

Shorebird Monitoring and Management Cape Cod National Seashore 2011



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Abstract

This report summarizes the 2011 shorebird nesting season for Cape Cod National Seashore (Seashore). Piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), American oystercatcher (*Haematopus palliatus*), and common tern (*Sterna hirundo*) nesting and brood-rearing were monitored on 25 beaches from Provincetown to Orleans. The first piping plovers were observed on Seashore beaches in late March and the first nest was found on 25 April. A total of 82 nesting pairs attempted 110 nests, 62 of which were successful. Peak nesting occurred the week of June 12 to June 19. A total of 90 chicks fledged, for a productivity of 1.10 chicks fledged/ nesting pair. A total of 48 nests failed before hatching. American crows (*Corvus brachyrhynchos*) were the main egg predators before nest exclosures were installed. Predator exclosures were erected around 69 nests. A total of 41 nests were not exclosed; of these, 33 failed to hatch. A total of 268 pairs of least terns nested in twelve colonies from Eastham to Provincetown. Productivity was approximately 0.40 chicks fledged/pair. Two pairs of American oystercatchers produced five nests on Jeremy Point with no productivity. Two pairs of common terns nested on New Island, Orleans but were unsuccessful. Post-breeding/staging roseate terns (*Sterna dougallii*) were present in large numbers at Hatches Harbor, Race Point, Nauset Marsh, Coast Guard (Eastham), Wood End, and Jeremy Point.

Thirty seven pairs of piping plovers and 72 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 plover chicks could fly. Off-road vehicle access at the Seashore is guided by rules developed in 1998 through a negotiated rule making (NegReg), the 2007 Environmental Assessment: Options for Managing ORV Access (NPS 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). The Seashore is also an important staging site for thousands of terns and other shorebirds, including the federally endangered roseate tern.

Methods

Shorebirds were monitored on 25 beaches in the Seashore from Provincetown to Orleans, 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, 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 plovers, 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-two pairs of piping plovers were monitored on 25 beaches in the Seashore in 2011 (Table 1 and Appendix A). The first piping plover was observed on Seashore beaches on 30 March. Most beaches had plovers present by early April, with birds continuing to arrive into mid-June. The first nest was found on 25 April at Wood End. Peak nesting for the Seashore occurred the week from 12 June to 19 June (Figure 1). The majority of nests were located along the upper beach in open sandy habitat. One notable nest was located at Coast Guard (Truro), approximately 10 meters up a sand cliff.

The breeding population of piping plovers was calculated based on the number of pairs observed nesting and the number of pairs that exhibited courtship or territorial behaviors (scraping, aerial calls) for longer than two weeks. In 2011, a pair at Hatches Harbor was observed scraping and displaying territorial behavior daily from 12 May through 17 July. Based on the frequency that this site was monitored and the lack of predator signs, it is unlikely a nest was missed. This behavior has been noted in previous years.

A total of 110 nests were found during the 2011 season. Of these, 62 hatched at least one chick and 48 failed (Table 2). Predation accounted for 60% of these failures, followed by overwash (19%), abandonment (19%), and infertility (2%). Of the nests lost to predation, 83% were lost to American crows, 10% to coyotes (*Canis latrans*), and 7% to unknown predators.

The 110 piping plover nests contained a total of 374 eggs. Of these, 207 hatched. The other 167 were lost to various causes, primarily predation (61%) or failed to hatch (Table 3). Although overall hatching success was 55%, it ranged considerably among the 25 beaches (Table 1).

Circular and canopy style predator exclosures were installed around 69 of the 110 nests (Table 4). However, exclosures were subsequently removed from 15 nests (seven canopy and eight circular style) due to concerns of predators keying into the exclosures, increasing the chances of adult plover mortality. Only seven of the nests were successful after removal of the exclosure; nest loss was primarily due to crow predation. Predator exclosures were not placed around some plover nests at Duck Harbor, Coast Guard (Eastham), and Great Island where the threat of predators (crows and coyotes) keying into exclosures was high. There were three exclosure related adult mortalities in 2011 at Exit 9 (1), Race Point North (1), and Jeremy Point (1) The use of exclosures was discontinued on any beach where adult plover mortality occurred.

Of the 54 nests that remained exclosed throughout incubation, 7 (13%) failed to hatch any eggs. The causes of nest loss in exclosed nests were: overwash (2), infertility (1), abandonment (1), and abandonment due to known adult mortalities (3). Hatching success of nests that remained exclosed until chicks hatched was high for both exclosure types (79% for canopy and 91% 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 41 nests were not exclosed; of these, 33 (80%) were not successful, mainly due to predation (52% crow, 6% unknown predator, 6% canid) (Table 4).

Discussion

From 2002 – 2011, the three main factors affecting nest and egg loss were predation, overwash, and abandonment. On average, 47% of nests were lost each year, mainly due to these factors (Table 7). In 2011, nest loss was slightly lower at 44%.

Renesting and productivity varied by district. Of the 48 nests lost overall, 28 were lost in the South District and 20 were lost in the North District (38% and 16% renesting rates respectively). Productivity in the North District was high compared to the South District (1.38 and 0.5 respectively). The reason for these differences in the districts is likely due to increased 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 running right up to the scrape, suggesting that crows may have taken the egg(s) before the nests were found. The 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 29 May to 23 July. Fledging dates ranged from 3 July to 23 August. Of the 207 plover chicks that hatched, 90 survived to fledge, resulting in an overall fledging success rate of 43% (a 15% decrease from 2010). By beach, fledging success ranged from 0% at Coast Guard (Eastham), Cahoon Hollow and Duck Harbor to 100% at Longnook Beach. Park-wide, productivity was 1.10 fledged chicks/nesting pair (90 fledged chicks from 82 pairs) (Table 1).

Chick mortality factors are extremely difficult to assess. In the vast majority of cases, the cause of chick loss is unknown. Three dead chicks were found in the North District and sent for necropsy. The results indicated that one chick had clear evidence of trauma, likely due to predation and the cause of the death for the other two was not evident or obvious at necropsy. 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 five consecutive days.

Discussion

Based on the last ten years (2002 – 2011) of piping plover nesting at the Seashore, 2011 was a below average year for parameters related to successful nesting. The number of pairs (82), nests (110) and eggs laid (374) were lower than the middle range of values recorded for these parameters. Nest success rate (56%) was slightly higher and the number of renests (25%) was equal to average and median values. However, the number of fledglings (90) and the overall productivity (1.10) in 2011 were lower than average and median values over the past 10 years (Table 7). The slightly higher than average nest success rate coupled with a low fledging success rate indicates that chick loss was more substantial than nest loss this season.

Regression analyses of annual productivity over the past twenty years (1992 – 2011) shows a statistically significant decline in annual productivity (slope of the regression line for year = - 0.04, p-value = 0.02, R square = 0.25). 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 for year = - 0.05, p-value = 0.0000007, R square = 0.68) (Figure 3 and Table 8). 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 2011 season was 43%, 15% lower than the 2010 value (58%) and about 10% lower than the mean and median values for the past ten years (54%) (Table 7). The hatching success and fledging success was higher in the North District (69% and 47% respectively) than in the South District (31% and 31% respectively). The difference between the two districts and the overall decrease in fledging success 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 2011, 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. In 2011, at least one chick from six broods exceeded 35 days to fledge (an average of 37 days) in the North District and three broods exceeded 30 days to fledge (an average of 33 days) in the South District. 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 two pairs of piping plovers were monitored on 25 beaches in the Seashore in 2011. Piping plovers were first observed on Seashore beaches on 30 March. Most beaches had plovers present by early April, with birds continuing to arrive into mid-June. Most plovers had left Seashore beaches by late August.

Discussion

Since 2002, the number of nesting pairs of piping plovers has ranged from 74 to 97. The 82 nesting pairs in 2011 is slightly below the mean of 84 for this 10 year period. During this same time period, annual productivity has ranged from 0.70 to 1.84, with a mean of 1.36 fledged per pair (Table 7 and Figure 2).

Productivity in 2011 (1.10) is below this mean and is the third lowest in this time period. The 5 year weighted average productivity is also below the USFWS recovery goal of achieving a five year average productivity of 1.5 fledged chicks/pair (Table 8). In addition, the USFW 5 year status review of piping plovers estimates that an annual productivity of 1.21-1.24 chicks fledged per pair is needed to maintain a stationary breeding population in New England.

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 14 May at Race Point, and first observed on the beach on 22 May at Race Point North. Egg-laying began on 29 May, with most least terns were on eggs by mid-June. Renesting attempts continued through to the beginning of August. 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 by walking through each colony and counting nests during two standardized periods defined by MDFW (“A-count” from June 5-20 and “B-count” after June 20). An estimated total of 130 pairs nested in the “A” count and 268 pairs in the “B” count. There were a total of 12 nesting sites from Eastham to Provincetown (Table 9).

Colony size and location shifted throughout the season. Jeremy Point supported the largest colony during the “B” count (72). This colony was heavily predated and only six chicks fledged. It is uncertain where birds from this colony went, but renesting and shifting of nest sites was common throughout the season. Wood End supported the second largest colony (56 nesting pairs observed during the “B” count) and fledged 20 chicks. There were smaller nesting sites at Great Island, Coast Guard Beach (Eastham), Marconi Beach, Ballston Beach, Head of the Meadow, Armstrong, Exit 9, Mission Bell (part of Race Point South), Race Point South, and Race Point North. These sites supported a range of 5 - 40 nesting pairs . (Table 9).

Predators were a major cause of nest loss. Tracks indicated coyote to be the main predator; crow and gull (*Larus* sp.) tracks were also observed in colonies.

Brood Monitoring and Productivity

Results

The first least tern chicks hatched on 26 June and the last chicks hatched on 20 August. Least terns are considered fledged when they are capable of flight. A total of 99 chicks fledged from 268 nesting pairs ; Wood End/Long Point (20), Race Point North (28), Race Point South (5), Exit 9 (3), Armstrong (1), Head of the Meadow (2), Ballston (1), Marconi Beach (15), Coast Guard (Eastham) (18), and Jeremy Point (6). There was no productivity at Great Island or Mission Bell. Total productivity was estimated at 0.40 chicks fledged per pair for the season (268 pairs/99 fledged chicks) (Table 9).

Discussion

Populations of least terns have varied over the past ten years from a high of 370 pairs in 2003 to a low of 86 pairs in 2007. There was a slight increase of nesting pairs in 2011 from 2010 (268 pairs and 226 pairs respectively) (Figure 3). Productivity this year was better than last year (0.40 vs. 0.13) but still relatively poor as a result of intense predation on eggs and chicks, mainly by coyotes.

Common Terns

Nesting Population and Productivity

Results

The first common tern was observed at Wood End on 3 May. Three pairs nested unsuccessfully on New Island, Orleans. Nests/chicks were likely lost to predation. One additional pair of common terns nested within the least tern colony on Jeremy Point (first island). Eggs from both nesting attempts were likely lost to coyote predation. Common tern productivity was zero.

American Oystercatchers

Nesting Population and Productivity

Results

The first American oystercatcher was seen on 8 April. In 2011, two pairs nested at Jeremy Point. The first nest was found on 26 April. A total of 5 nests were laid by the two pairs. Of these, three nests were predated by coyote before hatching. The other two nests successfully hatched a total of five chicks. One brood of three, two day old chicks was predated by coyote, and the other brood of two chicks disappeared after ten days. American oystercatcher productivity was zero.

Discussion

Oystercatchers were first recorded nesting on Seashore beaches in 2002. Since then, two to five pairs have nested in the South District. 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 -2011, productivity was zero. Both years, coyote predation was the main cause of nest loss and the likely cause of chick loss. American oystercatchers are a long lived bird that benefit from high annual adult survival and variable annual productivity. Modeling has shown that as variability in productivity decreases, the probability of population decline increases (Davis 1999). Though their annual productivity is naturally lower than that of piping plovers, continued low reproductive success would be a concern for oystercatcher populations.

Post Breeding/Staging Terns

In 2011, from the second week in July through October, shorebird staff conducted surveys of staging terns and shorebirds throughout the park. Hundreds of terns (predominately common and roseate) were observed at Head of the Meadow, Exit 9, and Jeremy Point throughout the post-breeding season and

thousands were observed at Hatches Harbor, Race Point North, Race Point South, and Coast Guard (Eastham)/Nauset Marsh.

As part of a long term roseate tern post-breeding study, researchers from U.S. Geological Survey (USGS) and Massachusetts Audubon conducted counts of staging terns and surveyed for color banded roseate terns along Seashore beaches from late July through the end of September. Banded roseate fledglings from all 6 breeding colony sites north of Cape Cod, the one major colony site to the west, and the one major colony south of Cape Cod were represented on Seashore beaches throughout the staging period. Many metal banded fledglings from the Buzzards Bay, MA colony site were also observed on the Seashore (Jeff Spendelow, personal communication, October 18, 2011).

On 9 September at Hatches Harbor, USGS researchers identified 51 different color banded roseate tern fledglings from colony sites north of Cape Cod, representing 20% of all fledglings banded in the Gulf of Maine and Canada this season. This data shows how important the Seashore is for staging terns.

Large staging flocks of common and roseate terns were also observed by Seashore staff in September and October: Nauset Marsh/Coast Guard (Eastham) (5,000 on 9/14, 3,500 on 9/19, and 450 on 9/30), Jeremy Point (800 on 9/14, and 1,000 on 9/30), and Hatches Harbor (3,000 on 10/3). Mass Audubon's Coastal Waterbird Program staff at Wood End observed 10,000 terns on 18 September and 1,000 terns on 9 October (Ellen Jedrey, personal communication, November 7, 2011).

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 2011, 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. communication) the majority of incomplete clutches were exclosed to reduce the chance of predation on eggs. If the nest was then abandoned, the re-nest 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 enclosed when they were: (1) located in thick vegetation, (2) located on the side of a dune or cliff that precluded installation of an enclosure due to slope or nest location; or (3) when a group of enclosed nests were abandoned on a single day at a particular site and there were concerns regarding adult plover mortality associated with enclosure use. Enclosures were also removed if tracking or direct observations indicated that predators were keying into the enclosures, harassing incubating adults.

Results

Predator enclosures were installed around 69 of the 110 nests in 2011 (Table 4). Fifteen of these enclosures (7 canopy and 8 circular) were subsequently removed before eggs hatched, due to predators “keying” into the enclosures, increasing the risk of adult plover mortality. Seven of these 15 nests were successful (Table 4). The success rate (i.e. hatching) of enclosed nests was high for both canopy and circular style enclosures (79% and 91% respectively). Of the canopy-enclosed nests lost, (1) was lost to overwash, (1) was abandoned, and (1) was abandoned due to a known adult mortality. Of the circular-enclosed nests lost, (1) was infertile, (1) was overwashed, and (1) was abandoned due to a known adult mortality. There was a third enclosure related adult mortality at a circular enclosure at Race Point North; however, the surviving adult in the pair incubated and reared surviving chicks. A total of 41 nests were not enclosed; of these nests, 33 (80%) were not successful: 64 % of the unsuccessful nests were lost to predation, 5 nests were abandoned (15% of the 80% that were not successful), and 7 nests were washed over (21% of the 80% that were not successful). Eight unenclosed nests hatched (20% of the total number of nests not enclosed) (Table 4).

There were three enclosure related adult mortalities in 2011: Exit 9 (1), Race Point North (1), and Jeremy Point (1) (Table 5). We suspected that the adult at Race Point North, that was found about 3-4 feet from its enclosure, was killed by a coyote based on tracks circling the enclosure and carcass. Because the adult at Exit 9 was found dead inside the circular enclosure with no discernable predator tracks surrounding the area, we suspect it was killed by an unknown avian predator. The carcass of the Exit 9 adult was sent to the U.S. Geological Survey- National Wildlife Health Center in Madison, WI for necropsy. Results confirmed our findings and indicated cause of death to be trauma related to probable predation. In the South District, an adult plover was killed by a coyote at Jeremy Point approximately seven meters from its enclosure. Fresh coyote tracks lead up to and around the enclosure and the carcass. The carcass was consumed and only a pile of feathers remained near the enclosure.

There have been at least eighteen plover deaths associated with the use of circular and canopy enclosures at the Seashore since 2002 (Table 5).

Discussion

Crow accounted for the greatest loss of predated nests over the past five years (Table 6). Field observations note groups of crows (especially during April and May) hunting within plover nesting areas and crow tracks covering the sand throughout nesting areas. The number of nests lost to crow predation would likely be higher if we did not install predator enclosures around some nests soon after they were discovered. These nests were often enclosed with an incomplete clutch, before the plovers were actively incubating the eggs. Even with predator enclosures being quickly installed around nests, predation accounted for the greatest number of nests lost in 2011 (60%) (Table 2).

It is clear that predators, especially crows, have a major impact on nest success. Of the 48 nests that were lost to predators in 2011, 24 (83%) were lost to crow. Coyote predation and predation by unknown predators were the second and third leading causes of egg predation (11% and 9% respectively) (Table 3). In the cases where the specific predator could not be determined (due to poor tracking conditions), 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) has gone. 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. Tern shelters are often placed inside some nesting colonies when chicks hatch. They are mostly used in colonies that lack sufficient vegetation for the chicks to hide in. 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).

Recreation Management

Habitat Protection

Posting of historic shorebird nesting habitat with symbolic fencing and signs began on 27 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 or six-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. In cases where nests were located less than 50 meters from the high tide line and birds were being disturbed by passersby, a secondary fence line (using 6 foot posts with no string) was erected in the intertidal zone. Signs informing visitors of the "high tide closure" were posted on each side of the closure. 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 signs, beginning in late July and remained through September.

Hand-held Kites/Kite Surfing

To prevent disturbance from kites, hand-held kite flying is prohibited on all beaches within 200 feet 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 . One exception is a small section of beach owned by the town of Wellfleet at the "Gut" where kite surfers can launch

their kites and take a direct route, one quarter mile offshore, outside of the park boundaries (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 gliders 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 2011, the south side of Coast Guard Beach (Eastham) and Jeremy Point were closed to pets on 1 April to protect nesting plovers. In 2011, these beaches remained closed through 30 September to protect the terns and other shorebirds utilizing the mudflats and beaches for feeding and resting during migration. The marsh area of Hatches Harbor was also closed to pets from 10 July to 29 September when there were > 50 migrating shorebirds. This 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 2011, this included sections of beach along the ORV corridor. "No Pet Area" signs were posted perpendicular to the water approximately 50 meters away from the symbolic fencing, extending down into the intertidal zone. The only exception to this was along the ORV corridor where a dog inside a vehicle can pass pet closures to access areas of beach open to pets. These sections of beach were closed until all chicks in the area fledged. Signs informing visitors of this temporary pet closure were moved as necessary to reflect the closures in effect at any one time. Beaches that did not have nesting shorebirds remained open to leashed pets.

Shorebird monitoring staff recorded a total of 401 dogs were recorded off leash on Seashore property (249 in the South District and 152 in the North District) (Table 1). Unleashed dogs were encountered most frequently in the South District at LeCount Hollow (39) and Newcomb Hollow (36) and in the North District at Wood End/Herring Cove (35) and Race Point North (27).

Temporary Pedestrian/Parking Lot/Boat Landing Closures and Detours

Winter storm erosion continues to narrow beaches in the South District. Where beaches were extremely narrow or birds nested close to access points, it was not always possible to provide a sufficient buffer within the symbolic fencing to prevent pedestrian disturbance of nesting birds. At sites where this was a problem, beaches were closed at times of high tide.

Some sections of beach were completely closed at all tides due to concerns that day hikers who start at low tide might not be off the beach in time to safely pass the nesting area without disturbing the nesting birds. Where possible, detours were established to provide visitor access around the nesting area. Informational/directional signs were erected informing visitors of these closures.

In 2011, sections of Great Island and Jeremy Point were temporarily closed/detoured to pedestrians and/or boats from late May through July. Signs were posted on Jeremy Point and at the Harbor Master's office informing boaters of landing restrictions.

A narrow section of Coast Guard Beach (Eastham) and Marconi Beach were temporarily closed to pedestrians at all tides (Coast Guard closed from 10 June to 26 July and Marconi Beach closed from 16 June to 5 July) to protect colonies of least terns.

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

There were additional high-tide pedestrian closures throughout the season at Coast Guard (Eastham), Marconi Beach, Exit 9 and at Head of the Meadow.

The Head of the Meadow parking lot was closed to vehicles from 26 June to 18 July to protect several adult plovers and chicks that were active in the parking area. Silt fencing was installed around sections of the perimeter of the parking lot and along the pedestrian walkway to prevent the unfledged plover chicks from accessing the lot from the beach. Throughout the closure, shorebird staff monitored the parking lot for plover activity several hours/day and fee collectors remained stationed at the entrance booth to inform visitors of the closure. Beach access remained open to walkers and bicyclists could use the bike rack in the parking lot. The town lot at Head of the Meadow remained open.

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), and 2006 Environmental Assessment: Options for Managing ORV Access (NPS 2007). Permit applicants receive information about nesting piping plovers and terns. A total of 4,056 ORV/SCV permits were sold in 2011 (1,408 seasonal permits and 2,648 weekly permits) (NPS 2011a).

The ORV corridor was open to vehicles during the egg laying and incubating phase of the plover nesting season in areas where there was an adequate protective buffer between the incubating plovers and vehicles. To determine the actual date of hatching and ensure that chicks are found as immediately as possible after hatching, plover 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 a brood of plover chicks which was 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. In 2011, the Seashore managed ORV use on sections of beach with unfledged least tern chicks on a case by case basis (certain sections were opened and other sections remained closed). In instances where sections of beach were opened to ORV's when there were unfledged least terns present, conservation measures, such as speed limits, signage, and increased monitoring/enforcement, were instituted.

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.

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 2011, two broods of plovers moved 1-2 miles over several days. Additionally, two broods of least tern chicks moved 0.4 miles over a period of a few days and it was not uncommon for both plover and tern chicks to move 0.2 miles overnight. There were also cases of plover chicks moving back and forth over 0.5 miles from their nest site over several days. For piping plovers, vehicle closures were lifted once chicks demonstrated repeated and sustained flight of 15 meters or more.

Additional information on ORV management can be found in the 2011 Off-Road Vehicle Activity Report (NPS 2011).

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, the Seashore initiated formal consultation in January 2010 on implementation of flexible management for piping plover at two beaches for the 2010-11 nesting season. The proposed action would allow the Seashore 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 2011, there were no nests within the flexible management area.

Management and Protection of Post Breeding Shorebirds

In late summer/early fall, thousands of migrating shorebirds congregate on the mudflats and beaches along the Seashore to feed and rest. 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 species use the Seashore during fall migration, one of the most notable is the federally endangered roseate tern, found within large flocks of staging common terns. The roseate tern has experienced a 20% population decline since 2000. Reasons for this decline are unclear, but research suggest a major factor in limiting population recovery may be due to low survival rates of young birds during their first 1-2 years of life. 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 disturbance to the birds in these areas can flush birds, separating the young birds from their parents, interrupting feeding or displace them, forcing them to expend the energy they are trying to store up for migration.

A multi-agency study initiated in 2005, expanded in 2007, and continuing through 2011, indicates that more than 90% of the entire North West Atlantic breeding population of roseate terns and their fledglings use Seashore beaches from mid July through October (Dr. Jeff Spendelow, USGS and Ellen Jedrey, MAS, personal communication, November 7, 2011). In addition to collecting data on flock composition and movement, Seashore staff and researchers documented disturbances to staging and migrating shorebirds from dogs, pedestrians, oversand vehicles and boats.

As in past years, some sections of upper beach and intertidal zone with concentrations of staging and migrating shorebirds were posted with symbolic fencing and/or signs to reduce human disturbance including: Coast Guard Beach (Eastham), Jeremy Point, Hatches Harbor, Race Point North and Race Point South. Pet closures were also implemented at several beaches. These closures were relatively effective in reducing disturbance.

Education, Outreach, and Public Involvement

Educating the public about natural and human impacts threatening nesting and staging shorebirds is important for gaining local support of shorebird management and facilitating their recovery. In March, the Seashore's Natural Resource Specialist visited local elementary schools throughout the Lower Cape and presented a Powerpoint and interactive classroom activity demonstrating the impacts of disturbance to nesting shorebirds. A total of 13 programs at five schools were given to 483 children.

In addition, two, 12 week, Student Conservation Association (SCA) interns were hired to provide informal interpretive services. The interns spent the majority of their time designing and developing educational material on shorebird conservation, manning a display table at the visitor centers and giving several public programs. In addition, when a temporary closure/detour was needed at Coast Guard beach in Eastham to protect nesting shorebirds on a narrow section of beach, the interns set up the shorebird information table at the high tide closure/detour. This not only ensured compliance, but provided an opportunity to advance visitor understanding of the park's shorebirds program. Interns also gave several public programs at the Salt Pond Visitor Center. Over 6,000 visitor contacts were made throughout the summer.

When not needed for interpretation, these interns worked with other shorebird team members to monitor nests, and assist with the installation of signage and exclosures.

Three volunteers donated a total of 167 hours to the Seashore's shorebird management program. Volunteers monitored nesting areas, were stationed at high tide closures and worked with Biological Technicians and SCA's in field operations from April through August.

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Tables

Table 1. Summary of Piping Plover Breeding Success, Cape Cod National Seashore, 2011.

Site	# Pairs	# Nests ¹	# Eggs Laid	# Nests Hatched	# Eggs Hatched	# Fledged Chicks	Hatching Success ²	Fledging Success ³	Productivity ⁴	Total # Dogs Off Leash
Herring Cove/Wood End/ Long Pt.	12	13	49	10	38	25	0.78	0.66	2.08	35
Hatches Harbor	2	1	4	1	4	3	1.00	0.75	1.50	4
Race Point North	8	8	31	7	23	6	0.74	0.26	0.75	27
Old Harbor	2	3	11	1	4	1	0.36	0.25	0.50	10
Race Point South	5	6	20	5	17	10	0.85	0.59	2.00	15
Exit 9	6	10	34	5	18	3	0.53	0.17	0.50	8
High Head	9	9	32	7	24	5	0.75	0.21	0.56	10
Head of the Meadow	4	6	18	4	11	3	0.61	0.27	0.75	9
Coast Guard, Truro	1	2	6	1	4	1	0.67	0.25	1.00	10
Long Nook	1	1	4	1	4	4	1.00	1.00	4.00	4
Ballston Beach	6	9	30	6	18	16	0.60	0.89	2.67	20
Coast Guard, Eastham	4	8	28	2	5	0	0.18	0.00	0.00	28
Nauset Light	0	0	0	0	0	0	0.00	0.00	0.00	37
Marconi Beach	5	5	19	5	16	8	0.84	0.50	1.60	25
Marconi Station	0	0	0	0	0	0	0.00	0.00	0.00	1
LeCount Hollow	0	0	0	0	0	0	0.00	0.00	0.00	39
White Crest	0	0	0	0	0	0	0.00	0.00	0.00	17
Cahoon Hollow	1	2	3	1	0	0	0.00	0.00	0.00	18
Newcomb Hollow	0	0	0	0	0	0	0.00	0.00	0.00	36
Bound Brook	1	1	2	0	0	0	0.00	0.00	0.00	5
Duck Harbor	2	4	9	1	1	0	0.11	0.00	0.00	18
Great Island	4	8	20	3	12	3	0.60	0.25	0.75	16
Jeremy Point	8	13	50	2	8	2	0.16	0.25	0.25	9
New Island	1	1	4	0	0	0	0.00	0.00	0.00	0
Totals	82	110*	374	62	207	90	0.55	0.43	1.10	401

¹ A "nest" is defined by individual scrapes with eggs. In 2011, each initial nest, re-nest, continuation nest and their respective outcomes are counted as separate "nests" with separate outcomes.

²Total number of eggs hatched /total number of eggs laid.

³Total number of chicks fledged/ total number of eggs hatched.

⁴Total number of chicks fledged/ total number of nesting pairs.

*This total value includes each "nest". A "nest" is defined by individual scrapes with eggs. A "clutch" is defined as the total number of eggs laid by an individual bird during one nesting cycle. Continuation nests (when a pair lays a certain number of eggs, loses these eggs, and continues laying additional eggs from the same "clutch" in a different nest bowl nearby) are included as separate events or additional "nests". One example of this in 2011 was Great Island nest 5B. This pair laid 3 eggs, they were eaten by crows, they continued laying an additional 1 egg from the same "clutch" nearby, and this egg was abandoned. This is counted as two separate "nests" even though the eggs were from the same "clutch". In 2011, each initial nest, re-nest, continuation nest and their respective outcomes are counted as separate "nests" with separate outcomes.

Table 2. Piping Plover Nest Loss Totals, Cape Cod National Seashore, 2011.

Nests				<i>Cause</i>	Loss By Cause	
# Nests	# Hatched	# Lost	% Lost ¹		# Lost	% Lost ²
110	62	48	77%			
				Predation	29	60%
				Overwash	9	19%
				Abandoned	9	19%
				Infertile	1	2%
				<i>Predation Types</i>	# Lost	% Lost ³
				Crow	24	83%
				Coyote	3	10%
				Unknown	2	7%

¹total number nests lost/total number nests laid

²number of nests lost to a particular cause/total number of nests lost

³number of nests lost to a particular predator/total number of nests lost to predation

Table 3. Piping Plover Egg Loss Totals, Cape Cod National Seashore, 2011.

Eggs			<i>Cause of Loss</i>	Loss by Cause	
Total #	# Lost	% Lost ¹		# Eggs Lost	% Lost ²
374	143	38%			
			Predation	87	61%
			Infertile	4	3%
			Overwash	24	17%
			Abandoned	28	20%
			<i>Predation Types</i>	# Eggs Lost	% Lost ³
			Crow	69	79%
			Unknown	8	9%
			Coyote	10	11%

¹total number eggs lost/total number eggs laid

²number of eggs lost to a particular cause/total number of eggs lost

³number of eggs lost to a particular predator/total number of eggs lost to predation

Table 4. Fate of Exclosed and Unexclosed Piping Plover Nests, Cape Cod National Seashore, 2011.

Type of Nest Protection	Total Nests	# Successful	# Unsuccessful	% Successful	% Unsuccessful	Cause of Failure	# Lost	% Lost
canopy exclosure in place for entire incubation period	19	15	4	79%	21%	Overwash	1	25%
						Abandoned	1	25%
						Abandoned due to known adult mortality	2	50%
canopy exclosure removed at some point during incubation	7	2	5	29%	71%	Crow	5	100%
circular exclosure in place for entire incubation period	35	32	3	91%	9%	Infertile	1	33%
						Overwash	1	33%
						Abandoned due to known adult mortality	1	33%
circular exclosure removed at some point during incubation	8	5	3	63%	38%	Crow	2	67%
						Canid	1	33%
unexclosed	41	8	33	20%	80%	Crow	17	52%
						Unknown Predator	2	6%
						Canid	2	6%
						Abandoned	5	15%
						Overwash	7	21%
TOTALS	110	62	48	56%	44%			

Table 5. Summary of Adult Mortality by exposure type, Cape Cod National Seashore, 2002-2011.

Year	# Circular	# Deaths	Rate ¹	# Canopy	# Deaths	Rate ²
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%
2011	43	1	2.32%	26	2	7.69%

¹number of deaths related to circular exposure use/total number of circular exposures used.

²number of deaths related to canopy exposure use/total number of canopy exposures used.

Table 6. Summary of Piping Plover Nest Loss, Cape Cod National Seashore, 2002-2011.

Year	Total Nests	# Successful Nests	# Unsuccessful	# Nests Lost to									
				Overwash/ Sanding	Abandonment/ Adult Mortality	Non- viable	Predation	Crows	Coyote	Gulls	Skunk	Unknown Predator	Other
2002	141	57	84	27	17	1	39	21%	15%	15%	10%	36%	3%
2003	121	54	67	14	14	N/A	39	13%	26%	10%	13%	26%	13%
2004	115	59	56	15	13	N/A	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	N/A	12	75%	8%	0%	0%	17%	0%
2007	113	67	46	21	15	N/A	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%	N/A	0%	20%	0%
2011	110	62	48	9	9	1	29	83%	10%	N/A	N/A	7%	N/A
Total	1147	610	537	155.5	103	6	272.5	47%	14%	7%	5%	25%	3%

Table 7. Summary of Piping Plover Nesting Parameters, Cape Cod National Seashore, 2002-2011.

Year	# Pairs	# Nests	# Eggs Laid	# Successful Nests	# Chicks Hatched	# Fledged	Nest Success Rate ¹	% Renests ²	Hatch Rate ³	Fledge Rate ⁴	Productivity ⁵
2002	97	141	428	57	175	88	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%	0.70
2010	85	115	386	68	236	137	59%	26%	61%	58%	1.61
2011	82	110	374	62	207	90	56%	25%	55%	43%	1.10
mean	84	115	390	61	209	114	53%	26%	55%	54%	1.36
median	85	114	382	61	214	123	53%	26%	54%	55%	1.50

¹number of successful nests/total number of nests.

²number of renests (including continuation nests)/total number of nests.

³number of chicks hatched/total number of eggs laid.

⁴number of chicks fledged/number of chicks hatched.

⁵number of chicks fledged/number of nesting pairs.

Table 8. Number of Piping Plover Breeding Pairs, Annual Nest Productivity, and 5 Year Weighted Average Productivity, Cape Cod National Seashore 1985-2011.

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
2011	82	85.00	90	1.10	1.38

Table 9. Number of Least Tern Pairs and Fledging Success at Twelve Sites, Cape Cod National Seashore, 2011.

	A Count¹	B Count²	# Chicks Fledged
Ballston	0	10	1
Head of the Meadow	3	8	2
Exit 9	6	8	3
Race Point South	8	13	5
Race Point North (Includes Old Harbor)	41	40	28
Wood End	19	56	20
Armstrong	0	1	1
Mission Bell	5	2	0
Great Island	0	5	0
Jeremy Point	24	72	6
Coast Guard	11	30	18
Marconi Beach	13	23	15
Totals	130	268	99

¹"A-Counts" are taken within the MA. State census window of June 5-20.

²"B-Counts" are taken outside the MA. State census window; after June 20.

Figures

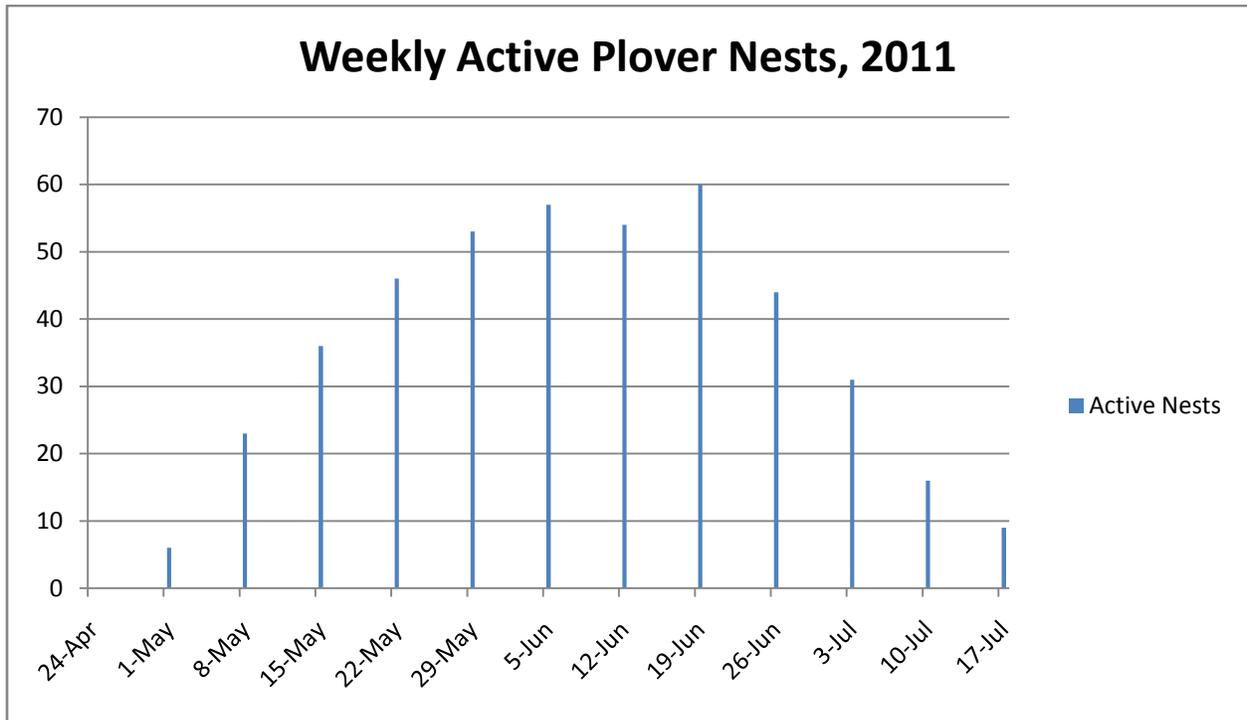


Figure 1. Weekly Active Plover Nests for Cape Cod National Seashore, 2011.

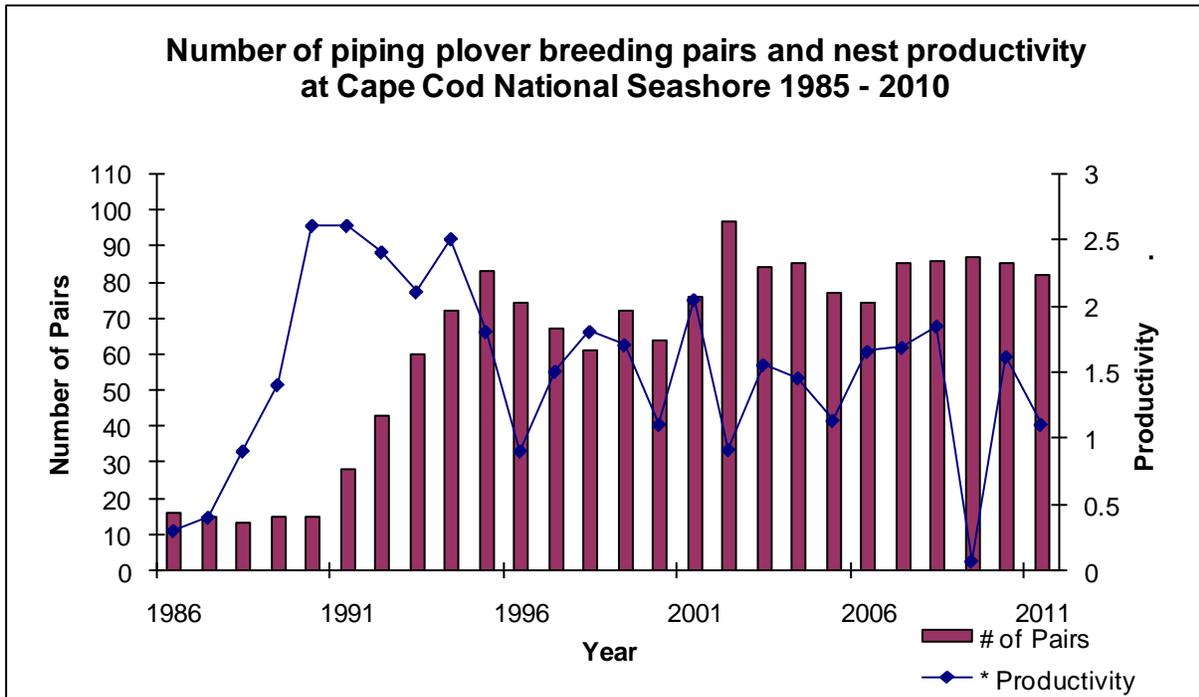


Figure 2. Number of Piping Plover Pairs and Nest Productivity on Cape Cod National Seashore from 1985 – 2011.

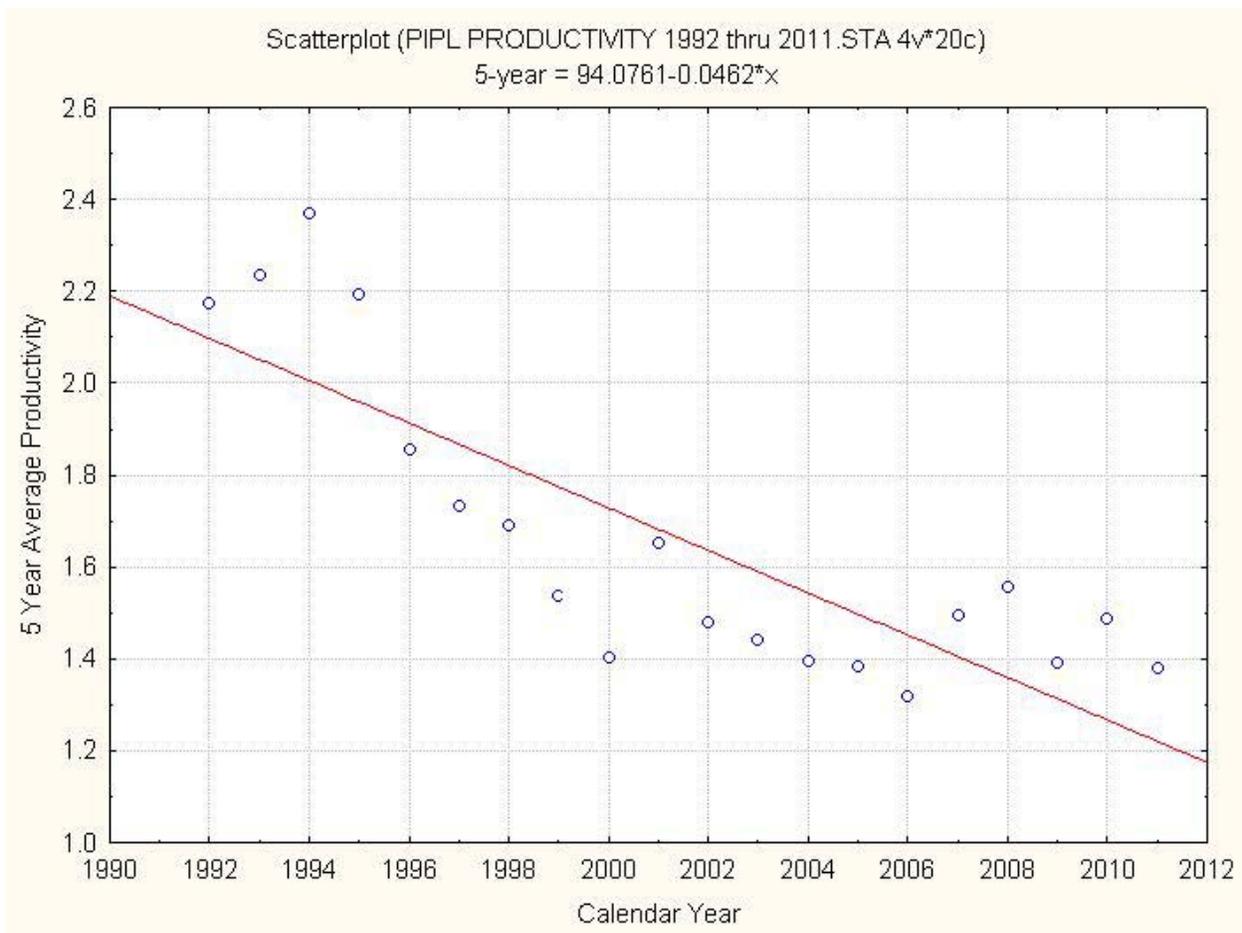


Figure 3. Piping Plover 5 Year Productivity Regression, Cape Cod National Seashore, 1992-2011.

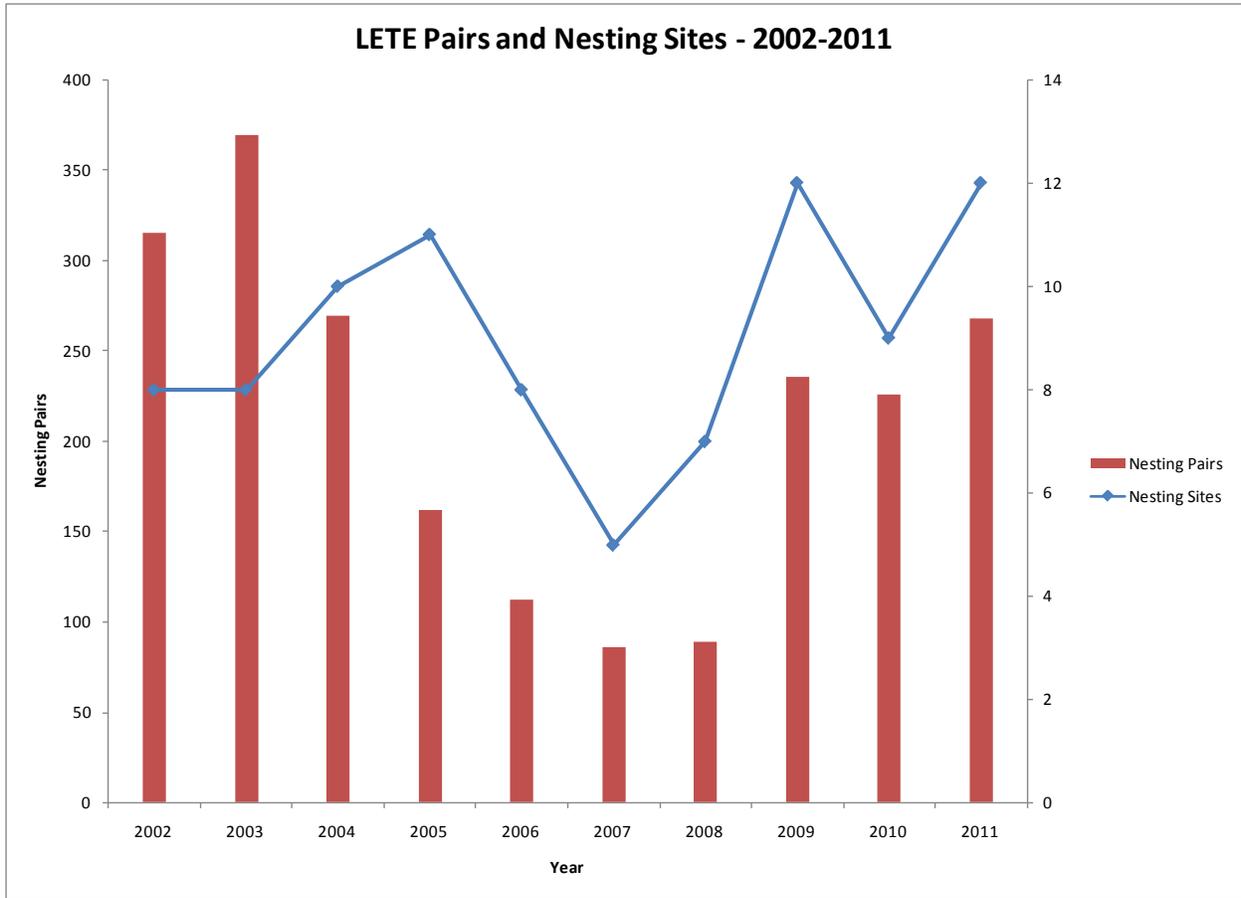


Figure 4. Number of Least Tern Pairs and Number of Least Tern Nesting Sites on Cape Cod National Seashore, 2002-2011.

Appendix A

Maps of 2011 Piping Plover, Least Tern and American Oystercatcher Nest Sites at Cape Cod National Seashore.



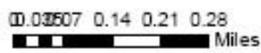
Piping Plover / Least Tern Nesting Activity 2011



Legend

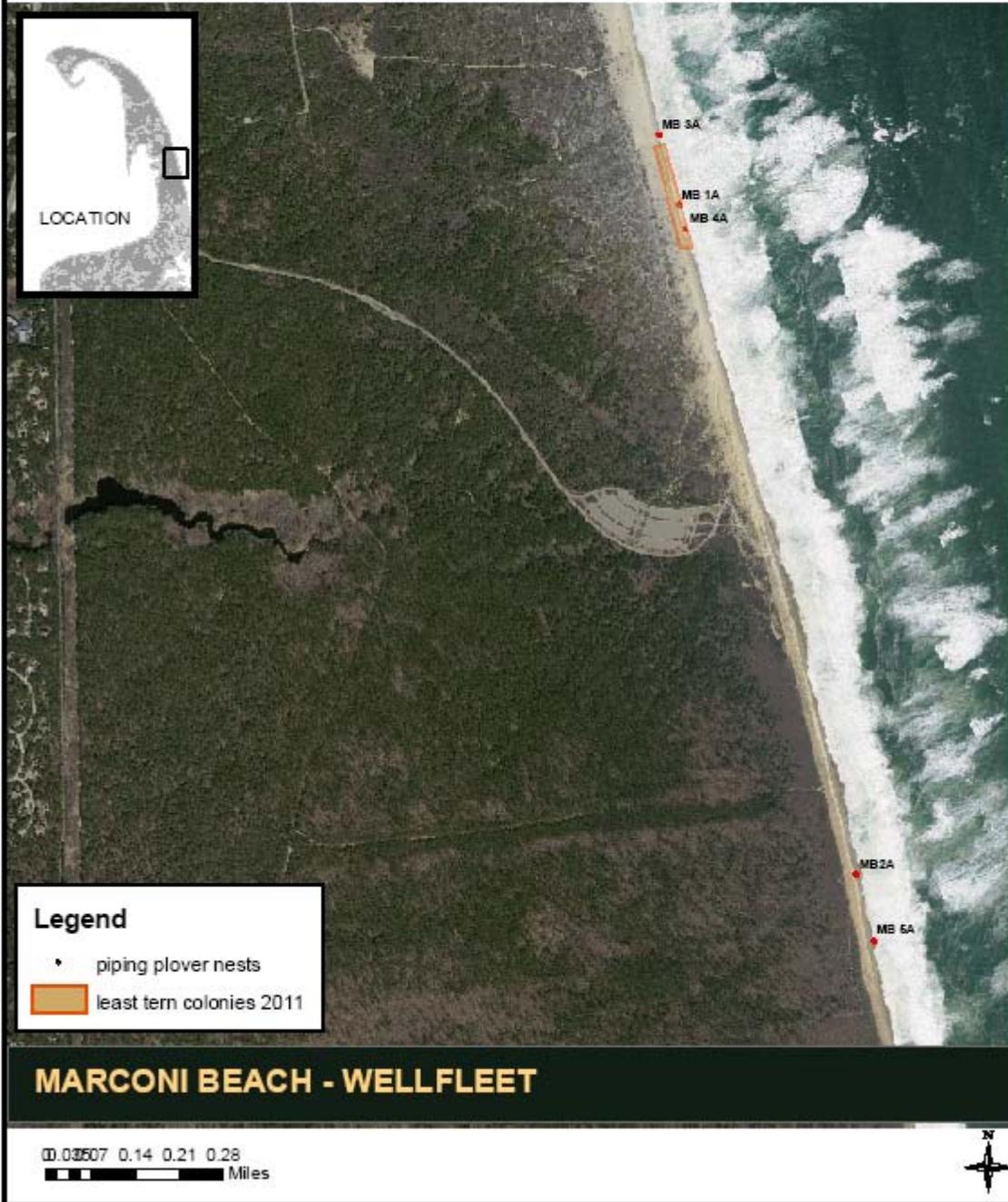
- piping plover nests
- least tern colonies 2011

COAST GUARD BEACH - EASTHAM



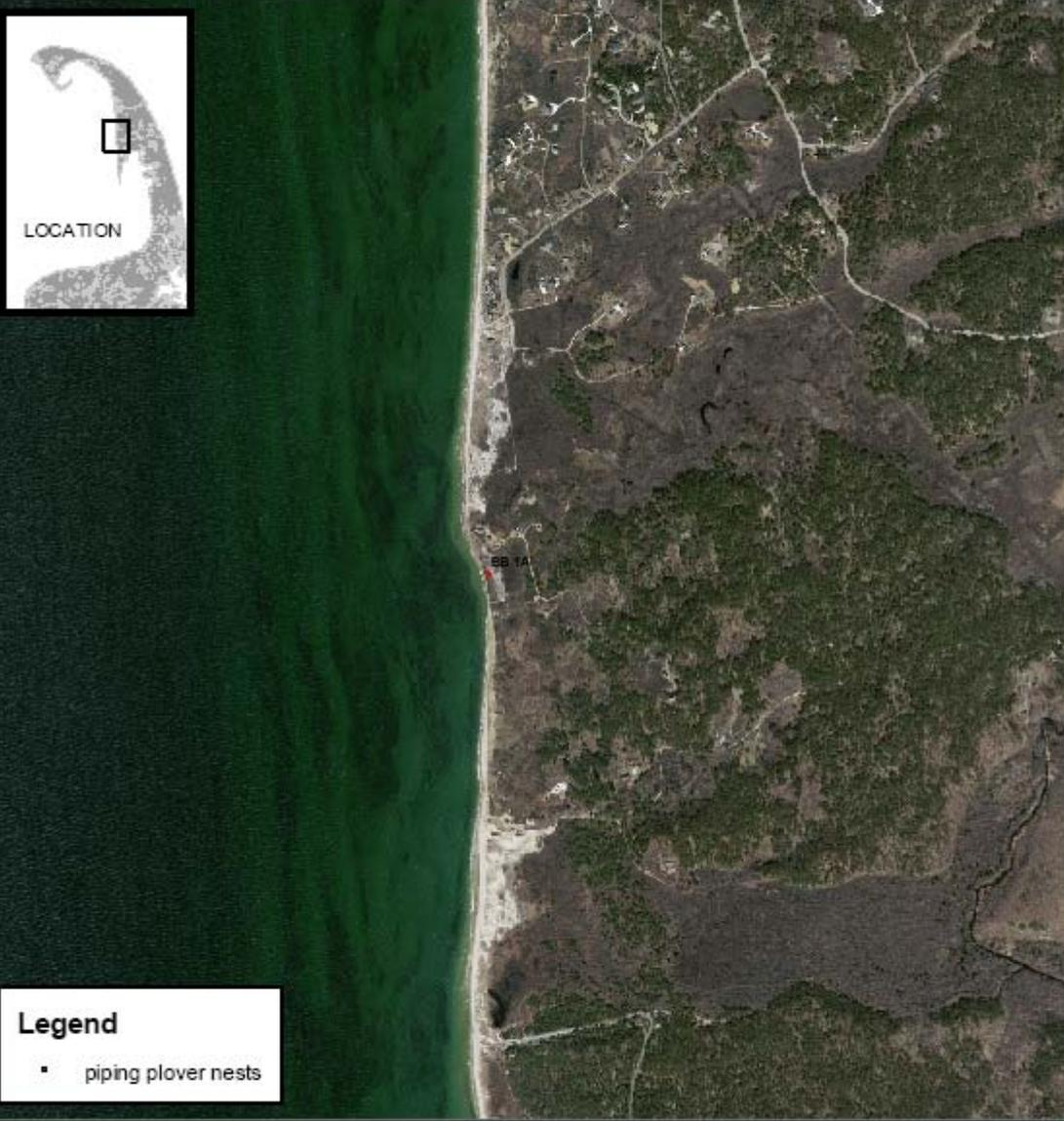


Piping Plover / Least Tern Nesting Activity 2011





Piping Plover Nesting Activity 2011

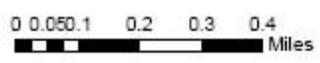


LOCATION

Legend

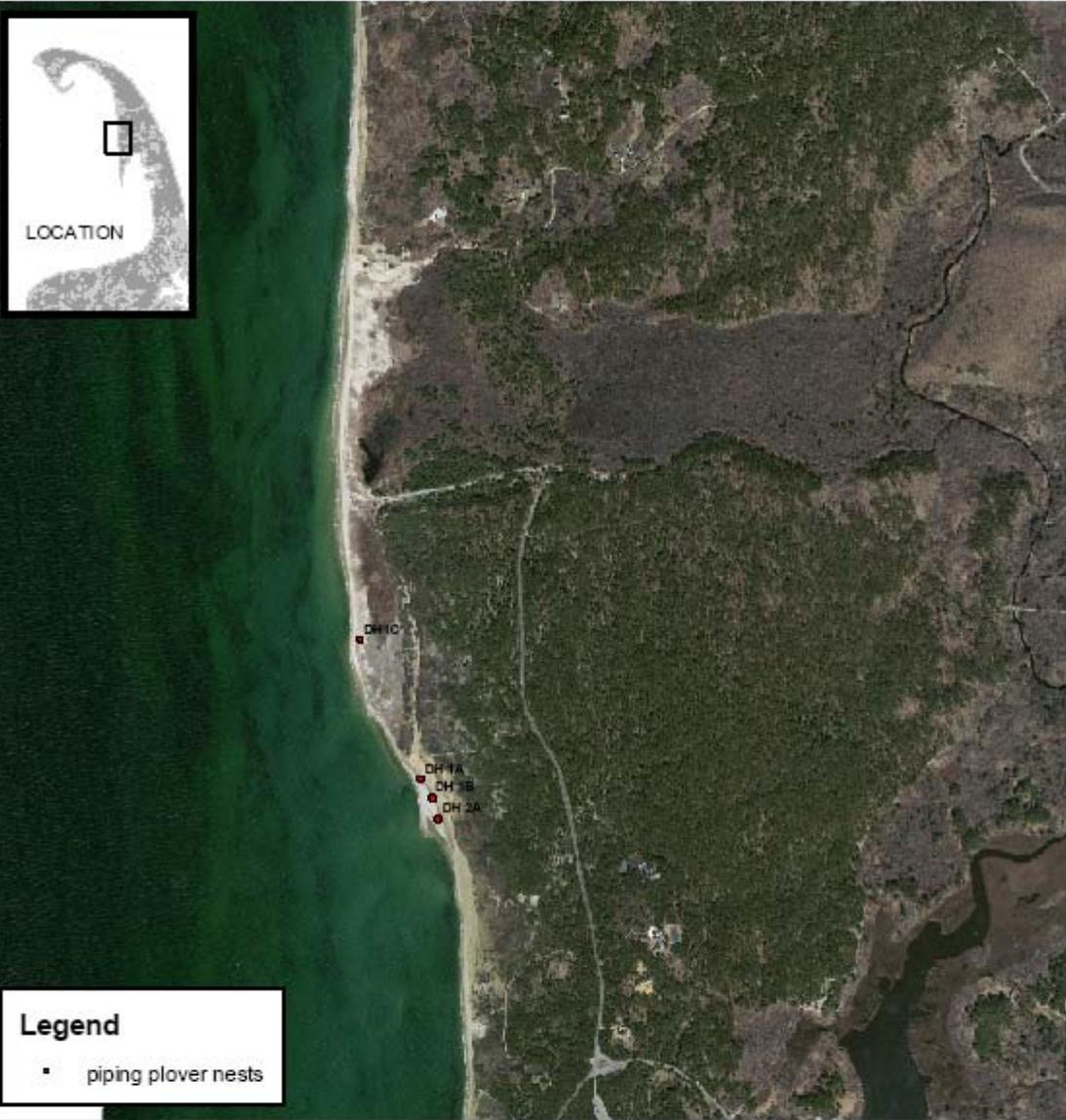
- piping plover nests

BOUND BROOK - WELLFLEET





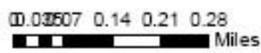
Piping Plover Nesting Activity 2011



Legend

- piping plover nests

DUCK HARBOR - WELLFLEET





Piping Plover / Least Tern Nesting Activity 2011



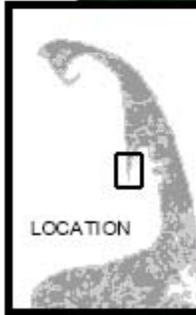
GREAT ISLAND - WELLFLEET

0.03507 0.14 0.21 0.28
Miles





Piping Plover / Least Tern Nesting Activity 2011



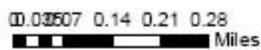
LOCATION



Legend

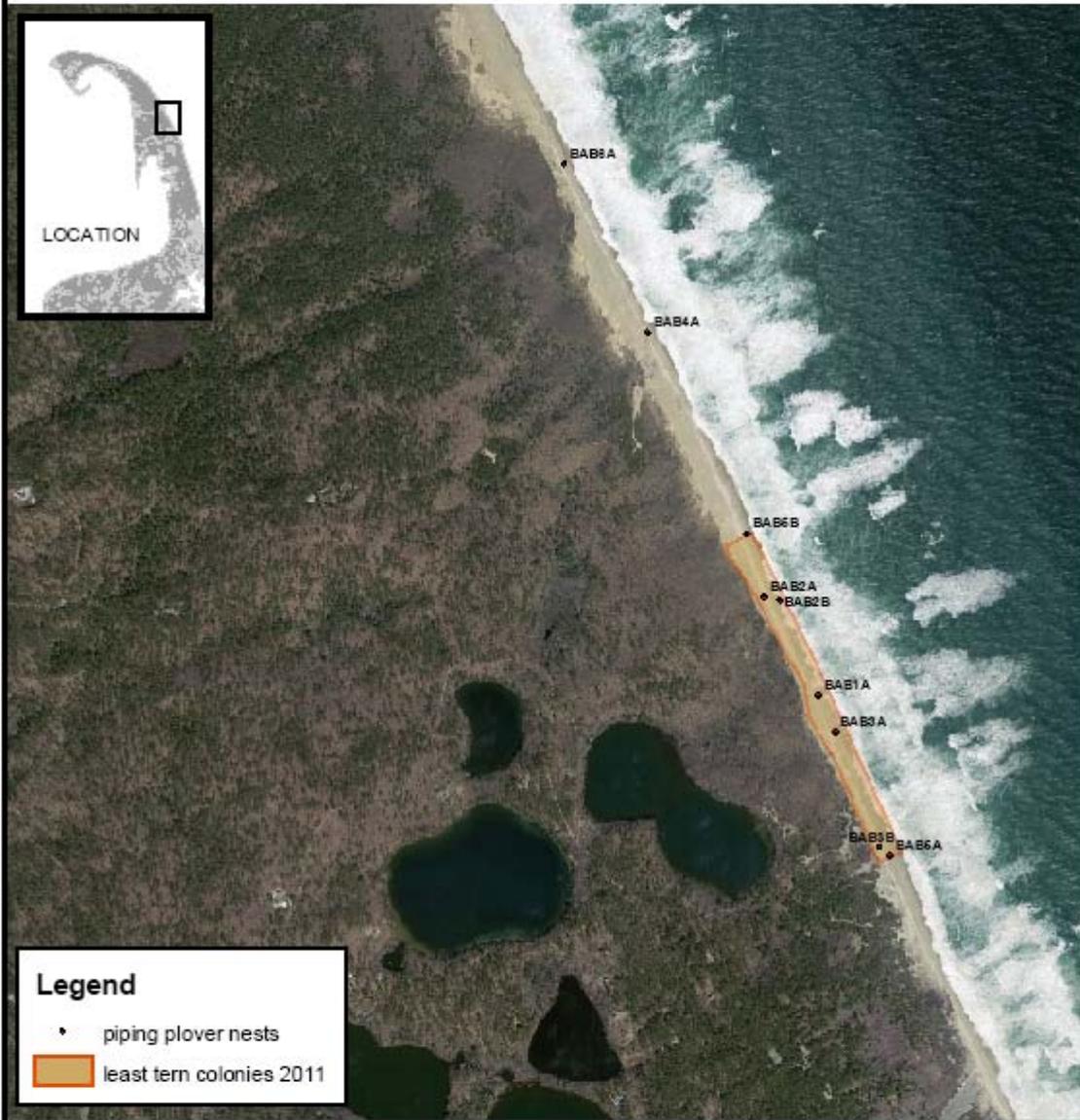
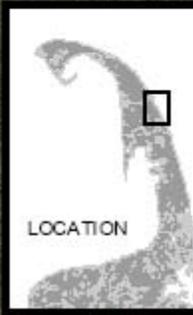
- piping plover nests
- least tern colonies 2011

JEREMY POINT - WELLFLEET





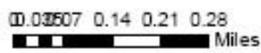
Piping Plover / Least Tern Nesting Activity 2011



Legend

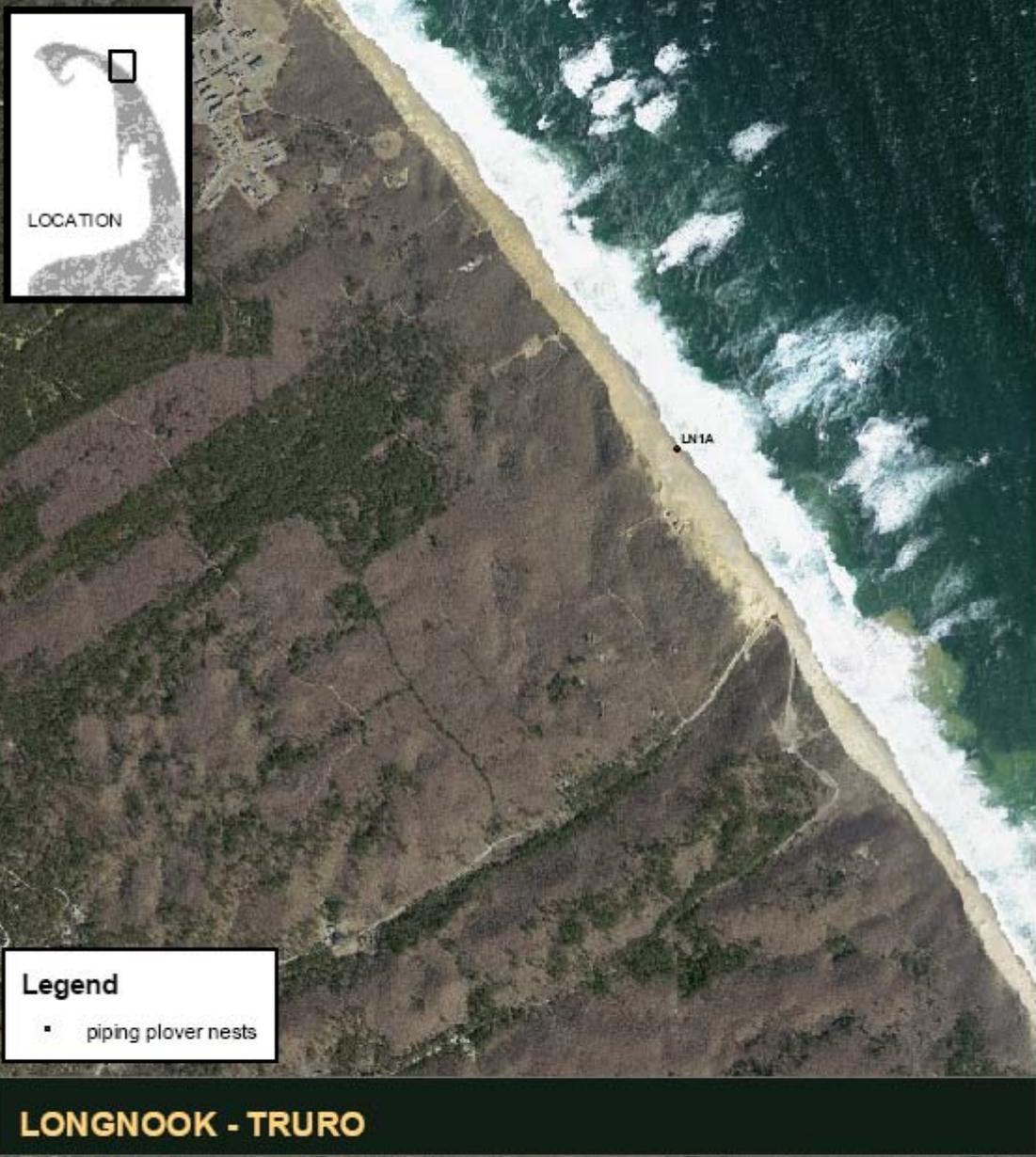
- piping plover nests
- least tern colonies 2011

BALLSTON BEACH - TRURO





Piping Plover Nesting Activity 2011



Legend

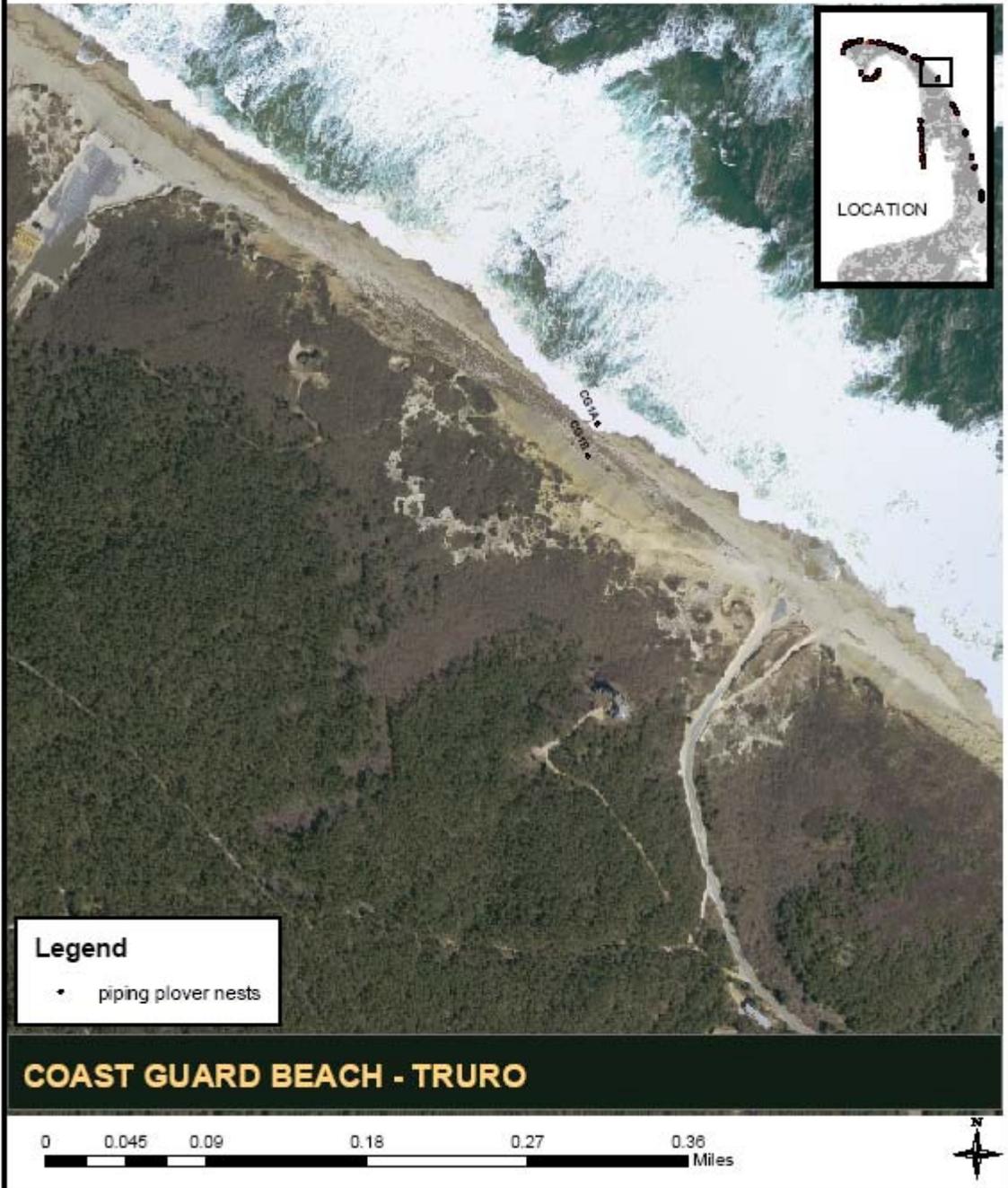
- piping plover nests

0 0.03507 0.14 0.21 0.28
Miles





Piping Plover Nesting Activity 2011





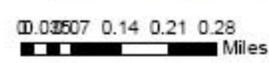
Piping Plover / Least Tern Nesting Activity 2011



Legend

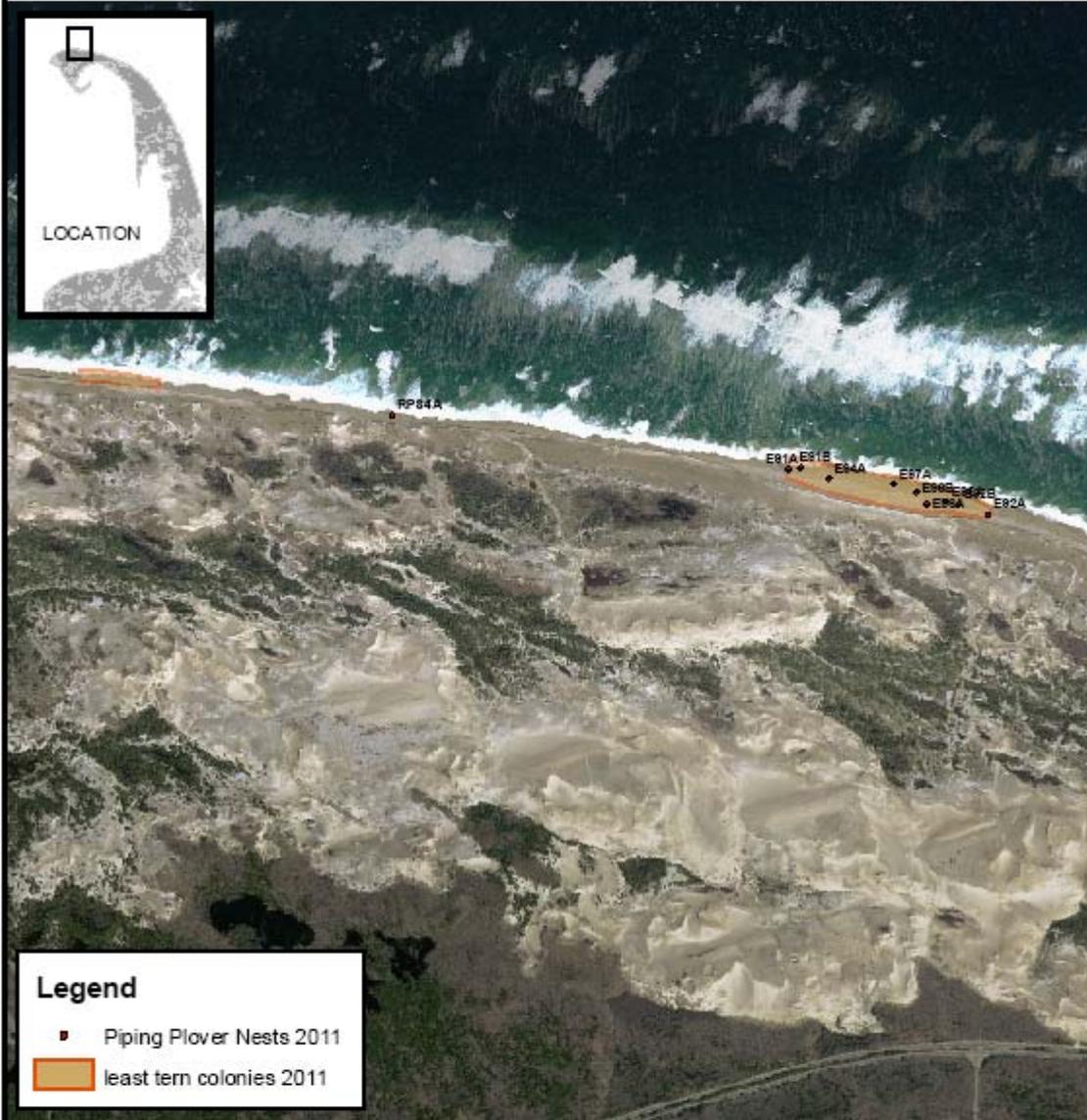
- piping plover nests
- least tern colonies 2011

HEAD OF THE MEADOW - TRURO





Piping Plover / Least Tern Nesting Activity 2011



Legend

- Piping Plover Nests 2011
- least tern colonies 2011

RACE POINT SOUTH (2 of 4) - PROVINCETOWN





Piping Plover Nesting Activity 2011



Legend

- piping plover nests
- least tern colonies 2011

RACE POINT SOUTH (3 of 4) - PROVINCETOWN

0.03507 0.14 0.21 0.28
Miles





Piping Plover Nesting Activity 2011



Legend

- piping plover nests

RACE POINT SOUTH (4 of 4) - PROVINCETOWN

0.03507 0.14 0.21 0.28
Miles





Piping Plover / Least Tern Nesting Activity 2011



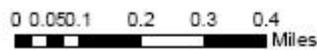
LOCATION



Legend

- Piping Plover Nests 2011
- least tern colonies 2011

RACE POINT NORTH - PROVINCETOWN





Piping Plover Nesting Activity 2011



Legend

- piping plover nests
- least tern colonies 2011

WOOD END / LONG POINT - PROVINCETOWN

0 0.1 0.2 0.3 0.4
Miles





American Oystercatcher Nesting Activity 2011



Legend

- American Oystercatcher Nests

JEREMY POINT - WELLFLEET

