apr

Appendix B

Maps of Cape Cod National Seashore, North District
2003 Piping Plover Nest Sites

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nests 2003 - North District

- Piping Plover Nest Locations

4000 0 4000 8000 Meters

Produced by CACO GIS OFFICE (plover03.apr)

October 2003

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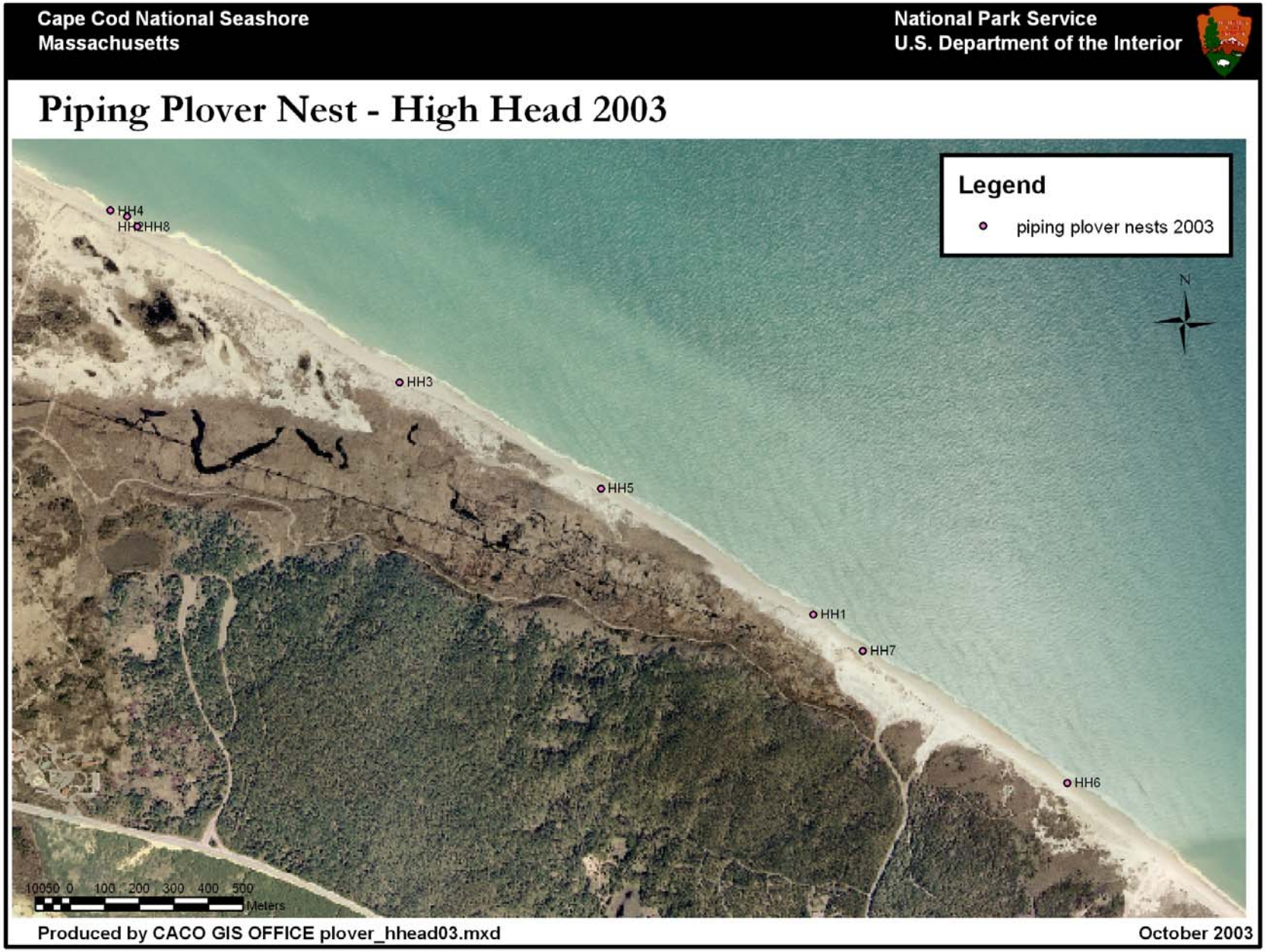

Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest - High Head 2003
Legend
piping plover nests 2003
N
HH4
HH2
HH8
HH3
HH5
HH1
HH7
HH6
10050 0 100 200 300 400 500
Meters
Produced by CACO GIS OFFICE plover_hhead03.mxd
October 2003

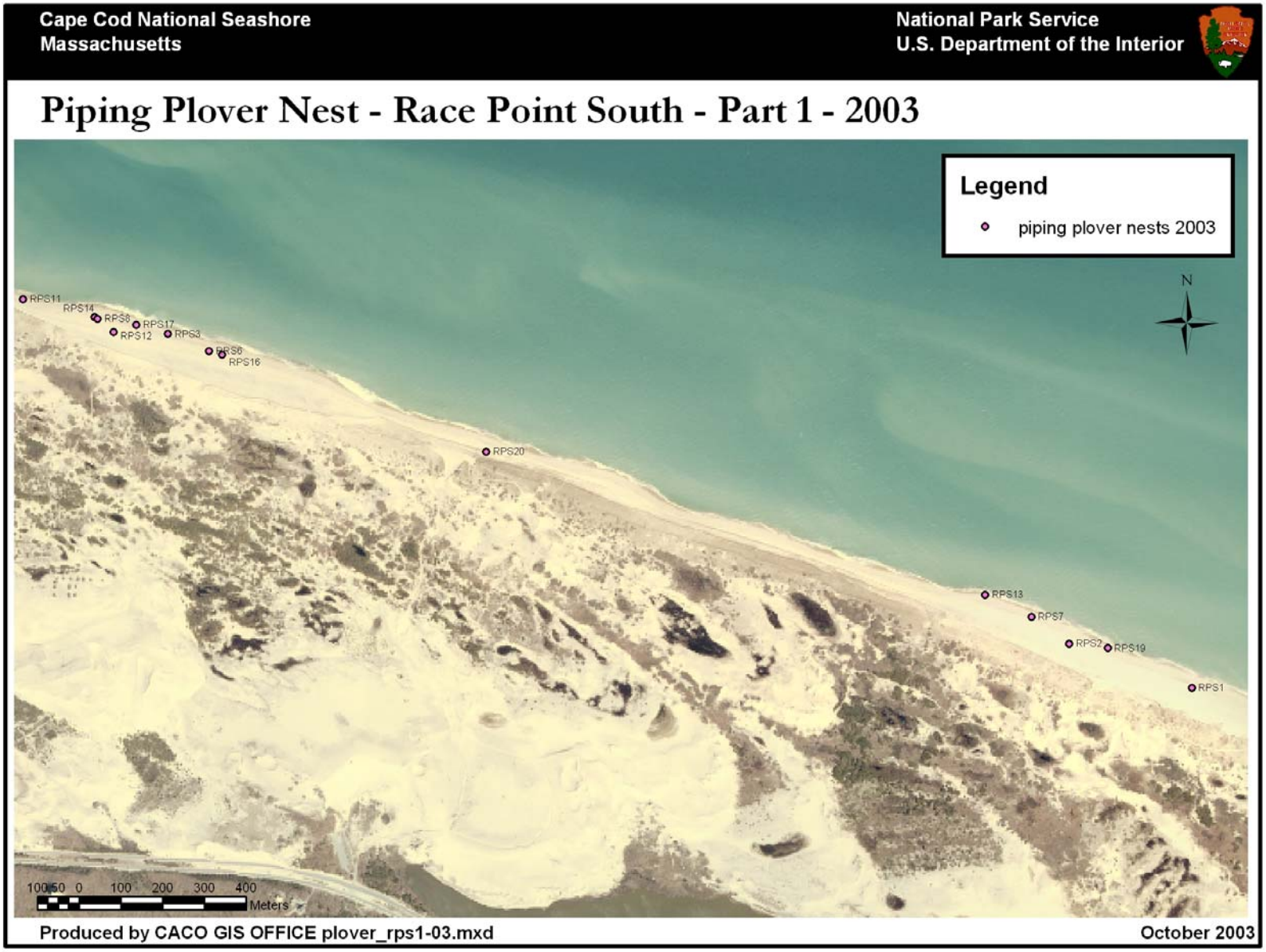
Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nest - Race Point North - 2003

Produced by CACO GIS OFFICE plover_rpn-03.mxd

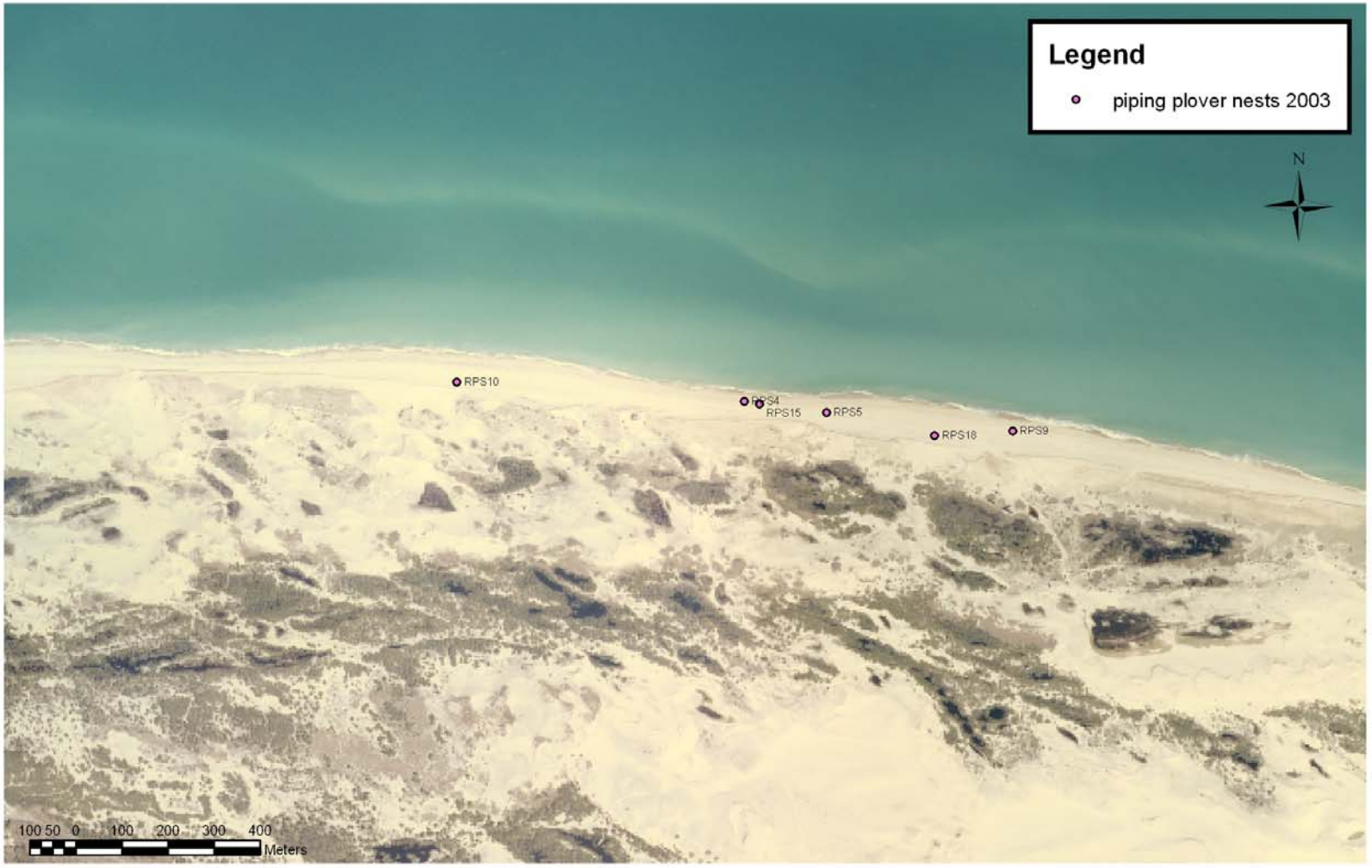
October 2003


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest - Race Point South - Part 1 - 2003
Legend
piping plover nests 2003
N
RPS11
RPS14
RPS8
RPS17
RPS12
RPS3
RPS6
RPS16
RPS20
RPS13
RPS7
RPS2
RPS19
RPS1
100 50 0 100 200 300 400
Meters
Produced by CACO GIS OFFICE plover_rps1-03.mxd
October 2003

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nest - Race Point South - Part 2 - 2003



Produced by CACO GIS OFFICE plover_rps2-03.mxd

October 2003

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nests - Wood End/Long Point - 2003

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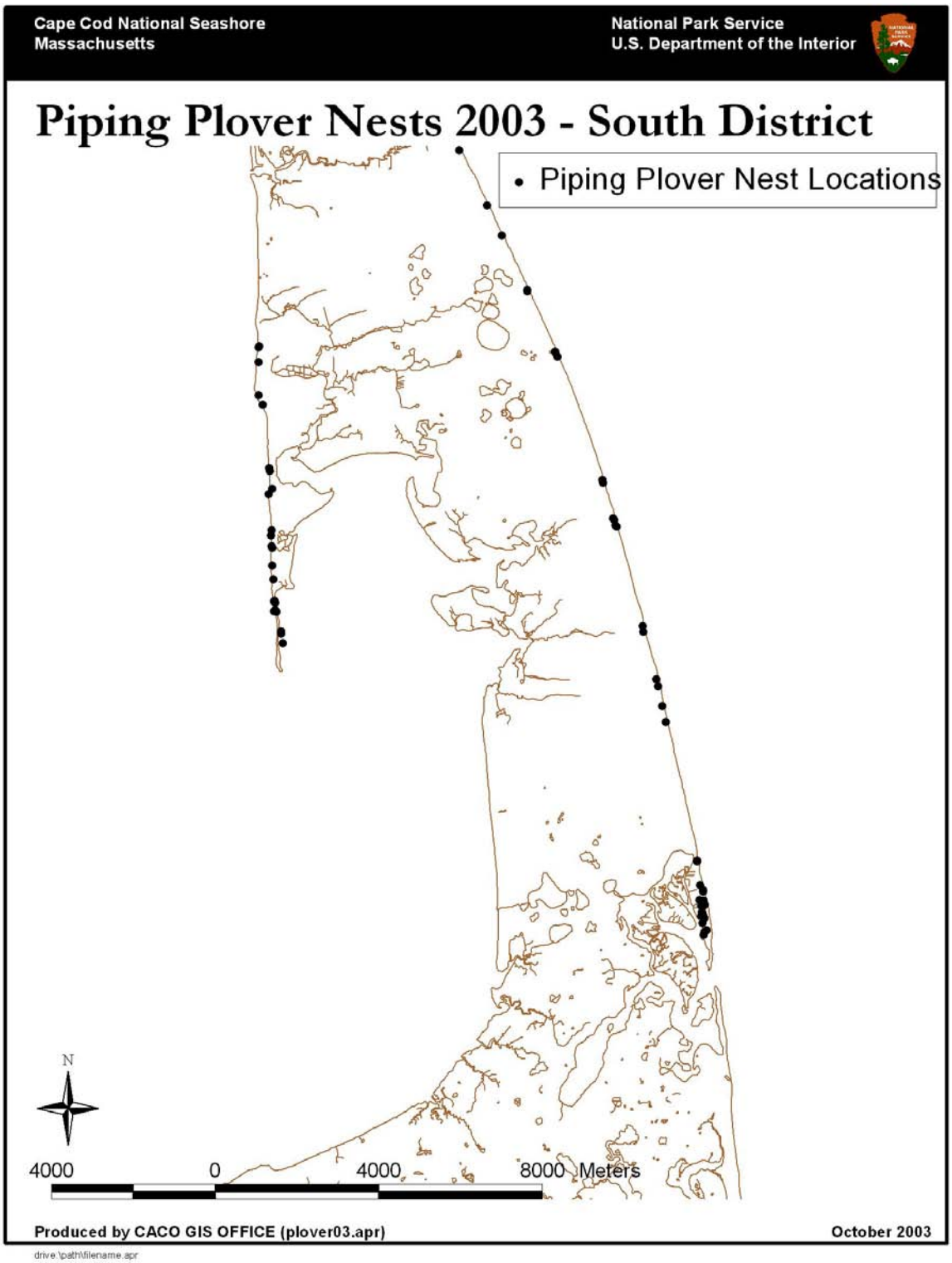
October 2003

Appendix C

Maps of Cape Cod National Seashore, South District
2003 Piping Plover Nest Sites


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nests 2003 - South District
• Piping Plover Nest Locations
N
4000
0
4000
8000 Meters
Produced by CACO GIS OFFICE (plover03.apr)
October 2003
drive:\path\filename.apr


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - Newcomb Hollow 2003
Legend
piping plover nests 2003
N
OS-9
OS-44
OS-45
OS-31
OS-32
100 50 0 100 200 300 400 500
Meters
Produced by CACO GIS OFFICE plover_newcomb03.mxd
October 2003

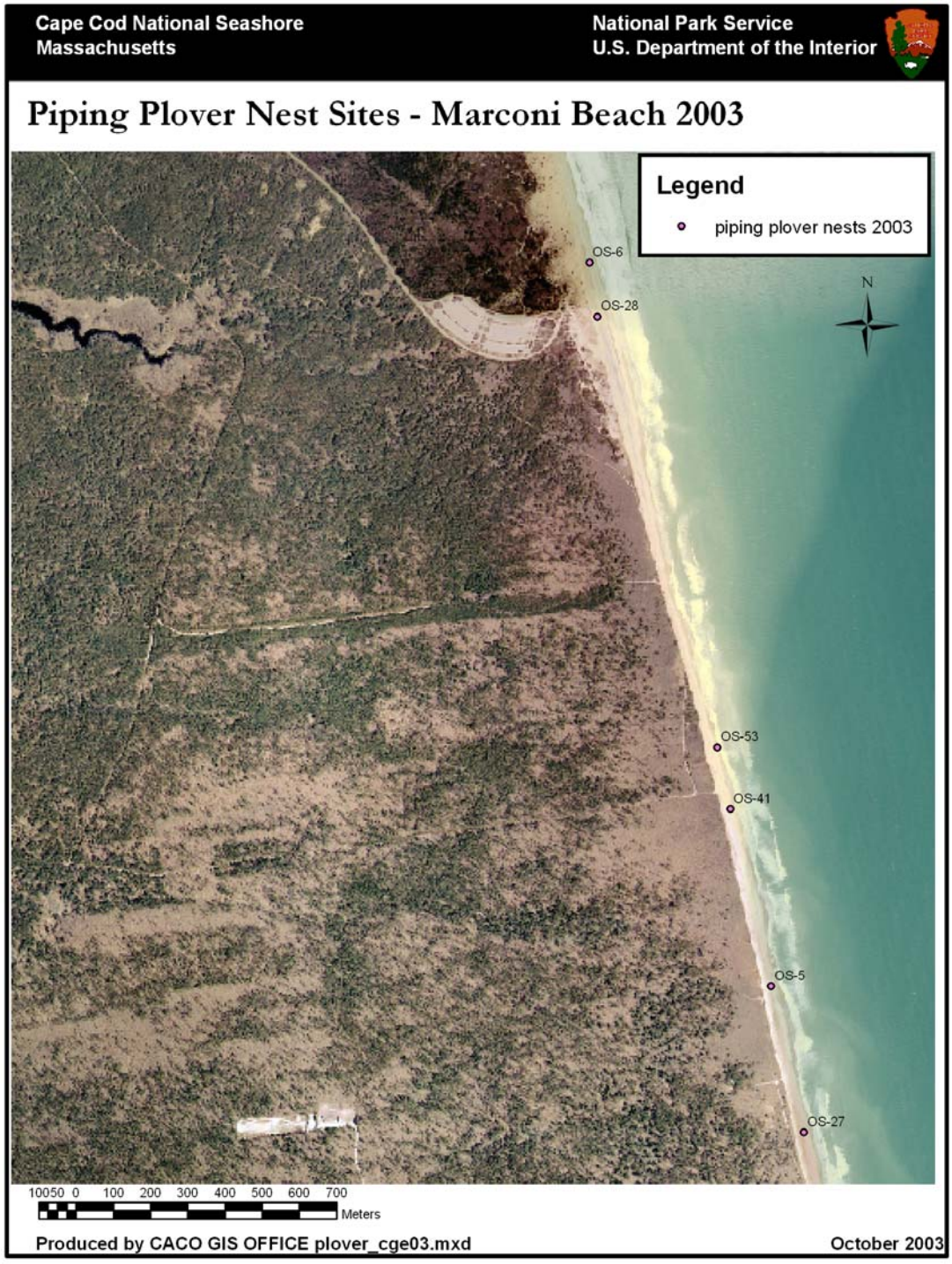

Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - Bound Brook Is to Griffin Is - 2003
Legend
piping plover nests 2003
BS-24
BS-2
BS-1
BS-25
BS-26
100 50 0 100 200 300 400 500 600
Meters
Produced by CACO GIS OFFICE plover_newcomb03.mxd
October 2003


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - Coast Guard, Eastham 2003
Legend
piping plover nests 2003
OS-29
Oystercatcher
OS-15
OS-43
OS-56
OS-40
OS-17
OS-20
OS-59
OS-21
OS-37
OS-61
OS-16
OS-54
OS-42
OS-38
OS-60
OS-14
OS-22
OS-50
Arctic Tern
N
100 50 0 100 200 300 400 500 600 700
Meters
Produced by CACO GIS OFFICE plover_cge03.mxd
October 2003


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - Great Island area - 2003
Legend
piping plover nests 2003
BS-10
BS-11
BS-4
BS-26
BS-46
BS-18
BS-48
BS-3
BS-62
100 50 0 100 200 300 400 500 600
Meters
Produced by CACO GIS OFFICE plover_newcomb03.mxd
October 2003


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - Great Island area - 2003
Legend
piping plover nests 2003
BS-35
BS-19
BS-36
BS-13
BS-12
BS-55
BS-39
BS-57
BS-47
BS-24
BS-30
oystercatcher2
oystercatcher1
100 50 0 100 200 300 400 500
Meters
Produced by CACO GIS OFFICE plover_newcomb03.mxd
October 2003


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - LeCount Hollow 2003
Legend
piping plover nests 2003
N
0S-34
OS-8
OS-49
OS-7
0S-58
OS-52
100 50 0 100 200 300 400
Meters
Produced by CACO GIS OFFICE plover_lecount03.mxd
October 2003


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nest Sites - Marconi Beach 2003
Legend
piping plover nests 2003
OS-6
OS-28
N
OS-53
OS-41
OS-5
OS-27
10050 0 100 200 300 400 500 600 700
Meters
Produced by CACO GIS OFFICE plover_cge03.mxd
October 2003