Shorebird Monitoring and Management
Cape Cod National Seashore
2010

Prepared by: Division of Natural Resources
Cape Cod National Seashore
Wellfleet, MA 02667

Reviewed: Shelley Hall
Chief, Natural Resources
Date: 10/21/11

Concurred: _____
Superintendent
Date: 10/21/11

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Abstract

This report summarizes the 2010 shorebird nesting season for Cape Cod National Seashore (Seashore). Piping plover (*Charadrius melodus*) nesting and brood-rearing were monitored on 24 beaches from Provincetown to Orleans. Observations of piping plovers began mid-March. Egg-laying began on 22 April. Peak nesting occurred during the last week of May and the first week of June. A total of 85 nesting pairs attempted 115 nests, 68 of which were successful. A total of 137 chicks fledged, for a productivity of 1.61 chicks fledged/ nesting pair. A total of 47 nests failed before hatching. American crows (*Corvus brachyrhynchos*) were the main egg predators before nest exclosures were installed. Predator exclosures were erected around 78 nests. A total of 37 nests were not exclosed; of these, 34 failed to hatch. A total of 226 pairs of least terns (*Sterna antillarum*) nested in nine colonies from Eastham to Provincetown. Productivity was low, approximately 0.17 chicks/pair, primarily due to coyote. Two pairs of American oystercatchers (*Haematopus palliates*) produced five nests on Jeremy Point, Wellfleet, with no productivity. Several pairs of common terns (*Sterna hirundo*) were observed at Jeremy Point and New Island, but no nests were laid. Post-breeding/staging roseate terns (*Stera dougallii*) were present in large numbers at Hatches Harbor, Nauset Marsh, Coast Guard (Eastham), Wood End, and Jeremy Point.

Dogs were prohibited on all beaches where nesting shorebirds were present. During daily patrols, 446 dogs were observed off leash by shorebird monitors. Dogs off leash were most frequently observed on LeCount Hollow and Newcomb Hollow in the South District and Ballston Beach and Wood End/Long Point in the North District.

Thirty-nine pairs of piping plovers and 45 pairs of least terns nested within the Off-Road Vehicle (ORV) corridor in Truro and Provincetown. The vehicle corridor remained open until chicks hatched. Sections of beach were closed to vehicles until the chicks could fly. Off-road vehicle access at the Seashore is guided by rules developed in 1998 through a negotiated rule making (NegReg) and NPS Environmental Assessment: Options for Managing ORV Access Cape Cod (2007).

Introduction

Cape Cod National Seashore was authorized by congress in 1961 as a unit of the National Park Service (NPS). The Park preserves approximately 44,600 acres of upland, wetland, tide lands, and nearshore waters located on Outer Cape Cod. As reflected in the Seashore's General Management Plan, this unit of the National Park System was established, in part, to protect the area's outstanding natural resources including federal and state listed sensitive species.

The Seashore provides miles of prime feeding, nesting, and roosting habitat for beach-nesting birds, including the federally threatened piping plover, the least tern and common tern, both listed by the Massachusetts Division of Fisheries and Wildlife (MDFW) as a species of special concern, and the American oystercatcher, identified by the U. S. Fish and Wildlife Service (USFWS) as a Bird of Conservation Concern in the United States (USFWS 2008).

Shorebirds were monitored on 24 beaches in the Seashore from Provincetown to Eastham, encompassing approximately 43.4 miles of beach. For staffing and operational purposes, these beaches are divided into two districts. The North District includes all NPS beaches located in Provincetown and Truro (Wood End/Long Point, Race Point North, Race Point South, High Head, and Ballston). The South District includes all NPS beaches located in Eastham and Wellfleet (Coast Guard, Nauset Light Beach, Marconi Beach, Marconi Station, LeCount Hollow, White Crest, Cahoon Hollow, Newcomb Hollow, Bound Brood, Duck Harbor, Great Island and Jeremy Point) and New Island in Orleans.

For nesting piping plover, the Seashore follows the monitoring and protection methods outlined in the U.S. Fish and Wildlife Service Piping Plover Atlantic Coast Population Revised Recovery Plan (1996) and Erwin (2003). For nesting terns, the Massachusetts State guidelines for monitoring and protection (Blodget and Melvin 1996) are followed to the greatest extent possible. These guidelines are also applied to the protection and management of American oystercatchers to the greatest extent possible.

During the nest location phase, Seashore monitors search the beach for shorebird nest scrapes, and tracks in the sand. To provide accurate predictions of hatching dates, beaches were monitored daily to find nests before clutch completion. The ability to predict hatching dates is important especially along the ORV corridor where vehicles are allowed to pass nesting areas until chicks hatch. All plover nests along the ORV corridor and nearly all other shorebird nests and colonies throughout the Seashore were monitored daily, often from a distance to reduce disturbance.

Population and Productivity

Piping Plovers

Nest Search and Incubation Monitoring

Results

Eighty five pairs of piping plovers were monitored on 24 beaches in the Seashore in 2010 (Table 1 and Appendix A). The first piping plover was observed on Seashore beaches on 18 March, and most beaches had plovers present by early April. Plovers continued to arrive into mid-June. The first nest was found on 22 April at Hatches Harbor. Peak nesting for the Seashore occurred during a three week period from

22 May to 12 June (Figure 1). The majority of nests were located along the upper beach in open sandy habitat. One notable nest was located at Ballston Beach, approximately 25 meters up a sand cliff.

The breeding population of piping plovers was based on the number of pairs observed nesting and any pairs that exhibited courtship or territorial behaviors (scraping, aerial calls) for longer than two weeks.

A total of 115 nests were found during the 2010 season. Of these, 68 hatched at least one chick and 47 failed (Table 2). Predation accounted for 84% of these failures, followed by overwash (5%), sanded over (4%), abandonment (4%), and infertile (2%). Of the nests lost to predation, 72% were lost to American crows, 20 % to unknown predators and 8% to coyotes (*Canis latrans*).

The 115 piping plover nests contained a total of 386 eggs. Of these, 236 hatched. The other 150 were lost to various causes, primarily predation (65%) (Table 3). Overall hatching success was 61%, ranging considerably among the 24 beaches, from 100% at Exit 9 to 19% at Coast Guard Beach (Eastham) (Table 1).

Circular and canopy style predator exclosures were installed around 68 of the 115 nests (Table 4). However, exclosures were subsequently removed from ten nests (eight canopy and two circular style) due to concerns of predators keying into the exclosures, increasing the chances of adult plover mortality. None of the nests were successful after the removal of the exclosure; due primarily to crow predation.

Of the 68 nests that remained exclosed throughout incubation, 3 (4.5%) failed to hatch any eggs. The causes of nest loss in exclosed nests were: overwash (1), sanded-over (1) and infertile (1). Hatching success of nests that remained exclosed was high for both exclosure types (95% for canopy and 96% for circular). All exclosed nests were monitored almost every day and no less than every other day to look for potential complications such as predators keying into exclosures or adult mortality. A total of 37 nests were not exclosed; of these, 34 (92%) were not successful, mainly due to predation (59% crow, 24% unknown predator, 6% canid sp.) (Table 4).

There was no exclosure-related adult mortality in 2010. A dead adult piping plover was discovered outside the posted area in a tire track on the lower beach at Race Point North on 9 May. This section of the vehicle corridor was closed to the public. The carcass was sent to the U.S. Geological Survey-

National Wildlife Health Center in Madison, WI for necropsy. Results indicated cause of death to be trauma compatible with vehicle impact.

Discussion

From 2001 – 2010, the three main factors affecting nest and egg loss were predation, overwash, and abandonment of nest after being exclosed (Table 7). On average, 48 % of nests were lost each year, mainly due to these factors. In 2010, nest loss was slightly lower at 41%.

Renesting and productivity varied by district. Of the 47 nests lost overall, 37 were lost in the South District and 10 were lost in the North District (39% and 15% renesting rate respectively). Productivity in the North District was high compared to the South District (2.04 and 0.97 respectively). Reasons for these differences in the districts may be due to increase predator pressures (mainly crow) in the South District (Table 1). Groups of crows were commonly observed foraging along oceanside beaches and on the bayside of Wellfleet. Their tracks blanketed the sand, and on several occasions active scrapes with numerous plover tracks had fresh crow tracks right up to the scrape, suggesting that crows took the egg(s) before the nests were found. Crow population appears to be increasing, most likely due to their ability to adapt and benefit from human development of the surrounding landscape (Marzluff et al 2001). It has been suggested that crow populations are larger in the South District, relative to the North District, due to the larger concentrations of people and to a lesser extent, because of the greater abundance of trees nearby for crows to nest in and perch on.

Brood Monitoring and Productivity

Results

Hatching dates of piping plovers ranged from 24 May to 12 July. Fledging dates ranged from 22 June to 22 August. Of the 236 plover chicks that hatched, 137 survived to fledge, resulting in an overall fledging success rate of 58% (a 26% increase from 2009). By beach, fledging success ranged from 0% at LeCount Hollow and Duck Harbor to 100% at Bound Brook, Hatches Harbor, and Ballston Beach. Park-wide, productivity was 1.61 fledged chicks/nesting pair (137 fledged chicks from 85 pairs) and ranged from 0.0 at LeCount Hollow and Duck Harbor to 4.0 at Hatches Harbor.

Chick mortality factors are extremely difficult to assess. In the vast majority of cases, the cause of chick loss is unknown. A chick was presumed dead if it was not seen for the remainder of the season. An entire brood was considered lost when chicks were not seen for 5 consecutive days.

Discussion

Based on the last ten years (2001 – 2010) in piping plover nesting at the Seashore, 2010 was a better than average year for parameters related to successful nesting. The number of pairs (85), nests (115) and eggs laid (386), nest success rate (59%) and the number of renests (26%) were equal to or above the middle of the range of values recorded for these parameters. However, the number of hatchlings (236) was relatively high (second highest during this period) and the number of chicks that fledged (137) was higher than most years. Productivity of 1.61 was higher than the mean, but fell within the median range for this time period (Table 5).

Although productivity was relatively high in 2010, regression analyses of annual productivity from over the past twenty years (1991 – 2010) shows a statistically significant decline in the annual productivity (slope of the regression line = - 0.549630, p-level = 0.012059). The five year average productivity ending in those years also shows a statistically significant decline in plover productivity over the past twenty year time period (slope of the regression line = - 0.787290, p-level = 0.000038) Factors that likely affected yearly productivity include predator pressures, storm frequency and beach morphology.

Chick survival (i.e. fledging rate) in the Seashore for the 2010 season was 58%, almost double the 2009 value (32%) and slightly above the mean and median values for the past ten years (56%). The relatively mild weather and lack of storms may have contributed to this increase. The hatching success and fledging success was higher in the North District (80% and 59%) than in the South (37% and 54%). The difference may be due to the higher rates of predation, especially crow predation, in the South District.

Brood monitoring is always challenging. Chicks are highly mobile and difficult to locate, especially in dense vegetation. Another factor affecting brood monitoring is human disturbance, which often causes brood dispersal. Young chicks are extremely reactive to human disturbance, and observations of chicks running away from humans were common. On several occasions in 2010, adult piping plovers were observed engaged in distress calls and broken wing displays when beachgoers approached chicks. Often chicks would disperse in several directions away from the perceived threat. An even more serious and potentially deadly threat to chicks occurs on narrow beaches with high human visitation. The lack of dry beach, especially at high tide, forces the beachgoer and plover broods to come in close contact with each other, increasing the frequency and probability of human disturbance.

In general, most piping plover chicks fledge at 25 to 27 days (Blodget and Melvin 1996). In recent years, however, it has not been uncommon for broods to take longer. A total of seven broods (five in the North District and two in the South District) exceeded 35 days to fledge. On average, these broods took 39 days to fledge with at least one chick from three of these broods (two from Race Point North and one from Marconi Beach) taking 40 -43 days to fledge. As outlined in the Atlantic Coast Piping Plover Recovery Plan (1996), Appendix G. Piping plover chicks are considered fledged at 35 days of age or when observed in sustained flight for at least 15 meters, whichever occurs first. For the purpose of vehicle management, vehicles are not allowed on beaches supporting unfledged plover chicks.

Population Trends

Results

Eighty five pairs of piping plovers were monitored on 24 beaches in the Seashore in 2010. Piping plovers were first observed on Seashore beaches in the third week of March, and most beaches had plovers present by early April. Plovers continued to arrive into mid-June. Most plovers had left Seashore beaches by late August.

Discussion

Since 2000, the number of nesting pairs of piping plovers has ranged from 64 to 97. The 85 nesting pairs in 2010 is above the mean of 82 for this recent period. During this same time period, annual productivity

has ranged from 0.70 to 2.04, with a mean of 1.46 fledged per pair (Table 5). Productivity in 2010 (1.61) exceeds this mean and is the third highest in this time period but just shy of attaining the USFWS minimum recovery goal of achieving a five year weighted average productivity of 1.5 fledged chicks/pair with 1.49 (Table 8).

Least Terns

Nest Search and Incubation Monitoring

Results

Least terns returned to the Seashore during the second week of May. They were first heard on 13 May at Wood End/Long Point, and first observed on the beach on 18 May at Race Point North. Egg laying began on 28 May, with most least terns on eggs by mid-June. Renesting attempts continued through July. Visual estimates of colony size were made from outside the symbolic fencing several times per week. Shorebird staff may walk inside the colony 1-2 times per week to count nests and or chicks.

The number of pairs in each colony was estimated during two standardized periods defined by MDFW ("A-count" from June 5-20 and "B-count" after June 20). An estimated total of 169 pairs nested in the "A" count and 226 pairs in the "B" count. There were a total of nine nesting sites from Eastham to Provincetown (Table 9).

Colony size and location shifted throughout the season. Head of the Meadow supported the largest colony in the "A" count (88 pairs). This colony was predated and only 19 pairs were counted on this beach during the "B" count. It is uncertain where birds from this colony went, but renesting and shifting of nest sites was common through the season. The colony at Marconi Beach increased in size from one pair during the "A" count to 36 pairs in the "B" count. Coast Guard Beach (Eastham). Race Point North, Race Point South, Exit 9 and High Head supported small colonies ranging from 1 - 33 pairs.

Predators were a major cause of nest loss. Tracks indicated coyote to be the main predator; crow, gull (*Larus* sp.) and Opposum (*Didelphis marsupialis)* tracks were also observed in colonies. Nests were also frequently lost to astronomic high tides and storms.

There was also one instance of a least tern incubating two small pebbles (Head of the Meadow, on 25 June), a behavior occasionally observed in the past.

Brood Monitoring and Productivity

Results

The first chicks hatched on 23 June. The last chicks hatched on 20 August. Most chicks disappeared soon after hatching. As outlined in the Massachusetts Tern and Plover Handbook (Blodget and Melvin 1996), "Least terns are considered fledged when they are capable of flight". A total of 29 chicks fledged from 226 nesting pairs ; Wood End/Long Point (2), Race Point North (6), Race Point South (2), Exit 9 (12), Head of the Meadow (1), Marconi Beach (3), and Jeremy Point (3); there was no productivity at High

Head or Coast Guard Beach, Eastham. Total productivity was estimated at 0.13 chicks fledged per pair for the season (226 pairs/29 fledged chicks) (Table 9).

Discussion

Populations of least terns have varied over the past ten years from a high of 380 pairs in 2000 to a low of 40 pairs in 2007 (Figure3). There was a slight reduction of nesting pairs in 2010 from 2009 (226 pairs and 236 pairs respectively), but both years showed an increase from four year prior. Even though populations have increased since 2007, productivity remains poor. Reasons for this low productivity may include the narrowing of some beaches, causing over washing of nests and intense predation on eggs and chicks, especially by coyotes.

Common Terns

Nesting Population and Productivity

Results

The first observation of common terns was on 18 May, at Race Point North. On 27 June two pairs were observed scraping at Jeremy Point, but no nests were established. Two pairs were also observed 23 May on New Island, Orleans, but no nests were ever found. There was no common tern nesting in the Seashore in 2010.

American Oystercatchers

Population and Productivity

Results

The first American oystercatcher was observed in the Seashore on 2 April. Two pairs nested at the southern tip of Jeremy Point. The first nest was found on 1 May. A total of five nests were laid. Of the five nesting attempts, four nests predated by coyote and two chicks hatched from the fifth nesting attempt on 7 July but were never seen again. Coyote predation was suspected due to fresh tracks in the area.

Discussion

Oystercatchers were first recorded nesting on Seashore beaches in 2002. Since then, two to five pairs have nested in the South District and on New Island, Orleans. During these years, most nests were lost to predation (predominately coyote) or overwash. A few nests hatched over this time period, but the chicks disappeared before fledging, often within the first week. Predation was the likely cause of chick lost. In 2006 – 2008, productivity was better, but still low with an average of 0.53 chicks fledged/nesting pair. In 2009 -2010, productive was zero. Both years, coyote predation was the main cause of nest loss and the likely cause of chick loss.

Post Breeding/Staging Terns

In 2010, from 22 August through 2 September, surveys of staging terns and shorebirds were conducted by Shorebird staff on the beaches of Truro and Provincetown, from Head of the Meadow to Long Point. Over 14,000 terns were estimated in these areas over the 12 day period, and over half of these were observed in Hatches Harbor. Although five species of terns were identified, the majority were common and roseate terns. In mixed-species flocks where individual species were tallied, up to 35% of terns were roseates and a considerable number of them were banded. There was a dramatic decrease in the number of staging terns on Race Point North after the beach was reopened to vehicles. In the South District, beginning in the middle of July, hundreds of mixed-species (common and roseate) terns were regularly seen congregating on the tidal flats at Coast Guard Beach (Eastham), Marconi Beach and Jeremy Point. Over 1,000 staging terns were observed at Jeremy Point on 1 September and over 2,000 were counted at Coast Guard Beach (Eastham) on 2 September.

Management and Protection

Predation Management

Piping Plover Nest Protection

Methods

Historically, the Seashore has focused on non-lethal predator management through the use of exclosures around nests. In 2010, two predator exclosure designs were used:

1. *Circular Exclosure* – This design has been used at the Seashore since the early 1990's. The circular exclosure is 10 feet' in diameter and 3 feet high, constructed of 2 x 4 inch wire fencing. A ½ inch plastic mesh bird netting is secured to the top.

2. *Canopy Exclosure* - This design uses 2 x 4 inch fencing to create a 4 x 4 foot square exclosure, 3 feet high. A heavy gauge plastic 2 x 2 inch deer netting is secured over the top and extends for 4 feet from all sides, creating a canopy. The canopy is secured with wooden and steel posts. An additional 4 x 6 foot piece of fencing is attached to two of the sides creating a second, domed top.

With concurrence from the MDFW (Melvin, pers. comm.) the majority of incomplete clutches were exclosed to reduce the chance of predation on eggs. If the nest was then abandoned, the renest was not exclosed until the pair was actively incubating eggs, to increase the likelihood that the pair would return to the nest after the exclosure was installed. If, after fifteen minutes they didn't return to the nest after the exclosure was installed, the exclosure was removed.

Nests were not exclosed when they were: (1) located in thick vegetation, (2) located on the side of a dune or cliff that precluded installation of 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. Exclosures were also removed if tracking or direct observations indicated that predators were keying into the exclosures, harassing incubating adults.

Results

Predator exclosures were installed around 78 of the 115 nests in 2010 (Table 4). Ten of these exclosures (two circular and eight canopy) were subsequently removed before eggs hatched, due to predators "keying" into the exclosures, increasing the risk of adult plover mortality. None of these ten nests were successful (Table 4). The success rate (i.e. hatching) of exclosed nests was similar for both circular and canopy style exclosures (96% and 95% respectively). Only one canopy-exclosed nest was lost to overwash; of the two circular-exclosed nests lost, one was infertile and the other sanded over. A total of 37 nests were not exclosed; of these nests, 34 (92%) were not successful: 88 % were lost to predation, two nests were abandoned (6 %), one nest was sanded over (3%) and one nest was washed over (3%). Three unenclosed nests hatched (8%). Although there were no documented cases of adult mortality associated with exclosure use, there have been at least fifteen plover deaths associated with the use of circular and canopy exclosures at the Seashore since 2002 (Table 6).

Discussion

Crow accounted for the greatest loss to nest predation over the past five years (Table 2). Field observations note groups of crows (especially during April and May) hunting within plover nesting areas and crow tracks throughout nesting areas. The number of nests lost to crow predation would likely be higher if we did not install predator exclosures around some nests soon after they were discovered. These nests were often incomplete, before the plovers were actively incubating the eggs. Even with predator exclosures being quickly installed around nests, predation accounted for the greatest number of nests lost in 2010 (84%) (Table 2).

It is clear that predators, especially crows, have a major impact on nest success. Of the 47 nests that were lost to predators in 2010, 28.5 (72%) were lost to crow. Undetermined predators and coyote predation were the second and third leading cause of egg predation (20% and 8% respectively) (Table 3). In the cases were the specific predator could not be determined (due to poor tracking), it is likely that in most cases, nest loss was due to the most common known predators (crows and coyotes).

Protection for least tern chicks

One of the most effective strategies used by terns to protect eggs and chicks from predators is to nest in large colonies. Any predator that enters the colony is attacked by the large group of birds until the predator (or perceived threat) left. As colony size has decreased over the past several years along Seashore beaches, this behavior has become ineffective and predators appear undeterred by the few birds defending the nesting area. In 2010 tern shelters were placed inside some nesting colonies when chicks hatched. The triangular plywood shelters were approximately 25"x 8"x 8", with a 7" x 8" opening for the chicks to enter. This design was taken from the U.S. Fish and Wildlife Service Tern Management Handbook, Coastal Northeast United States and Atlantic Canada (2004). Chicks were observed in the shelters at Jeremy Point.

Recreation Management

Habitat Protection

Posting of historic shorebird nesting habitat with symbolic fencing and signs began on 31 March at Race Point North and Race Point South and continued through mid- April to include Exit 9, Head of the Meadow, Coast Guard Beach (Eastham), Great Island, Jeremy Point and New Island. Symbolic fencing was placed around all other areas where nests and active scrapes were found, and where shorebirds were observed exhibiting courtship behavior. Symbolic fencing is used to identify and protect shorebird nesting habitat. Five-foot wooden posts were placed 40'-50' apart and connected by a line of cotton twine to delineate nesting habitat. Plastic and wooden "Area Closed- Bird Use Area" informational signs are affixed to every second or third post. A variety of shorebird and natural resource informational and regulatory signs were also posted at the entrance to most beaches and nesting sites. Additionally, shorebird staging areas (Race Point North and South, Hatches Harbor, Coast Guard Beach/Eastham, and Jeremy Point) were posted with symbolic fencing and signs, beginning in late July and remaining into September.

Kites/Kite Surfing

When kites are flown in or near nesting habitat, plovers exhibit the same behaviors as when avian predators are present (Hoopes et al. 1992). Both hand held kites and those used in kite surfing/boarding simulates the flight of birds of prey. The use and launching of these different types of kites could cause the birds to shift or abandon breeding territories, flush incubating birds off nests, cause nest abandonment, disturb feeding adults or chicks, or physically harm eggs or unfledged chicks. To prevent disturbance from kites, hand-held kite flying is prohibited on all beaches within 200' of any shorebird nesting sites and kite surfing is prohibited on Cape Cod Bayside beaches and Cape Cod Bay waters within the Seashore from 1 April until the last chicks have fledged in the area (NPS 2008). Signs explaining these restrictions were posted at all bathing beaches.

Additionally, at the request of the Seashore, hang-gliders and para-gliders are temporarily banned from launching along Wellfleet town beaches from April 15 through Labor Day. These kites disturb nesting plovers and terns when they fly low along the coastline directly over nesting areas.

Pets

Pets are required to be on a six-foot leash anywhere they are allowed within the Seashore. In addition, a number of areas are closed to pets to protect park resources. In 2010, the south side of Coast Guard Beach (Eastham) and Jeremy Point were closed to pets on 1 April to protect nesting plovers. Since 2008, these beaches remained closed through Columbus Day to protect the thousands of terns and other shorebirds utilizing the mudflats and beaches for feeding and resting during migration. In 2010, the marsh area of Hatches Harbor was also closed to pets when there was > 50 migrating shorebirds. The area remained closed until 30 September. Signs were posted along the high tide line on the marshside of Hatches Harbor spit. The oceanside of the spit remained open to leashed pets.

Additional sections of bay and ocean beaches were also temporarily closed to pets as needed to protect nesting areas. In 2010, this included sections of beach along the ORV corridor. Pets were not allowed out of ORVs in front of nesting shorebirds, but ORV users with pets could drive by nesting areas to access other areas of the beach where pets were permitted. "No Pet Area" signs were posted perpendicular to the water approximately 50 meters away from the symbolic fencing, extending down into the intertidal zone. These signs were moved as necessary to reflect the closures in effect at any one time. These sections of beach were closed until all chicks fledged. Signs informing visitors of this temporary pet closure were installed and moved as necessary to reflect the closures in effect at any one time. Sections of beach were closed until all chicks fledged. Beaches that did not have nesting shorebirds remained open to leashed pets.

A total of 446 dogs were recorded off-leash on Seashore property in 2010 from 15 April to 28 August by shorebird monitors (Table 1). Unleashed dogs were encountered most frequently in the South District at LeCount Hollow and Newcomb Hollow (43 and 42 respectively) and in the North District at Ballston Beach and Wood End/Long Point (30 and 24 respectively).

Pedestrians and Boat Landing

Winter storm erosion continues to narrow beaches in the South District. Where beaches were extremely narrow, it was not always possible to provide sufficient buffers within the symbolic fencing (especially at high tide) to prevent pedestrian disturbance of nesting birds.

Some sections of beach had to be completely closed at all tides due to concerns that day hikers who start at low tide may not be off the beach in time to safely pass the nesting area without disturbing the nesting birds. The east and west side of Jeremy Point (north of the overwash area) was closed on 27 June. The east side was reopened on 4 July and the west side was reopened on 18 July.

The north and/or south fork access road to Race Point North was temporarily closed to pedestrians in late June through early July to protect nesting least terns.

Off-Road Vehicles

Off-road vehicle (ORV) access is permitted along a designated beach corridor in Provincetown and Truro. Off-road vehicle access at the Seashore is guided by rules developed in 1998 through a negotiated rule making (NegReg), 2006 Environmental Assessment: Options for Managing ORV Access (NPS 2007). Permit applicants receive some education about nesting piping plovers and terns. A total of 4469 ORV/SCV permits were sold in 2010 (1492 seasonal permits and 2,977 weekly permits).

The ORV corridor was open to vehicles during the egg laying and incubating phase of the nesting season in areas where there was an adequate protective buffer between the incubating shorebirds and vehicles. To determine the actual date of hatching and ensure that chicks are found as immediately as possible after hatching, piping plover and least tern nests along the ORV corridor are checked twice a day starting two days prior to the estimated hatching date.

As nests hatched, sections of the beach were closed to vehicles to protect the flightless chicks. These vehicle closures extended 0.2 miles on each side of the brood for piping plover chicks and 0.91 m from either side of lines drawn through the outermost nests in the colony and perpendicular to the long axis of the beach for least terns. These vehicle closures were adequate for most nesting. However, actual closure limits for each brood were adjusted based on beach morphology, brood behavior, or other conditions as appropriate to ensure the chicks were protected. All chicks were monitored daily, noting their movements, location, and number in each brood. Broods adjacent to ORV corridor closures were often monitored twice a day, in the mornings and evenings, to ensure that there was an adequate protective buffer between the flightless chicks and ORVs. Vehicle closures were lifted on sections of beach if broods demonstrated repeated and sustained flight for at least 15 meters or if chicks moved out of the area or had not been observed for five consecutive days.

Field observations of unfledged chick movements in both piping plovers and least terns suggest that broods tend to move greater distances along the beach when there are no neighboring nesting birds keeping them within a defined territory. In 2010, At Race Point North, there were two separate instances where a brood of least tern chicks moved over 0.3 miles from their nest in a 25 day period. It was not uncommon for plover and tern chicks to move 0.1 miles overnight. In addition, there were cases of plover chicks moving back and forth over 0.5 miles from their nest site over several days.

For piping plovers and least terns, vehicle closures were lifted once chicks demonstrated repeated and sustained flight of 15 meters or more. However, fledged least tern chicks that were still being fed by adults on the beach resulted in a continuation of a vehicle closure on that beach.

Additional information on ORV management can be found in the 2010 Off-Road Vehicle Activity Report (NPS 2010a).

Park Beach Operations/Essential Vehicles

Seashore staff in vehicles routinely operate on beaches that host shorebird nesting, in order to perform their functions of public beach operations, monitoring and protecting threatened and endangered species, enforcing park regulations, and providing visitor safety.

The Seashore takes several precautions to minimize the risk of driving vehicles in areas with nesting shorebirds, as outlined in the 1998 NegRegs. In addition, all designated staff driving on beaches are knowledgeable of shorebird biology, identification, and current nesting locations and required to comply with the Seashores SOP for ATV use including completing the on-line "Introduction to Basic ATV operations and the ATV Rider Course" along with a one day "hands-on" field training course given by a certified Off-Highway Vehicle trainer (NPS 2010b).

To reduce accidentally crushing adults and chicks, the use of vehicles on beaches with nesting shorebirds is avoided or minimized and speed limits are reduced.

Flexible Management

In accordance with Section 7 of the Endangered Species Act of 1973, CACO initiated formal consultation in January 2010 on implementation of flexible management for piping plover at two beaches for the 2010-11 nesting seasons. The proposed action would allow CACO some flexibility in managing a very limited number of piping plovers nesting on or near high visitation beaches where the beach has eroded to the point where fully protecting piping plovers would render the beach unusable to visitors at high tide. More specifically, flexible management actions would be limited to sections of beach that include a pedestrian access point and life-guarded beach, with the goal of providing visitors a length of beach for swimming and sunbathing.

On May 11, 2010, The U.S. Fish and Wildlife Service issued a Biological Opinion (BO), granting permission for this action. The BO determined that the flexible management proposed for a total of 400 meters of suitable piping plover habitat, affecting no more than three pairs of piping plovers within the Seashore, was not likely to jeopardize the continued existence of the Atlantic Coast piping plover population or the New England recovery unit.

In 2010, a one egg piping plover nest was found on 4 June, 125 meters south of the stairs at Marconi Beach, within the identified flexible management area. Symbolic fencing was installed around the nest to prevent the nest from being stepped on, but not enough to prevent disturbance (the buffer between the visitors and the incubating bird was eight meters). No exclosure was installed. The adults continued incubation and laid a total of three eggs. The nest was first overwashed on 13 June, losing one of the three eggs and again on 14 June, losing another egg. The last egg was washed away 15 June during the high tide. The pair left the area after losing the nest.

Management and Protection of Post Breeding Shorebirds including Common and Roseate Terns

In late summer/early fall, thousands of migrating shorebirds and terns congregate on the mudflats and beaches along the Seashore to feed and rest before migration. Nauset Marsh/Coast Guard Beach, Jeremy Point, Hatches Harbor, and Wood End/Long Point are particularly important, as they represent the most important staging and roosting areas for these birds on Cape Cod (Hadden 2001, Trull et al. 1999).

While dozens of migratory species use the Seashore during fall migration, the most notable one is the roseate tern, a federally listed endangered species, which has experienced a 20% population decline since 2000. Researchers have established that most mortality occurs away from breeding colonies, and furthermore that it is post-fledging survival during the first year of life that constitutes a major factor in limiting population recovery. It has also been established that young roseate terns' migration (more than 10,000 km.) and overwintering survival depends on parental care after the young have fledged. This care is provided at staging and roosting areas, and disturbances to the birds in these areas can alter activity and energy budgets, and thus affect survival.

Multi-agency studies initiated in 2005, expanded in 2007, and continuing through 2010, documented that more than 90% of the entire North West Atlantic population of roseate terns used areas of the Seashore from mid July through late September in these years. Areas of particular importance were Hatches

Harbor and the Nauset Marsh/Coast Guard (Eastham) Complex. Disturbances at these sites were documented: dogs off leash and pedestrian disturbance were regular occurrences at Hatches Harbor and other sites; Jeremy Point experienced disturbance from boaters; and the level of disturbance at the Race Point beaches was partially dependent on vehicle access.

In 2009, in addition to counting numbers of terns at Hatches Harbor, biologists from Audubon and USGS recorded a variety of disturbances negatively impacting shorebirds. At least 14 (43%) of the observation days had significant disturbances recorded; of these, 50% had at least one disturbance caused by a leashed or unleashed dog. When the flocks of terns were disturbed by dogs, part or all of the flock vacated the area and didn't return during the observation period. On nice weather days and weekends, 50 cars or more (maximum count of 100 vehicles counted on 4 August) were observed on the outer beach at Hatches Harbor. The majority of human and dog disturbance occurred in and around the bay side intertidal flats after vehicles began to arrive on the beach. In addition, this area was a popular spot for dog owners to play fetch with their unleashed dogs (Jedrey unpub. 2009).

Beginning in 2009, and continuing in 2010, sections of intertidal zone with staging shorebirds were posted with symbolic fencing and signage at Coast Guard Beach, (Eastham), Jeremy Point, Race Point North and South, and Hatches Harbor, temporarily closing them to pedestrians. Signs guided visitors along the upper beach away from the birds, reducing disturbance.

Education, Outreach, and Public Involvement

Educating the public about shorebird biology and the human factors affecting shorebirds is important for gaining local support and facilitating their recovery. In early spring, an outreach program featuring a PowerPoint presentation and interactive activity demonstrating the impacts of disturbance to nesting shorebirds was presented to local schools. A total of 508 elementary grade students and teachers took part in this program (16 programs were given to 25 classes).

In 2010, two Student Conservation Association (SCA) interns were hired as shorebird interpreters. They developed educational materials on shorebird conservation. Interns manned a information table at visitor centers and at various beach access points. The portable display tables included photographs of nesting shorebirds, interactive games, plover coloring sheets, a naming contest for a two-foot replica of a piping plover, and free "I'm a plover protector" tattoos. This type of informal interpretation was very effective in reaching a broad range of visitors. A total of 4,005 visitor contacts were made.

Volunteers donated a total of 350 hours to CACO shorebird management program. Volunteers worked closely with Shorebird Biological Technicians and Student Conservation Association interns (SCAs) in field operations from April through August.

Literature Cited

Blodget B. G and S. M Melvin. 1996. Massachusetts Tern and Piping Plover Handbook, a manual for stewards. Mass. Div. of Fisheries and Wildlife. Natural Heritage and Endangered Species Program. Westborough, MA.

Erwin R. M. 2003 Waterbird monitoring protocol for Cape Cod National Seashore and other Coastal Parks, Refuges, and protected areas. A protocol for the Long term Coastal Ecosystem Monitoring Program at Cape Cod National Seashore. Unpublished report submitted to Cape Cod National Seashore, South Wellfleet, MA.

Hadden, S.W. 2001. Waterbird Inventory and Monitoring: Report on Protocol Implemention and Development at Cape Cod National Seashore. Unpublished report submitted to Cape Cod National Seashore, South Wellfleet, MA .

Hoopes, E.M., C.R. Griffin, and S.M. Melvin. 1992. Relationships between human recreation and Piping Plover foraging ecology and chick survival. Unpublished report. University of Massachusetts, Amherst, Massachusetts.

Marzluff, J. M., K. J. McGowan, R. Donnelly, and R. L. Knight. 2001. Causes and consequences of expanding American Crow populations. Pp. 331-363 in Avian ecology and conservation in an urbanizing world (J. M. Marzluff, R. Bowman, and R. Donnelly, eds.). Kluwer Academic Press, Norwell, MA.

Murphy, Sean. 2009. Boston. Color Banding American Oystercatchers. Harbor Island National Recreation Area, Island Research Abstract .

National Park Service 2007a Environmental Assessment: Options for Managing ORV Access Cape Cod National Seashore. Wellfleet MA.

National Park Service. 2007b FONSI and alternative Selection for Options for managing ORV Access. Cape Cod National Seashore. Wellfleet MA.

NPS. 2008. Cape Cod National Seashore Superintendent's Compendium. Wellfleet MA.

National Park Service. 2010a. Cape Cod National Seashore Off-Road Vehicle Activity Report. Wellfleet, MA.

National Park Service. 2010b. Cape Cod National Seashore Standard Operating Procedure (SOP) for All Terrain Vehicles Training and Certification Program. Wellfleet, MA.

Trull, P., S. Hecker, M. J. Watson and I. C. T. Nisbet. 1999. Staging of Roseate Terns Sterna Dougalli in the Post-Breeding Period around Cape Cod, Massachusetts, USA. Atlantic Seabird 1(4): 145.

U.S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*), Atlantic Coast Population, revised recovery plan. USFWS. Hadley, Massachusetts.

U.S. Fish and Wildlife Service. 2004. Tern Management Handbook, Coastal Northeastern United States and Atlantic Canada. U.S. Fish and Wildlife Service, Hadley, Massachusetts.

U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.

Tables

Table 1. Summary of Piping Plover Breeding Success, Cape Cod National Seashore, 2010

Site	# Pairs	# Nests[1]	# Eggs Laid	# Eggs Hatched	# Fledged Chicks	Hatching Success[2]	Fledging Success[3]	Productivity?
Coast Guard	8	16	42	8	2	0.19	0.25	0.25
Marconi Beach	6	11	33	7	5	0.21	0.71	0.83
LeCount Hollow	1	1	4	2	0	0.50	0.00	0.00
White Crest	1	3	7	4	1	0.57	0.25	1.00
Newcomb Hollow	2	3	7	3	3	0.43	1.00	1.50
Jeremy Point	7	7	27	21	17	0.78	0.81	2.43
Great Island	2	3	9	3	2	0.33	0.67	1.00
Duck Harbor	5	9	29	10	0	0.34	0.00	0.00
Bound Brook	2	2	8	3	3	0.38	1.00	1.50
Wood End / Long Point	7	7	26	24	18	0.92	0.75	2.57
Hatches Harbor	1	1	4	4	4	1.00	1.00	4.00
Race Point North	9	11	44	34	17	0.77	0.50	1.89
Old Harbor	2	2	7	5	3	0.71	0.60	1.50
Race Point South	5	7	26	16	1	0.62	0.06	0.20
Exit 9	8	9	36	36	22	1.00	0.61	2.75
High Head	9	11	35	25	18	0.71	0.72	2.00
Head of the Meadow	4	4	15	14	7	0.93	0.50	1.75
Coast Guard	1	1	4	4	1	1.00	0.25	1.00
Ballston Beach	5	7	23	13	13	0.57	1.00	2.60
TOTAL	85	115	386	236	137	0.61	0.58	1.61

[1] Includes re-nests

[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. Piping Plover Nest Loss Totals, Cape Cod National Seashore, 2010

Nests					Loss By Cause	
# Nests	# Hatched	# Lost	% Lost	Cause	# Lost	% Lost
115	68	47	41%			
				Predation	39.5	84%
				Overwash	2.5	5%
				Sanded-over	2	4%
				Abandoned	2	4%
				Infertile	1	2%
				Predation Types		
				Crow	28.5	72%
				Coyote	3	8%
				Unknown	8	20%

Table 3. Piping Plover Egg Loss Totals, Cape Cod National Seashore, 2010

Eggs				Loss by Cause	
Total #	# Lost	% Lost	Cause of Loss	# Eggs Lost	% Lost
386	150	39%			
			Predation	98	65%
			Infertile	23	15%
			Sanded-over	9	6%
			Overwash	9	6%
			Abandoned	8	5%
			Unknown	2	1%
			Chick Died in Egg	1	1%
			Predation Types		
			Crow	74	76%
			Unknown	16	16%
			Coyote	8	8%

Table 4. Fate of Exclosed and Unexclosed Piping Plover Nests, Cape Cod National Seashore, 2010.

Type of Nest Protection	Total Nests	# Successful	# Unsuccessful	% Successful	% Unsuccessful	Cause of Failure	# Lost	% Lost
Canopy Exclosure	21	20	1	95%	5%	Overwash	1	100%
Canopy Exclosure subsequently removed	8	0	8	0%	100%	Crow	6.5	81%
						Canid	1	13%
						Overwash	0.5	6%
Circular Exclosure	47	45	2	96%	4%	Infertile	1	50%
						Sanded-over	1	50%
Circular Exclosure subsequently removed	2	0	2	0%	100%	Crow	2	100%
Unexclosed	37	3	34	8%	92%	Crow	20	59%
						Unknown	8	24%
						Canid	2	6%
						Abandoned	2	6%
						Sanded-over	1	3%
						Overwash	1	3%
TOTAL	**115**	**68**	**47**	**59%**	**41%**			

Table 5. Summary of Piping Plover Nesting Parameters at Cape Cod National Seashore, 2000-2010

Year	# Pairs	# Nests	# Eggs Laid	# Successful Nests	# Chicks Hatched	# Fledged	Nest Success Rate	% Renests	Hatch Rate	Fledge Rate	Productivity
2001	78	88	415	48	154	73	40%	11%	70%	70%	2.04
2002	97	141	317	61	223	155	40%	31%	41%	50%	0.91
2003	84	121	450	54	189	130	45%	31%	49%	69%	1.55
2004	85.5	115	425	59	220	124	51%	26%	52%	56%	1.45
2005	77	118	378	49	163	87	42%	35%	43%	53%	1.13
2006	74	96	336	70	233	122	73%	23%	69%	52%	1.65
2007	85	113	368	67	233	143	59%	25%	63%	61%	1.68
2008	86	109	386	69	244	158	63%	21%	63%	65%	1.84
2009	87	109	367	55	190	60	50%	20%	52%	32%	0.7
2010	85	115	386	68	236	137	59%	26%	61%	58%	1.61
mean	84	113	383	60	209	119	52%	25%	56%	57%	1.46
median	85	114	382	60	221.5	127	51%	26%	57%	57%	1.58

Table 6. Summary of adult mortality by exclosure type, 2001-2010 at Cape Cod National Seashore

Year	# Circular	# Deaths	Rate	# Canopy	# Deaths	Rate
2001	70	0	0.00%	0	0	
2002	77	1	1.30%	0	0	
2003	57	2	3.51%	0	0	
2004	57	3	5.26%	5	0	0.00%
2005	35	0	0.00%	12	0	0.00%
2006	32	1	3.13%	46	0	0.00%
2007	27	1	3.70%	52	1	1.92%
2008	15	0	0.00%	50	3	6.00%
2009	39	0	0.00%	38	3	7.89%
2010	49	0	0.00%	29	0	0.00%
Overall	458	8	1.75%	232	7	3.02%

Table 7. Summary of Piping Plover Nest Loss at Cape Cod National Seashore, 2001-2010

				# Nests Lost to									
Year	Total Nests	# Successful Nests	# Unsuccessful	Overwash/Standing Over	Abandonment/Adult Mortality	Non-viable	Predation	Crows	Coyote	Gulls	Skunk	Unknown Predator	Other
2001	88	61	27	2	11	1	13	15%	0%	23%	0%	62%	0%
2002	141	57	84	27	17	1	39	21%	15%	15%	10%	36%	3%
2003	121	54	67	14	14		39	13%	26%	10%	13%	26%	13%
2004	115	59	56	15	13		28	43%	21%	11%	7%	18%	0%
2005	118	49	69	32	11	1	25	20%	24%	8%	0%	32%	16%
2006	96	70	26	8	6		12	75%	8%	0%	0%	17%	0%
2007	113	67	46	21	15		10	40%	20%	0%	0%	40%	0%
2008	109	69	40	7	8	1	24	38%	4%	8%	17%	33%	0%
2009	109	55	54	18	8	1	27	67%	7%	4%	0%	22%	0%
2010	115	68	47	4.5	2	1	39.5	72%	8%		0%	20%	0%
Total	**1125**	**609**	**516**	**148.5**	**105**	**6**	**256.5**	**39%**	**14%**	**8%**	**6%**	**28%**	**4%**

Table 8. Number of Piping Plover Breeding Pairs, Annual Nest Productivity, and 5 Year Weighted Average Productivity at Cape Cod National Seashore, 1985-2010.

Year	#pairs	5 year average pairs	#fledged	annual productivity	5-year weighted average productivity
1985	18		13	0.70	
1986	16		5	0.30	
1987	15		6	0.40	
1988	13		12	0.90	
1989	15	15.40	21	1.40	0.74
1990	15	14.80	39	2.60	1.12
1991	28	17.20	73	2.60	1.76
1992	43	22.80	103	2.40	2.18
1993	60	32.20	124	2.07	2.24
1994	72	43.60	178	2.47	2.37
1995	83	57.20	149	1.80	2.19
1996	77	67.00	68	0.88	1.86
1997	67	71.80	103	1.54	1.73
1998	61	72.00	111	1.82	1.69
1999	72	72.00	123	1.71	1.54
2000	64	68.20	73	1.14	1.40
2001	78	68.40	155	1.99	1.65
2002	97	74.40	88	0.91	1.48
2003	84	79.00	130	1.55	1.44
2004	85.5	81.70	124	1.45	1.40
2005	77	84.30	87	1.13	1.39
2006	74	83.50	122	1.65	1.32
2007	85	81.10	143	1.68	1.49
2008	86	81.50	158	1.84	1.56
2009	87	81.80	60	0.69	1.39
2010	85	83.40	137	1.61	1.49

Table 9. Number of Least Tern Pairs and Fledging Success at Nine Colonies at Cape Cod National Seashore, 2010

	# Nesting Pairs		
	A Count	B Count	# Fledge
WELP	5	22	2
RPN	16	16	6
RPS	7	28	2
E9	7	34	12
HH	3	17	0
HOM	88	19	1
CG	10	22	0
MB	1	36	3
JP	32	32	3
TOTAL	169	226	29

* Red number indicates that no B Count was noted on state forms and the A Count number is being used.

Figures

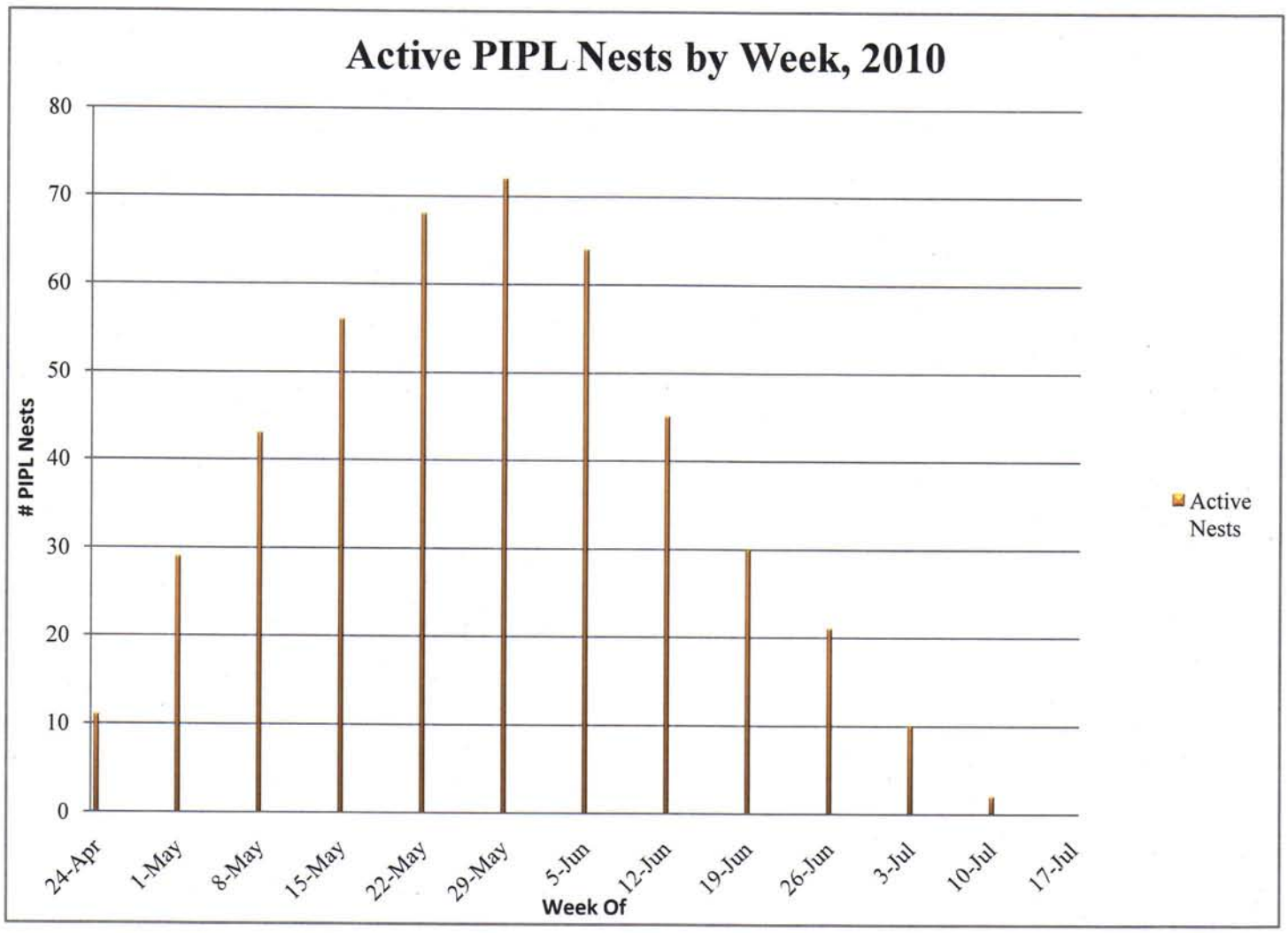


Figure 1. Weekly Active Piping Plover Nests at Cape Cod National Seashore, 2010.

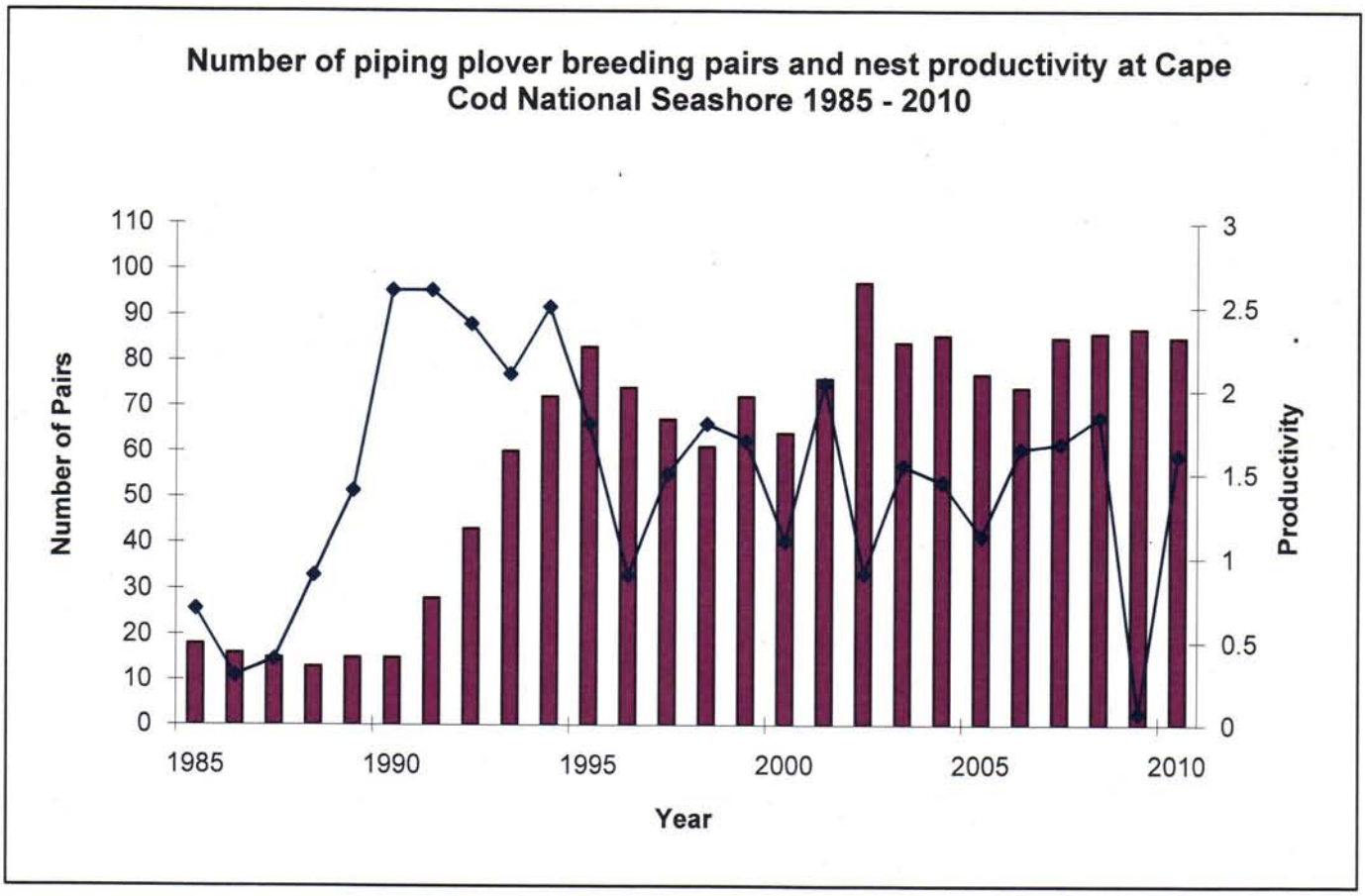


Figure 2. Number of Piping Plover Pairs and Nest Productivity on Cape Cod National Seashore from 1985 – 2010

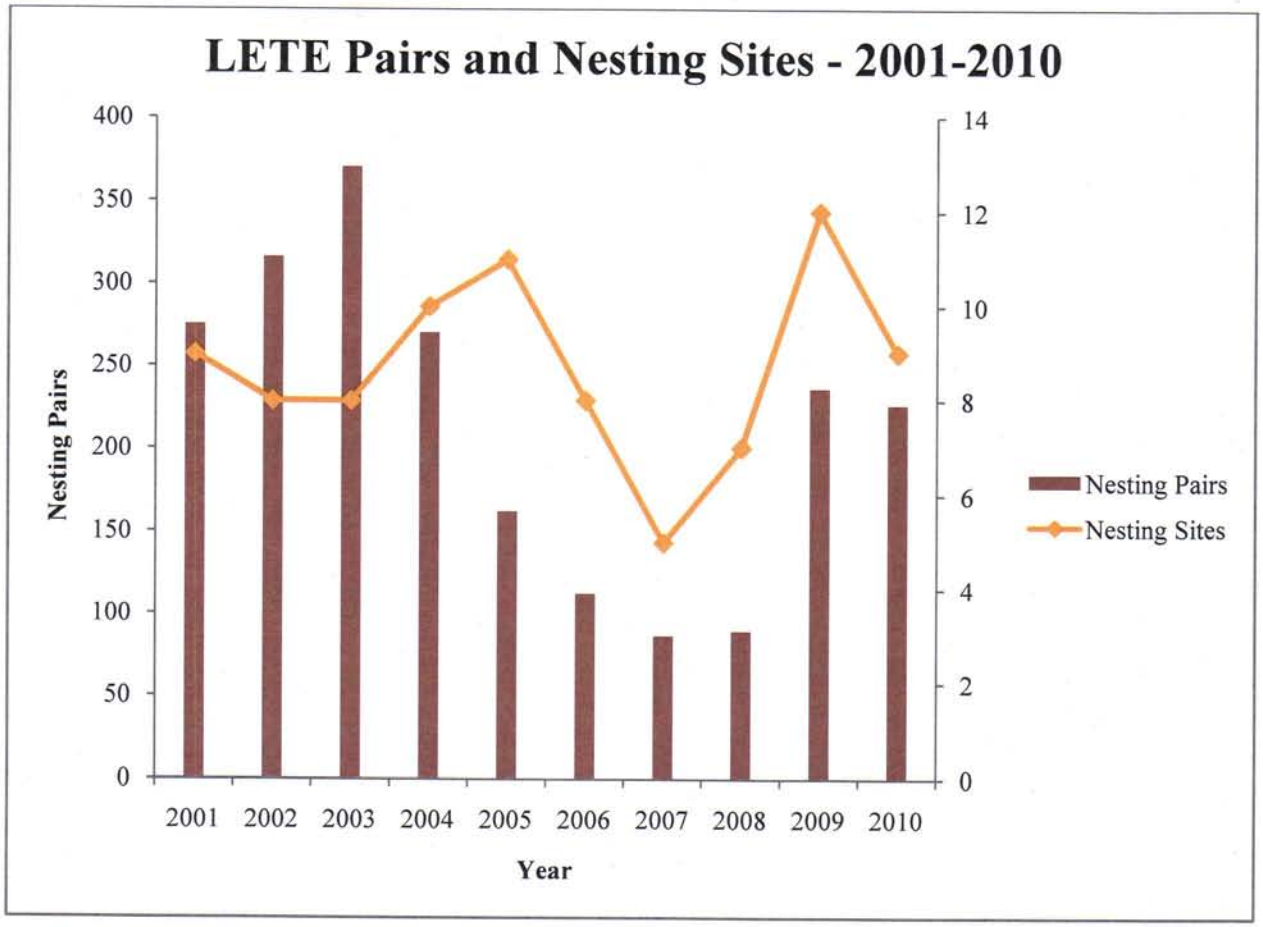
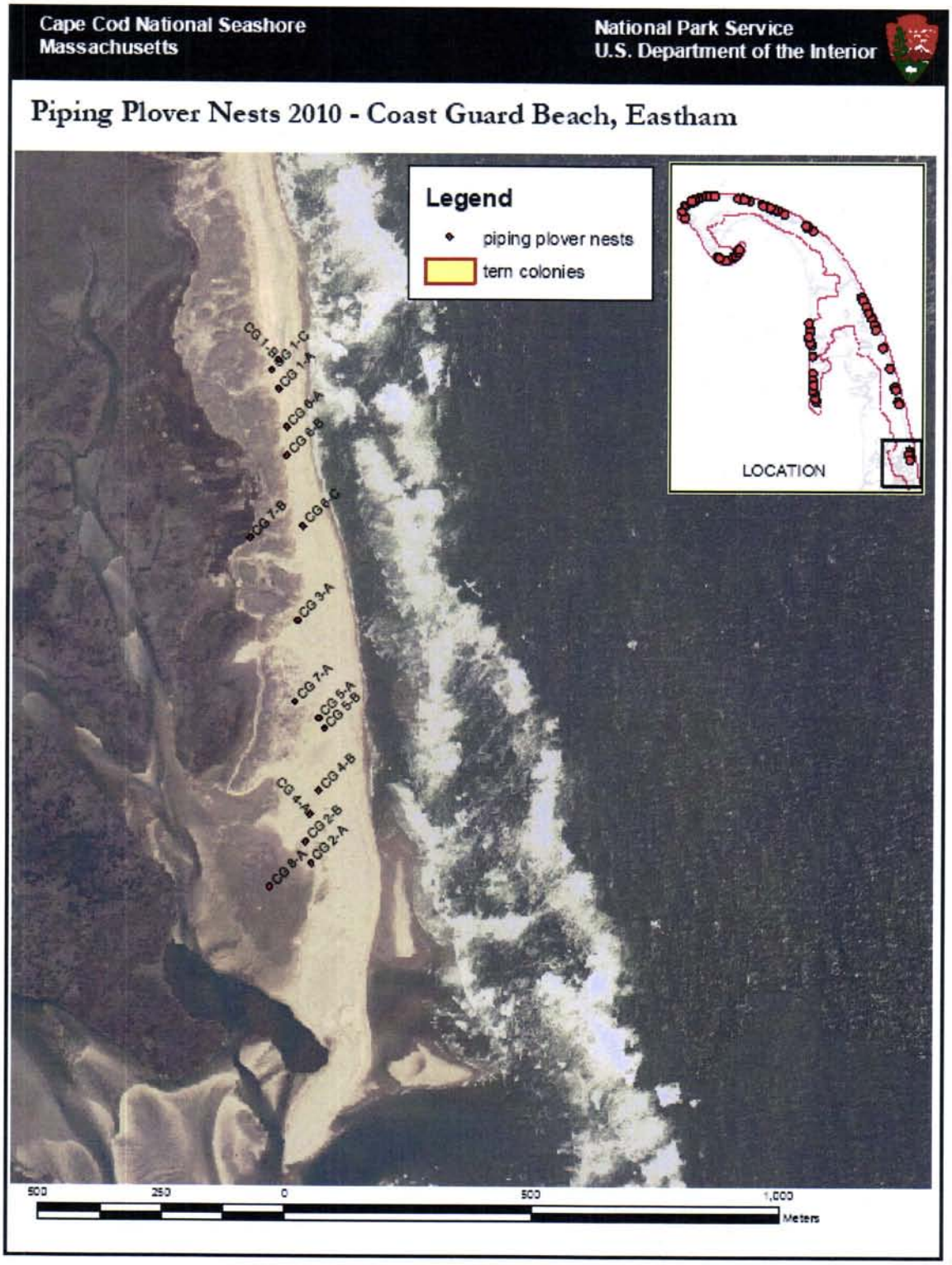


Figure 3. Number of Least Tern Pairs and Number of Least Tern Nesting Sites on Cape Cod National Seashore, 2001-2010

Appendix A

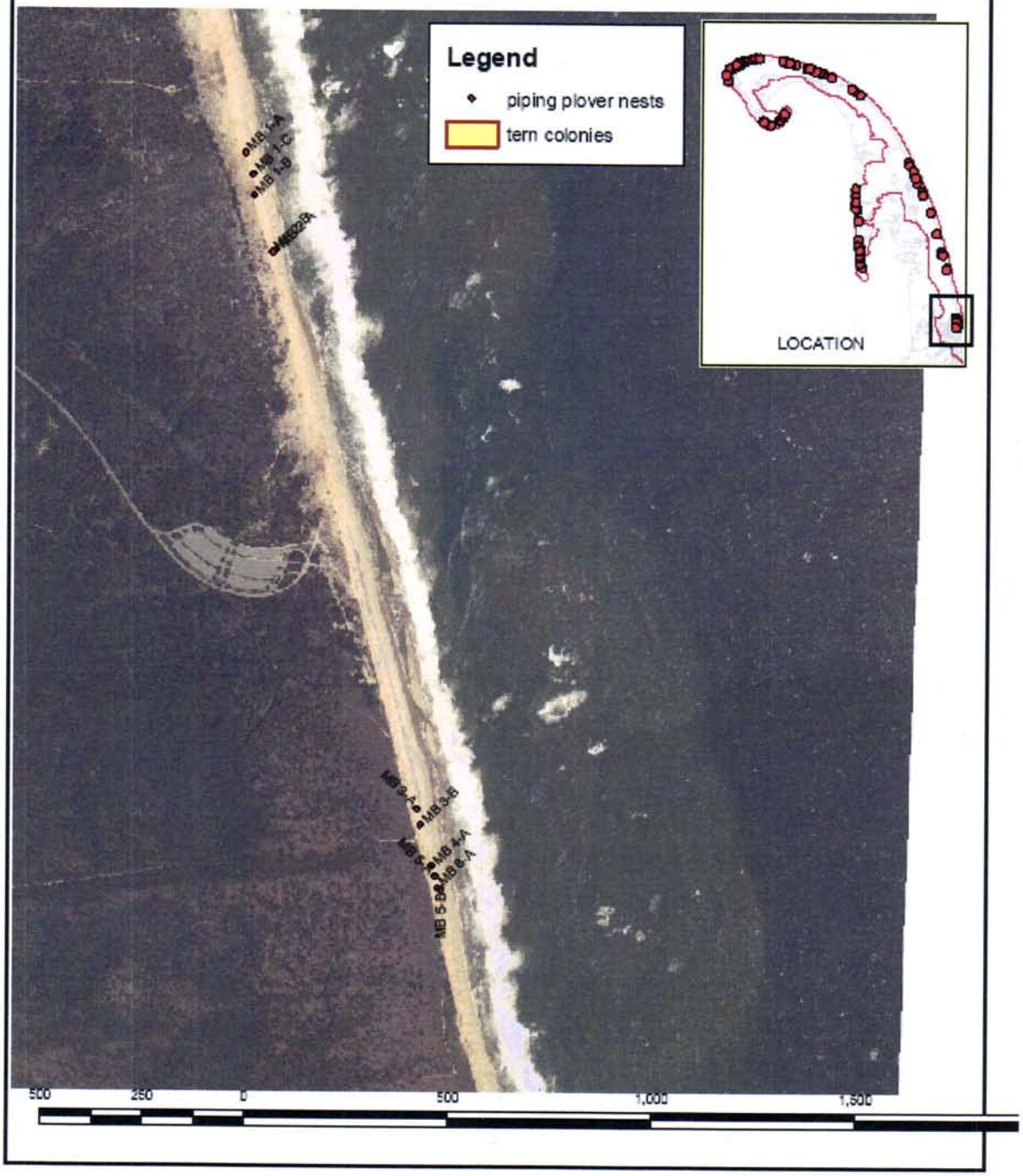
Maps of 2010 Piping Plover, Least Tern and American Oystercatcher Nest Sites at Cape Cod National Seashore


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nests 2010 - Coast Guard Beach, Eastham
Legend
piping plover nests
tern colonies
LOCATION
CG 1-B
CG 1-C
CG 1-A
CG 6-A
CG 6-B
CG 7-B
CG 6-C
CG 3-A
CG 7-A
CG 5-A
CG 5-B
CG 4-B
CG 4-A
CG 2-B
CG 6-A
CG 2-A
500
250
0
500
1,000
Meters

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nests 2010 - LeCount Hollow

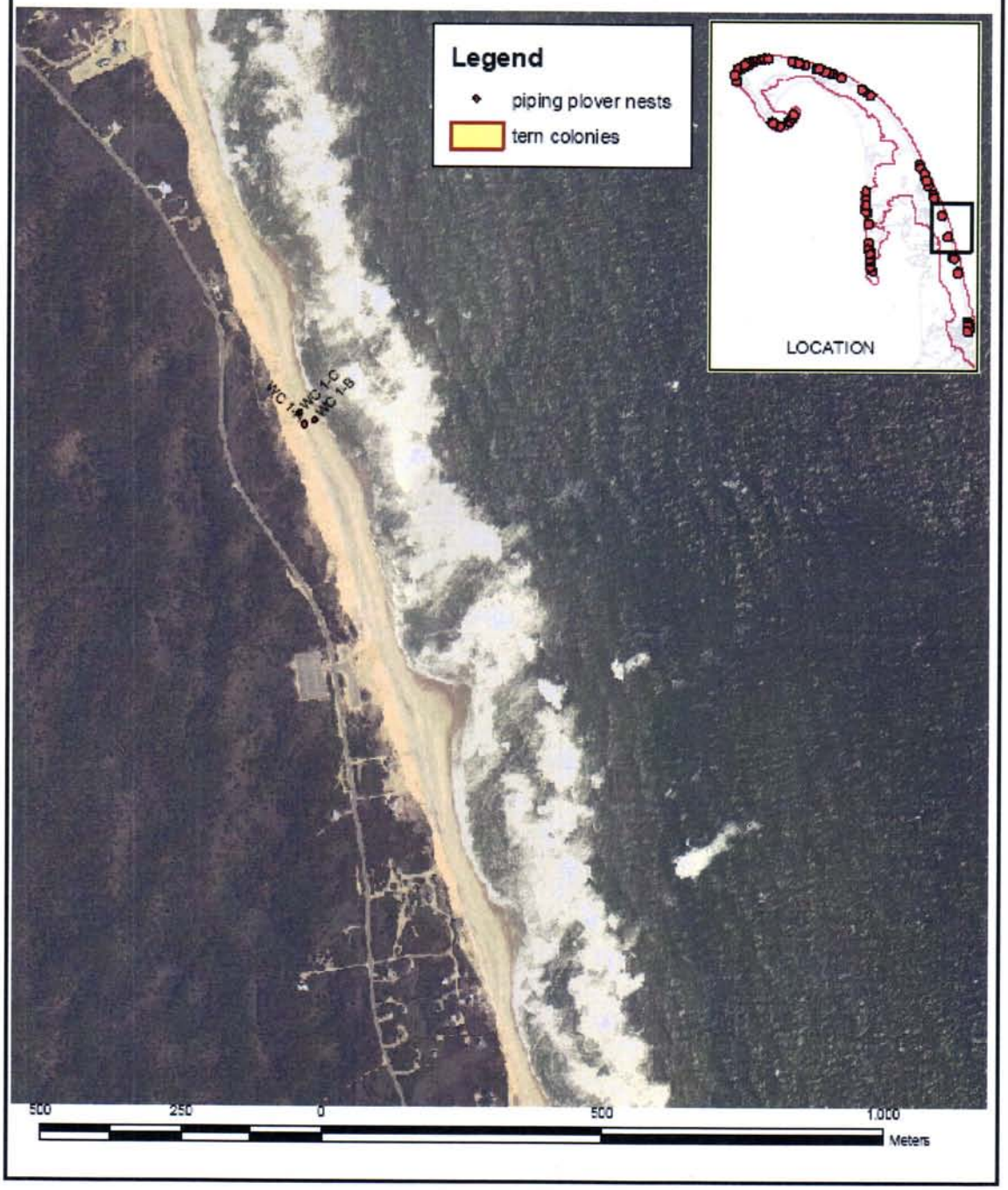



Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nests 2010 - LeCount Hollow
Legend
piping plover nests
tern colonies
LOCATION
LH 1-A
500
250
0
500
Meters

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

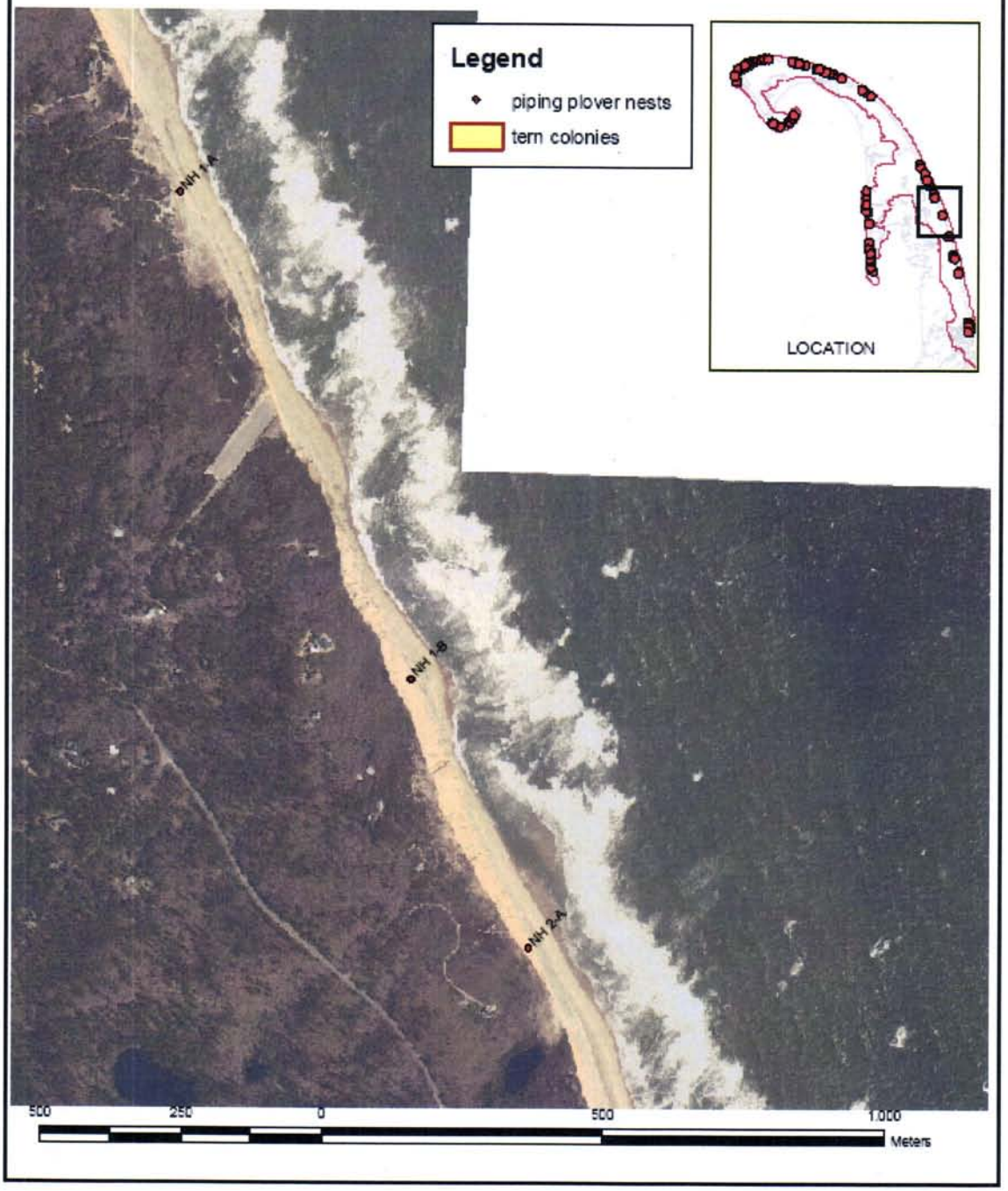
Piping Plover Nests 2010 - White Crest



Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nests 2010 - Newcomb Hollow



Cape Cod National Seashore
Massachusetts

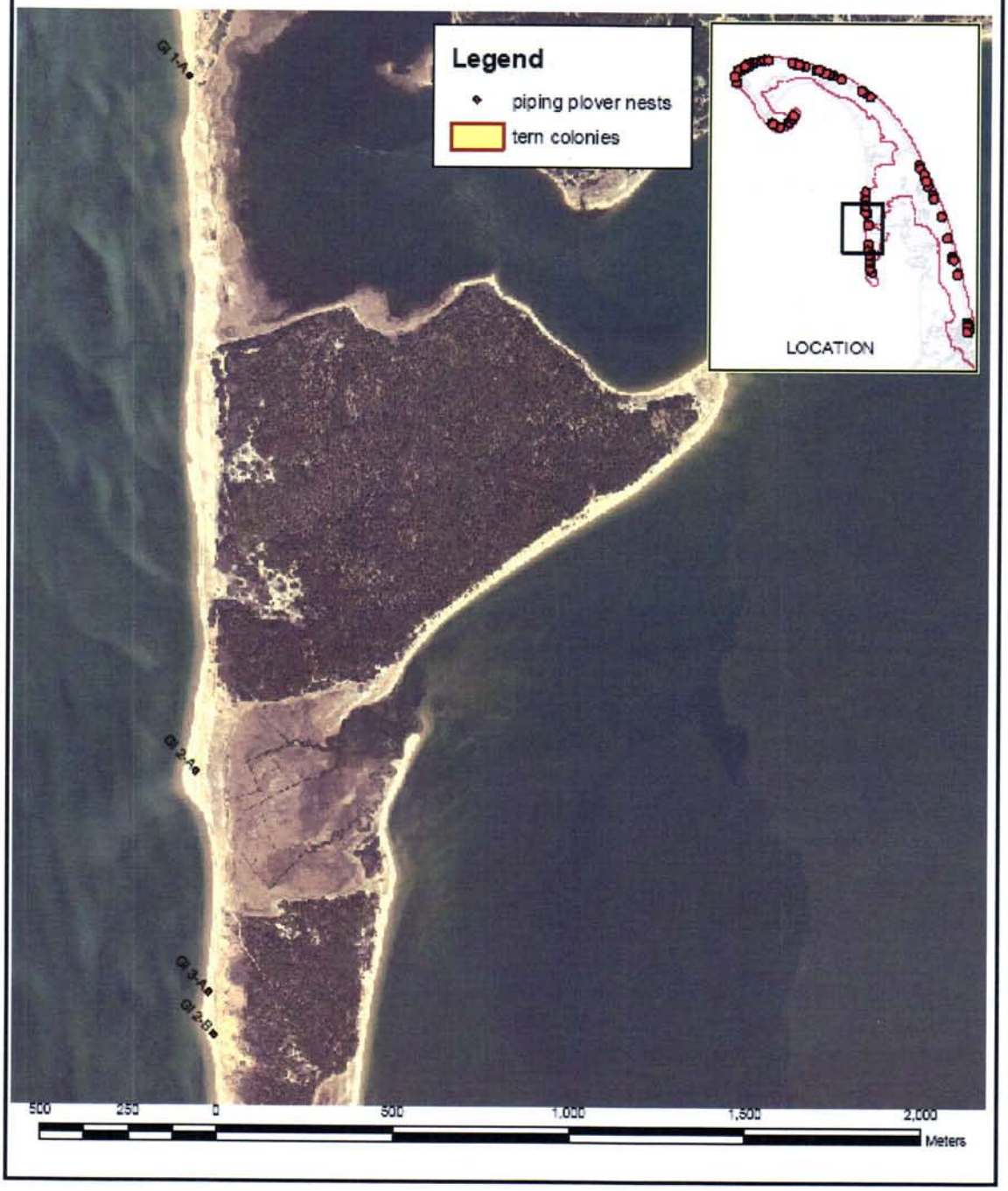
National Park Service
U.S. Department of the Interior

Piping Plover Nests 2010 - Bound Brook/Duck Harbor

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

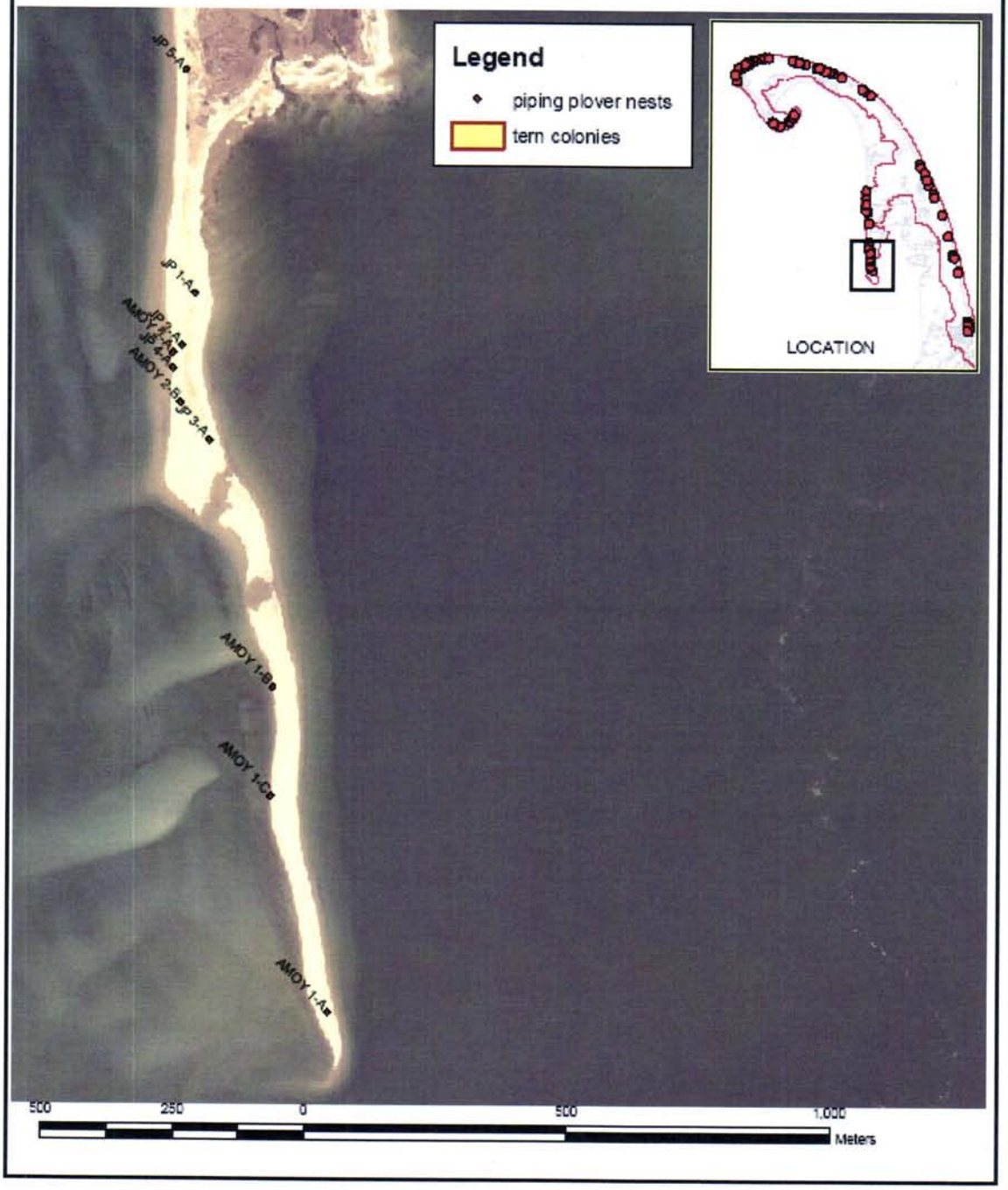
Piping Plover Nests 2010 - Great Island



Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

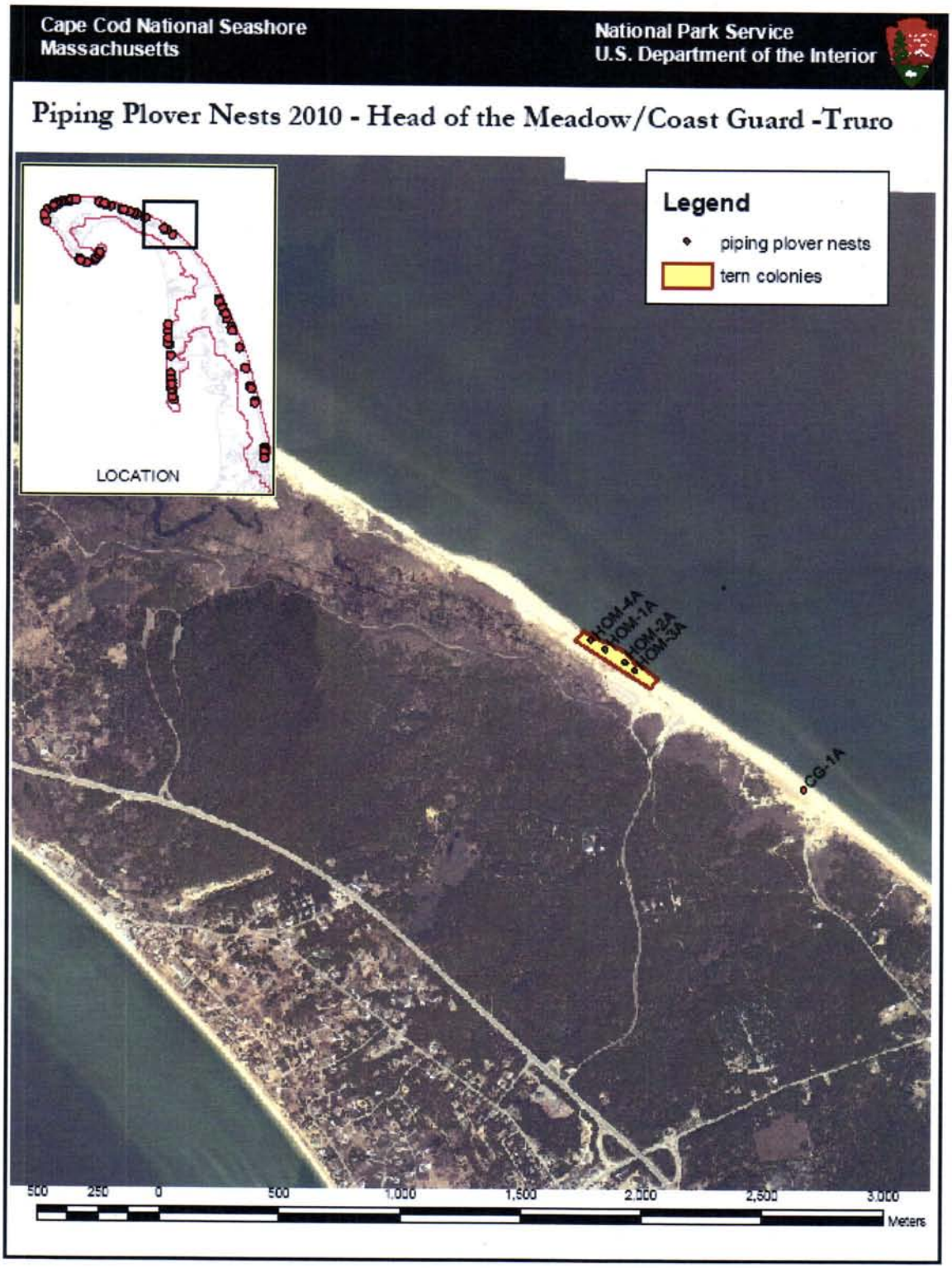
Piping Plover/Oystercatcher Nests 2010 - Jeremy Point



Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover/Oystercatcher Nests 2010 - Ballston - Newcomb Hollow


Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nests 2010 - Head of the Meadow/Coast Guard -Truro
Legend
piping plover nests
tern colonies
LOCATION
HOM-4A
HOM-1A
HOM-2A
HOM-3A
CG-1A
500 250 0 500 1,000 1,500 2,000 2,500 3,000
Meters

Cape Cod National Seashore
Massachusetts

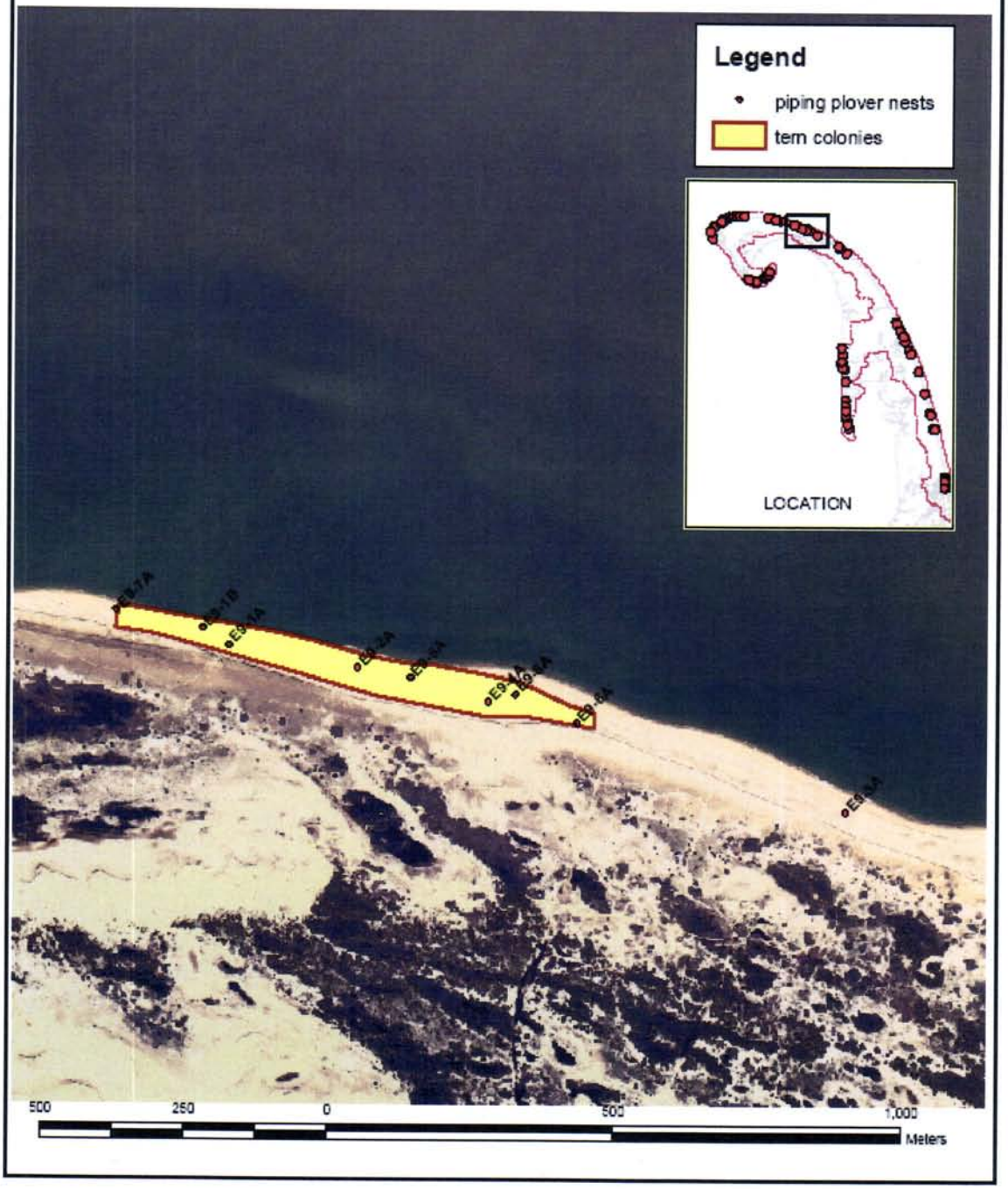
National Park Service
U.S. Department of the Interior

Piping Plover Nests 2010 - Head of the Meadow/Coast Guard -Truro

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

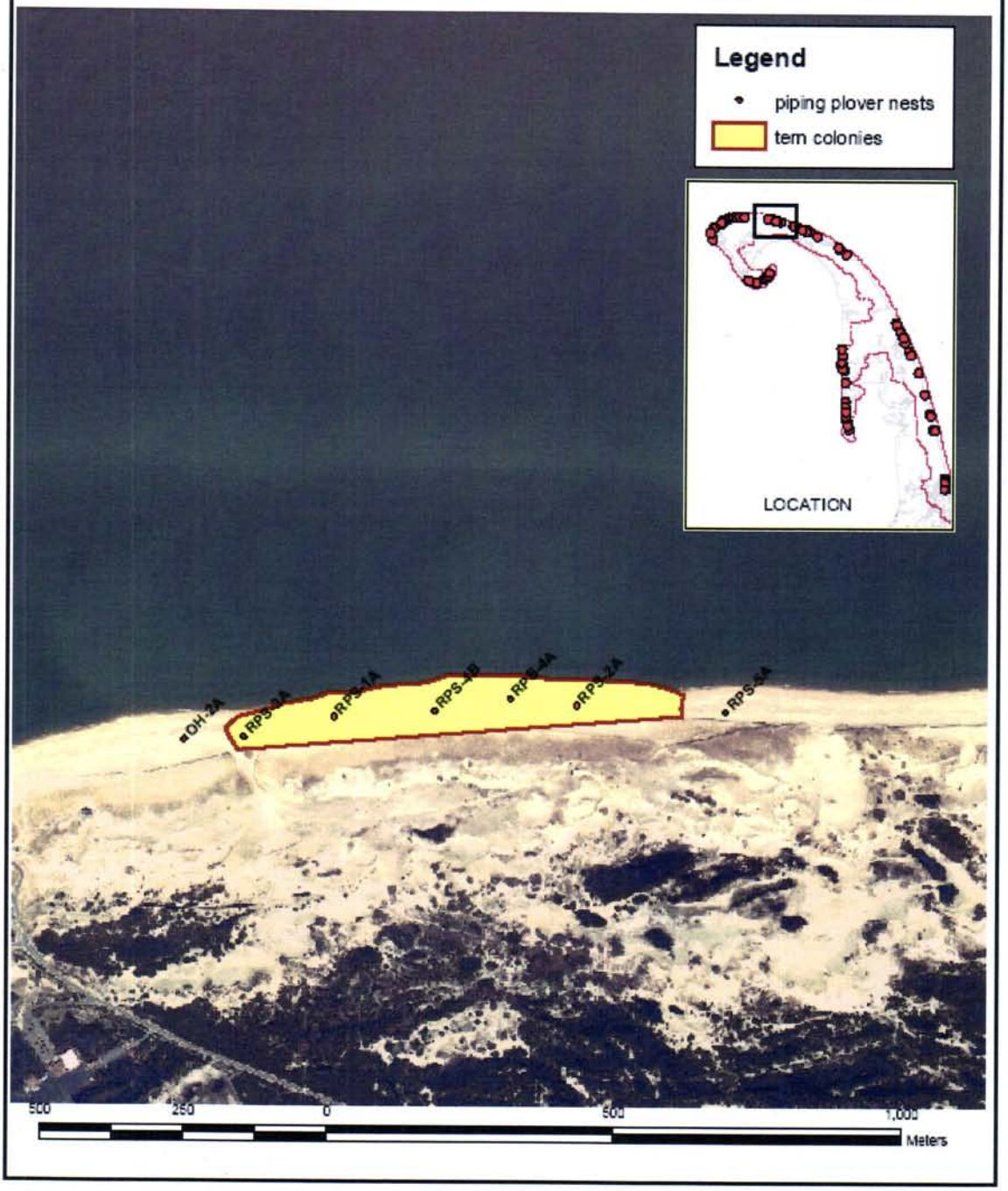
Piping Plover Nests 2010 - Race Point Exit 9

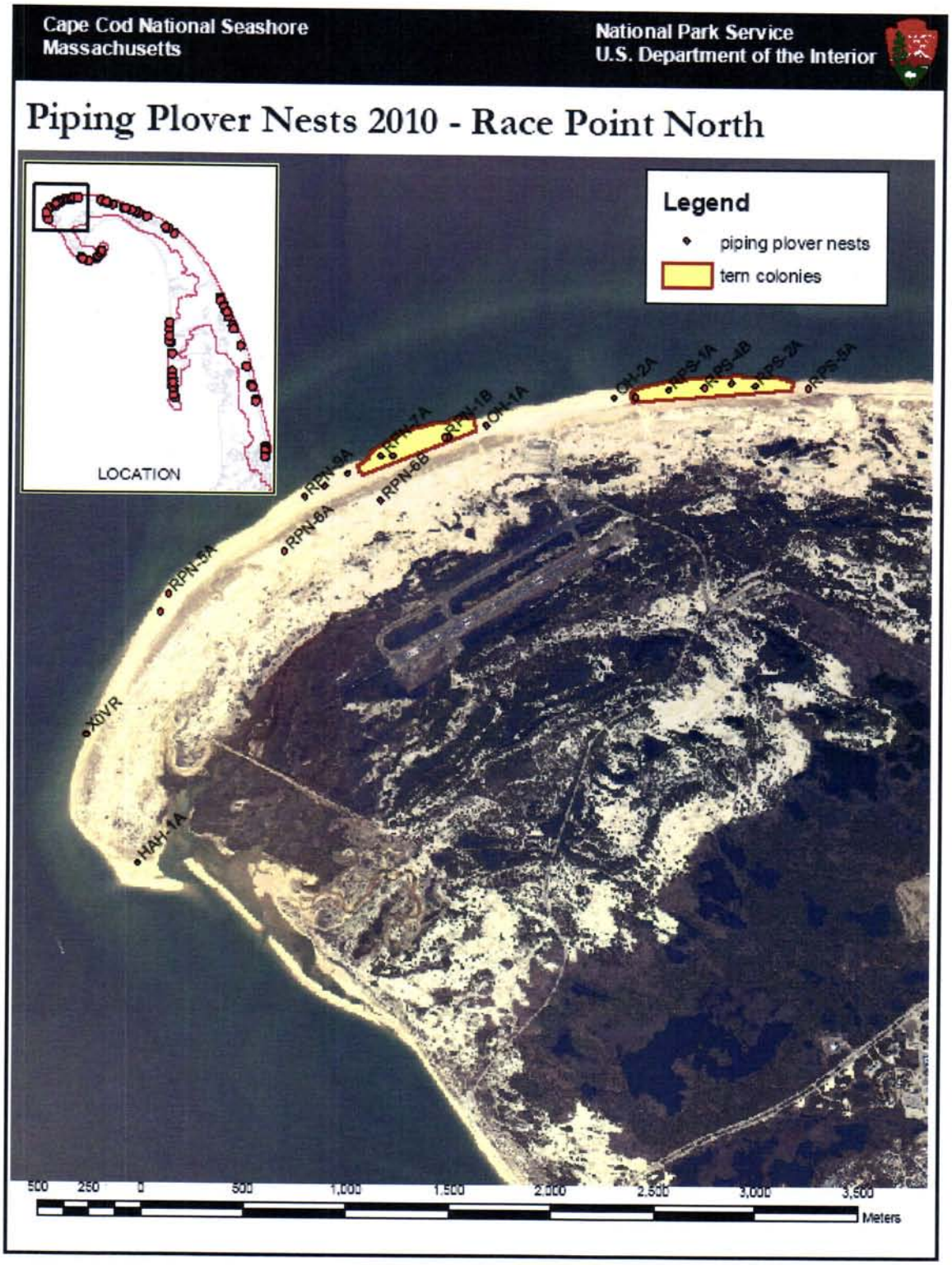


Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nests 2010 - Race Point South




Cape Cod National Seashore
Massachusetts
National Park Service
U.S. Department of the Interior
Piping Plover Nests 2010 - Race Point North
Legend
piping plover nests
tern colonies
LOCATION
OH-2A
RPS-1A
RPS-4B
RPS-2A
RPS-5A
RPN-7A
RPN-1B
OH-1A
RPN-5A
RPN-6B
RPN-6A
RPN-3A
X0VR
HAH-1A
500 250 0 500 1,000 1,500 2,000 2,500 3,000 3,500
Meters

Cape Cod National Seashore
Massachusetts

National Park Service
U.S. Department of the Interior

Piping Plover Nests 2010 - Wood End/Long Point