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

# 2002

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**ABSTRACT**

This report summarizes the 2002 Piping Plover (*Charadrius melodus*) and waterbird nesting season for Cape Cod National Seashore (CACO). Piping Plover nesting and brood-rearing were monitored at 13 beaches in Cape Cod National Seashore from Provincetown to Orleans. Observations of Piping Plovers began mid March. Ninety-seven pairs of plovers were monitored at these 13 sites. Egg laying began in the third week of April in the South District and the fourth week of April in the North District. Peak nesting occurred during the last week of May. There were a total of 97 nesting pairs, 52 in the South District and 45 in the North. Hatching success was 41%. Fledging success was 50%. A total of 88 chicks fledged. Productivity was 0.91 chicks fledged/pair. Sixty percent (84 of 141 nests (82 total nests in South, 59 total nests in North)) of all nests initiated failed to hatch at least 1 chick. The leading causes of nest loss included predation (40%), overwash (20%) and nest abandonment (17%). Of 77 exclosed nests, 49 (64%) successfully hatched young. Of the 28 exclosed nests that did not hatch, 14 failed due to abandonment, 10 to overwash, 3 to predation, and one nest was non-viable. Of 64 unexclosed nests, 56(87%) failed to hatch. Of these 56 failed unexclosed .nests, 37 were lost to predators and 10 to overwash, 6 were sanded over, and 3 were abandoned. This was the fifth year the 1995 negotiated rule for ORV management was in effect. Twenty-seven pairs of plovers nested within the ORV corridor. Thirteen of these pairs nested in the 4-mile section of Race Point South Beach closed per Negotiated Rule 15 November until at least 21 July, and six 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 33 days. Closures, to some extent, were imposed on Race Point North Beach for a total of 58 days. By 20 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 Cape Cod National Seashore and throughout Massachusetts. In 2002, 97 pairs, representing approximately 20% of the state total, nested on CACO beaches. Productivity at Cape Cod National Seashore 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 2002 Piping Plover/Colonial Waterbird monitoring and management program at Cape Cod National Seashore.

## STUDY AREA

Piping Plovers were monitored on 13 beaches in Cape Cod National Seashore 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, Nauset, and Coast Guard Beach). A map of all Piping Plover nest sites monitored by the Cape Cod National Seashore 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 2001. Kite flying was also prohibited in the North District near any potential plover nesting sites. Large signs were installed to inform beachgoers of these restrictions, and a press release was submitted to the local media.

Historic plover nesting sites (Coast Guard, Marconi, and Jeremy Point) were closed with symbolic fencing/signs, installed by the second week of April. 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 April, during the period of arrival and courtship, most beaches were visited three to four times per week. The exception was Great Island, monitored every 2-4 days. Once nests were established, all beaches were visited almost daily (> 5 times per week) except for Great Island/Jeremy Point which was visited 2-3 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 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 2002, 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 Cape Cod National Seashore beaches on 17 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 third week of April in the South District and the fourth week in the North District. The first nest (with 4 eggs) was found on 25 April at Jeremy Point. Because it was a complete clutch it cannot be determined when the first egg was laid but it was no later than 17 April. This nest was overwashed on 1 May. The first nest to hatch chicks occurred on 26 May at Race Point South Beach and this nest fledged 1 chick. Peak nesting for the Seashore occurred during the last week of May (Fig.1). The last nest was initiated on 25 June (15 days later than 2001) at Ballston Beach. The last nest hatched 25 July and fledged two chicks on 22 August. Peak nesting for the Seashore this year was consistent with the patterns exhibited in years past, however the nesting season was prolonged by many renests. In the North District, the main reason for renesting was nest loss to overwash accounting for 19% of the losses (Table 3). In the South District, overwash was also a problem accounting for roughly 14% of the losses, but it was primarily 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) that accounted for nearly 40% of the losses in the South (Table 3).

Hatching dates ranged from 26 May to 25 July. Fledging dates ranged from 24 June to 22 August. These dates are about two weeks later than previous years.

Nesting Pairs

Ninety-seven pairs of Piping Plovers were monitored at 13 sites in Cape Cod National Seashore in 2002. This represents approximately 20% of the total breeding population in Massachusetts. Number of nesting pairs at the 13 sites monitored increased by 28 from 2001 (69 pairs in 2001 to 97 pairs in 2002) (Fig. 2). Most beaches saw an increase of nesting pairs. The greatest increase in number of nesting pairs occurred at High Head, where numbers rose from the 4 observed in 2001 to 8 pairs in 2002. Marconi, Great Island/Jeremy Point, Bound Brook/Duck Harbor, Wood End/Long Point and Race Point South all saw an increase of two nesting pairs. For the first time in recent history, pairs nested at White Crest, Cahoon Hollow and Newcomb Hollow Beach. Coast Guard Beach and Ballston remained the same. Race Point North saw the only decline, losing one nesting pair.

Hatching Success

Hatching success (total number of eggs hatched/total number of eggs laid) for all sites combined was 0.41 and ranged from 0 to 100% (Table 1). Overall, hatching success was 29% lower than in 2001. Reasons for this decrease in hatching success include increased egg predation associated with recommended discontinued use of predator exclosures in the South District and nests getting overwashed.

Hatching success was greatest at Newcomb Hollow (100%), Race Point North (82%), Wood End/Long Point (65%), High Head (64%), LeCount (63%), Race Point South (61%), and Bound Brook/Duck Harbor (60%). The lowest hatching success occurred on Great Island/Jeremy Point (25%), Coast Guard (22%) Cahoon Hollow (14%) Nauset/Marconi (9%). White Crest had no eggs hatch (Table 1).

Fledging Success

Fledging success (total number of chicks fledged/total number of eggs hatched) for all sites combined was 0.57 and ranged from 0 to 100% (Table 1). Overall, fledging success decreased 26% from 2001. The greatest fledging success occurred on Newcomb Hollow (100%), Cahoon Hollow (100%), and Ballston Beach (86%), but these sites represent only seven nesting pairs. The sites with the lowest fledging success were White Crest (0), Great Island/Jeremy Point (27%), and High Head (30%) (Table 1). Although the number of nesting pairs increased at High Head from 2001, fledging success for 2002 decreased from 100% to 30%.

Productivity

Productivity (number of chicks fledged/nesting pair) for all sites was 0.91 (88 chicks fledged from 97 pairs) and ranged from 0 to 4.00 (Table 1). This is significantly lower than 2001 when total productivity was 2.04. The North District had higher productivity (1.18 chicks/pair) than the South (0.67 chicks/pair).

Productivity incorporates both hatching success and fledging success. While it is relatively easy to determine and quantify the causes of nest loss, doing so for chicks is far more difficult. In 2002 the principal causes of decreased productivity likely were predation and the associated discontinued use of exclosures on some beaches, unfavorable weather conditions, and abandonment of exclosures.

Productivity was greatest at Newcomb Hollow (4.00), Bound Brook/Duck Harbor (2.25), and Race Point North (1.67), while the lowest productivity occurred at Great Island/Jeremy Point (0.32), Nauset/Marconi (0.29) and White Crest (0.00) (Table 1). It is important to note that productivity greater than 1.25 is required for maintaining the population at current levels. The goal of the Atlantic Coast Piping Plover Recovery Plan is to maintain productivity at a minimum of 1.24 (Melvin and Gibbs 1994).

Nest Loss

Sixty percent (84 of 141 nests) of all nests initiated failed to hatch at least 1 chick (Table 2). This is an increase from 2001 when only 31% (27 of 88) nests were lost. Seven of the eight South District beaches lost at least one nest and four of the five North District beaches lost at least one nest in 2002 (Table 3). Predation (n=39), overwash (n=20) and abandonment after the nest was exclosed (n=14) were the leading causes of nest loss, accounting for 73 of the 84 (87%) nests lost (Table 2). Of the 84 lost nests, 56 (67%) had not been exclosed and 28 (33%) had been exlclosed. Predators, particularly gulls, crows, and skunks continue to be more apparent on beachfronts than in recent years and accounted for 66% (37 of 56) of unexclosed nest failures (Table 4), an increase of 12% from 2001. A total of 92 eggs were lost from unexclosed nests (Table 5). Some of these eggs were lost before the pair was actively incubation the nest and 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 77 of the 141 (55%) nests. Of the 77 exclosed nests, 49 (63%) successfully hatched young. Of the 28 exclosed nests that did not hatch, 14 (50%) failed due to abandonment and 10 (34%) were lost to overwash (Table 4). The remaining exclosed nests were lost to skunk (4%), unknown predator (4%), non-viable (4%) and to a dead adult plover inside the exclosure (4%).

There was a total of 64 unexclosed nests. Of these nests, 56 (88%) failed to hatch (Table 4). Although the number of unexclosed nests seems extremely high, 45 of these nests (70%) were

either incomplete clutches (with < 3 eggs), not actively being incubated, or lost before they were ready for the placement of the exclosures around nest.

The greatest loss of unexclosed nests was to predation (66%) including 13 (23%) to unknown predators, 8 (14%) to crow, 6 (11%) gull, 5 (9%) canid, 4 (7%) to skunk and 1 (2%) to coyote. The remaining loss of unexclosed nests were to overwash (n=10, 18%), sanding over (n= 6, 11%) and abandonment (n= 3, 5%).

Also, early in the season, several exclosures were taken down immediately after being installed. Pairs were exhibiting distress behavior (running in and out of the exclosure) and did not resume incubation and accept the presence of the exclosure. When the exclosure was removed, the bird sat back on the nest. These nests were later lost to predation. An additional 5 nests were not exclosed due to their location in dense vegetation or on the side of a steep dune.

Abandonment of Exclosed Nests

Prior to 2001, abandonment of exclosed nests was low in both districts. In 2001, 14% (10 of 70) of all exclosed nests were abandoned, with all but one occurring on South District beaches. In 2002, 18% (14 of 77) of all exclosed nests were lost to abandonment on three South District beaches and accounted for 49 lost eggs (Table 6). Although some exclosures were placed around an incomplete nest, most nest abandonment occurred over two weeks after clutch completion (Table 7).

In 2002, not only was there a higher frequency of nest abandonment, there was greater concern regarding the risk of adult mortality associated with the use of predator exclosures. On 2 June, Mary Hake found an adult plover dead inside an exclosure at Coast Guard Beach, Eastham. The bird had been dead for several days. There was no evidence (tracks, feathers etc.) of a predator inside or outside the exclosure, nor any sign of mammals digging under the exclosure. It appeared that an animal picked at the chest of the plover, but it's hard to say if this is a result of a

predator killing it or if it occurred postmortem. On the same day, four other exclosed nests were found abandoned on Coast Guard Beach, with the eggs still present at all nests. This incident was reported to Dr. Scott Melvin, Sr. Zoologist, Massachusetts State Fisheries and Wildlife Department and Ms. Anne Hecht, Endangered Species Biologist, U.S Fish and Wildlife Service.

Prior to 2002, abandonment of an exclosed nest was attributed to disturbance or a plover not accepting the presence of the exclosure. Dr. Melvin explained that there is now a growing suspicion among plover biologists that plovers are being killed inside exclosures by predators, and that the "abandonment" is due to the loss of the adult bird(s). Dr. Melvin recommended monitoring the remaining exclosed nests at Coast Guard Beach daily and to not exclose any new nests found on this beach.

Nest abandonment occurred again on Great Island and Jeremy Point when six exclosed nests were found abandoned on 9 June. The cause could not be determined, but when several exclosed nests at a particular site are abandoned on the same day, it is often predator related. It may have been one "smart predator" (crow or owl) that perched on each exclosure, disturbing the plovers to the point of abandonment and in one case possibly killing an adult.

Great effort was taken to account for the nesting pairs that abandoned their nests at all sites. Eleven of 14 nesting pairs were accounted for.

After this second case of multiple nest abandonment, Dr. Melvin recommended that we stop exclosing all new nests found in the South District for the season due to concerns regarding adult mortality associated with abandonment. The remaining exclosed nests throughout the district remained up and monitored daily.

The question is what to do next year in the South District. The increased frequency of abandonment in exclosed nests is substantial, and there are concerns regarding adult mortality. But, if nests are not exclosed, they are usually depredated. If abandonment is caused by a "smart predator" perching on the exclosure, perhaps trying a new exclosure design on a few nests (that

would then be monitored closely) is called for. This has been successful at other sites in Massachusetts, including Parker River National Wildlife Refuge (Melvin 2001).

Increased effort is also needed to assess the abundance of all predators and, if needed, identifying the individual "smart predators" on specific beaches.

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). This year an increased number of older (11+-day-old) chicks failed to fledge. We could not directly attribute chick mortality to any specific factor, although weather and late nesting may have affected chick survival. May and June had several periods of unseasonably cold/windy and wet weather, which at times coincided with severe storms and extreme high tides (Wapple 2002). Conversely July/August were unusually hot and dry (Lawrimore 2002). Visser and Ricklefs (1993) showed that Charadriidae neonates are not able to properly regulate their own body temperature, due to relatively low metabolic rates. It is speculated that the inclement weather led to significant chick loss, possibly due to starvation from prolonged brooding periods.

Shorebird personnel noted an increase in predator sightings since 2001, including Northern Harriers (*Circus cyaneus*), Northern Ravens (*Corvus corax*) and coyotes (*Canis latrans*). It is possible that these species, along with gulls, crows (which congregate in large groups on the beachfront), and frequently observed unleashed dogs may have contributed to chick mortality.

Implementation of the Negotiated Rule

*ORV Management* - ORV management, as it relates to plover management at Cape Cod National Seashore, is a dynamic process. This was the fifth year of the negotiated rule of 1995. We observed no direct negative impacts to Piping Plover (PIPL) adults or chicks in 2002.

The presence of PIPL chicks caused the closure to ORV traffic on portions of Race Point North beach (RPN) for a total of 58 days (7 days greater than 2001). On 2 August (4 days earlier than 2001) the entire RPN oversand route was opened to ORV traffic due to the absence of PIPL chicks. Race Point South beach (RPS) was closed to some extent between Exit 8 and RPS Self-contained Vehicle (SCV) Area for 55 days (20 days greater than 2001). The Night Fishing corridor located at Coast Guard beach (Truro) was not effected due to lack of PIPL nesting. The stretch of beach between Head of the Meadow and High Head was completely open (20 August) for 11 days, in comparison with the 5 weeks it was open in 2001. As of this date the entire ORV corridor was opened to vehicles.

*Plover management* - Twenty-seven of 45 (60%) North District PIPL pairs nested within the ORV corridor (3 more than in 2001). Seventeen pairs (25 nests) chose to nest in the area closed to ORV traffic, 10 pairs (11 nests) chose to nest in areas open to ORV traffic (opening/closure mandated by the Negotiated Rule). 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.

This year's Piping Plover breeding period was prolonged in comparison to recent years, due mainly to continual renest attempts stemming from reasons stated earlier (see Results and Discussion). These repeated renest attempts combined with nest site locations that were in proximity to ORV access points, resulted in extensive closures.

The following is a chronological discussion of the principal events and responses. This information is summarized in Table 8, written in fulfillment of requirements of the Negotiated Rule.

A PIPL nest along the pole-line route began to hatch late afternoon 19 June. North District Rangers and shorebird personnel worked together to monitor the brood continually until it safely moved into Hatches Harbor at 0830 the following morning 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.

The anticipated hatching of two nests in close proximity to ORV corridor entrances prompted several new actions to be initiated to best accommodate both visitors and breeding PIPL pairs. In coming years, different management actions may be undertaken to what appears to be similar scenarios. At RPN the location of a PIPL nest made it inevitable that upon hatching (expected 30 June) the area in which the RPN SCV Area occupied would be closed. Likewise on RPS, the location of another PIPL nest would restrict travel to 0.2 miles south of the RPS entrance upon hatching (expected 30 June). To prepare for these closures 0.2 miles were added to RPS SCV Area by extending the corridor north of the RPS entrance on 25 June. This area was previously closed to ORV traffic. This allowed the RPS SCV Area to be extended to the greatest extent it could, given foresight into future corridor availability. The following day, 26 June, a single-track lane for ORV passage was laid as high as possible across the RPN protected beach. This would enable large SCVs that could not navigate the RPS entrance to access the RPS SCV Area and the available corridor. The single-track corridor was posted with informational signs to Race Point 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.

On the evening of 27 June (three days prior to the estimated hatch date of the PIPL nest) the remaining RPN SCVs were escorted to the RPS SCV Area and the RPN SCV Area was closed. The RPN corridor remained open until the nest hatched, as usual.

The following morning, 28 June, the RPN PIPL nest began to hatch (2 days early) and the RPN corridor was closed. The RPN entrance remained open for vehicles to enter RPN beach and park, as well as for SCVs to access the single-track corridor to RPS SCV Area. In accordance with state and federal guidelines the brood was scrupulously monitored to insure it did not wander proximal the open RPN entrance parking area. The morning of 30 June the RPS PIPL nest began to hatch and the RPS corridor was reduced to 0.4 miles.

In the early morning of 8 July the brood from the RPN PIPL nest began to move into the RPN entrance parking area. The RPN entrance was subsequently closed. This brought forth a change in the designated hours of travel implemented at the single-track corridor across the protected beach. The PIPL brood was to be monitored continually by shorebird personnel during the hours that the single-track corridor was open (0530-0800 & 1730-2000 daily). This practice would continue until the evening of 15 July when it was clear that the brood had moved to a location again allowing a safe buffer between them and the RPN entrance. The RPN entrance was reopened and the hours of the single-track corridor were changed to 1730-0800 daily.

One mile of RPN opened on 29 July due to the fledging of (all) two chicks from the RPN PIPL nest. This allowed the RPN SCV Area to be reestablished. All SCVs present in RPS SCV Area were notified that the single-track corridor would be closed and removed at 0800 hours 2 Aug. All vehicles that could not navigate the RPS entrance must move to the RPN SCV Area prior to that date. On 2 August the single-track corridor was closed and removed. Coincidentally the remainder of RPN beach was opened, due to the failure of the final RPN PIPL brood. The pole-line route was then closed, because access to Hatches Harbor was available via RPN beach. Also on 2 Aug 2.0 miles of corridor opened on RPS following the fledging of two chicks from the PIPL nest. The remainder of RPS beach wasopened on 13 Aug.

## COLONIAL WATERBIRDS

Least Terns

Least Terns returned to Cape Cod National Seashore during the second week of May. Egg laying began the last week of May, with most Least Terns on eggs by 15 June. Renesting attempts continued through late August. The first chick was observed on 7 July in the North District.

A total of 153 pairs nested on three beaches in the South District (Table 10). Approximately 85% of the first nesting attempts on all beaches were depredated by 20 June. Tracks indicated coyote, skunk and gulls to be the major predators. Most pairs renested with some shifting of nesting locations. Egg predation continued for the duration of the breeding season. It was not uncommon to walk through a colony and observe many nests, only to return a week later to find empty scrapes. A total count of 3 chicks was observed in the entire South District and only one chick fledged.

The North District fared much better. A total of 163 pairs nested on five beaches (Table 10). Minor egg depredation by coyote and other unidentified predators occurred at all areas, but was heaviest at Wood End and Long Point. 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. Overall depredation combined with overwash led to Least Terns having to breed later in the season. Despite a prolonged breeding season visual estimates of the fledglings suggest a relatively productive year. The last Least Tern fledged at High Head during the fourth week of September.

Common Terns

Common Terns were first sighted on 16 May. The first nest was found at Coast Guard Beach on 1 June. In the South District, nesting occurred only on the Southern tip of Coast Guard Beach with 112 pairs. This new nesting location is probably birds relocating from New Island, Orleans. For the first time in over 20 years, there were no colonial waterbirds nesting on New Island. For the past two years, this island experienced a continued decline in nesting birds and extremely low productivity due to intense predator pressure. The colony at Coast Guard fared no better. Gull, skunk and perhaps coyote depredated all nests. A single pair attempted to breed on Race Point North Beach, but the nest was depredated by an unidentified canid.

Roseate Terns

No Roseate Terns nested on New Island in 2002. Since 1999, this island supported 3-4 nesting pairs. 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 two alternative sites in the state that ensured that if the Buzzard Bay colonies were hit hard by some disaster, a few Roseates would survive.

Arctic Terns

For the past 25 years, three pairs of Arctic Terns nested on New Island. In 2002, there was no confirmed nesting of Arctic Terns. On 9 June, one pair was exhibiting territorial behavior on the southwest corner of New Island, but no nest was found. An additional pair was observed

in with Common Terns on the Southern tip of Coast Guard Beach. The pair was acting territorial (dive-bombing) but no nest was found.

Black Skimmers

There were no Black Skimmers nesting on New Island or anywhere in the state in 2002.

Laughing Gulls

There were no Laughing Gulls nesting on New Island this year. Historically, this island supported the largest Laughing Gull colony in the state. Over the past four years, the number of nesting pairs has slowly declined and productivity has been low to none (Table 9). The reason for the decline in nesting birds and productivity may be due to intense predator pressure.

American Oystercatchers

A total of three pairs of American Oystercatchers nested at Cape Cod National Seashore, all in the South District. An unknown predator depredated one nest located on Coast Guard Beach. The other two nests were on Jeremy Point. An unknown predator also depredated one of these nests; the other hatched one chick. This chick disappeared shortly after hatching and is not thought to have fledged.

## MANGEMENT RECOMMENDATIONS

1. 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.
2. Approximately 0.2 miles of the eastern side of Jeremy Point was closed to pedestrians to protect a plover nest that was found on an extremely narrow piece of beach. This practice was effective, well received by the public and should continue if needed in 2003.
3. Dogs off leash continue to be a chronic problem in the park. 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 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 record incidences of dogs off leash formally in 2003 to determine usage trends.

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**Figure 1.** Weekly Active Piping Plover Nests at Cape Cod National Seashore 2002

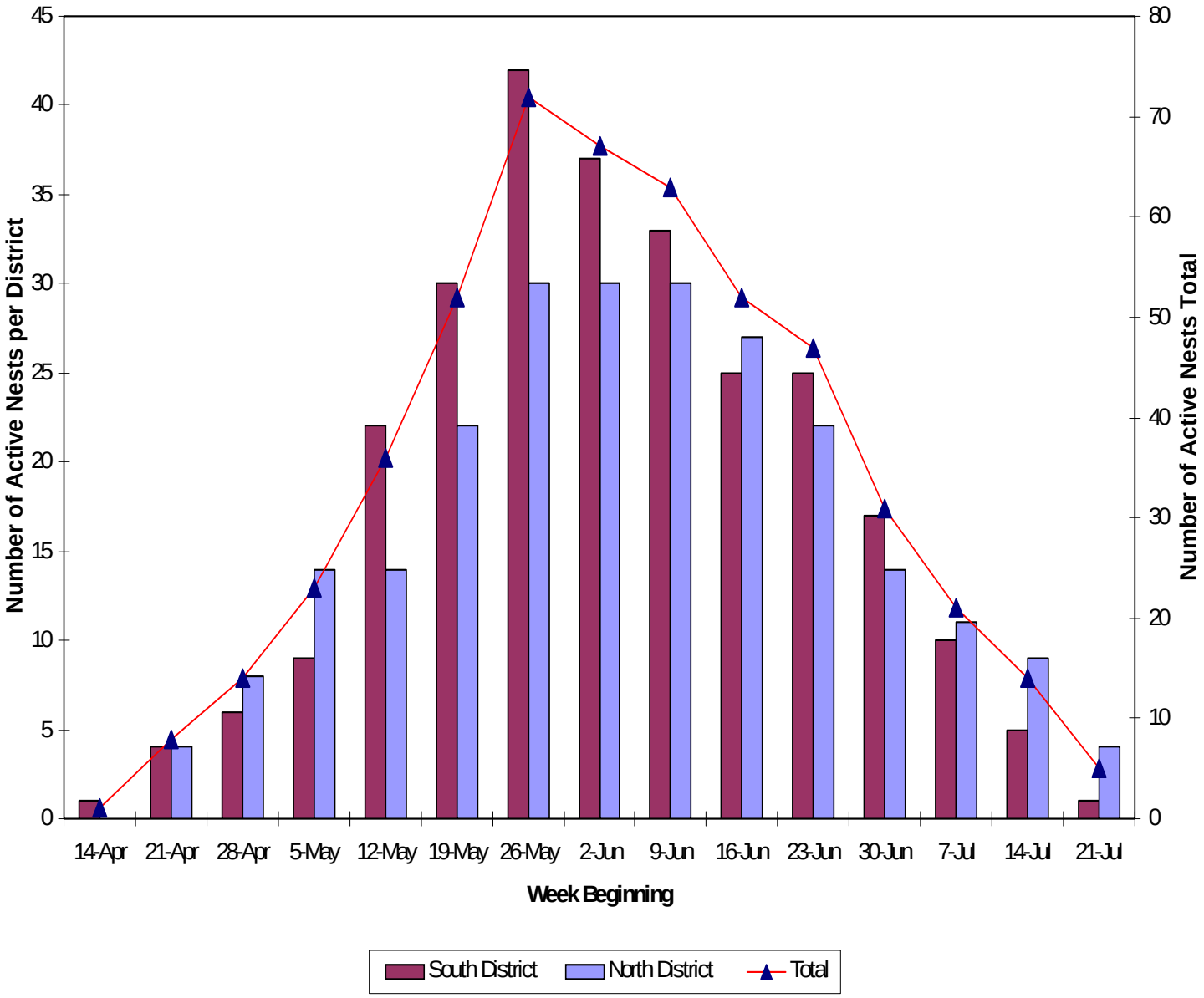


**Figure 2.** Number of Piping Plover breeding pairs and nest productivity on beaches managed by the National Park Service, Cape Cod National Seashore, 1985-2002.

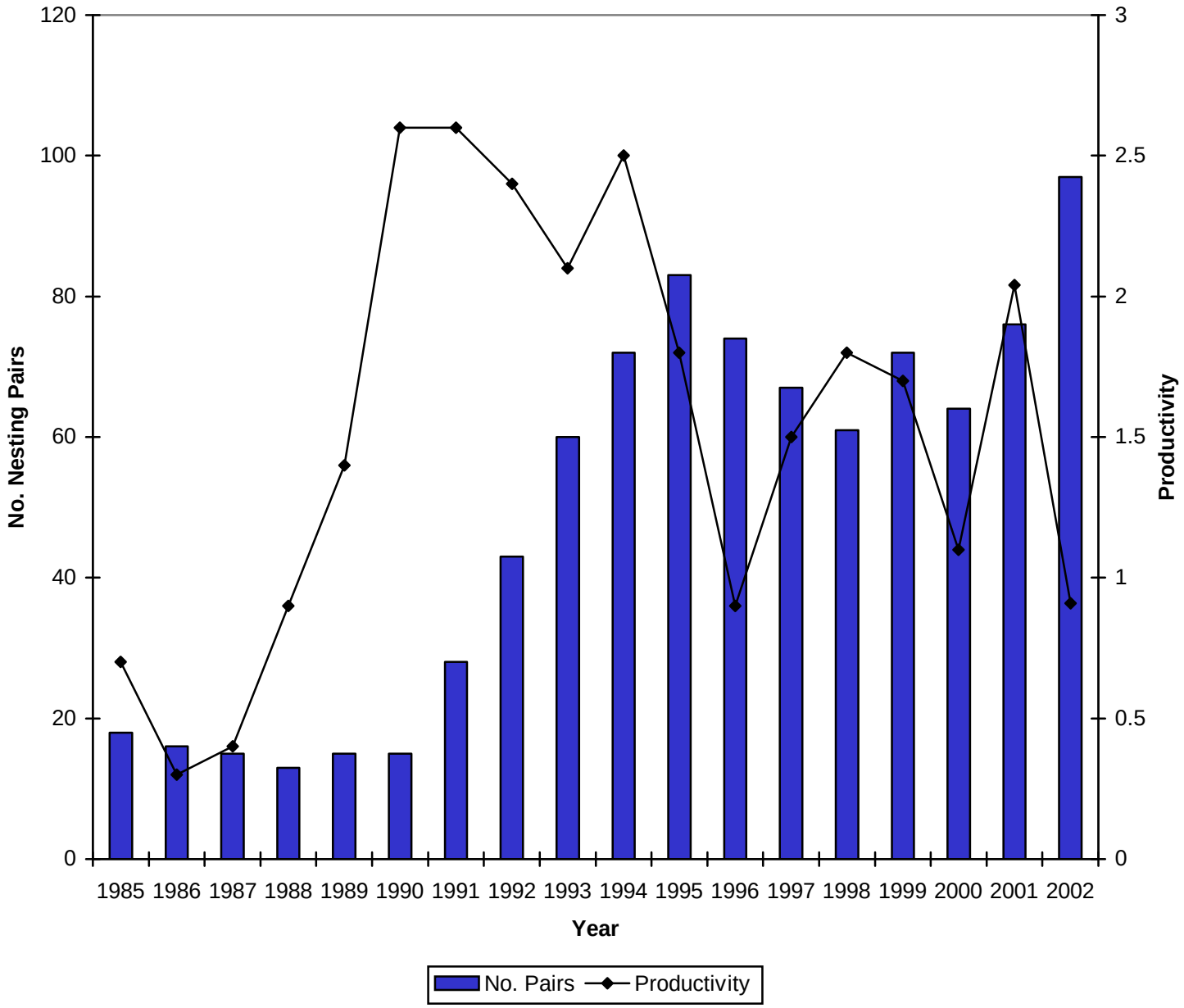


**Table 1.** Summary of Piping Plover Breeding Success, Cape Cod National Seashore, 2002.

| 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 | 14 | 27 | 81 | 18 | 10 | 0.22 | 0.56 | 0.71 |
| Nauset - Marconi | 7 | 13 | 33 | 3 | 2 | 0.09 | 0.67 | 0.29 |
| LeCount | 4 | 4 | 8 | 5 | 3 | 0.63 | 0.60 | 0.75 |
| White Crest | 1 | 1 | 4 | 0 | 0 | 0.00 | 0.00 | 0.00 |
| Cahoon Hollow | 2 | 3 | 7 | 1 | 1 | 0.14 | 1.00 | 0.50 |
| Newcomb Hollow | 1 | 1 | 4 | 4 | 4 | 1.00 | 1.00 | 4.00 |
| Great Is - Jeremy Pt | 19 | 27 | 88 | 22 | 6 | 0.25 | 0.27 | 0.32 |
| Bound Brook - Duck Harbor | 4 | 6 | 20 | 12 | 9 | 0.60 | 0.75 | 2.25 |
| Ballston Beach | 4 | 10 | 26 | 7 | 6 | 0.27 | 0.86 | 1.50 |
| High Head | 8 | 12 | 36 | 23 | 7 | 0.64 | 0.30 | 0.88 |
| Race Point South | 17 | 20 | 62 | 38 | 16 | 0.61 | 0.42 | 0.94 |
| Race Point North | 6 | 6 | 22 | 18 | 10 | 0.82 | 0.56 | 1.67 |
| Wood End - Long Point | 10 | 11 | 37 | 24 | 14 | 0.65 | 0.58 | 1.40 |
| **TOTAL** | **97** | **141** | **428** | **175** | **88** | **0.41** | **0.50** | **0.91** |

[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 pairs

**Table 2.** Nest Loss Totals, Cape Cod National Seashore, 2002 .

| Total Nests | NESTS | | | PER CAUSE | | Cause |
|---|---|---|---|---|---|---|
| | No. Hatched | No. Lost | % Lost | No. Lost | % Lost | |
| 141 | 57 | 84 | 60% | | | |
| | | | | 39 | 46% | Total predation |
| | | | | 20 | 24% | Overwash |
| | | | | 14 | 17% | Abandoned after excl. |
| | | | | 7 | 8% | Sanded over |
| | | | | 3 | 4% | Abandoned pre-excl. |
| | | | | 1 | 1% | Non-viable |
| | | | | | | Predation types |
| | | | | 12 | 14% | Unknown Pred (not excl.) |
| | | | | 8 | 10% | Crow (pre-excl.) |
| | | | | 6 | 7% | Canid (spp. ?) (not-excl.) |
| | | | | 6 | 7% | Gull (pre-excl.) |
| | | | | 3 | 4% | Skunk (pre-excl.) |
| | | | | 1 | 1% | Dead adult plover inside excl. |
| | | | | 1 | 1% | Skunk (excl.) |
| | | | | 1 | 1% | Small mamal (spp. ?) |
| | | | | 1 | 1% | Unknown Pred (inside excl.) |

**Table 3.** Causes of Piping Plover Nest Failures Cape Cod National Seashore, 2002. (Page 1 of 2)

| SITE | NESTS | | | PER CAUSE | | CAUSE |
|---|---|---|---|---|---|---|
| | Total No. | No. Lost | % Lost | No. Lost | % Lost | |
| Coast Guard Beach | 27 | 22 | 81% | | | |
| | | | | 15 | 68% | Total predation |
| | | | | 4 | 18% | Abandoned after excl. |
| | | | | 2 | 9% | Overwash |
| | | | | 1 | 5% | Sanded over |
| | | | | | | Predation types |
| | | | | 6 | 27% | Unknown Pred (not excl.) |
| | | | | 3 | 14% | Gull (pre-excl.) |
| | | | | 2 | 9% | Skunk (pre-excl.) |
| | | | | 1 | 5% | Canid (spp. ?) (not-excl.) |
| | | | | 1 | 5% | Dead adult inside excl. |
| | | | | 1 | 5% | Poss. Crow (pre-excl.) |
| | | | | 1 | 5% | Skunk (excl.) |
| Nauset - Marconi Beach | 13 | 11 | 85% | | | |
| | | | | 7 | 64% | Overwash |
| | | | | 2 | 18% | Canid (spp. ?) (not-excl.) |
| | | | | 1 | 9% | Abandoned after excl. |
| | | | | 1 | 9% | Sanded over |
| LeCount | 4 | 2 | 50% | | | |
| | | | | 1 | 50% | Poss. Crow (pre-excl.) |
| | | | | 1 | 50% | Gull (pre-excl.) |
| White Crest | 1 | 1 | 100% | | | |
| | | | | 1 | 100% | Unknown Pred (excl.) |
| Cahoon Hollow | 3 | 2 | 67% | | | |
| | | | | 1 | 50% | Overwash |
| | | | | 1 | 50% | Poss. Crow (pre-excl.) |
| Newcomb Hollow | 1 | 0 | 0% | | | |

**Table 3.** Causes of Piping Plover Nest Failures Cape Cod National Seashore, 2002. (Page 2 of 2)

| SITE | NESTS | | | PER CAUSE | | CAUSE |
|---|---|---|---|---|---|---|
| | Total No. | No. Lost | % Lost | No. Lost | % Lost | |
| Great I./Jeremy Point | 27 | 21 | 78% | | | |
| | | | | 19 | 90% | Total predation |
| | | | | 2 | 10% | Overwash |
| | | | | | | Predation types |
| | | | | 8 | 38% | Abandoned after excl. |
| | | | | 3 | 14% | Canid (spp. ?) (not-excl.) |
| | | | | 3 | 14% | Poss. Crow (pre-excl.) |
| | | | | 3 | 14% | Unknown Pred (not excl.) |
| | | | | 1 | 5% | Non-viable |
| | | | | 1 | 5% | Skunk (pre-excl.) |
| Duck Harbor - Bound Brook | 6 | 3 | 50% | | | |
| | | | | 2 | 67% | Unknown Pred (pre excl.) |
| | | | | 1 | 33% | Abandoned after excl. |
| Ballston Beach | 10 | 7 | 70% | | | |
| | | | | 4 | 57% | Total predation |
| | | | | 3 | 43% | Overwash |
| | | | | | | Predation types |
| | | | | 2 | 29% | Unknown Pred (pre excl.) |
| | | | | 1 | 14% | Gull |
| | | | | 1 | 14% | Crow |
| High Head | 12 | 3 | 25% | | | |
| | | | | 2 | 67% | Overwash |
| | | | | 1 | 33% | Sanded over |
| Race Point Beach South | 20 | 8 | 40% | | | |
| | | | | 3 | 38% | Overwash |
| | | | | 3 | 38% | Sanded over |
| | | | | 2 | 25% | Total predation |
| | | | | | | Predation types |
| | | | | 1 | 13% | Poss. Crow (pre-excl.) |
| | | | | 1 | 13% | Gull (pre-excl.) |
| Race Point Beach North | 6 | 0 | 0% | | | |
| Wood End/Long Point | 11 | 4 | 0% | | | |
| | | | | 3 | 75% | Abandoned pre excl. |
| | | | | 1 | 25% | Unknown Pred (pre-excl.) |

**Table 4.** Fates of Exclosed and Unexclosed Piping Plover Nests, Cape Cod National Seashore, 2002.

| Treatment | Total | No. Successful | No. Not-Successful | % Successful | % Not-Successful | Cause of Failure | No. Lost | % Lost |
|---|---|---|---|---|---|---|---|---|
| Exclosed | 77 | 49 | 28 | 63% | 37% | | | |
| | | | | | | Abandoned | 14 | 50% |
| | | | | | | Overwash | 10 | 34% |
| | | | | | | Total predation | 3 | 12% |
| | | | | | | Non-viable | 1 | 4% |
| | | | | | | Predation types | | |
| | | | | | | Dead adult inside excl. | 1 | 4% |
| | | | | | | Skunk | 1 | 4% |
| | | | | | | Unknown predator | 1 | 4% |
| Unexclosed | 64 | 8 | 56 | 11% | 88% | | | |
| | | | | | | Total predation | 37 | 66% |
| | | | | | | Overwash | 10 | 18% |
| | | | | | | Sanded over | 6 | 11% |
| | | | | | | Abandoned | 3 | 5% |
| | | | | | | Predation types | | |
| | | | | | | Unknown predator | 13 | 23% |
| | | | | | | Crow | 8 | 14% |
| | | | | | | Canid (spp. ?) | 6 | 11% |
| | | | | | | Gull | 6 | 11% |
| | | | | | | Skunk | 4 | 7% |

**Table 5.** Egg Loss Totals, Cape Cod National Seashore, 2002 .

| Total Nests | EGGS | | | PER CAUSE | | Cause |
|---|---|---|---|---|---|---|
| | No. Total | No. Lost | Total % Lost | No. Eggs Lost | % Lost | |
| 141 | 428 | 253 | 59% | | | |
| | | | | 92 | 36% | Total predation |
| | | | | 72 | 28% | Overwash |
| | | | | 49 | 19% | Abandoned after excl. |
| | | | | 24 | 9% | Non-viable |
| | | | | 10 | 4% | Abandoned pre-excl. |
| | | | | 6 | 2% | Sanded over |
| | | | | | | Predation types |
| | | | | 23 | 9% | Unknown Pred (not excl.) |
| | | | | 16 | 6% | Canid (spp. ?) (not-excl.) |
| | | | | 14 | 6% | Crow (pre-excl.) |
| | | | | 13 | 5% | Gull (pre-excl.) |
| | | | | 11 | 4% | Skunk (pre-excl.) |
| | | | | 4 | 2% | Small mamal (spp. ?) |
| | | | | 4 | 2% | Unknown Pred (inside excl.) |
| | | | | 3 | 1% | Skunk (excl.) |
| | | | | 2 | 1% | Dead adult plover inside excl. |
| | | | | 2 | 1% | Unknown Pred (pre-excl.) |

**Table 6.** Fate of Piping Plover Eggs, Cape Cod National Seashore, 2002. (Page 1 of 2)

| SITE | No. Nests | Eggs Total Laid | Eggs No. Hatched | Eggs No. Failed | % eggs Failed Per site | No. Eggs Failed Per cause | % Failed Per cause | CAUSE |
|---|---|---|---|---|---|---|---|---|
| Coast Guard Beach | 27 | 81 | 18 | 63 | 78% | | | |
| | | | | | | 40 | 63% | Total predation |
| | | | | | | 13 | 21% | Abandoned after excl. |
| | | | | | | 8 | 13% | Overwash |
| | | | | | | 2 | 3% | Non-viable |
| | | | | | | | | Predation types |
| | | | | | | 12 | 19% | Unknown Pred (not excl.) |
| | | | | | | 7 | 11% | Gull (pre-excl.) |
| | | | | | | 7 | 11% | Skunk (pre-excl.) |
| | | | | | | 4 | 6% | Small mammal (spp. ?) |
| | | | | | | 3 | 5% | Poss. Crow (pre-excl.) |
| | | | | | | 3 | 5% | Skunk (excl.) |
| | | | | | | 2 | 3% | Canid (spp. ?) (not-excl.) |
| | | | | | | 2 | 3% | Dead adult plover inside excl. |
| Nauset - Marconi | 13 | 33 | 3 | 30 | 91% | | | |
| | | | | | | 22 | 73% | Overwash |
| | | | | | | 4 | 13% | Canid (spp. ?) (not-excl.) |
| | | | | | | 2 | 7% | Non-viable |
| | | | | | | 1 | 3% | Abandoned after excl. |
| | | | | | | 1 | 3% | Sanded over |
| LeCount | 4 | 8 | 5 | 3 | | | | |
| | | | | | | 2 | 66% | Total predation |
| | | | | | | 1 | 34% | Non-viable |
| | | | | | | | | Predation types |
| | | | | | | 1 | 33% | Poss. Crow (pre-excl.) |
| | | | | | | 1 | 33% | Gull (pre-excl.) |
| White Crest | 1 | 4 | 0 | 4 | 100% | | | |
| | | | | | | 4 | 100% | Unknown Pred (inside-excl.) |
| Cahoon Hollow | 3 | 7 | 1 | 6 | 86% | | | |
| | | | | | | 4 | 67% | Overwash |
| | | | | | | 2 | 33% | Poss. Crow (pre-excl.) |
| Newcomb Hollow | 1 | 4 | 4 | 0 | 0% | | | |

**Table 6.** Fate of Piping Plover Eggs, Cape Cod National Seashore, 2002. (Page 2 of 2)

| SITE | No. Nests | Eggs Total Laid | Eggs No. Hatched | Eggs No. Failed | % eggs Failed Per site | No. Eggs Failed Per cause | % Failed Per cause | CAUSE |
|---|---|---|---|---|---|---|---|---|
| Great Is - Jeremy Pt | 27 | 88 | 22 | 66 | 75% | | | |
| | | | | | | 32 | 48% | Abandoned after excl. |
| | | | | | | 23 | 35% | Total predation |
| | | | | | | 7 | 11% | Overwash |
| | | | | | | 4 | 6% | Non-viable |
| | | | | | | | | Predation types |
| | | | | | | 10 | 15% | Canid (spp. ?) (not-excl.) |
| | | | | | | 6 | 9% | Unknown Pred (pre-excl.) |
| | | | | | | 4 | 6% | Crow (pre-excl.) |
| | | | | | | 3 | 5% | Skunk (pre-excl.) |
| Bound Brook - Duck Harbor | 6 | 20 | 12 | 8 | 40% | | | |
| | | | | | | 5 | 63% | Unknown Pred (pre-excl.) |
| | | | | | | 3 | 37% | Abandoned after excl. |
| Ballston Beach | 10 | 26 | 7 | 19 | 73% | | | |
| | | | | | | 13 | 68% | Overwash |
| | | | | | | 6 | 32% | Total predation |
| | | | | | | | | Predation types |
| | | | | | | 4 | 21% | Gull (pre-excl.) |
| | | | | | | 1 | 5% | Poss. Crow (pre-excl.) |
| | | | | | | 1 | 5% | Poss. Skunk (pre-excl.) |
| High Head | 12 | 36 | 23 | 13 | 36% | | | |
| | | | | | | 6 | 47% | Overwash |
| | | | | | | 5 | 38% | Non-viable |
| | | | | | | 2 | 15% | Sanded over |
| Race Point South | 20 | 62 | 38 | 24 | 39% | | | |
| | | | | | | 12 | 50% | Overwash |
| | | | | | | 5 | 21% | Non-viable |
| | | | | | | 4 | 17% | Total predation |
| | | | | | | 3 | 13% | Sanded over |
| | | | | | | | | Predation types |
| | | | | | | 3 | 13% | Poss. Crow (pre-excl.) |
| | | | | | | 1 | 4% | Gull (pre-excl.) |
| Race Point North | 6 | 22 | 18 | 4 | 18% | | | |
| | | | | | | 4 | 100% | Non-viable |
| Wood End - Long Pt | 11 | 37 | 24 | 13 | 35% | | | |
| | | | | | | 10 | 77% | Abandoned pre excl. |
| | | | | | | 2 | 15% | Unknown Pred (pre-excl.) |
| | | | | | | 1 | 8% | Non-viable |

**Table 7.** Frequency of Abandonment In Exclosed Nests, Cape Cod National Seashore, 2002.

| Location | Nests | | | Per cause (%) [4] | Cause of Abandonment | Days to aband post exclosed [5] | No. of Eggs Lost [6] |
|---|---|---|---|---|---|---|---|
| | No. Excl. [1] | No. Abandoned [2] | (%) Abandoned [3] | | | | |
| Coast Guard | 10 | 5 | 50% | 80% | Unknown Cause | 9 | 15 |
| | | | | 20% | Dead plover inside exclosure | | |
| Nauset - Marconi | 8 | 1 | 13% | 100% | Unknown Cause | 8 | 1 |
| Le Count | 2 | 0 | 0% | 0% | NA | NA | NA |
| White Crest | 1 | 0 | 0% | 0% | NA | NA | NA |
| Cahoon | 0 | 0 | 0% | 0% | NA | NA | NA |
| Newcomb | 1 | 0 | 0% | 0% | NA | NA | NA |
| Great Is - Jeremy Pt. | 13 | 8 | 62% | 100% | Unknown Cause | 19 | 32 |
| Bound Brook - Duck Harbor | 5 | 1 | 20% | 100% | Unknown Cause | 18 | 3 |
| Wood End/Long Pt. | 5 | 0 | 0% | 0% | NA | NA | NA |
| Race Point North | 6 | 0 | 0% | 0% | NA | NA | NA |
| Race Point South | 14 | 0 | 0% | 0% | NA | NA | NA |
| High Head | 9 | 0 | 0% | 0% | NA | NA | NA |
| Ballston Beach | 4 | 0 | 0% | 0% | NA | NA | NA |

1 = Total number of nests that were exclosed per location
2 = Total number of exclosed nests that were abandoned
3 = Number of nests that were abandoned divided by total number of of nests exclosed (%)
4 = Number of abandoned nests per cause divided by total number abandoned (%)
5 = Number of days after nest was exclosed that nest was abandoned
6 = Total number eggs lost from exclosed nests that were abandoned

**Table 8.** North District Off-Road Vehicle Corridor Openings and Closures, Cape Cod National Seashore, 2002.

| Date | Beach | Mileage Change | Total Open | Total Closed | Reason |
|---|---|---|---|---|---|
| 30-May | RPS | NA | 1.8 | 0.0 | SCV Area moved 0.2 miles north (away form N. No.18) |
| 6-Jun | RPN | 0.0 | 1.9 | 0.4 | N. No.2 Hatched |
| 6-Jun | RPN | NA | NA | NA | Poleline Route Opened |
| 9-Jun | RPS | 0.5 | 1.3 | 0.5 | N. No. 5 Hatched, .01 Open @ Exit 8[1] |
| 10-Jun | RPN | -0.1 | 1.8 | 0.5 | N. No.2 moving south due to Least Tern pressure |
| 18-Jun | RPN | -0.5 | 1.3 | 1.0 | N. No.3 Hatched |
| 25-Jun | RPS | 0.2 | 1.5 | 0.4 | Expaned RPS SCV Area north |
| 26-Jun | RPN-RPS | NA | NA | NA | Laid single track through Protected B. for SCV access[2] |
| 27-Jun | RPN | NA | NA | NA | Closed RPN SCV Area, escorted vehicles to RPS SCV Area |
| 27-Jun | RPS | -0.7 | 0.8 | 1.1 | N. No. 17 Hatched |
| 28-Jun | RPN | -0.4 | 0.9 | 1.4 | N. No.4 Hatched, RPN Entrance open for fisherman parking |
| 30-Jun | RPS | -0.4 | 0.4 | 1.5 | N. No.18 Hatched, SCV Area 0.4 miles |
| 1-Jul | HH | 0.5 | 0.5 | 1.0 | Negotiated Rule |
| 1-Jul | HOM | 0.1 | 0.1 | 1.0 | Negotiated Rule |
| 6-Jul | RPS | 0.35 | 0.4 | 1.5 | 0.35 Opened for Commercial Dune Tours, total 0.45[1] |
| 8-Jul | RPN | Entrance | 0.9 | 1.4 | Nest No.4 moved into corridor, RPN Entrance closed[2] |
| 15-Jul | RPN | -0.1 | 0.8 | 1.5 | Closed RPN Light Cut-off, N. No.6 hatched |
| 15-Jul | RPN | Entrance | 0.9 | 1.4 | Nest No.4 moved north out of corridor, RPN Entrance opened[2] |
| 15-Jul | HOM | 0.5 | 0.6 | 0.8 | HH N. No.4 Fledged |
| 15-Jul | HH | -0.3 | 0.2 | 0.8 | HH N. No.7 Hatched |
| 16-Jul | HOM | -0.6 | 0.0 | 1.4 | HH N. No.6 moved onto corridor, HOM Entrance Closed |
| 21-Jul | RPS | 0.8 | 1.2 | 3.9 | Southern-end of RPS opened, accessable from HH Entrance |
| 25-Jul | HH | Entrance | 0.4 | 4.7 | HH N. No.9 Hatched, HH Entrance Closed |
| 29-Jul | RPN | 1.0 | 1.7 | 0.6 | Nest No.4 Fledged |
| 29-Jul | RPN | NA | NA | NA | SCV Area reestablished on RPN |
| 2-Aug | RPS | 2.0 | 2.3 | 2.8 | Corridor Open 2.3 miles south form RPS Entrance |
| 2-Aug | RPN-RPS | NA | NA | NA | Removed single track through Protected B. laid for SCV access[2] |
| 2-Aug | RPN | 0.6 | 2.3 | 0.0 | RPN beach fully opened |
| 2-Aug | RPN | NA | NA | NA | Poleline Route Closed |
| 13-Aug | HH | Entrance | | | Entrance reopened |
| 13-Aug | RPS | 2.8 | 5.1 | 0.0 | RPS Fully Open to HH Entrance |
| 19-Aug | HOM | 0.6 | 0.6 | 0.9 | HOM Entrance reopened, HH N. No. 10 Fledged |
| 20-Aug | HH | 0.9 | 1.5 | 0.0 | Route from HH to HOM fully Opened, HH N. No. 11 Fledged |
| 1-Sep | HOM | -1.5 | 0.0 | 1.5 | Negotiated Rule |

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

[1] = Corridor Open from Exit 8 for Commercial Dune Tours for given milage
[2] = See Implementation of the Negotiated Rule in Results/Discussion

**Table 9.** Number of Pairs of Other Waterbirds Nesting at Cape Cod National Seashore

| SITE | LETE | COTE | ROST | ARTE | BLSK | LAGU | AMOY | WILL | CAGO |
|---|---|---|---|---|---|---|---|---|---|
| New Island | 0 | 0 | 0 | 1* | 0 | 0 | 0 | 0 | 0 |
| Coast Guard | 13 | 112 | 0 | 1* | 0 | 0 | 1 | ✠ | 0 |
| Nauset - Marconi | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great Is - Jeremy Pt | 124 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| Ballston Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| High Head | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Race Point South | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Race Point North | 35 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wood End - Long Pt. | 84 | 0 | 0 | 0 | 0 | 0 | 0 | ✠ | 0 |
| Total | 316 | 113 | 0 | 2* | 0 | 0 | 3 | ✠ | 0 |

* = Probable breeding attempt
✠ = Possibly breed in abundance

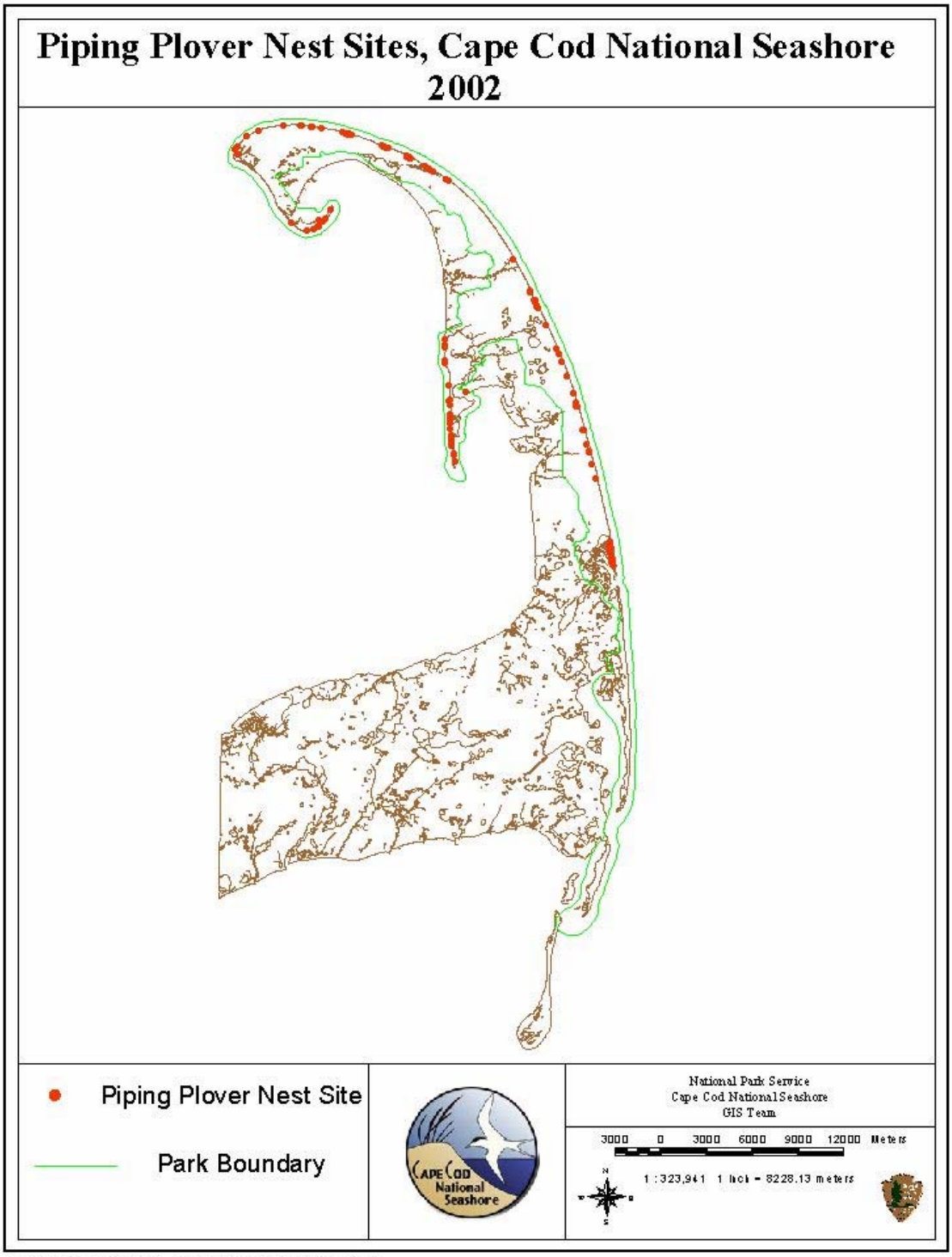
**Table 10.** Pairs of Colonial Waterbirds on New Island – Orleans, MA, 1999-2002

| | YEAR | | | | TRENDS | | |
|---|---|---|---|---|---|---|---|
| Species | 1999 | 2000 | 2001 | 2002 | 1999-2000 | 2000-20001 | 2001-2002 |
| Common Tern | 2176 | 1073 | 493 | 0 | -51% | -54% | -100% |
| Roseate Tern | 3 | 4 | 4 | 0 | 33% | 0% | -100% |
| Arctic Tern | 3 | 3 | 3 | 2* | 0% | 0% | -67% |
| Black Skimmer | 0 | 5 | 3 | 0 | NA | -40% | -100% |
| Laughing Gull | 784 | 721 | 517 | 0 | -8% | -28% | -100% |

* = Probable breeding attempt

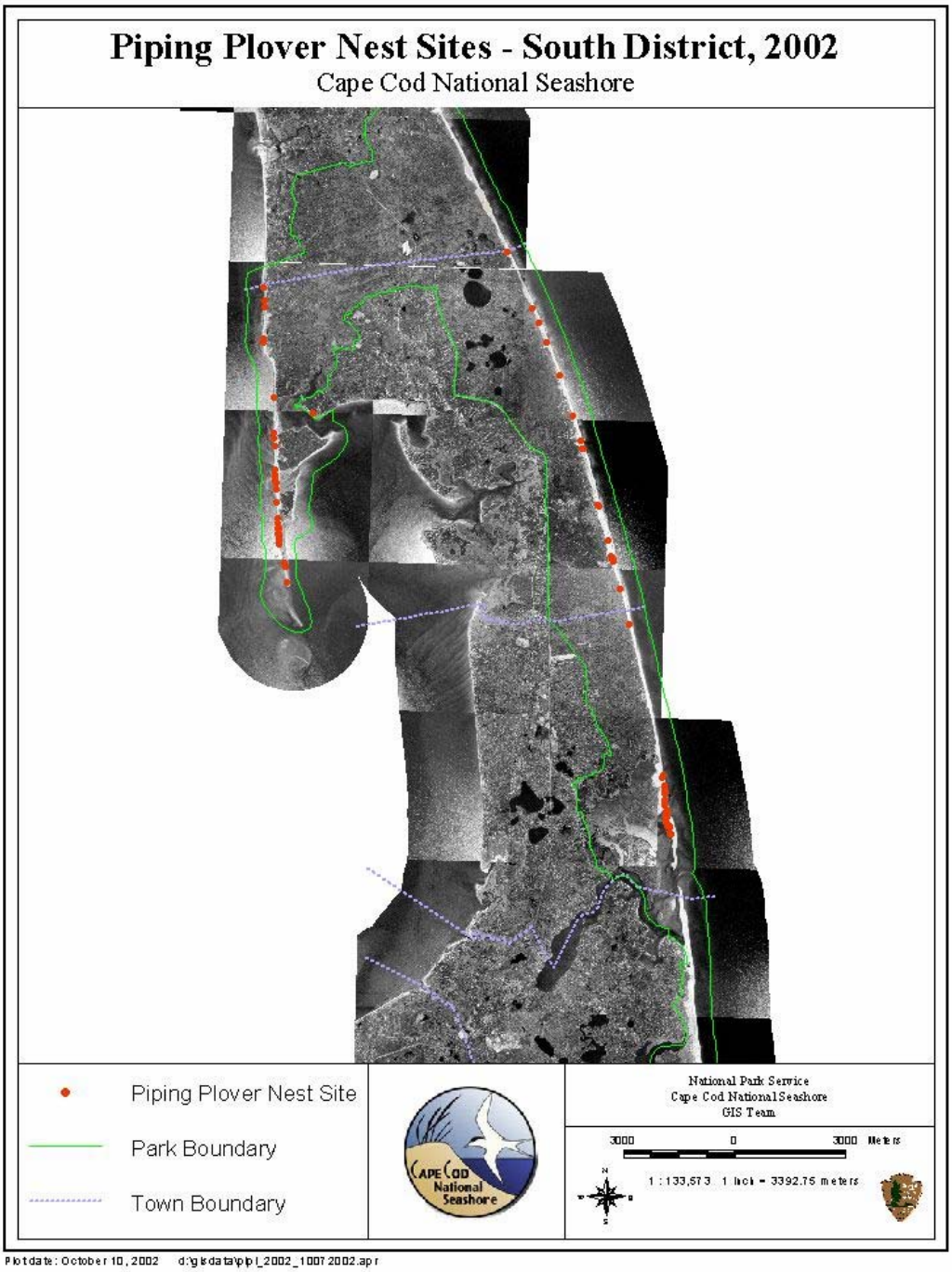
# Appendix A

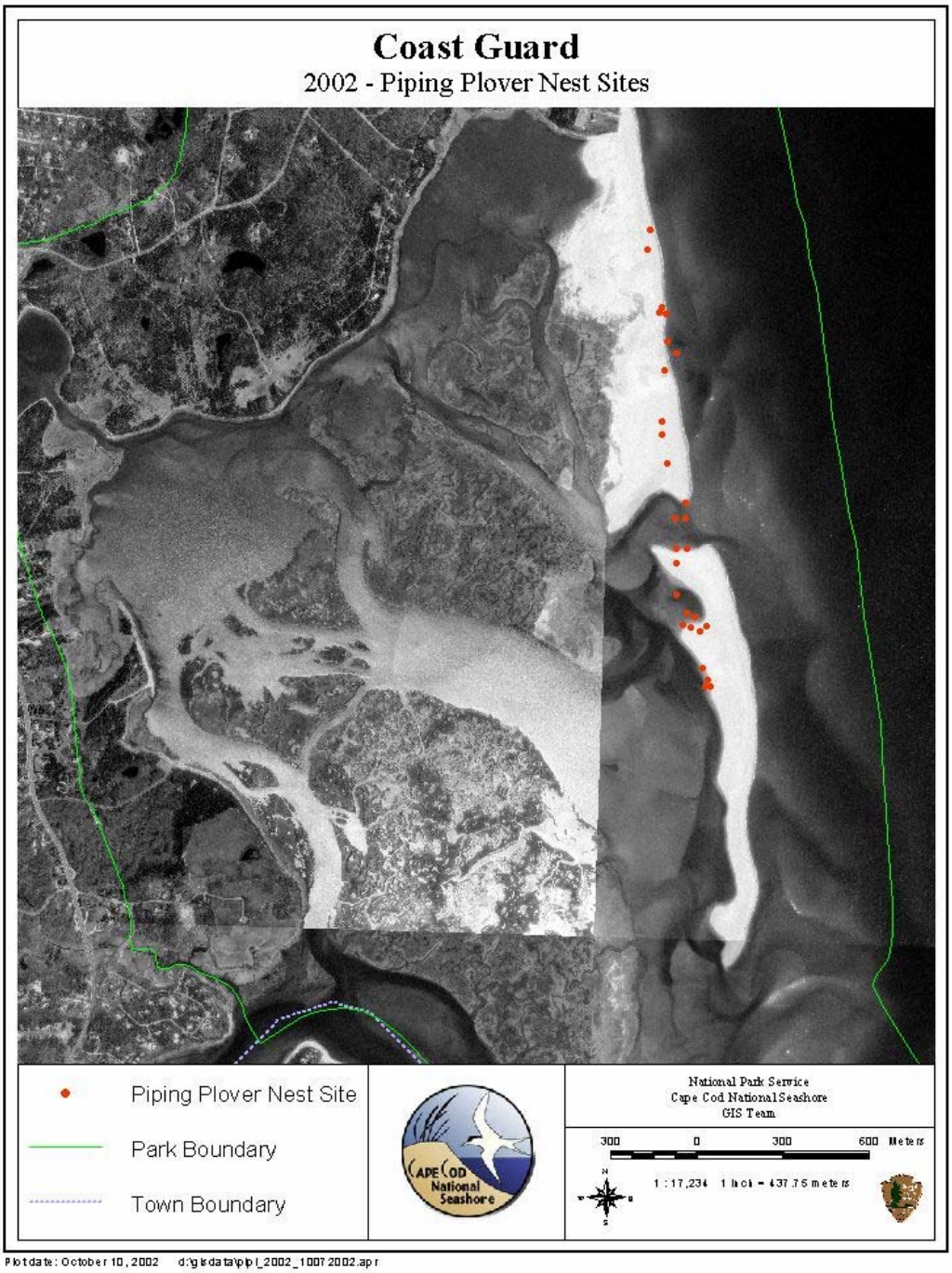
## Map of Piping Plover Nest Sites Monitored by Cape Cod National Seashore - 2002

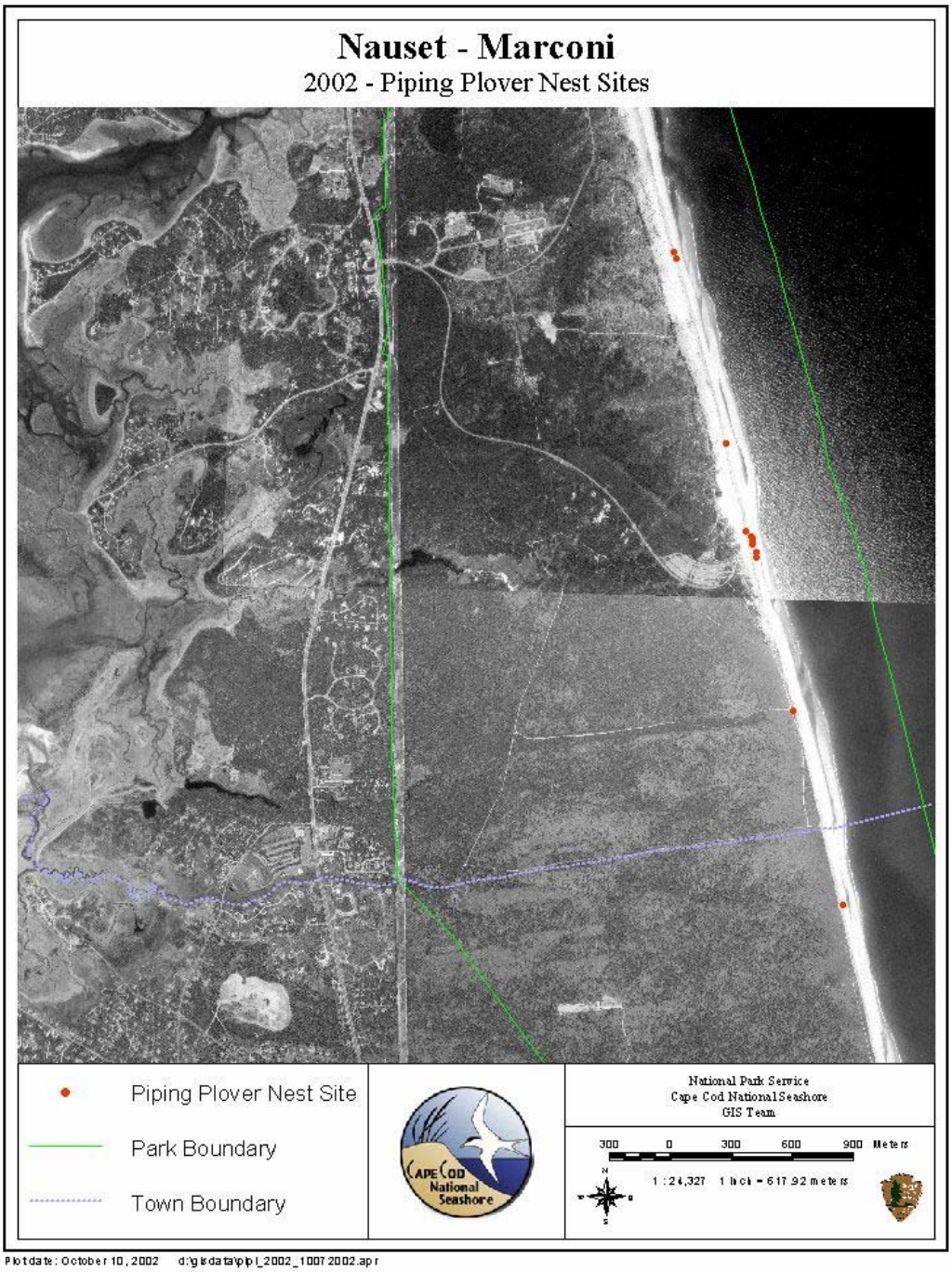

Piping Plover Nest Sites, Cape Cod National Seashore 2002
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
3000 0 3000 6000 9000 12000 Meters
1 : 323,941 1 Inch = 8228.13 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10072002.apr

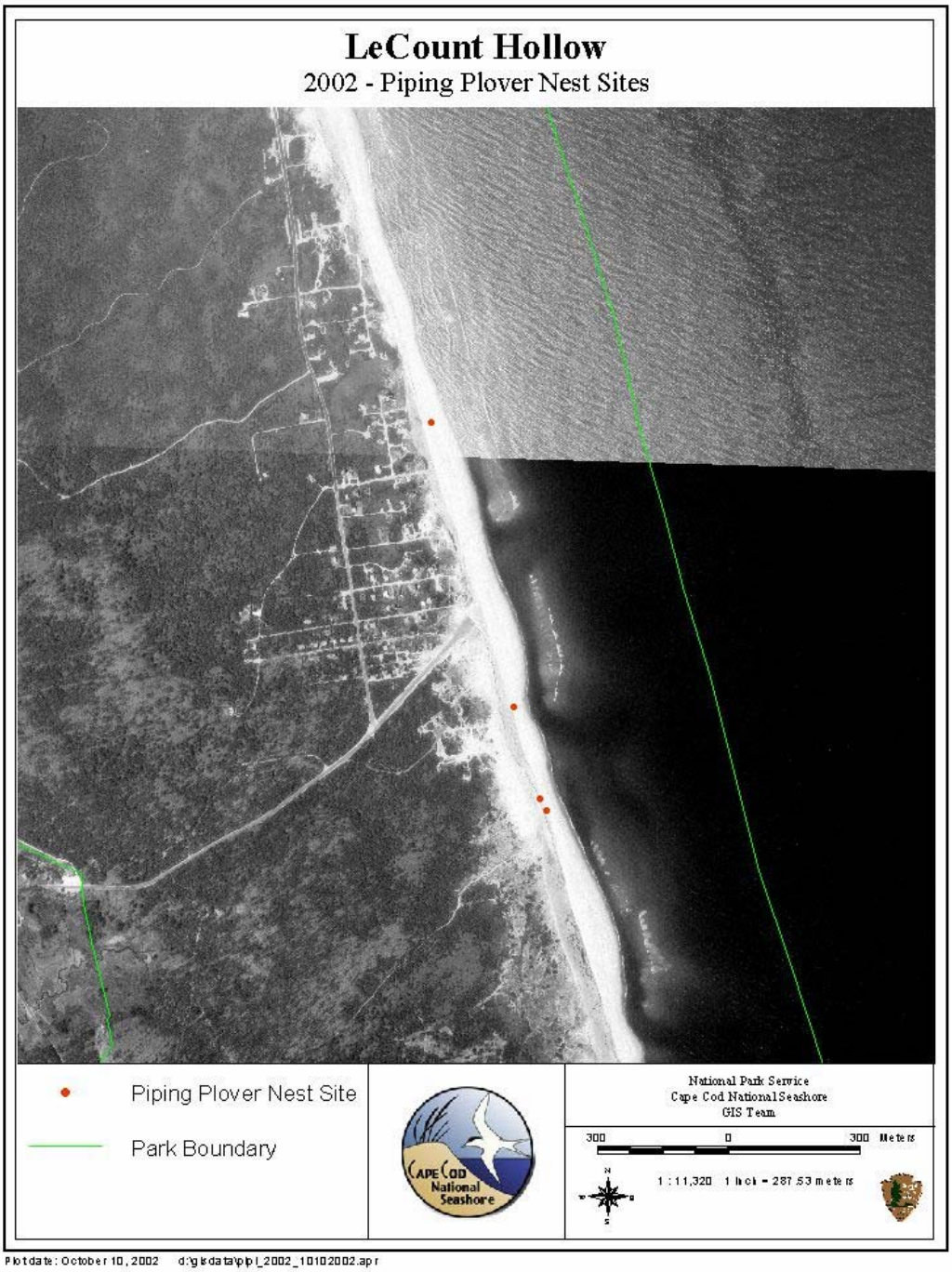
# Appendix B

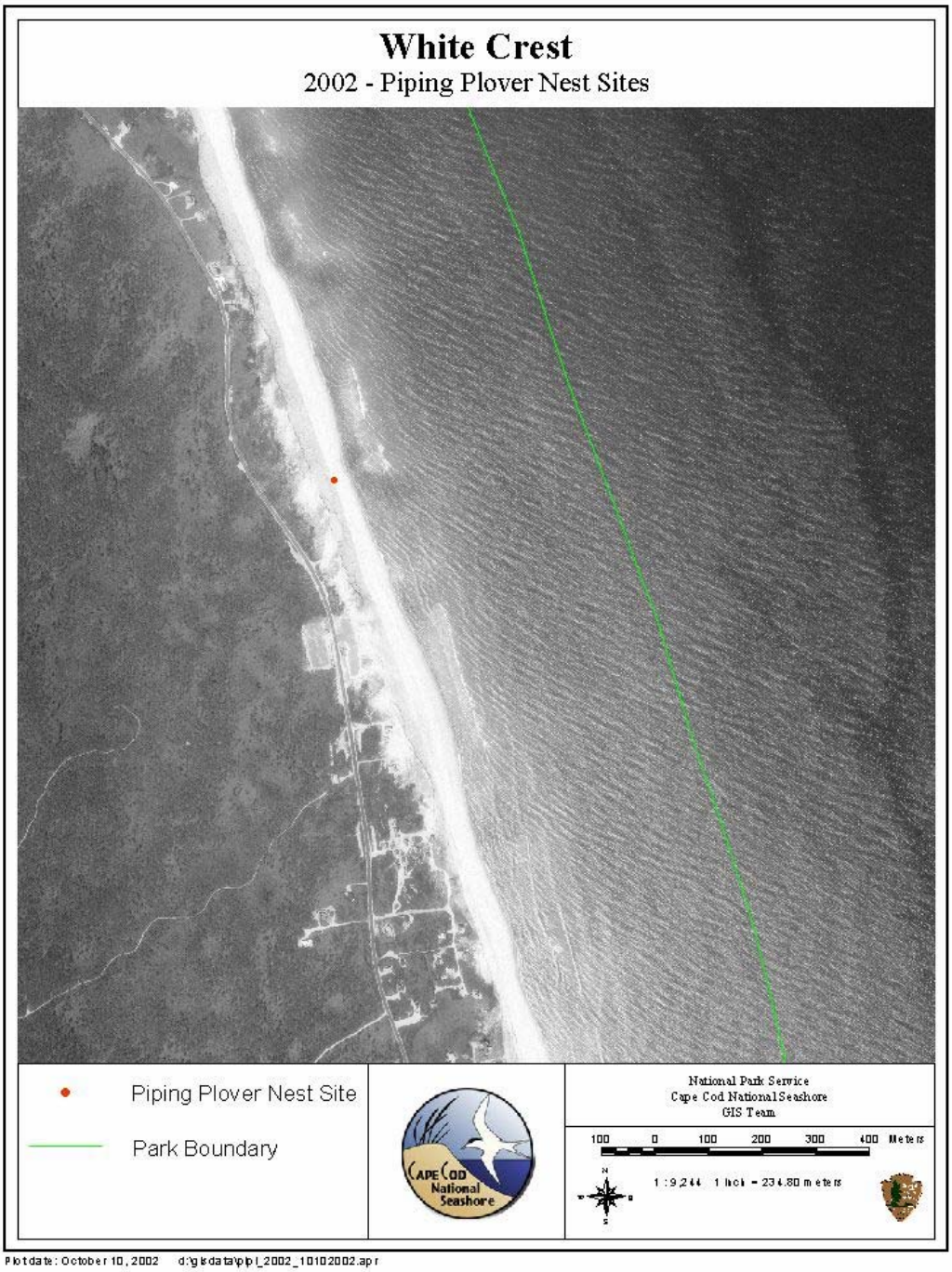
Maps of South District Piping Plover Nest Sites
Cape Cod National Seashore - 2002


Piping Plover Nest Sites - South District, 2002
Cape Cod National Seashore
Piping Plover Nest Site
Park Boundary
Town Boundary
National Park Service
Cape Cod National Seashore
GIS Team
3000
0
3000 Meters
1 : 133,573 1 Inch = 3392.75 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10072002.apr


Coast Guard
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Town Boundary
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 Meters
1 : 17,234 1 Inch = 437.75 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10072002.apr

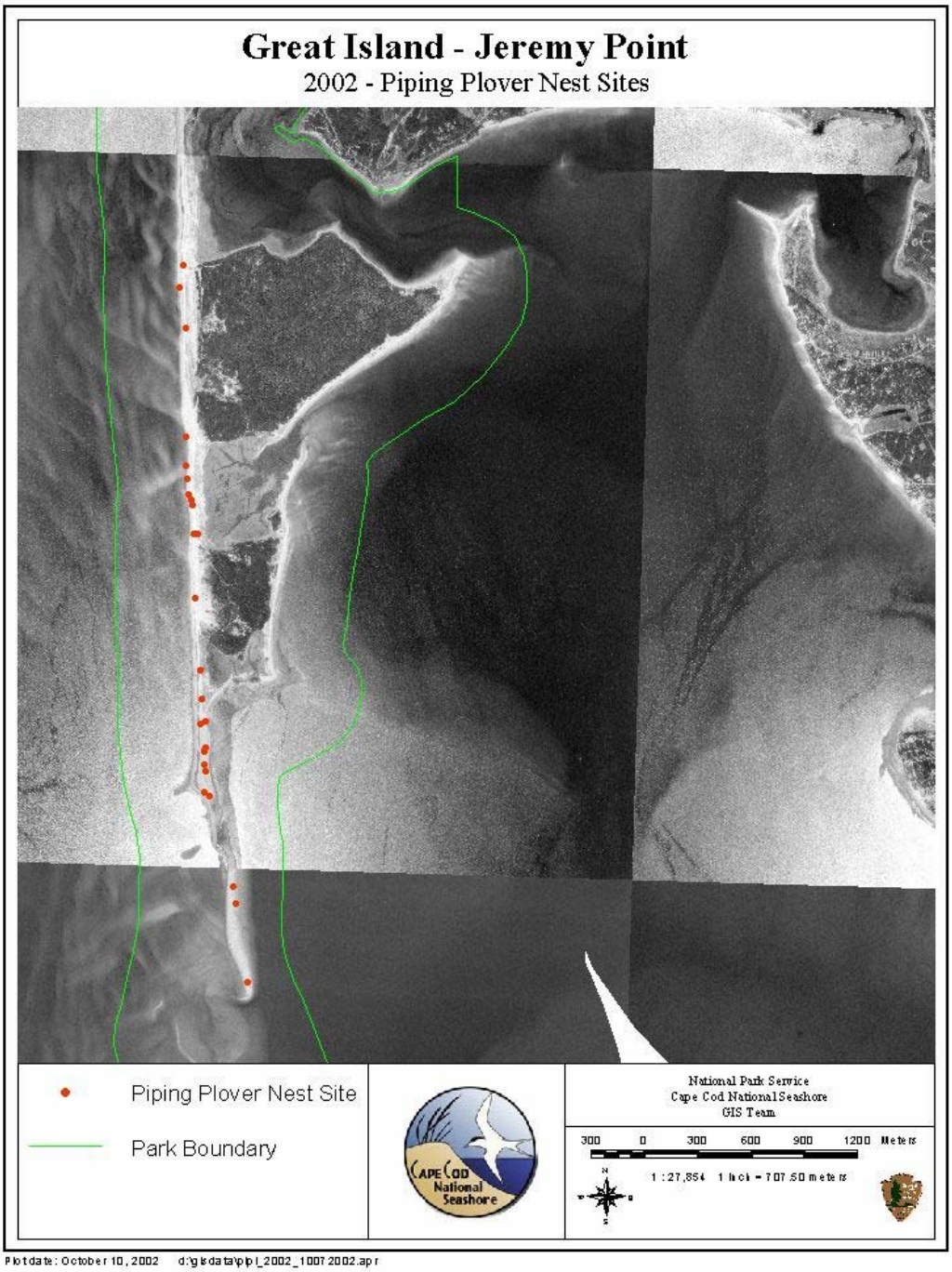

Nauset - Marconi
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Town Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 900 Meters
1 : 24,327 1 Inch = 617.92 meters
Plot date: October 10, 2002 d:\gisdata\pplp_2002_10072002.apr

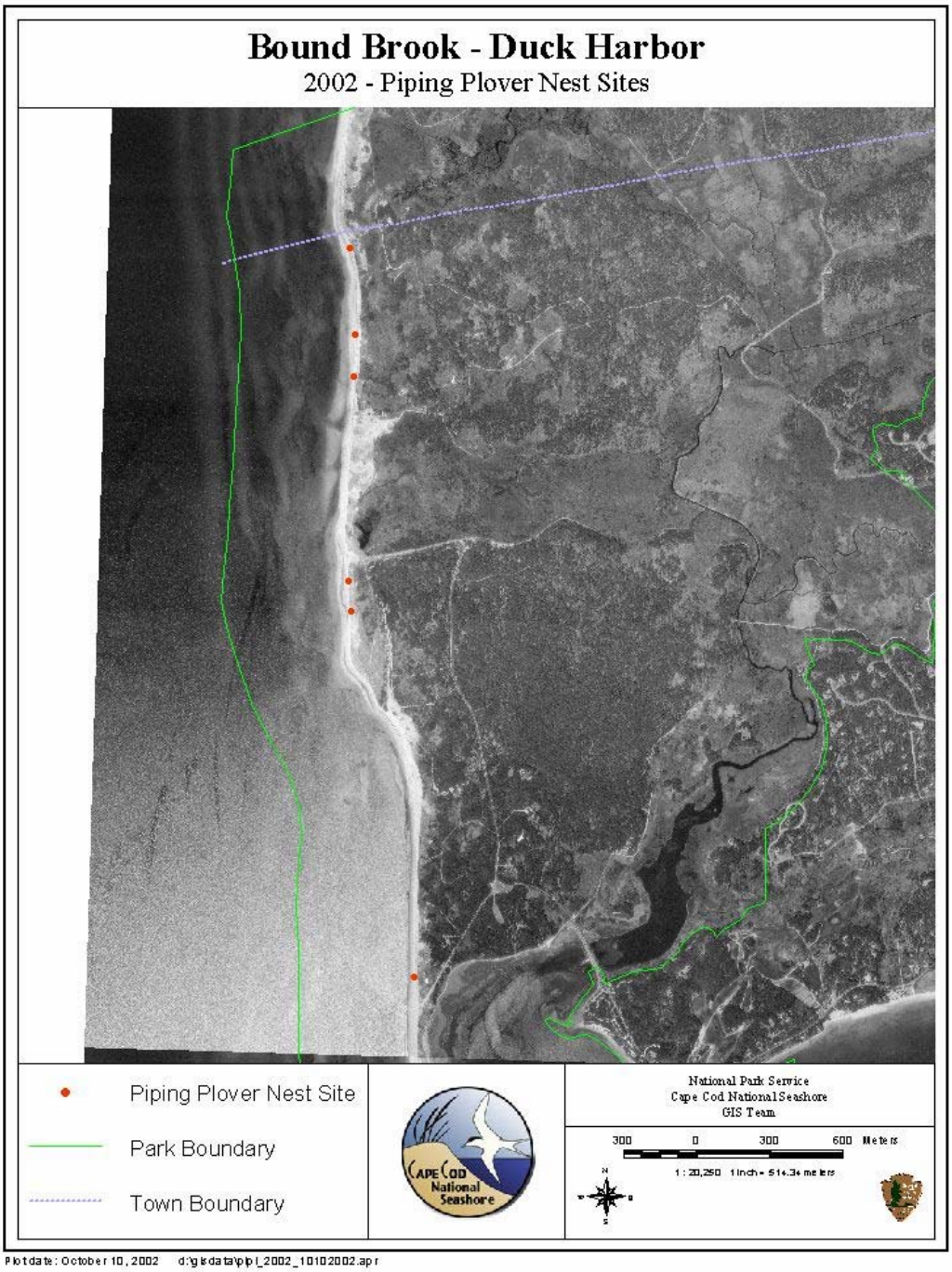

LeCount Hollow
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
300
0
300 Meters
1 : 11,320 1 Inch = 287.53 meters
Plot date: October 10, 2002 d:\gisdata\pplp_2002_10102002.apr


White Crest
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
100 0 100 200 300 400 Meters
1 : 9,244 1 inch = 234.80 meters
Plot date: October 10, 2002 d:\gisdata\pplp1_2002_10102002.apr


Cahoon Hollow
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
100 0 100 200 300 400 Meters
1 : 9,563 1 Inch = 242.90 meters
Plot date: October 10, 2002 d:\gisdata\pplp_2002_10102002.apr

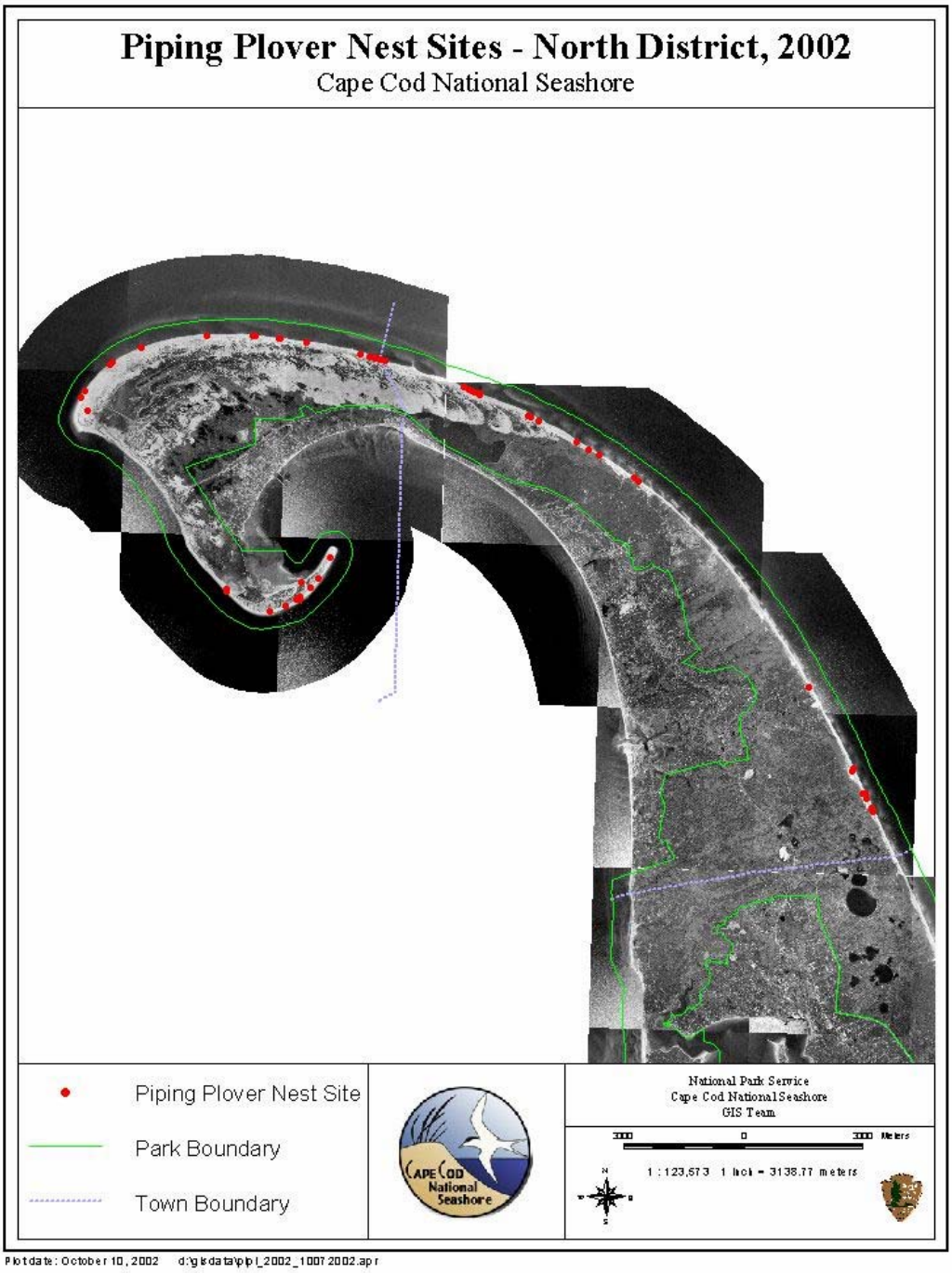

Newcomb Hollow
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Town Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
50 0 50 100 150 Meters
1 : 4,206 1 Inch = 106.85 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10102002.apr

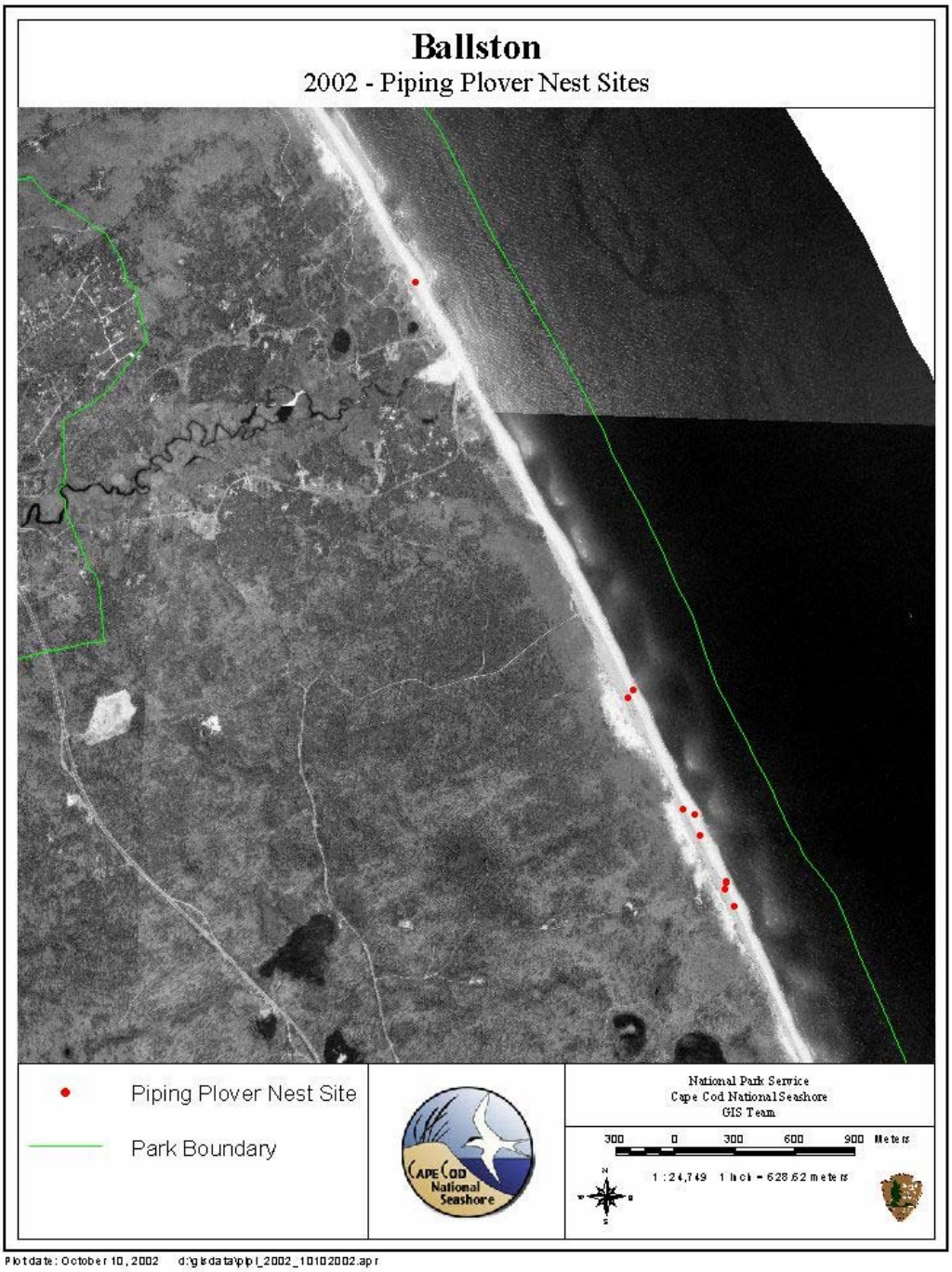

Great Island - Jeremy Point
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 900 1200 Meters
1 : 27,854 1 Inch = 707.50 meters
Plot date: October 10, 2002 d:\gisdata\pplp1_2002_10072002.apr

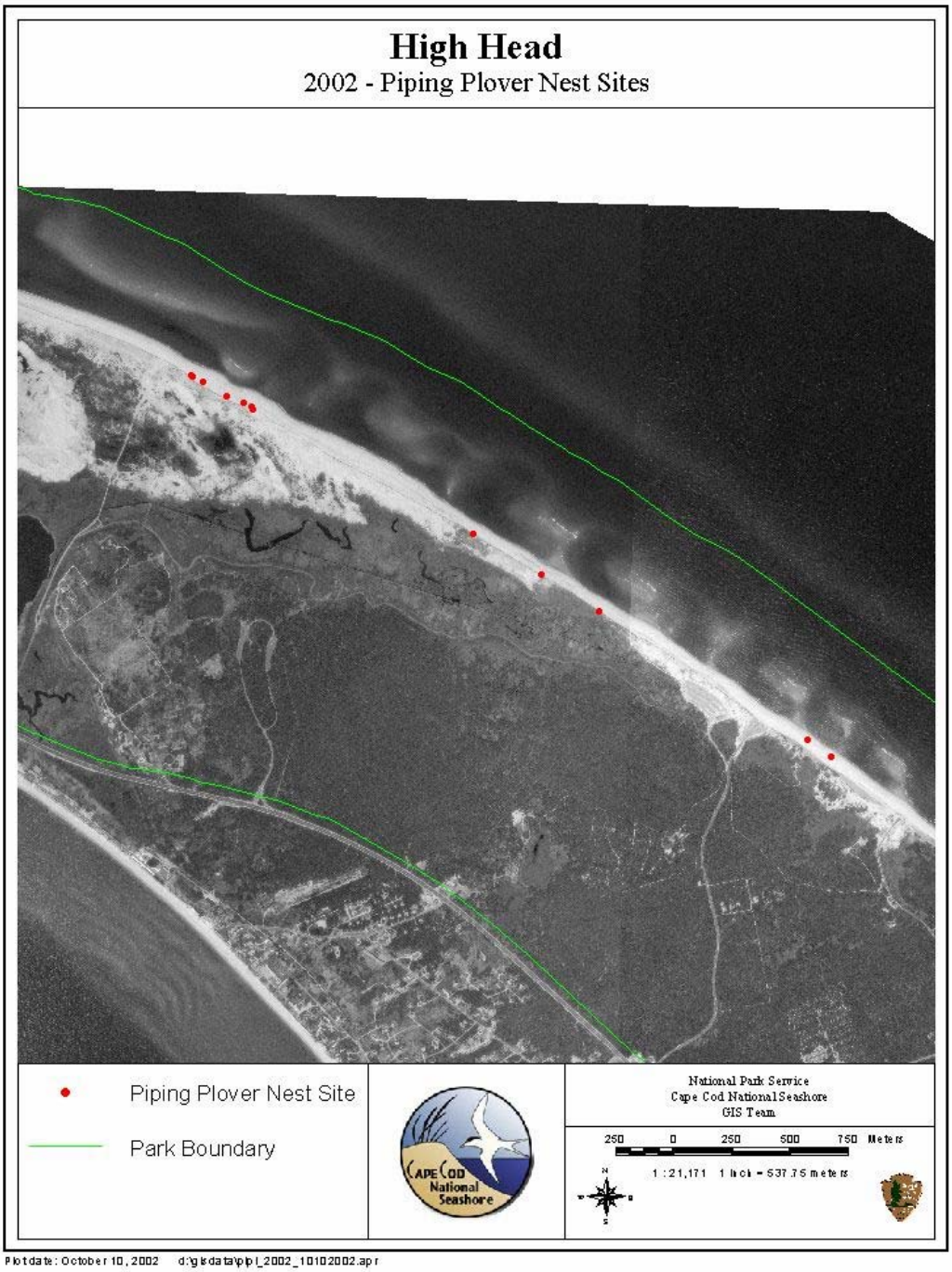

Bound Brook - Duck Harbor
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Town Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 Meters
1:20,250 1 inch = 514.34 meters
Plot date: October 10, 2002 d:\gisdata\pplp_2002_10102002.apr

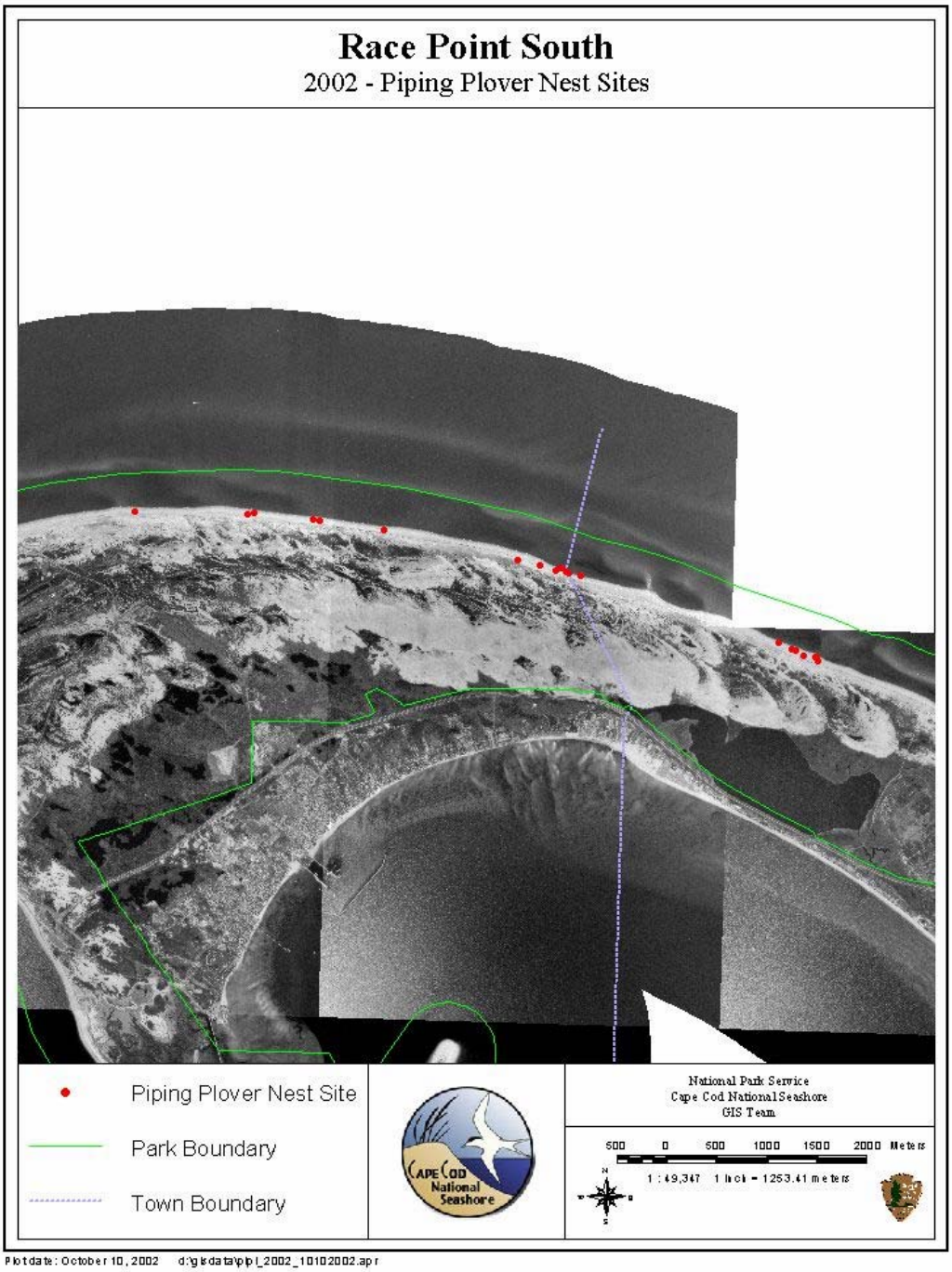
# Appendix C

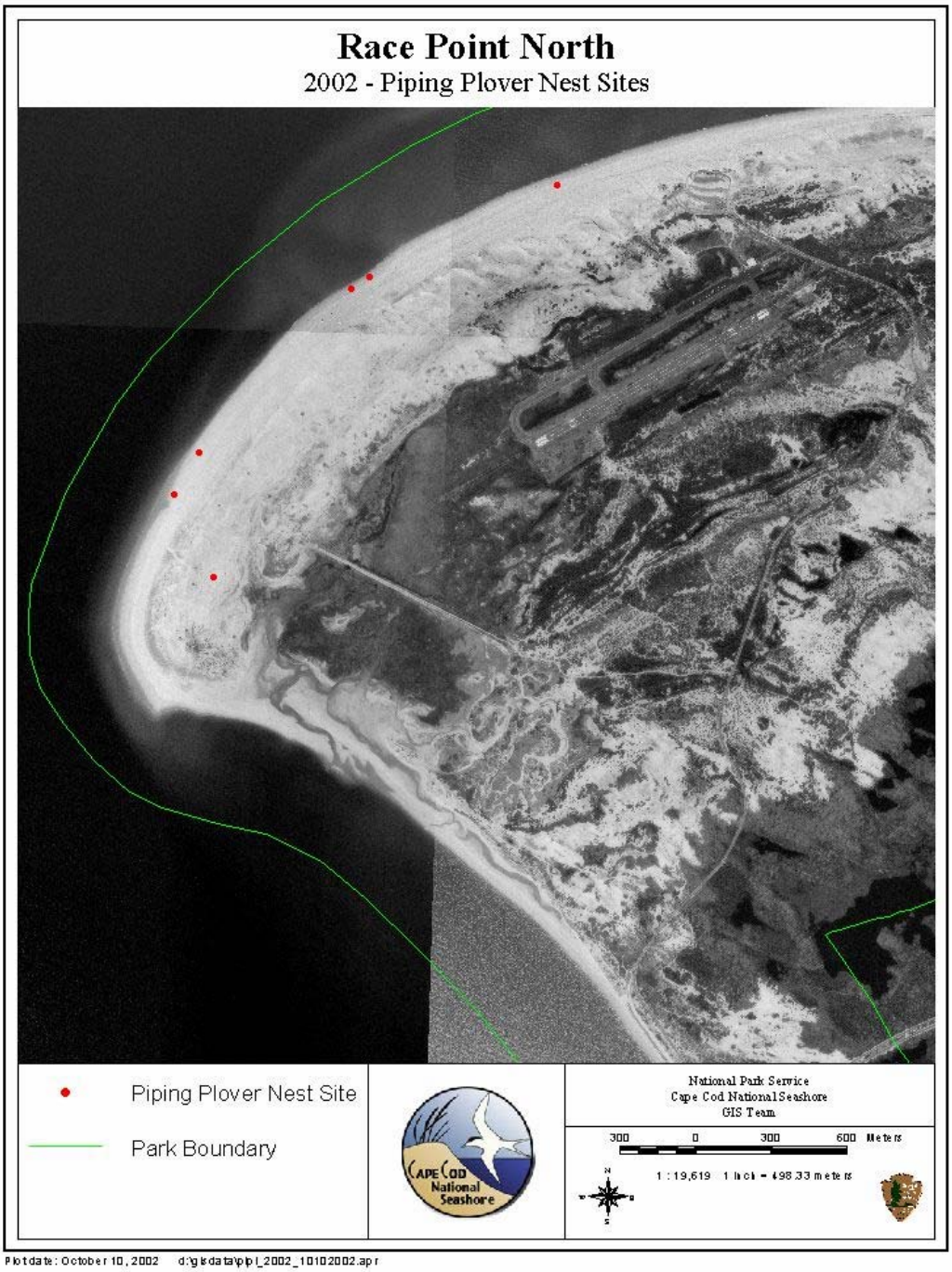
## Maps of North District Piping Plover Nest Sites
## Cape Cod National Seashore - 2002

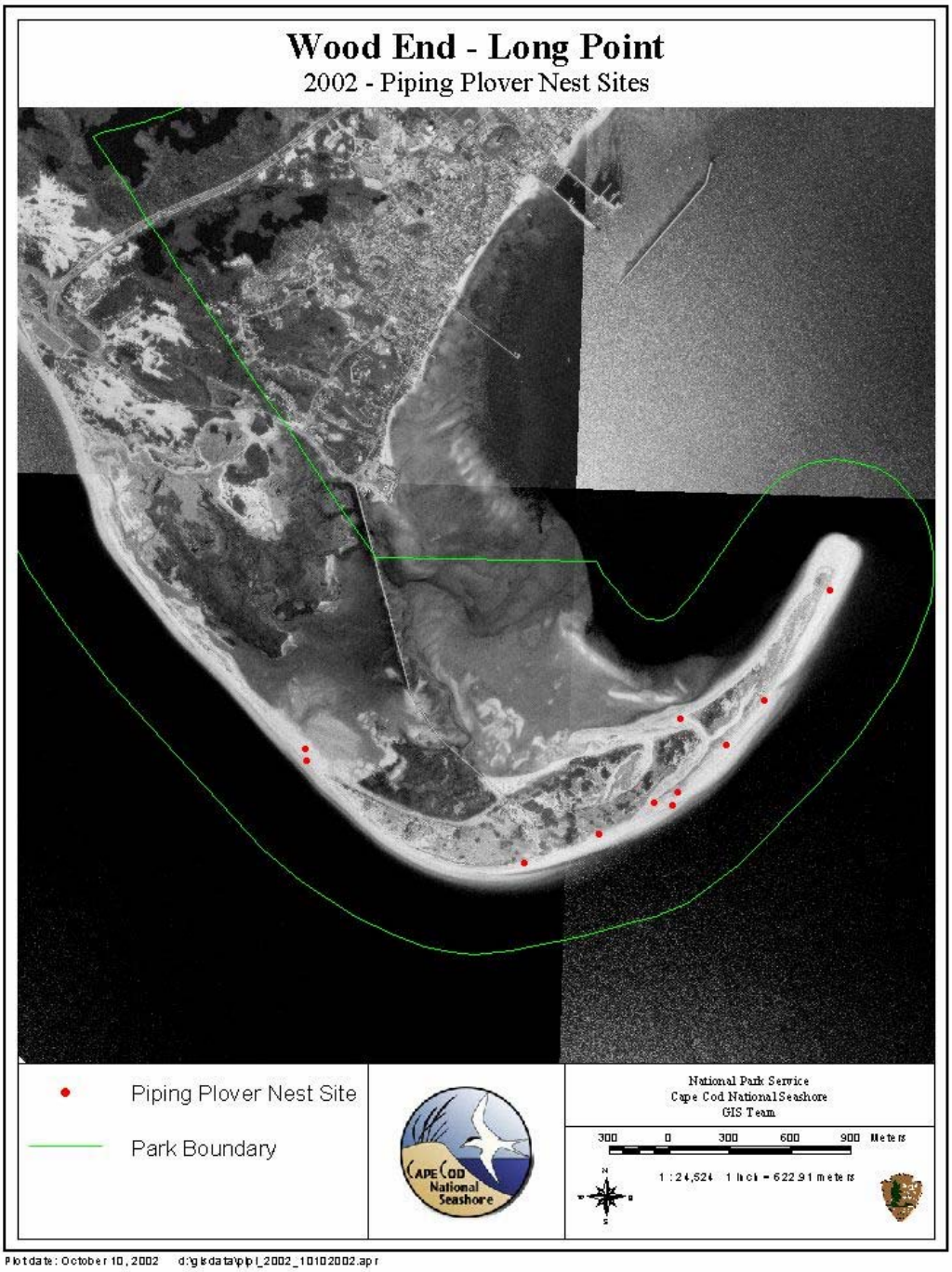

Piping Plover Nest Sites - North District, 2002
Cape Cod National Seashore
Piping Plover Nest Site
Park Boundary
Town Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
3000
0
3000 Meters
1 : 123,673 1 Inch = 3138.77 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10072002.apr


Ballston
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 900 Meters
1 : 24,749 1 Inch = 628.62 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10102002.apr


High Head
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
250 0 250 500 750 Meters
1 : 21,171 1 inch = 537.75 meters
Plot date: October 10, 2002 d:\gisdata\pplp1_2002_10102002.apr


Race Point South
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Town Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
500 0 500 1000 1500 2000 Meters
1 : 49,347 1 Inch = 1253.41 meters
N
W
E
S
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10102002.apr


Race Point North
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
Cape Cod National Seashore
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 Meters
1 : 19,619 1 inch = 498.33 meters
Plot date: October 10, 2002 d:\gisdata\pplp_2002_10102002.apr


Wood End - Long Point
2002 - Piping Plover Nest Sites
Piping Plover Nest Site
Park Boundary
National Park Service
Cape Cod National Seashore
GIS Team
300 0 300 600 900 Meters
1 : 24,624 1 Inch = 622.91 meters
Plot date: October 10, 2002 d:\gisdata\ppl_2002_10102002.apr