Shorebird Monitoring and Management
Cape Cod National Seashore

2012

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Abstract

This report summarizes the 2012 shorebird nesting season for Cape Cod National Seashore (hereafter Seashore). Piping plover (*Charadrius melodus*), least tern (*Sterna antillarum*), common tern (*Sterna hirundo*) and American oystercatcher (*Haematopus palliates)* nesting and brood-rearing were monitored on 25 beaches over 40 miles from Provincetown to Orleans. The first piping plovers were observed on Seashore beaches on 16 March, the first nest was found on 24 April, and peak nesting occurred the week of 27 May. A total of 99 nesting pairs attempted 212 nests, with 27 pairs successful at producing at least one chick and 185 pairs failing to produce any hatchlings. Predation accounted for 56% (103/185) and overwash accounted for 30% (55/185) of nest failures. Eastern coyote (*Canis latrans)* and American crow (*Corvus brachyrhynchos*) were the main predators accounting for 40% (41/103) and 34% (35/103) respectively, of all nests lost to predators. Predator exclosures were not used in 2012 due to the increasing frequency of predators keying into exclosures in past years, which causes nest abandonment and increased risk of adult mortality. Overall, 30 chicks fledged, for a productivity of 0.30 chicks fledged/ nesting pair. Poor nesting success, coupled with low fledging success in 2012, accounted for the lowest productivity the Seashore has seen since piping plovers were listed in 1986. Over the 20 year period since 1993, even though the total population of nesting pairs has increased within the Seashore (with 2012 being a record high year), there has been a statistically significant decline in piping plover productivity, with the five year weighted average annual productivity declining 0.0443 fledglings/pair each year.

A total of 257 pairs of least terns nested in 11 colonies from Eastham to Provincetown. Productivity was approximately 0.26 chicks fledged/pair (66 chicks fledged/257 pairs). Three pairs of American oystercatchers nested at the Seashore; a total of four nests were laid and overall productivity was zero. One pair of common terns established a nestbut was unsuccessful. Post-breeding/staging roseate terns (*Sterna dougallii*) and common terns were present in large numbers in the Seashore and thousands of other migrating shorebirds were observed on Seashore beaches in the spring and fall, including about 200 red knots *(Calidris canutus rufa)*.

Introduction

The 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, tidal lands, and near shore waters located on Outer Cape Cod. As reflected in the Seashore's General Management Plan, this unit of the NPS was established, in large 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 and migratory stopover-site for thousands of terns, including the federally endangered roseate tern, and many other shorebird species, including the red knot (a candidate for endangered species act protection), whimbrel (*Numenius phaeopus*), short-billed dowitcher (*Limnodromus griseus*), semi-palmated sandpiper (*Calidris pusilla*), and lesser yellowlegs (*Tringa flavipe*). These latter four are identified by the USFWS as a *Bird of Conservation Concern* in the United States (USFWS 2008). Staging terns and shorebirds use Seashore beaches and inter-tidal flats to rest and feed in order to build the body mass and fat reserves necessary to fuel their long migration.

Methods

Shorebirds were monitored on 25 beaches in the Seashore from Provincetown to Orleans, encompassing approximately 44 miles of beach. Staffing consisted of one permanent lead shorebird biologist in each district, three, full time 18 week seasonal biological technicians (one in the South District and two in the North District) as well as four, 16 week full-time Student Conservation Association interns, two in each district and several volunteers. 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, Hatches Harbor, Race Point North, Race Point South, Exit 9, Armstrong, High Head, Head of the Meadow,,Coast Guard Beach in Truro, Longnook and Ballston). The South District includes all NPS beaches located in Eastham and Wellfleet (Coast Guard Beach in Eastham, 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 least terns, the Seashore follows *The Massachusetts State Guidelines for Monitoring and Protection of Tern and Plovers* (Blodget and Melvin 1996). For day to day operations of shorebird management and protection, the Seashore is guided by the 2012 Cape Cod National Seashore Shorebird Management Standard Operating Procedures (SOP).

During the nest location phase, monitors search the beaches for shorebird nest scrapes and tracks in the sand. To provide accurate predictions of hatching dates, most beaches are 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 drive past 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

Nesting and Hatching Success

Results

Ninety- nine nesting pairs of piping plovers were monitored on 25 beaches in the Seashore in 2012 (Table 1 and Appendix A - Maps). The first piping plover was observed on 16 March. Piping plovers were present at most beaches by early April, with birds continuing to arrive into mid-June. Most plovers left Seashore beaches by late August, although some lingered through September.

The first nest was found on 24 April at Head of the Meadow. Peak nesting for the Seashore occurred the week of 27 May (Figure 1). Hatching dates of piping plovers ranged from 31 May to 26 July.
The majority of nests were located along the upper beach, in open sandy habitat. A few notable nests at Coast Guard Beach in Truro, Longnook, and Great Island were located approximately 10-30 meters up a steep sand scarp in the backshore section of beach. Another noteworthy nest at Hatches Harbor was located inside a bayberry bush.

The breeding population of piping plovers was calculated based on the number of pairs observed nesting at the Seashore. Instances of nest loss and egg loss were calculated separately due to eggs from some nests being lost to two different causes (or two different predators) (Tables 2 and 3).

A total of 212 nests were found in 2012, 144 in the North District and 68 in the South District. Of these, 27 nesting pairs produced at least one chick and 185 failed to produce any (Table 2). Of the 185 nests lost, 55 were in the South District and 130 were in the North District. In the South District, re-nests accounted for 46% of total nests (31/68) and in the North re-nests accounted for 57% (82/144) of total nests.

Predation accounted for 56% (103/185) of failed nests, followed by overwash (30%; 55/185), unknown causes (7%; 13/185), abandonment (5%; 9/185), cliff erosion (1%; 2/185), stepped on by gulls (1%; 2/185), and stepped on by a person (0.5%; 1/185). Of the 103 nests lost to predation, 40% (41/103) were lost to coyote, 34% (35/103) to American crow, 20% (21/103) to unknown predators, 5% (5/103) to fox and 1% (1/103) to *canid* (species).

The 212 piping plover nests contained a total of 636 eggs. Of these, 72 hatched. The remaining 548 eggs were lost to various causes, primarily predation (58%; 318/548) or failed to hatch (Table 3). Overall, hatching success was 11% (72/636) (Table 1).

Discussion

Over the last ten years (2003-2012), the three main factors affecting nesting success have been predation, overwash, and abandonment/adult mortality (Table 4). In 2012, nesting success was 13% (27/212), the lowest it has been in the past ten years (Table 5).

The 41 nests lost to coyote predation this season (Table 2) exceeded the previous high of nine in 2003. In 2012, coyotes were observed on beaches in the middle of the day and coyote tracks blanketed the sand in both North and South districts. Coyotes in Massachusetts are now well established statewide (with the exception of Martha's Vineyard and Nantucket), originally moving into the central and western regions of Massachusetts in the 1950s. The coyote expanded into the eastern sections of Massachusetts and Cape

Cod in the 1970s. Population trends for Massachusetts provided by the MDFW (2004) indicate an increasing trend in the coyote population. No population estimates are available for coyotes in Massachusetts. If coyotes only occupy 50% of the land area of Massachusetts and the density of coyotes in the Commonwealth ranges from 0.5 coyotes per square mile to 1.0 coyotes per square mile, the statewide population could be estimated to range from nearly 2,000 coyotes to a high of nearly 4,000 coyotes (USDA 2011).

The crow population appears to be increasing most likely due to their ability to adapt to and benefit from human development of the surrounding landscape (Marzluff et al. 2001). The American crow population in Massachusetts has been estimated at 110,000 crows statewide based on breeding bird survey (BBS) data (Rich et al. 2004). From 1966 through 2007, trend data from the (BBS) indicates the number of crows observed in the Commonwealth of MA during the survey has increased at an annual rate of 1.2% (Sauer et al. 2008). The number of crows observed in the Commonwealth in areas surveyed during the Christmas Bird Count has shown a general increasing trend since 1966 (NAS 2010).

In 2012, crows were a leading cause of egg loss. Groups of crows were commonly observed foraging along oceanside beaches from Eastham to Provincetown and on the bayside of Wellfleet. Shorebird staff routinely observes crows in the early morning feeding on food scraps left on high visitor use beaches. It was previously suggested that crow populations are larger in the South District, relative to the North District, due to the larger concentrations of people and development, and to a lesser extent, because of the greater abundance of trees nearby for crows to nest in and perch on. However, more crows were observed on beaches in the North District this season than in previous years, suggesting that the population of crows throughout the park is increasing.

Overwash also played a significant role in nest loss this season. A major storm during the first week in June over-washed 42 piping plover nests and the majority of symbolic fencing in the Park. The fencing was reinstalled and most pairs renested.

Brood Monitoring

Brood monitoring is critical for determining location of broods, fledging dates, fledging rates, and causes of chick mortality. Because piping plover chicks are highly mobile and difficult to locate, especially in dense vegetation, brood monitoring is challenging. Human disturbance can also affect brood monitoring by causing chicks to disperse, making it harder to keep track of them. On several occasions in 2012, adult piping plovers were observed engaged in distress calls and broken wing displays when beachgoers were within 10 meters of chicks. Chicks would disperse in several directions away from the perceived threat. Brood monitoring is even more difficult 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.

Causes of chick mortality 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. For ORV management, sections of beach were re-opened to vehicles when an entire brood was not seen in the area for five consecutive days. On 24 June, 2011, at Head of the Meadow, a shorebird Biological Technician observed a crow with an eight day old piping plover chick in its bill, presumably killed by the crow. Prior to this observation, four chicks from this brood were last seen on 22 June in the same area. No chicks from this brood were subsequently observed.

Fledging dates ranged from 4 July to 3 September. Although State guidelines for piping plovers (Blodget and Melvin 1996) suggest that most plover chicks fledge at 25 to 27 days, this does not seem to be the case at the Seashore and other piping plover breeding locations. In recent years, it has been common for

piping plover broods to take longer than 27 days to fly. For example, in 2011 in the town of Duxbury, MA, of 35 chicks that hatched from 9 nests, 19 survived to fledge. Age of fledging ranged from 31 to 42 days old, with most chicks taking over 35 days to fledge. At the Seashore in 2011, 28 of 40 broods took longer than 30 days to fledge. In 2012, chicks from nine of twelve broods took more than 30 days to fledge, with chicks averaging 34 days to fledge. In 2012, one chick at Coast Guard Beach in Eastham appeared stunted from the day it hatched and took 47 days to fledge. More studies are needed to understand why plover chicks are taking longer to fledge, but Catlin et al. (2012) suggests that the duration of the pre-fledge period appears to be affected by environmental conditions.

For management purposes, piping plover chicks are considered fledged when they are observed in sustained flight for at least 15 meters (for the State records, plovers chicks are considered fledged at 25 days old).

Use of Feeding Habitats

Seashore biologists not only survey piping plover nesting areas, but also monitor piping plover feeding, staging, and roosting habitats throughout the park. In 2012, five to ten adult piping plovers were observed feeding on the marsh flats of Hatches Harbor at low tide throughout the nesting season. Only one pair nested at Hatches Harbor this year so we know that the other adults came from surrounding nesting areas (perhaps Race Point North). On 15 April, 26 adult piping plovers were seen feeding off the breakwater on the back side of Wood End. These birds were likely the same birds setting up nesting territories on the front beach at Wood End and Long Point. These observations indicate the abundance of food resources on the marsh flats at Hatches Harbor and Wood End and the importance of not only managing nesting habitat, but also protecting important feeding areas. Groups of post breeding piping plovers were also seen in late summer feeding and resting throughout the park including two notable occasions at Jeremy Point where groups of 16 and 13 plovers were observed (2 August and 31 August respectively).

Fledging Success, Productivity and Population Trends

Results

Of the 72 plover chicks that hatched, 30 chicks fledged (42%). Fledging success ranged from 0% at Hatches Harbor, Race Point North, Old Harbor, Race Point South, Exit 9, Armstrong, High Head, Head of the Meadow, Coast Guard inTruro, Longnook, Cahoon Hollow and Duck Harbor to 100% at Great Island and Newcomb Hollow.

Park-wide, productivity was 0.30 fledged chicks/nesting pair (30 fledged chicks from 99 pairs) (Table 1). For the first time since 2009 productivity was higher in the South District (0.70 fledged/pair) than in the North District (0.06 fledged/pair) (Table 1).

Discussion

Although the number of piping plover pairs nesting at the seashore has continued to increase (with the 99 pairs in 2012 being a record number), productivity in 2012 (0.30 fledged/pair) tied the lowest amount recorded at the Seashore (Table 6). A pair's productivity is the end product of successfully hatching chicks and having them survive to fledging. Low success for either one or both of these stages can limit recruitment of young into the next generation.

In 2012, the fledging rate (42%) was 11 percentage points lower than the mean for the past ten years (53%) and the second lowest of this period (Table 5). However, measures of success during the nest stage for 2012 were even less as compared to the ten year mean. Compared to 2011, fledge rates in 2012 were similar (43% and 42%, respectively), but there were large differences in hatching rates, 56% in 2011 and 11% in 2012, indicating that the lower productivity of 2012, as compared to 2011 (0.30 and 1.10 respectively), was driven by low hatching success. Another indicator of low hatching success is the renest rate for 2012 (53%), which was the highest recorded in the last ten years, and double the median value for this parameter during this time period (Table 5). Thus, record low nest/hatching success, coupled with below average fledging success accounted for the lowest productivity the Seashore has seen since piping plovers were listed in 1986. Reasons for the low nest/hatching success in 2012 are likely related to an abundance of predators and predation and storm related loss (see discussion in nesting and hatching success section).

Recovery and viability of piping plover populations requires both an increase in abundance and a sustained level of annual productivity. At the Seashore, annual productivity increased dramatically in the initial years of the plover management program but has been trending downward more recently, with a low of 0.30 chicks fledged/pair in 2012 (Table 6, Figure 2). For the most recent 20 year period (1993-2012), annual productivity has declined significantly, by 0.05 chicks per pair per year (slope of the regression line for year = - 0.05, p-value = 0.02, R square = 0.28).

However, because annual productivity can be so variable, a preferable measure of productivity is the five-year moving average of annual productivity. This measure reduces the effect of annual variability and combines the results for five years into a single weighted average. For the Atlantic Coast population of piping plover, viability models estimate that a five-year average annual productivity of 1.5 chicks fledged/pair/year is needed to maintain the relatively small recovery goal population of 2000 pairs with minimal extinction risk (USFWS 1996, 2009). For the five year period ending with 2012, the 5-year average productivity at the Seashore was 1.09 chicks fledged/pair/year and since 2003, this measure of productivity has been below the recovery goal in seven of ten years. When viewed over a 20 year period (1993-2012) the five year weighted average annual productivity has declined significantly, by 0.0443 chicks fledged/ pair/year(slope of the regression line for year = - 0.0443, p-value = 0.00001, R square = 0.66) (Figure 3, Table 6). Thus, although the breeding population of piping plovers at the Seashore has increased, its productivity is in decline and is no longer achieving the USFWS recovery goal of a five year average annual productivity of 1.5 fledged chicks/pair/year.

It is hard to predict what this decline in productivity will have on the breeding population at the Seashore and the overall recovery of the species. But continued low reproductive is a concern considering the Seashore supports over 15% of the Massachusetts breeding piping plover population.

Least Terns

Population Trends

The least tern is listed by the MDFW as a species of special concern and as a *Bird of Conservation Concern* by the USFWS. Least tern numbers in Massachusetts increased from 1985 to 2001, declined for several years, and then increased sharply after 2006. From 1985 to 2011, population size in Massachusetts has ranged from 2,109 to 4,309 pairs (with the highest year occurring in 2011 with a mean of 2,881 pairs (Mostello 2012). In the mid-1970's – 1980's, the population of nesting least terns at the Seashore generally ranged from 200- 600 pairs. Over the past ten years (2003 – 2012) at the Seashore, the least tern population has fluctuated between a low of 86 nesting pairs in 2007 and a high of 370 pairs in 2003 (Figure 4). The most recent four years from the last decade have demonstrated a relatively high, stable population of least terns within the Seashore (Figure 4).

Nest Searching and Incubation Monitoring

Methods

Due to concerns of predators keying into human activity or scent inside a nesting area, visual estimates of least tern colony sizes were made from outside the symbolic fencing several times per week. Shorebird staff occasionally walked through colonies to get better estimates of numbers of nests and chicks. The number of pairs in each colony was estimated by walking through each colony and counting nests during two standardized periods defined by Massachusetts Division of Fisheries and Wildlife ("A-count" from June 5-20 and "B-count" after June 20).

Results

Least terns returned to the Seashore during the second week of May. They were first heard on 14 May at Wood End, and first observed on the beach on 18 May at Wood End. Egg laying began on 27 May, with most least terns on eggs by early June. Renesting attempts continued through the beginning of August. Approximately 151 pairs had nests during the "A" count and 257 pairs had nests during the "B" count. There were a total of 11 nesting colonies from Eastham to Provincetown (Table 7).

Colony sizes fluctuated throughout the season but most were relatively small with fewer than 50 pairs. Jeremy Point supported the largest colony with 63 nesting pairs. Through tracking, it was determined that this colony was predated by coyotes and only one chick fledged. Like Jeremy Point, most colonies throughout the Seashore were heavily predated and renesting occurred. Head of the Meadow supported the second largest and most productive colony with 50 nesting pairs present during the "B" count, fledging 32 chicks. There were smaller nesting colonies at Coast Guard Beach in Eastham, Marconi Beach, Ballston Beach, Race Point South (including: Armstrong, Exit 9 and Mission Bell), Race Point North, and Wood End; these beaches supported a range of 5 - 40 nesting pairs (Table 7).

Discussion

Predators are a major cause of nest loss. In most years, predator pressure is so intense that very few nests hatch, causing constant re-nesting. Tracks observed daily through the colony and up to the nests indicate coyote to be the main least tern predator in the North District. In the South District coyote and American crow are the main least tern predators. Coyotes seem to be attracted to tern colonies due to the concentration and abundance of eggs. Other predators include skunk (M*ephitis mephitis*), red fox (*Vulpes vulpes*), raccoons (*Procyon lotor*), opossum (*Didelphis marsupialis*), and gull (*Larus* sp.). It is more difficult to determine specific predators of the least tern chicks, but they are likely the same species that prey on the eggs Field observations suggested that colonies were visited daily by coyotes, most often resulting in loss of nests or chicks. Coyotes can develop a search pattern that is highly effective in locating ground nesting birds in open habitat, allowing them to easily key into exclosed nests. Coyotes may be attracted to the smells of garbage, food storage, and food cooking associated with human recreation. The increased number of fish remains left on the beach by fishermen during the nesting season may also encourage coyote use of these beaches.

A strategy 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) departs. Although the number of nesting least terns has slightly increased on Seashore beaches in recent years, colony size has decreased. This nesting strategy is ineffective in small colonies. Predators appear undeterred by the few birds defending the nesting area.

Brood Monitoring and Productivity

Results

The first least tern chicks hatched on 1 July at Head of the Meadow and the last chicks hatched on 26 August at Armstrong (part of Race Point South). Least terns are considered fledged when they are capable of flight. Approximately 66 chicks fledged from 257 nesting pairs ; Wood End/Long Point (6 chicks), Race Point North (6), Race Point South (2), Mission Bell (4), Armstrong (3), Head of the Meadow (32), Coast Guard (Eastham) (12), and Jeremy Point (1). There was no productivity at Exit 9, Marconi Beach, and Ballston Beach. Total productivity was estimated at 0.26 chicks fledged per pair for the season (66 fledged chicks/257 pairs) (Table 7).

Discussion

Least tern productivity has varied over the past ten years, but has generally been poor, less than one chick fledged/pair. Since 2003, productivity at the Seashore has been less than 0.035 chicks' fledged/nesting pair. The low productivity of least terns is likely due to intense predation on eggs and chicks, mainly by coyotes. In addition, the narrowing of beaches and increased frequency of late spring/summer storms make nesting areas more vulnerable to washovers.

Common Terns

Population Trends

The common tern is listed by the MDFW as a *Species of Special Concern*. In Massachusetts, from 1985 to 2003, common tern numbers rose fairly steadily then stabilized at about 16,000-17,000 pairs. Since 1985, population size has ranged from 6,483 to 16,760 pairs (with a mean of 12,427 pairs) in the State (Mostello 2012).

Over the past ten years, a few common terns pairs (<10) have nested within or near least tern colonies at Jeremy Point, Coast Guard Beach in Eastham, Race Point North and Wood End, but the majority of nesting has historically occurred on New Island, Orleans. In 1999, 2176 pairs nested on this small island. This number sharply declined by over 50% in both 2000 and 2001 (to 1078 and 495, pairs respectively) and productivity was low due to intense egg predation from coyotes, gulls, striped skunks, and ants. In 2002, for the first time in 20 years (Peter Trull, pers. comm.) common terns did not nest on New Island. More recently, nine pairs attempted to nest on New Island in 2009, but all nests were lost to predation. Since 2009, one or two pairs have nested on New Island unsuccessfully.

Nesting Population and Productivity

Results

The first common tern was observed at Race Point North on 8 May. One pair nested unsuccessfully on New Island, Orleans. It is likely that the nest was lost to predation due to the high density of predator tracks throughout the site. An additional pair was observed scraping in the least tern colony on Jeremy Point but no eggs were found. At Race Point North, a pair was observed scraping late in the season but no nest was found. Common tern productivity in the Park was zero.

American Oystercatchers

Population Trends

In the United States, the American oystercatcher is designated a *Species of High Concern* and is one of the most uncommon species of breeding shorebirds in North America (Brown et. al. 2001) due to a restricted range, small population size, widespread habitat loss, and threats during the breeding and non-breeding seasons (Brown et al. 2001). In addition, it is listed as a "*Bird of Conservation Concern"* by the USFWS (2008). The oystercatcher has experienced a dramatic range expansion along the Atlantic Coast, reaching Massachusetts only 40 years ago. However, this northward range expansion may well be a recolonization of formerly occupied habitat (Forbush 1912). The eastern U.S. population of was estimated by Brown et al. (2005) at about 11,000 birds. In 2011, observers reported totals of > 418 adults and > 202 pairs of American Oystercatchers at 110 sites in Massachusetts. The American oystercatcher is still an uncommon bird at the Seashore. Over the last ten years (2003-2012), 2-5 pairs of oystercatchers have nests each year. Nesting has occurred only in the South Distict at Jeremy Point, Coast Guard Beach (Eastham), and New Island, Orleans.

Nesting Population and Productivity

Results

The first American oystercatcher was observed on 31 March at Coast Guard Beach in Eastham. A total of three pairs of oystercatchers nested at the Seashore in 2012; two pairs at Jeremy Point and one pair on New Island in Orleans. The first nest was found on 2 May at Jeremy Point. A total of four nests were laid by the two pairs at Jeremy Point. Of these, two nests were predated by coyote before hatching. The other two nests successfully hatched a total of five chicks. A brood of three chicks was lost to suspected gull predation, and the other brood of two chicks disappeared 16 days after hatching. The pair on New Island made two nest attempts and both were lost to suspected coyote predation. 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. From 2009 through 2012, productivity has been zero. Over the years, coyote predation has been the main cause of nest loss and the likely cause of chick loss. American oystercatchers are a long lived bird that benefits from high annual adult survival and variable annual productivity. The latter could be considered a benefit because modeling results have shown that as variability in productivity decreases, the probability of population decline increases (Davis 1999). Even so, continued low reproductive is a concern.

Threats to American oystercatchers during the breeding and non-breeding seasons include direct habitat loss, pressure from recreational disturbance, increases in nest predators, potential contamination of food resources, and alteration of habitat through beach stabilization. Unfortunately, the relative impact of each threat on oystercatcher population is poorly understood (Schulte et al. 2007).

Post Breeding/Staging Shorebirds

In late summer/early fall, thousands of migrating shorebirds congregate on 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.

A multi-agency study initiated in 2005, expanded in 2007, and continuing through 2012, indicates that more than 90% of the entire Northwest 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 2012, 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, Armstrong, Exit 9, Race Point North and Jeremy Point throughout the post-breeding season and thousands were observed at Hatches Harbor, Race Point South, and Coast Guard in Eastham/Nauset Marsh. Large flocks of staging common and roseate terns were also observed by Seashore staff in September and October. On 4 September, 3,500 terns were seen at Hatches Harbor, 2,000 were observed at Wood End, and 675 were counted at High Head. At Race Point North, 400 terns were seen on 12 October and 85 were counted on 22 October. Flocks of 400-600 common terns were reported in Provincetown through the end of October (Cape Codder newspaper, November 2nd, 2012). In addition to collecting data on flock size, composition and movement, Seashore staff and researchers documented disturbances to staging and migrating shorebirds from dogs, pedestrians, oversand vehicles and boats.

As part of a long term roseate tern post-breeding study within the US, researchers from U.S. Geological Survey (USGS) and Massachusetts Audubon Society conducted counts of staging terns and surveyed for color banded roseate terns along Seashore beaches from late July through the end of September. As part of an international cooperative study, in 2012 a total of 339 roseate terns were banded in the Northeastern US and Nova Scotia, Canada. These terns received three-character, plastic, field-readable bands (a new type of band that is easier to read in the field). Of the 339 birds that were banded this season, 257 were observed and resighted by researchers, volunteers, and Park staff on staging grounds throughout the region. The majority of resights came from locations within the Seashore, demonstrating the importance of the Seashore for staging terns (Dr. Jeff Spendelow, personal communication, November 8, 2012).

In addition, red knots were observed in large numbers at the Seashore in 2012. Between 14 August and 22 August, 100-200 red knots were observed daily at Race Point South (about one mile north of the High Head ORV access) (Table 8). Monitors were surveying this area regularly, from the middle of April through the middle of September, for piping plover and least tern activity but knots were only seen for this brief period of time in August.

Thousands of other migrating shorebirds including: whimbrel, short-billed dowitcher, semipalmated plover, sanderling and species of sandpiper were present on Seashore beaches from the end of July through the beginning of September (Table 8). The largest concentrations of migratory shorebirds were observed at Hatches Harbor, Race Point South (Armstrong), Jeremy Point, Wood End, and Coast Guard, Eastham (Nauset Marsh complex).

Management and Protection

Predator Management

Exclosures were not used in 2012 due to concerns of predators keying into them, causing nest abandonment and an increased risk of adult mortality.

Piping Plover Nest Protection

Results

In 2012, 86% (548/636) of eggs failed. The two main causes of egg failure were overwash (28 % (178/636) of eggs laid) and predation (50% (318/636) of eggs laid)(Table 3). Of the 72 eggs that hatched, 30 chicks fledged (Table 1). There were no known adult mortalities this season (Table 9).

Discussion

Historically, the Seashore has focused on non-lethal predator management through the use of exclosures around nests; however, in 2012, exclosures were not used in the Park due to past and present observations and conditions including: (1) Exclosures can greatly increase nest survival; however, their benefits are outweighed by the increased frequency of predators keying into them, causing nest abandonment and an increased risk of adult mortality; (2) When predators have keyed into an exclosure and the exclosure has been removed (due to concerns about adult mortality), the nest is usually lost to predation soon after removal; (3) It is not advantageous to put the adult birds at risk to protect the eggs only to have the chicks predated once they leave the safety of the exclosures.

In the past, exclosures were erected around incomplete clutches due to the high frequency of egg predation. This season, most nests were predated before they were complete and many scrapes were found with predator tracks running through them, suggesting some nests may have been predated before being found by monitors. Over the past five years, crows predated the majority of nests at the Seashore. This season, coyotes were responsible for the greatest loss of predated nests (40% (41/103)) with loss from crows being the second leading cause (34% (35/103)) (Table 4). In the last ten years, instances of coyote predation ranged from 9 nests in 2003 to 41 nests in 2012 (Table 4).

It is clear that predators, especially crows and coyotes, have a major impact on nest success at the Seashore. In cases of nest loss where the specific predator could not be determined (due to poor tracking conditions), it is likely that these nests were loss to the most common known predators.

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 sizes have 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. In 2012, they were used in colonies that lack sufficient vegetation for the chicks to hide in. The triangular plywood shelters are 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 suitable and historic shorebird nesting habitat with symbolic fencing and signs began on 22 March at Head of the Meadow and Race Point and continued through mid April to include: Wood End, Exit 9, High Head, Head of the Meadow, Coast Guard Beach in Truro, Longnook, Ballston, Newcomb Hollow, Cahoon Hollow, White Crest, Marconi Beach, Nauset Light, Coast Guard Beach in Eastham, Duck Harbor, Bound Brook, Great Island, Jeremy Point and New Island. Symbolic fencing was placed around most areas of suitable habitat, where nests and active scrapes were found, and where shorebirds were observed exhibiting courtship and territorial behavior.

Symbolic fencing is used to identify and protect shorebird nesting habitat. Five or six-foot wooden posts were placed 40'-50' apart, connected by a line of cotton twine to delineate nesting habitat. Plastic and wooden "Area Closed- Bird Use Area" informational signs were 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 and this section of beach was closed during high tide. 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. Symbolic fencing remained up on some sections of beach after the nesting season to protect staging and migrating shorebirds along the upper and lower (intertidal) beach (e.g. Coast Guard Beach in Eastham, Duck Harbor, Jeremy Point and Head of the Meadow). This fencing generally remained up through September. On most beaches where piping plovers were no longer nesting the removal of symbolic fencing began on 1 July (e.g. sections of Hatches Harbor, Race Point and the north side of Coast Guard Beach in Eastham).

Temporary Pedestrian/Parking Lot/Boat Landing Closures and Detours

Storm erosion continues to narrow beaches at the Seashore. 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 during the incubation phase of nesting. At sites where this was a problem, sections of beaches were temporarily closed at times of high tide. Pedestrians would be able to access the area at low tide when there was adequate exposed beach. Where possible, detours were established to provide visitor access around nesting areas. These sections of beach remained closed for an additional 1-3 days after hatching to protect the newly hatched chicks (e.g. Coast Guard Beach in Eastham, Jeremy Point, Great Island, and Head of the Meadow).

Some sections of beach were completely closed at all tides due to concerns at low tide that visitors might not be off the beach in time to safely pass the nesting area without disturbing the nesting birds (e.g. Great Island). Where possible, detours were established to provide visitor access around nesting areas.

Informational/directional signs were erected informing visitors of all closures. In addition, shorebird staff and volunteers were often stationed at these closures to provide information about the closure and educational material about the shorebird program.

In 2012, sections of Great Island, Jeremy Point, and Coast Guard Beach in Eastham were temporarily closed or detoured to pedestrians and/or boat landing from late May through July. Signs were posted in the intertidal zone on Jeremy Point to inform incoming boaters and at the Harbor Master's office, informing boaters of landing restrictions.

Sections of beach at Head of the Meadow were closed to pedestrians at all tides from 10 July to 27 August to protect piping plovers and least terns nesting close to the high tide line and to prevent disturbance to staging roseate and common terns utilizing the area.

As in past years, piping plover adults and chicks were active in the Head of the Meadow parking lot this season. Shortly after plover nests hatched on the front beach, adults started calling their chicks toward the parking lot. Silt fencing was installed around sections of the perimeter of the parking lot and along pedestrian walkways on 13 July to prevent the unfledged chicks from accessing the lot from the beach. On 15 July, one brood was able to navigate around the silt fencing, walking down one of the pedestrian access ways into the parking lot. When chicks were observed in the lot, vehicles that were already parked were allowed to stay but no additional vehicles were allowed to enter for the remainder of the day. In days that followed, the pedestrian walkway that the chicks used to access the lot was closed (the southern, main pedestrian access remained open), and the parking lot was closed between 8:30 a.m. and 7:00 p.m., allowing monitors to ensure there were no chicks in the vicinity of the lot first thing in the morning and last thing in the evening. Adults continued to land in the lot and exhibit territorial displays but no chicks were observed in the parking lot for the rest of the season. Monitors were stationed in the lot each day until adults and chicks were no longer using the area.

Hand-held Kites/Kite Surfing

To prevent disturbance from kites, kite flying, including kites used for kite surfing is prohibited on all beaches within 200 meters of any shorebird nesting sites. In addition, 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 Duck Harbor where kite surfers can launch their kites and take a direct route, one quarter mile offshore, outside of park boundaries (NPS 2012). 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 at all times, anywhere they are allowed within the Seashore. In addition, a number of areas are closed to pets to protect park resources. The south side of Coast Guard Beach in Eastham and Jeremy Point are closed to pets from 1 April through 30 September to protect nesting and migrating shorebirds. The marsh area of Hatches Harbor was closed to pets from 1 July through 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. “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 beyond closures that are open to pets. These sections of beach were closed to pets until all chicks in the area fledged. Signs informing visitors of temporary pet closures 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 543 dogs off leash on Seashore property (272 in the South District and 271 in the North District) (Table 1). Unleashed dogs were encountered most frequently at Wood End/Long Point (86), Newcomb Hollow (50), Marconi Beach (50), and Lecount Hollow (45).

Off-Road Vehicles

Off-road vehicle access is permitted along a designated beach corridor in Provincetown and Truro. ORV access at the Seashore is guided by rules developed in response to Executive Orders 11644 and 11989 with Seashore-specific details provided in the 1985 ORV management plan, as modified through negotiated rule making (NegReg) (DOI 1998), and the 2007 Environmental Assessment: Options for Managing ORV Access (NPS 2007a) and 2007 FONSI (2007b). Permit applicants receive information about nesting piping plovers and terns. A total of 4,112 ORV/SCV permits were sold in 2012 (1,460 seasonal permits and 2,652 weekly permits) (NPS 2012a).

The ORV corridor was open to vehicles during the egg laying and incubating phase of the shorebird 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 to ensure that chicks are found immediately 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 and 91 meters on each side of a brood of least tern chicks. Actual closure limits for each brood were adjusted based on beach morphology and brood behavior to ensure 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.
In 2012, field observations of unfledged chick movements in both piping plovers and least terns suggested that broods tended to move greater distances along the beach when there are no neighboring nesting birds keeping them within a defined territory. At Race Point North, a brood of least tern chicks moved 0.3 miles multiple times a day.

For management purposes, piping plover and least tern chicks are considered fledged when they are observed in sustain flight of at least 15 meters. In addition, as outlined in 1996 State Guidelines (Blodget and Melvin 1996), rearing or nursery areas used by unfledged or recently fledged tern chicks were identified by symbolic fencing and all access by vehicles into these nursery areas was prohibited.

Vehicle closures were lifted on sections of beach when chicks fledged or the chick(s) were not seen for five consecutive days. Additional information on ORV management can be found in the 2012 Off-Road Vehicle Activity Report (NPS 2012).

Park Beach Operations/Essential Vehicles

Seashore staff routinely operate vehicles 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 NegReg and the 2012 Shorebird Management Procedures (NPS 2012) In addition, all designated staff driving on beaches are knowledgeable of shorebird biology, identification,

and current nesting locations and are required to comply with the Seashore's SOP for ATV use (NPS 2010b), 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 2010c) and an eight hour on-the-job training by riding alongside an experienced rider.

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 plovers at two beaches for the 2010-11 nesting seasons. 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 2012, the Seashore requested an extension to the 2010 BO addressing flexible management of piping plovers. A letter sent by USFWS on 25 April 2012, formally amended the BO to extend through 31 December 2014.

In 2012, 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 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 suggests a major factor, limiting population recovery, may be low survival rates of young birds during their first one to two 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 in these areas can cause birds to flush, separating the young birds from their parents, interrupting feeding or displacing them, forcing them to expend energy they are trying to store up for migration.

A multi-agency study initiated in 2005, expanded in 2007, and continuing through 2012, indicates that more than 90% of the entire Northwest 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 size, 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 in Eastham, Jeremy Point, and Hatches Harbor. 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 and Lead Biological Technician visited local elementary schools throughout the Lower Cape and presented a Powerpoint presentation and interactive classroom activity, demonstrating the impacts of disturbance to nesting shorebirds. A total of 11 programs were given to 512 fifth and sixth grade students.

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 or at Head of the Meadow to protect nesting shorebirds, 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 shorebird program. Interns also gave several public programs at the Salt Pond Visitor Center. Over 6000 visitor contacts were made throughout the summer.

Five volunteers donated a total of 524 hours to the Seashore's shorebird management program. Volunteers were stationed at high tide closures, monitored nesting areas, and worked with Biological Technicians and SCA's 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.

Brown, S, C. Hickey, B. Harrington, and R. Gill, Eds. 2001. The U. S. Shorebird Conservation Plan, 2nd ed. Manomet Center for Conservation Sciences, Manomet, MA.

Catlin, D. H., J. H. Felio, and J. D. Fraser. 2012. Effects of Water Discharge on Fledging Time, Growth, and Survival of Piping Plovers on the Missouri River. The Journal of Wildlife Management 77(3):525–533; 2013; DOI: 10.1002/jwmg.494.

Davis, M.B. 1999. Reproductive success, status and viability of American Oystercatcher (*Haematopus palliates*). Unpublished M.Sc. thesis, University of Gerogia, Athens, GA.

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.

Gareau, G. 2011. Duxbury Beach, Duxbury, MA, 2011 Beach Nesting Bird Summary Report Beach Nesting Bird Summary Report. Massachusetts Audubon Coastal Waterbird Program. http://www.duxburybeach.com/tech%20comm%20reports/DuxBeachEndangeredSpeciesReport2011.pdf

Hadden, S.W. 2001. Waterbird Inventory and Monitoring: Report on Protocol Implementation 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.

Hyslop, C., Morrison R, I. G., Donaldson G., & Davidson, I. 2000. The Canadian Shorebird Conservation Plan. CanadianWildlife Service Special Publication. Canadian Wildlife Service, Ottawa.
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.

Melvin, S.M. Summary of 2011 Census of American Oystercatcher in Massachusetts. 2012.Natural Heritage and Endangered Species Program,Massachusetts Division of Fisheries and Wildlife. Westborough, MA 01581.

Mostello, C. S. 2012. Innentory of Terns, Laughing Gulls, and Black Skimmers Nesting in Massachusetts in 2011.Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program,Rte. 135, Westborough, MA 01581.

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

National Audubon Society. 2010. The Christmas Bird Count Historical Results [Online]. Available http://www.christmasbirdcount.org. Accessed March 22, 2011.

National Park Service 2012. Final 2012. Shorebird Management Standard Operating Procedures. Wellfleet, MA.

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.

National Park Service. 2012. Cape Cod National Seashore Superintendent's Compendium. Wellfleet MA.

National Park Service. 2012a. Cape Cod National Seashore ORV 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.

Rich, T. D., C. J. Beardmore, H. Berlanga, P.J. Blancher, M.S. W. Bradstreet, G.S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Inigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pahsley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, T .C. Will. 2004. Partners in Flight North American Landbird Conservation Plan. Cornell Lab of Ornithology. Ithaca, NY.

Sauer, J.R., J.E. Hines, and J.Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, Maryland.

Schulte, S., S. Brown, D. Reynolds, and the American Oystercatcher Working Group. 2007. Version 2.0. American Oystercatcher Conservation Action Plan for the United States Atlantic and Gulf Coasts.

The Cape Codder. Wildlife Sightings. 2 November 2012, Cape Experience: 42. Print.

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. Department of Agraculture, Animal and Plant Health Inspection Service, Wildlife Services. 2011. Environmental Assistment, Management of Predation Losses to the Threatened and Endangered Species populations in the Commonwealth of Massachusetts. 463 West Street, Amherst, Massachusetts 01002.

U.S. Department of the Interior. 1998. Cape Cod National Seashore; Off-Road Vehicle Use, National Park Service. Federal Register 63(36): 9143-9149.

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, 2012.

SITE	PAIRS	NESTS[1]	EGGS LAID	NESTS HATCHED	EGGS HATCHED	CHICKS FLEDGED	HATCH RATE[2]	FLEDGE RATE[3]	PRODUCTIVITY[4]	DOGS OFF LEASH
BOUND BROOK	0	0	0	0	0	0	0%	0%	0.00	4
CAHOON HOLLOW	2	3	5	0	0	0	0%	0%	0.00	29
COAST GUARD (EASTHAM)	5	10	25	2	7	5	28%	71%	1.00	15
DUCK HARBOR	2	3	12	0	0	0	0%	0%	0.00	8
GREAT ISLAND	8	15	53	2	5	5	9%	100%	0.63	3
JEREMY POINT	6	9	24	5	13	6	54%	46%	1.00	8
LE COUNT HOLLOW	0	0	0	0	0	0	0%	0%	0.00	45
MARCONI BEACH	10	21	70	2	7	4	10%	57%	0.40	50
MARCONI STATION	0	0	0	0	0	0	0%	0%	0.00	6
NAUSET LIGHT	0	0	0	0	0	0	0%	0%	0.00	38
NEWCOMB HOLLOW	3	6	17	1	4	4	24%	100%	1.33	50
WHITECREST	1	1	4	1	3	2	75%	67%	2.00	16
SOUTH DISTRICT TOTALS	**37**	**68**	**210**	**13**	**39**	**26**	**19%**	**67%**	**0.70**	**272**
ARMSTRONG	5	9	24	3	5	0	21%	0%	0.00	1
BALLSTON BEACH	9	24	68	1	2	1	3%	50%	0.11	39
COAST GUARD (TRURO)	3	6	18	1	4	0	22%	0%	0.00	33
EXIT 9	4	9	28	2	5	0	18%	0%	0.00	4
HATCHES HARBOR	1	3	12	0	0	0	0%	0%	0.00	8
HEAD OF THE MEADOW	6	21	52	3	8	0	15%	0%	0.00	33
HIGH HEAD	7	13	39	0	0	0	0%	0%	0.00	13
LONGNOOK	2	5	14	0	0	0	0%	0%	0.00	4
OLD HARBOR	1	1	4	0	0	0	0%	0%	0.00	3
RACE POINT NORTH	7	13	45	1	2	0	4%	0%	0.00	14
RACE POINT SOUTH	3	6	19	1	3	0	16%	0%	0.00	33
WOOD END/LONG POINT	14	34	103	2	4	3	4%	75%	0.21	86
NORTH DISTRICT TOTALS	**62**	**144**	**426**	**14**	**33**	**4**	**8%**	**12%**	**0.06**	**271**
GRAND TOTALS	**99**	**212**	**636**	**27**	**72**	**30**	**11%**	**42%**	**0.30**	**543**

[1] A "nest" is defined by individual scrapes with eggs. In 2012, each initial nest, renest, continuation nest and their respective outcomes are counted as separate "nests" with separate outcomes.

[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, 2012.

Nests					Loss By Cause	
# Nests	# Hatched	# Lost	% Lost[1]	*Cause*	# Lost	% Lost[2]
212	27	185	87%	Predation	103	56%
				Overwash	55	30%
				Abandoned	9	5%
				Unknown	13	7%
				Stepped on by Gull	2	1%
				Cliff Erosion	2	1%
				Stepped on by Human	1	0.5%
					185	**100%**
				Predation Types	*# Lost*	*% Lost[3]*
				Coyote	*41*	*40%*
				Crow	*35*	*34%*
				Unknown	*21*	*20%*
				Fox	*5*	*5%*
				Canid	*1*	*1%*
					103	***100%***

[1]total number nests lost/total number nests laid

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

[3]number 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, 2012.

Eggs					Loss By Cause	
# Eggs	# Hatched	# Lost	% Lost[1]	*Cause*	# Lost	% Lost[2]
636	72	548	86%			
				Predation	318	58%
				Overwash	178	32%
				Abandoned	17	3%
				Unknown	27	5%
				Stepped on by Gull	2	0.4%
				Cliff Erosion	5	1%
				Stepped on by Human	1	0.2%
					548	**100%**
				Predation Types	*# Lost*	*% Lost[3]*
				Coyote	*144*	*45%*
				Crow	*98*	*31%*
				Unknown	*58*	*18%*
				Fox	*14*	*4%*
				Canid	*4*	*1%*
					318	***100%***

[1]total number eggs lost/total number eggs laid

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

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

Table 4. Summary of Piping Plover Nest Loss, Cape Cod National Seashore, 2003-2012.

					Number of Nests Lost to						Percentage of Predated Nests Lost to					
Year	**# of pairs**	**Total Nests**	**# Successful Nests**	**# Unsuccessful**	**Overwash/Sanding Over**	**Abandonment[1]**	**Non-viable**	**Unknown**	**Other**	**Predation**	**Crows**	**Coyote**	**Gulls**	**Skunk**	**Fox**	**Unknown Predator**
2003	84	121	54	67	13	16	0	0	5	33	15%	27%	12%	15%	0%	30%
2004	85.5	115	59	56	15	13	0	0	0	28	43%	21%	11%	7%	0%	18%
2005	77	118	48	70	33	11	1	0	4	21	24%	29%	10%	0%	0%	38%
2006	74	96	70	26	8	4	0	3	0	11	82%	0%	0%	0%	0%	18%
2007	82	113	66	47	24	12	0	2	0	9	44%	22%	0%	0%	0%	33%
2008	86	109	70	39	8	8	1	1	0	21	43%	5%	5%	19%	0%	29%
2009	83	108	54	54	16	9	1	2	1	25	68%	4%	4%	0%	0%	24%
2010	85	115	68	47	3	2	1	3	0	38	74%	5%	0%	0%	0%	21%
2011	82	110	61	49	8	9	1	2	0	29	83%	10%	0%	0%	0%	7%
2012	99	212	27	185	55	9	0	13	5	103	34%	40%	0%	0%	5%	21%
TOTAL	**837.5**	**1217**	**577**	**640**	**183**	**93**	**5**	**26**	**15**	**318**	**47%**	**22%**	**3%**	**3%**	**2%**	**23%**

[1]Includes nests abandoned due to adult mortality

Table 5. Summary of piping plover nesting parameters at Cape Cod National Seashore 2003-2012

Year	# Pairs	# Chicks Fledged	Productivity[1]	# Nests Laid	# Successful Nests	Nest Success Rate[2]	% Renests[3]	# Eggs Laid	# Eggs Hatched	Hatch Rate[4]	Fledge Rate[5]
2003	84	130	1.55	121	54	45%	31%	450	189	42%	69%
2004	85.5	124	1.45	115	59	51%	26%	425	220	52%	56%
2005	77	87	1.13	118	48	41%	35%	378	163	43%	53%
2006	74	122	1.65	96	70	73%	23%	336	233	69%	52%
2007	82	146	1.78	113	66	58%	25%	368	233	63%	63%
2008	85	157	1.85	109	70	64%	21%	386	243	63%	65%
2009	83	60	0.72	108	54	50%	20%	362	186	51%	32%
2010	85	136	1.60	115	68	59%	26%	386	235	61%	58%
2011	82	90	1.10	110	61	55%	25%	378	210	56%	43%
2012	99	30	0.30	212	27	13%	53%	636	72	11%	42%
mean	84	108	1.31	122	58	51%	29%	411	198	51%	53%
median	83.5	123	1.50	114	60	53%	26%	382	215	54%	55%
min	74	30	0.30	96	27	13%	20%	336	72	11%	32%
max	99	157	1.85	212	70	73%	53%	636	243	69%	69%

[1]number of chicks fledged/number of nesting pairs

[2]number of successful nests/total number of nests

[3]number of renests (including continuation nests)/total number of nests

[4]number of eggs hatched/total number of eggs laid

[5]number of chicks fledged/number of eggs hatched

Table 6. Number of Piping Plover Breeding Pairs, Annual Nest Productivity, and 5 Year Weighted Average Productivity, Cape Cod National Seashore, 1985-2012.

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	74	2.60	1.77
1992	43	22.80	101	2.40	2.17
1993	60	32.20	124	2.07	2.23
1994	72	43.60	178	2.47	2.37
1995	83	57.20	147	1.77	2.18
1996	77	67.00	68	0.88	1.84
1997	67	71.80	104	1.55	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	76	68.00	155	2.04	1.66
2002	97	74.00	88	0.91	1.49
2003	84	78.60	130	1.55	1.45
2004	85.5	81.30	124	1.45	1.40
2005	77	83.90	87	1.13	1.39
2006	74	83.50	122	1.65	1.32
2007	82	80.50	146	1.78	1.51
2008	85	80.70	157	1.85	1.58
2009	83	80.20	60	0.72	1.43
2010	85	81.80	136	1.60	1.52
2011	82	83.40	90	1.10	1.41
2012	99	86.80	30	0.30	1.09

Table 7. Number of Least Tern Pairs and Fledging Success at Eleven Sites, Cape Cod National Seashore, 2012.

	A Count[1]	B Count[2]	# Chicks Fledged
Ballston	0	13	0
Head of the Meadow	12	50	32
Exit 9	0	4	0
Race Point South	2	7	2
Race Point North (Includes Old Harbor)	15	29	6
Wood End	14	36	6
Armstrong	0	1	3
Mission Bell	0	5	4
Jeremy Point	40	63	1
Coast Guard, Eastham	34	34	12
Marconi Beach	34	15	0
Totals	**151**	**257**	**66**

[1]"A-Counts" are taken within the MA. State census wind of June5-20.
[2]"B-Counts" are taken outside the MA. State census window; after June 20.

Table 8. Migrating Shorebird Observations 2012.

Date	Location	Species	Approximate # Observed
8/2/2012	Jeremy Point	Ruddy Turnstones Semipalmated Sandpipers Piping Plovers	60 40 16
	Great Island	Whimbrels Semipalmated Sandpipers Ruddy Turnstones	4 350 150
8/11/2012	Southern Tip of Coast Guard, Eastham	Sempalmated Plovers	600
8/14/2012-8/22/2012	Race Point South (about 1 mile north of High Head access)	Red Knots	100-200
8/18/2012	Jeremy Point	Black Bellied Plovers Semipalmated Plovers Piping Plovers Sanderlings Ruddy Turnstones	130 800 8 125 65
	Great Island	Whimbrels Semipalmated Plovers Ruddy Turnstones Black Bellied Plovers	3 120 30 10
8/25/2012	Southern Tip of Coast Guard, Eastham	Semipalmated Plovers Least Sandpipers Whimbrels	100 22 1
8/31/2012	Jeremy Point	Piping Plovers Semipalmated Plovers Sanderlings Ruddy Turnstones Black Bellied Plovers Spotted Sandpipers Least Sandpipers	13 400 100 40 50 1 20

Table 9. Summary of Adult Mortality by Exlosure Type, Cape Cod National Seashore, 2003-2012.

Year	# Circular Erected	# Deaths	Rate[1]	# Canopy Erected	# Deaths	Rate[2]
2003	57	2	3.51%	0	0	0.00%
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	2.33%	26	2	7.69%
2012	0	0	0.00%	0	0	0.00%

[1]number of deaths related to circular exclosure use/total number of circular exclosures used.

[2]number of deaths related to canopy exclosure use/total number of canopy exclosures used.

Figures

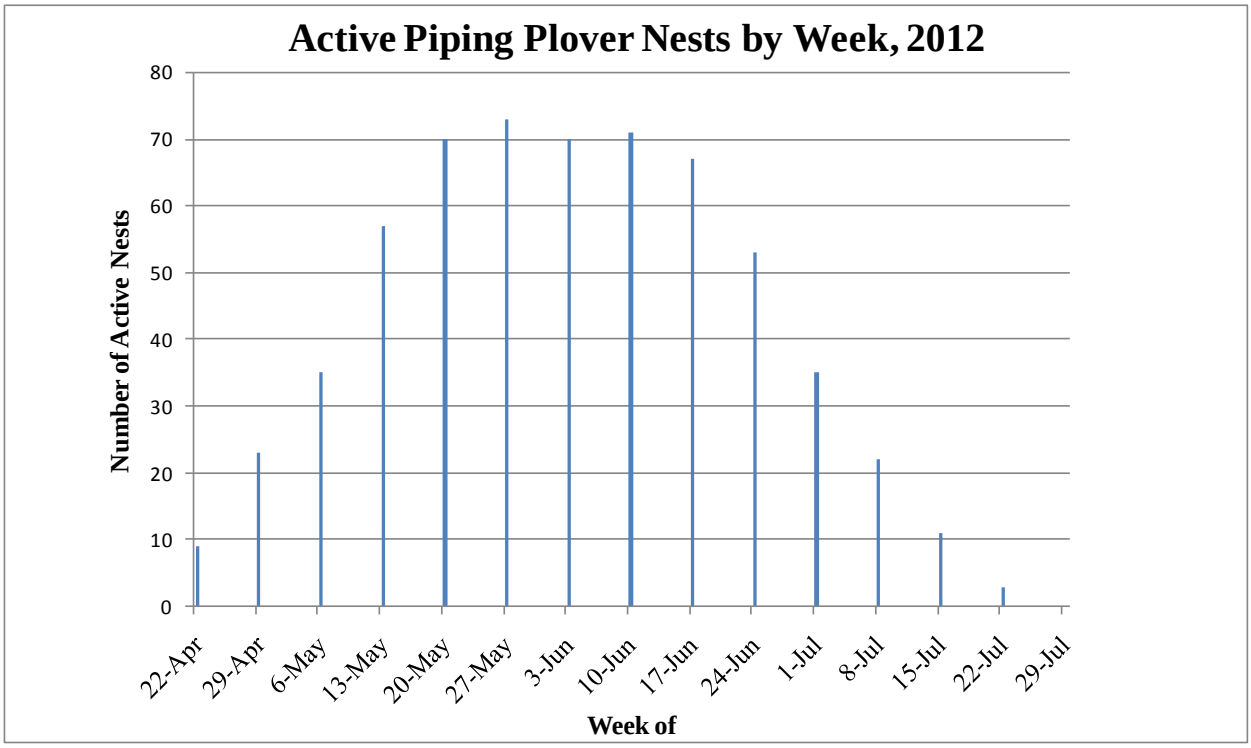


Figure 1. Weekly Active Plover Nests for Cape Cod National Seashore, 2012.

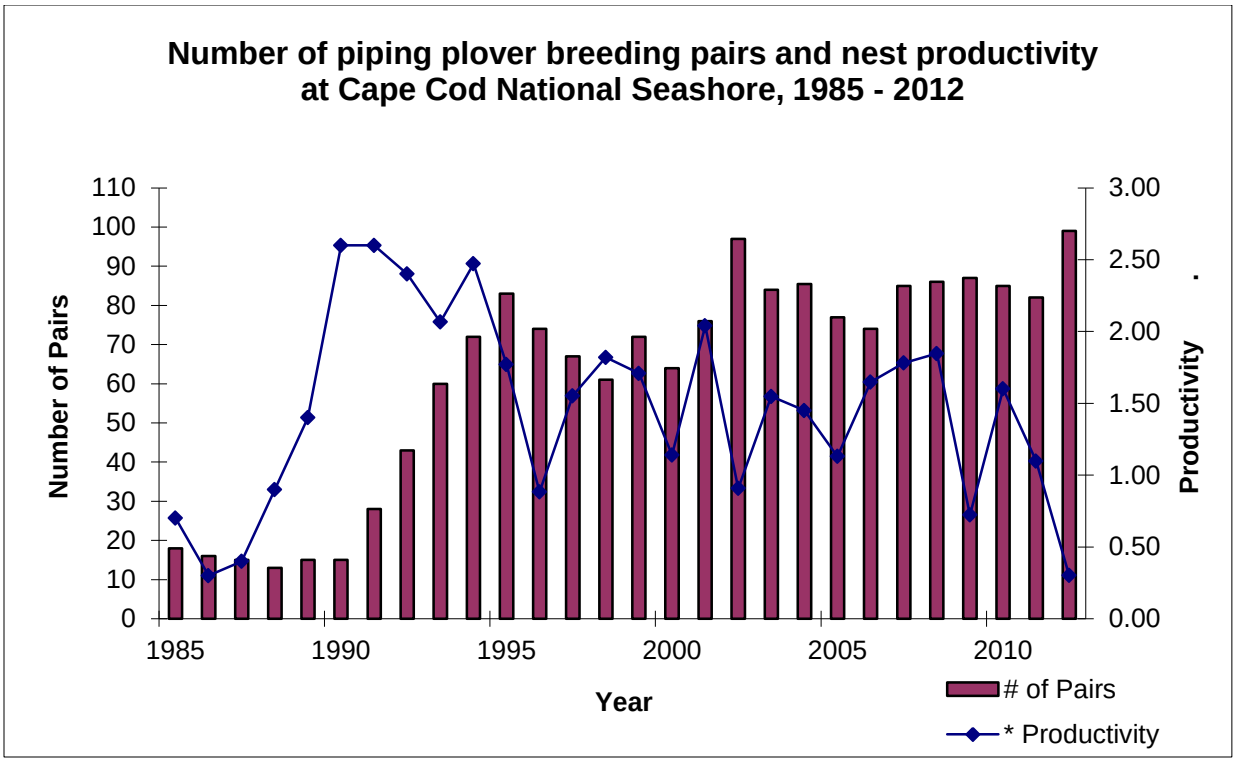


Figure 2. Number of Piping Plover Pairs and Nest Productivity on Cape Cod National Seashore from 1985 – 2012.

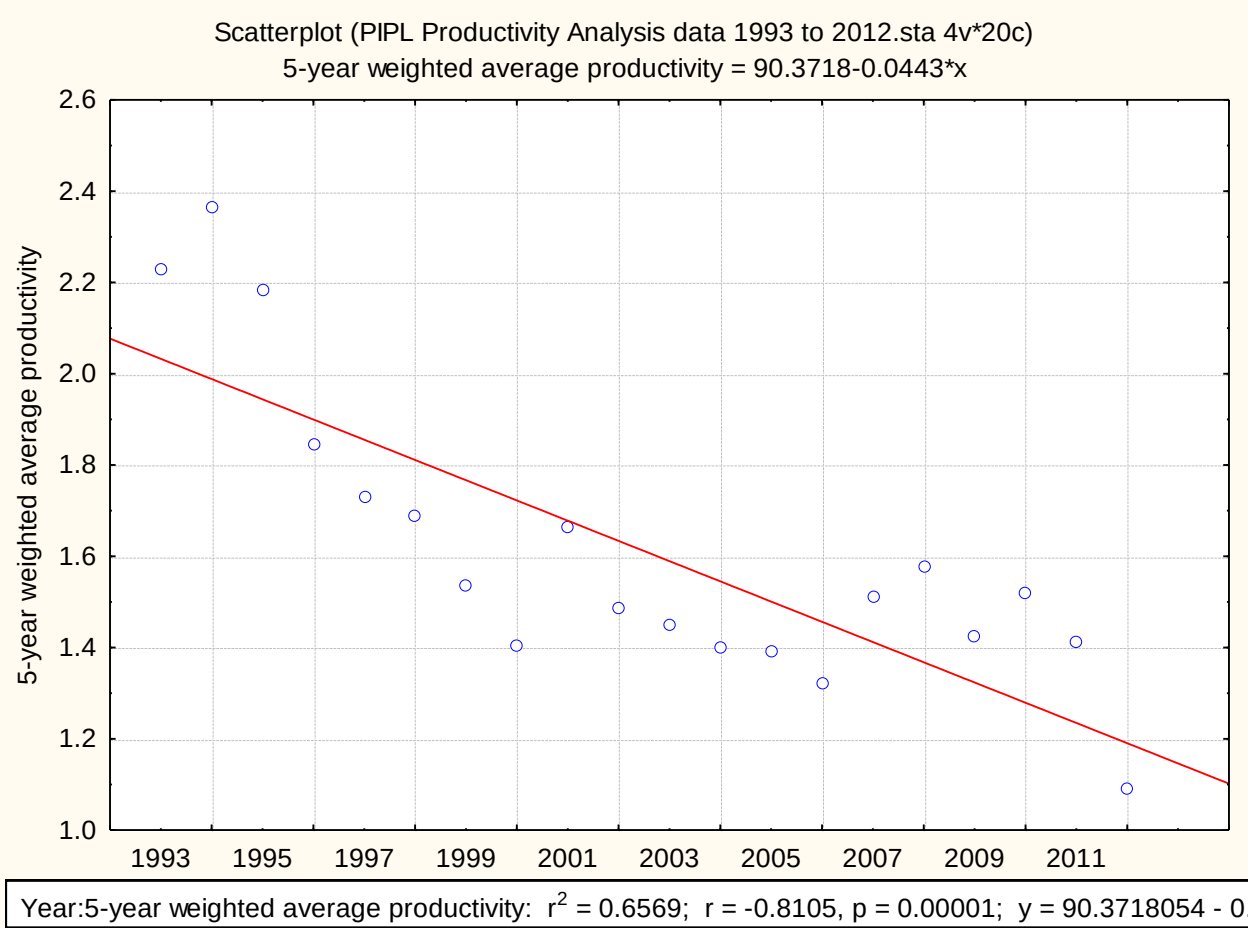


Figure 3. Piping Plover 5 Year Productivity Regression, Cape Cod National Seashore, 1993-2012.

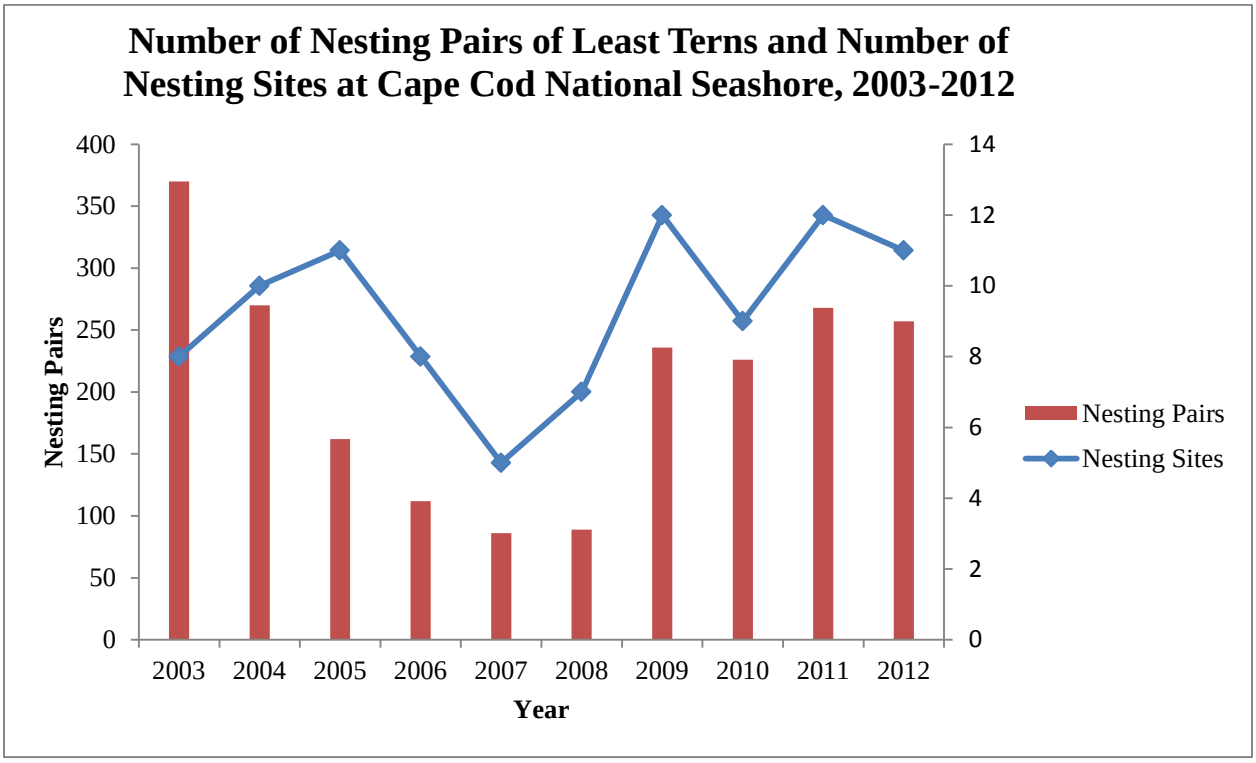
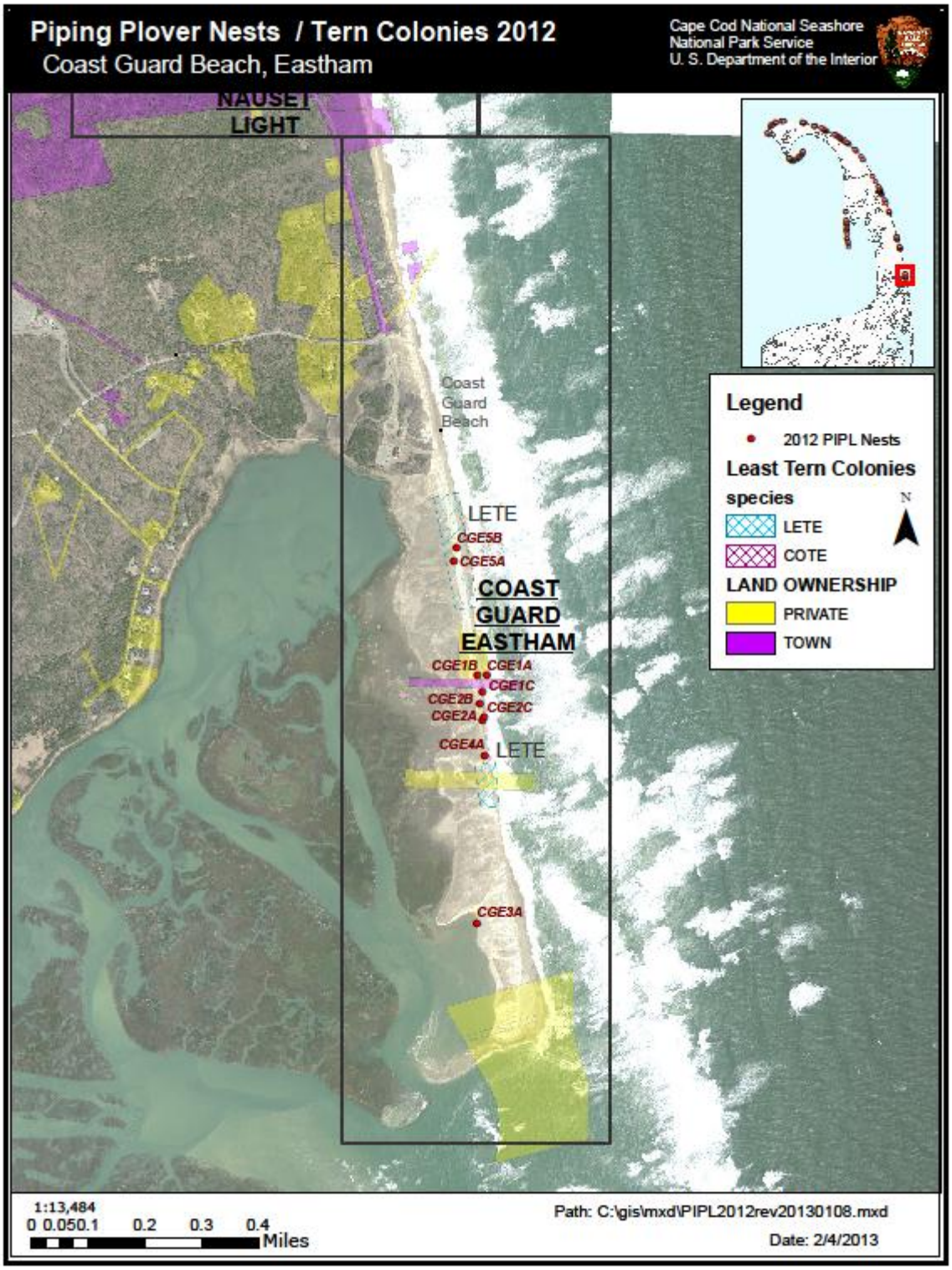


Figure 4. Number of Least Tern Pairs and Number of Least Tern Nesting Sites on Cape Cod National Seashore, 2003-2012.

Appendix A

Maps of 2012 Piping Plover, Least Tern and American Oystercatcher Nest Sites at Cape Cod National Seashore.


Piping Plover Nests / Tern Colonies 2012
Coast Guard Beach, Eastham
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
NAUSET LIGHT
Coast Guard Beach
LETE
CGE5B
CGE5A
COAST GUARD EASTHAM
CGE1B
CGE1A
CGE1C
CGE2B
CGE2C
CGE2A
CGE4A
LETE
CGE3A
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:13,484
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Miles
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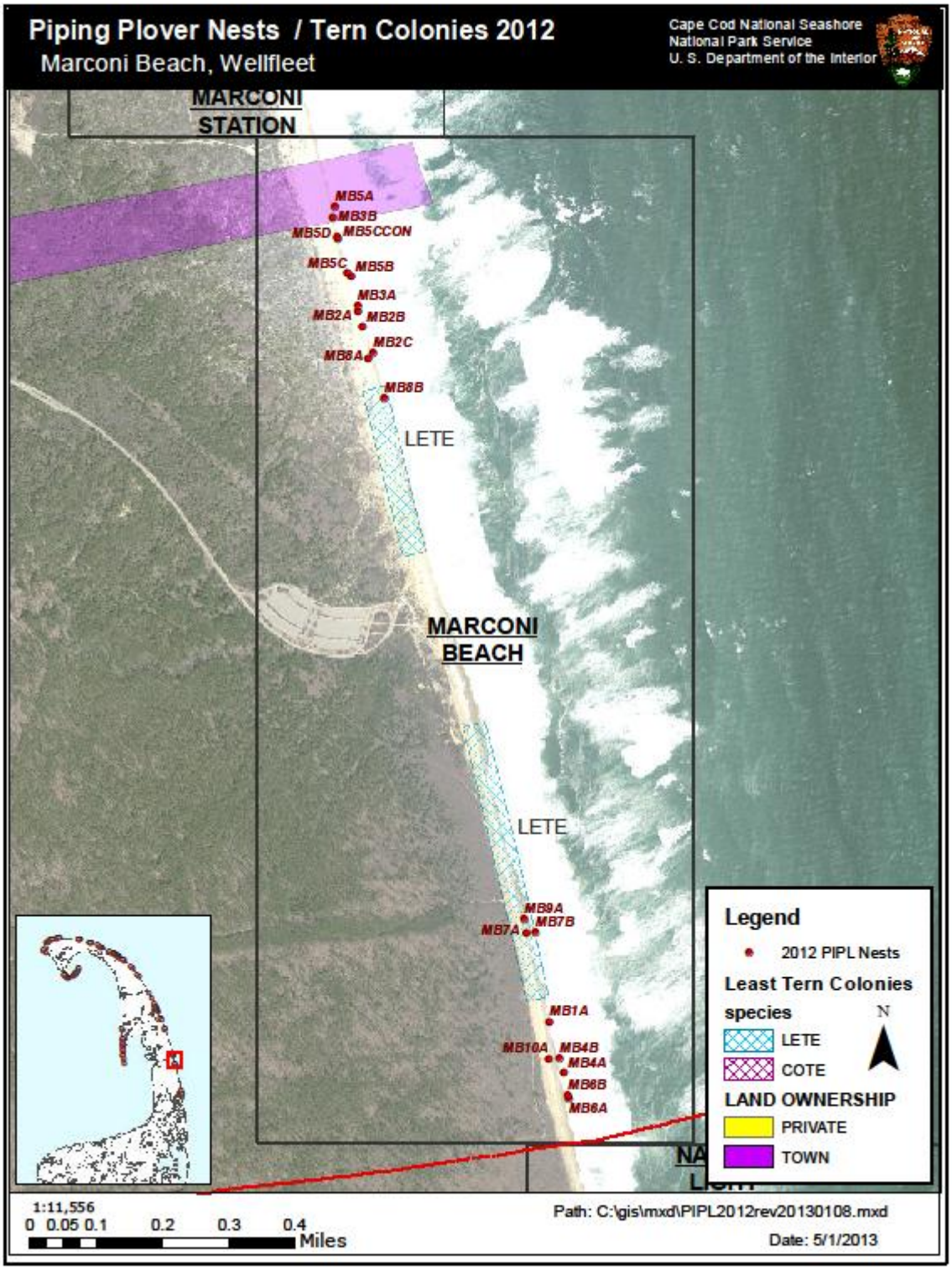
Date: 2/4/2013


Piping Plover Nests / Tern Colonies 2012
Marconi Beach, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
MARCONI STATION
MB5A
MB3B
MB5D
MB5CCON
MB5C
MB5B
MB3A
MB2A
MB2B
MB2C
MB8A
MB8B
LETE
MARCONI BEACH
LETE
MB9A
MB7B
MB7A
MB1A
MB10A
MB4B
MB4A
MB6B
MB6A
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:11,556
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Miles
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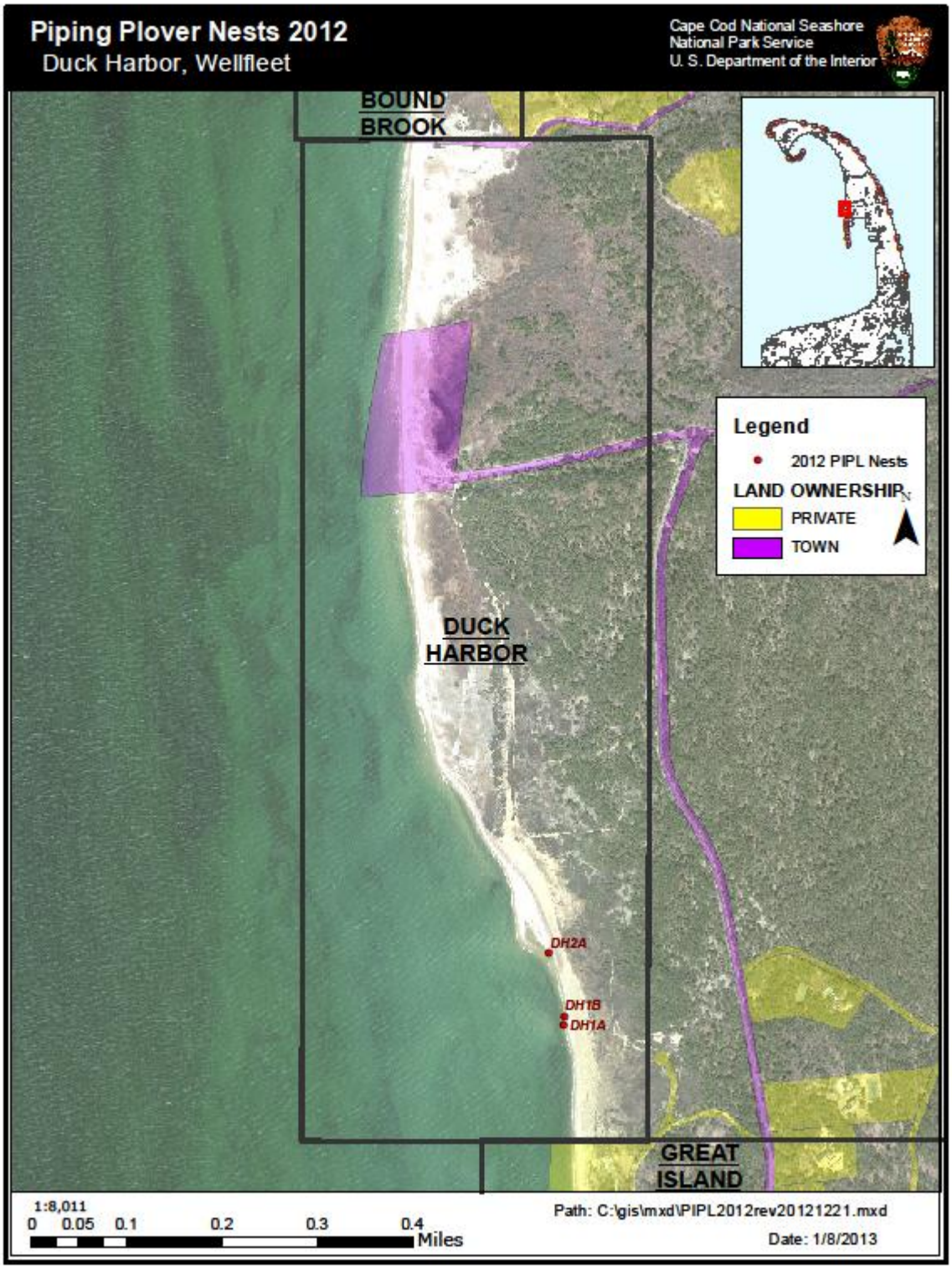
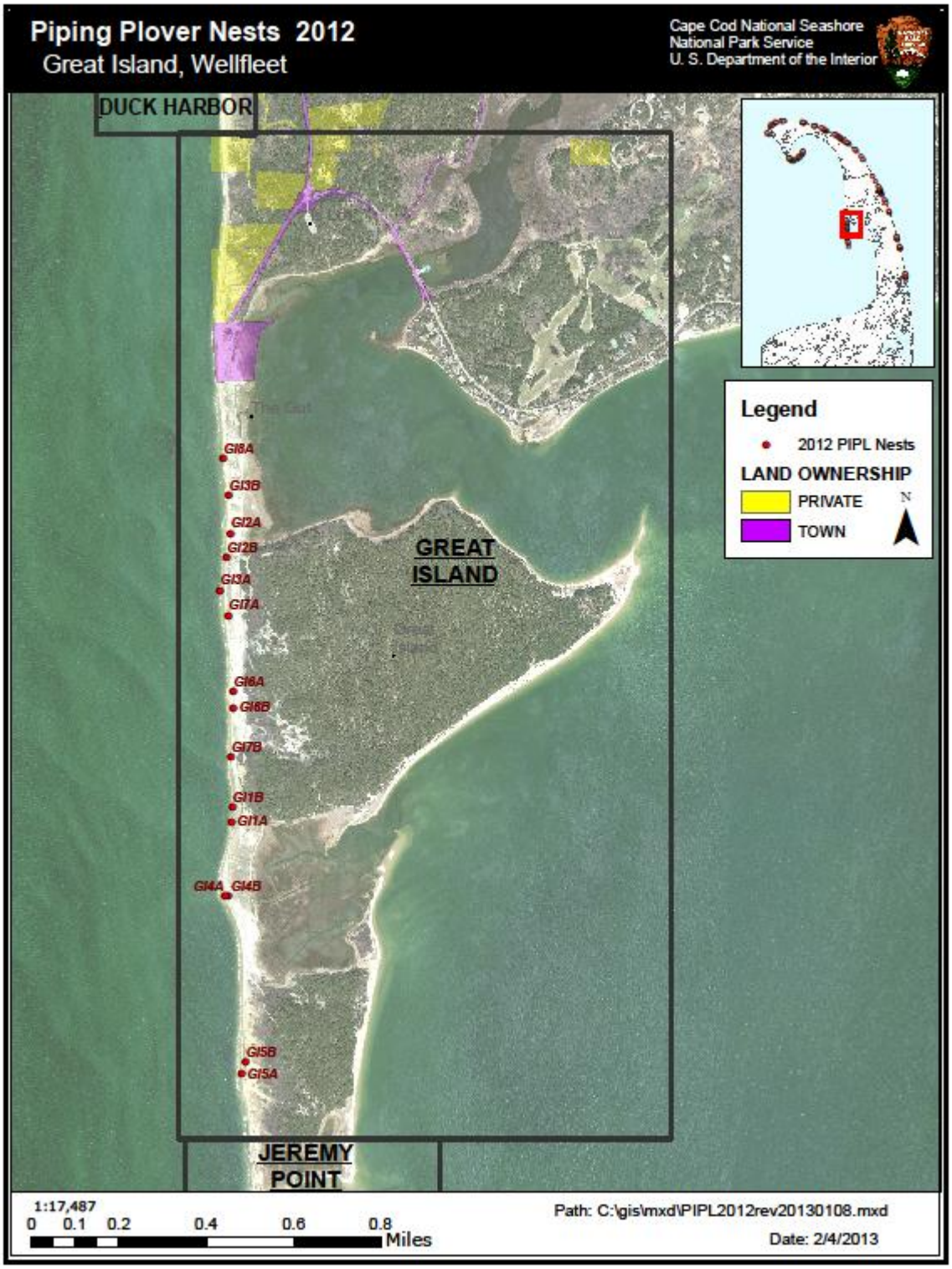
Date: 5/1/2013


Piping Plover Nests 2012
Duck Harbor, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
BOUND BROOK
DUCK HARBOR
GREAT ISLAND
DH2A
DH1B
DH1A
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
1:8,011
0 0.05 0.1 0.2 0.3 0.4 Miles
Path: C:\gis\mxd\PIPL2012rev20121221.mxd
Date: 1/8/2013


Piping Plover Nests 2012
Great Island, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
DUCK HARBOR
GI8A
GI3B
GI2A
GI2B
GI3A
GI7A
GI6A
GI6B
GI7B
GI1B
GI1A
GI4A
GI4B
GI5B
GI5A
GREAT ISLAND
JEREMY POINT
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
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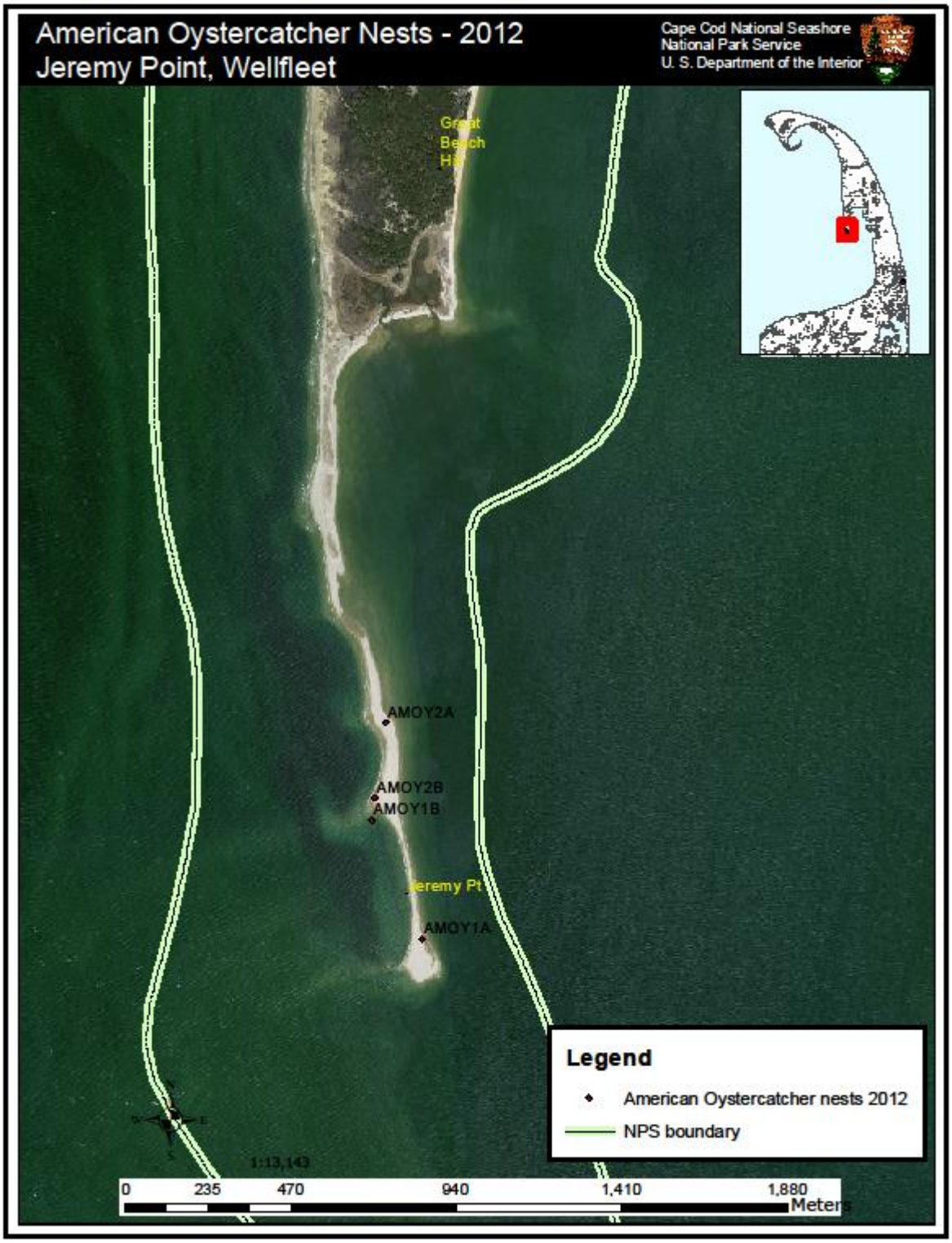
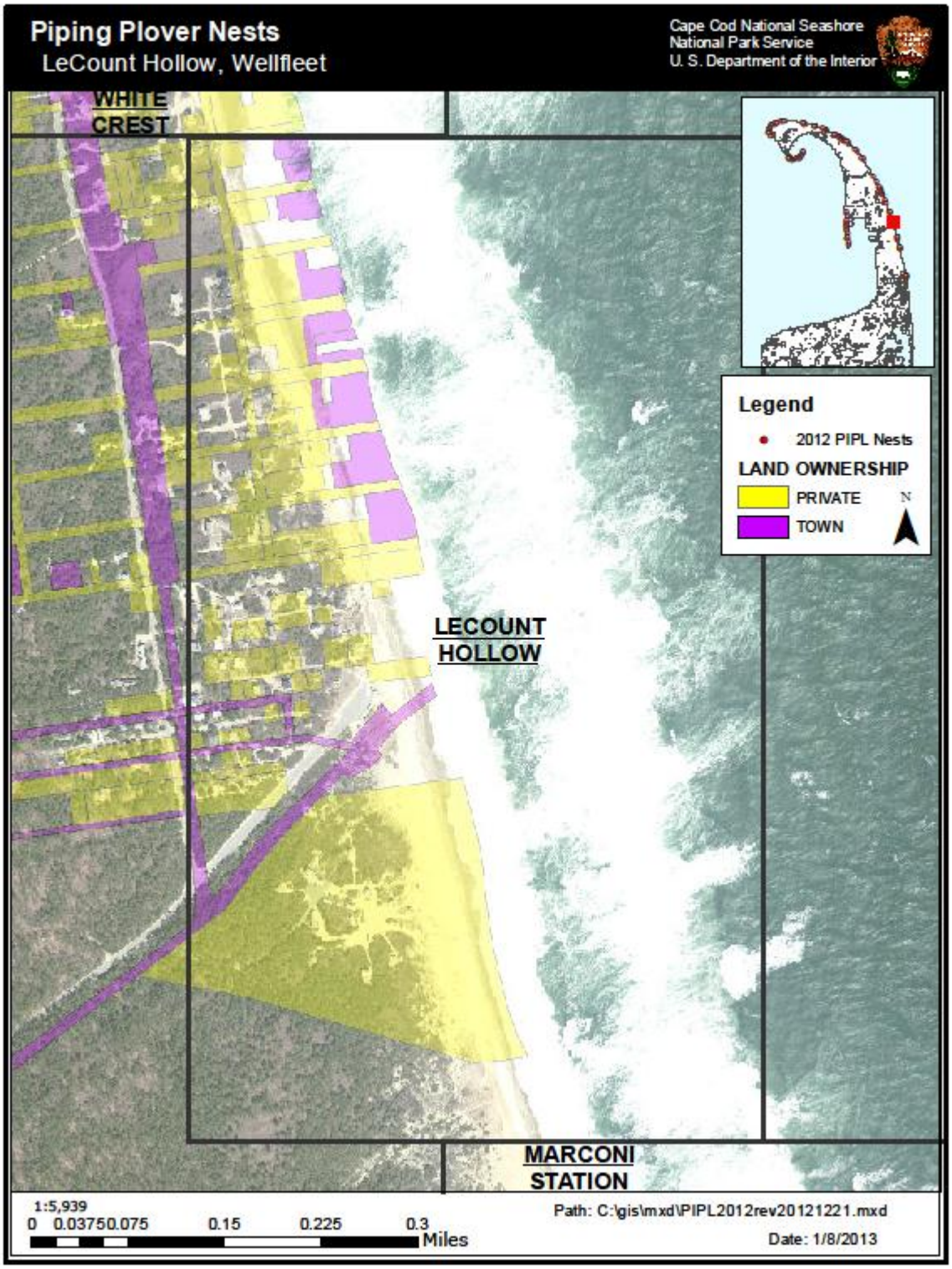
Date: 2/4/2013


American Oystercatcher Nests - 2012
Jeremy Point, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
Great Beach Hill
AMOY2A
AMOY2B
AMOY1B
Jeremy Pt
AMOY1A
Legend
American Oystercatcher nests 2012
NPS boundary
1:13,143
0
235
470
940
1,410
1,880
Meters


Piping Plover Nests
LeCount Hollow, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
WHITE CREST
LECOUNT HOLLOW
MARCONI STATION
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
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Miles
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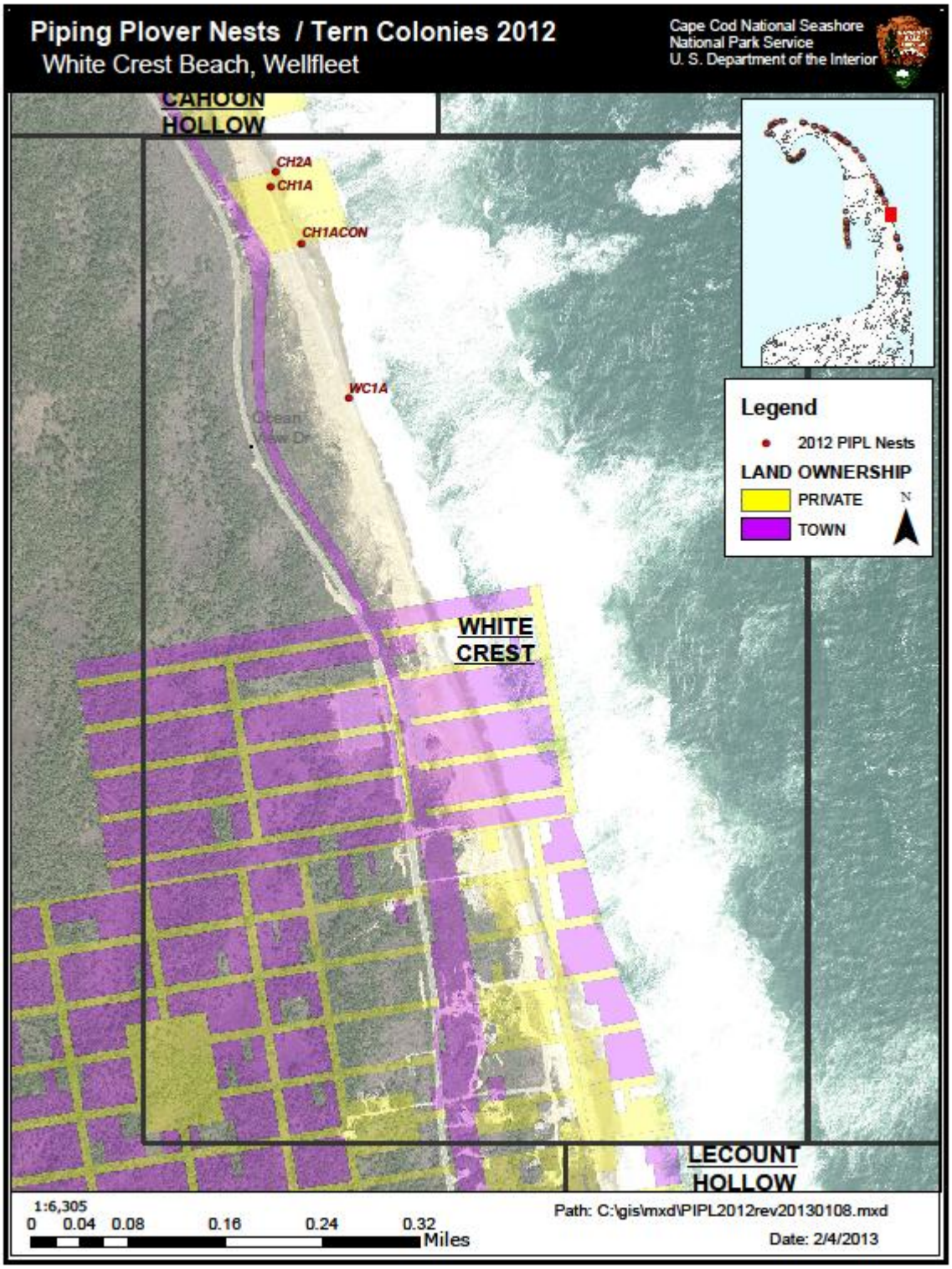
Piping Plover Nests / Tern Colonies 2012
White Crest Beach, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
CAHOON HOLLOW
CH2A
CH1A
CH1ACON
WC1A
Ocean View Dr
WHITE CREST
LECOUNT HOLLOW
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
1:6,305
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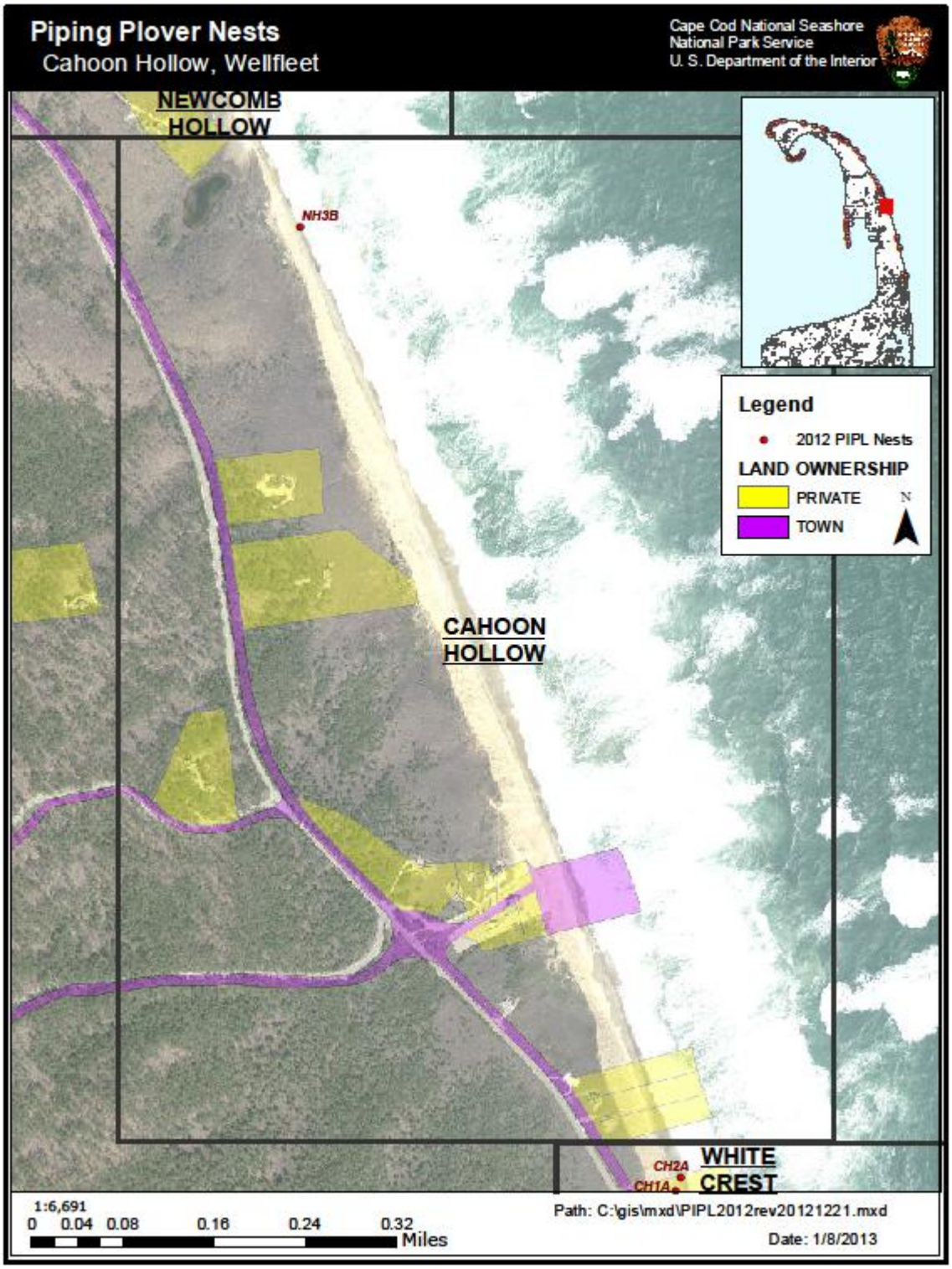
Date: 2/4/2013


Piping Plover Nests
Cahoon Hollow, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
NEWCOMB HOLLOW
NH3B
CAHOON HOLLOW
CH2A
CH1A
WHITE CREST
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
1:6,691
0 0.04 0.08 0.16 0.24 0.32
Miles
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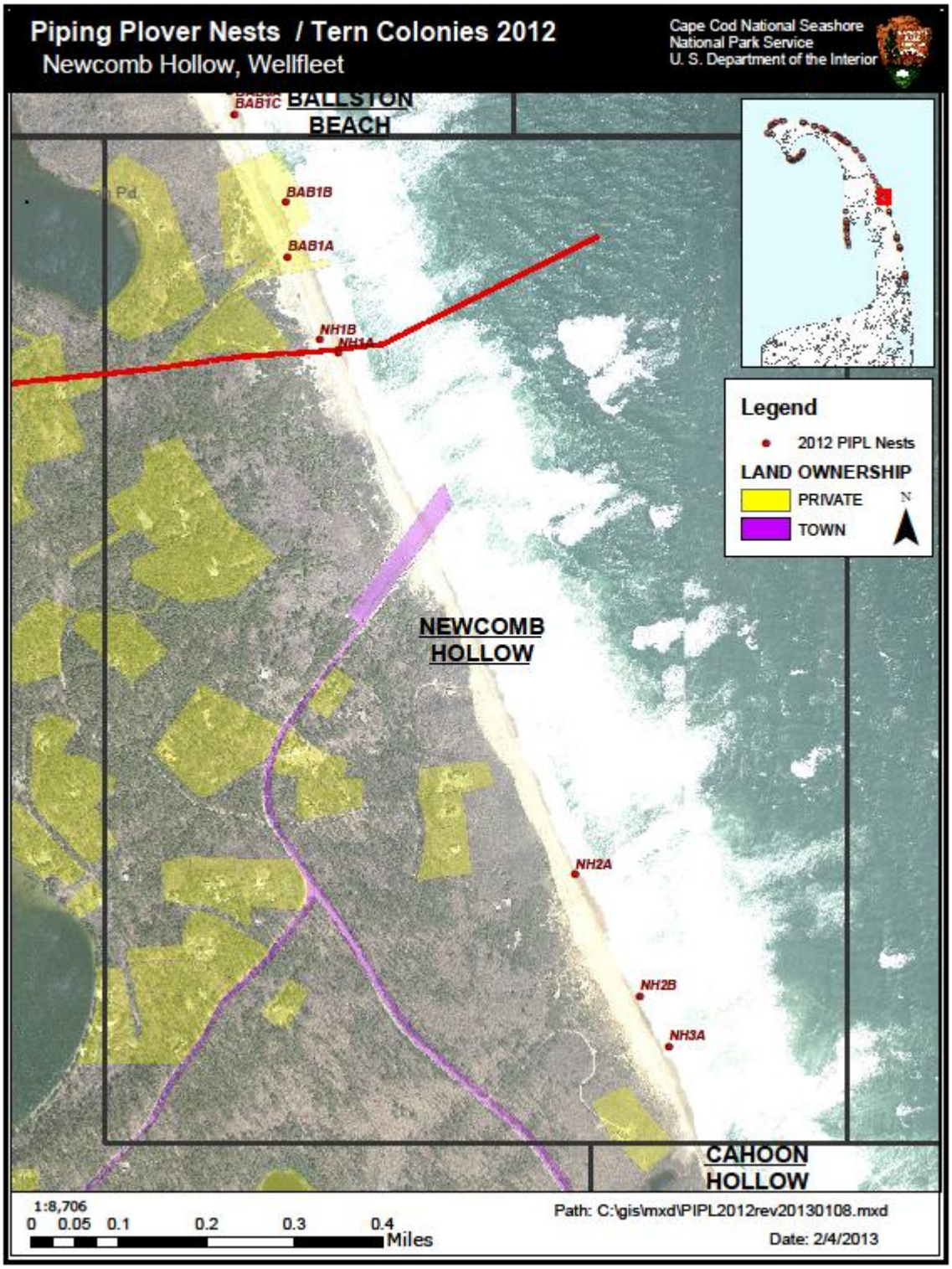
Piping Plover Nests / Tern Colonies 2012
Newcomb Hollow, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
BALLSTON BEACH
BAB1C
BAB1B
BAB1A
NH1B
NH1A
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
NEWCOMB HOLLOW
NH2A
NH2B
NH3A
CAHOON HOLLOW
1:8,706
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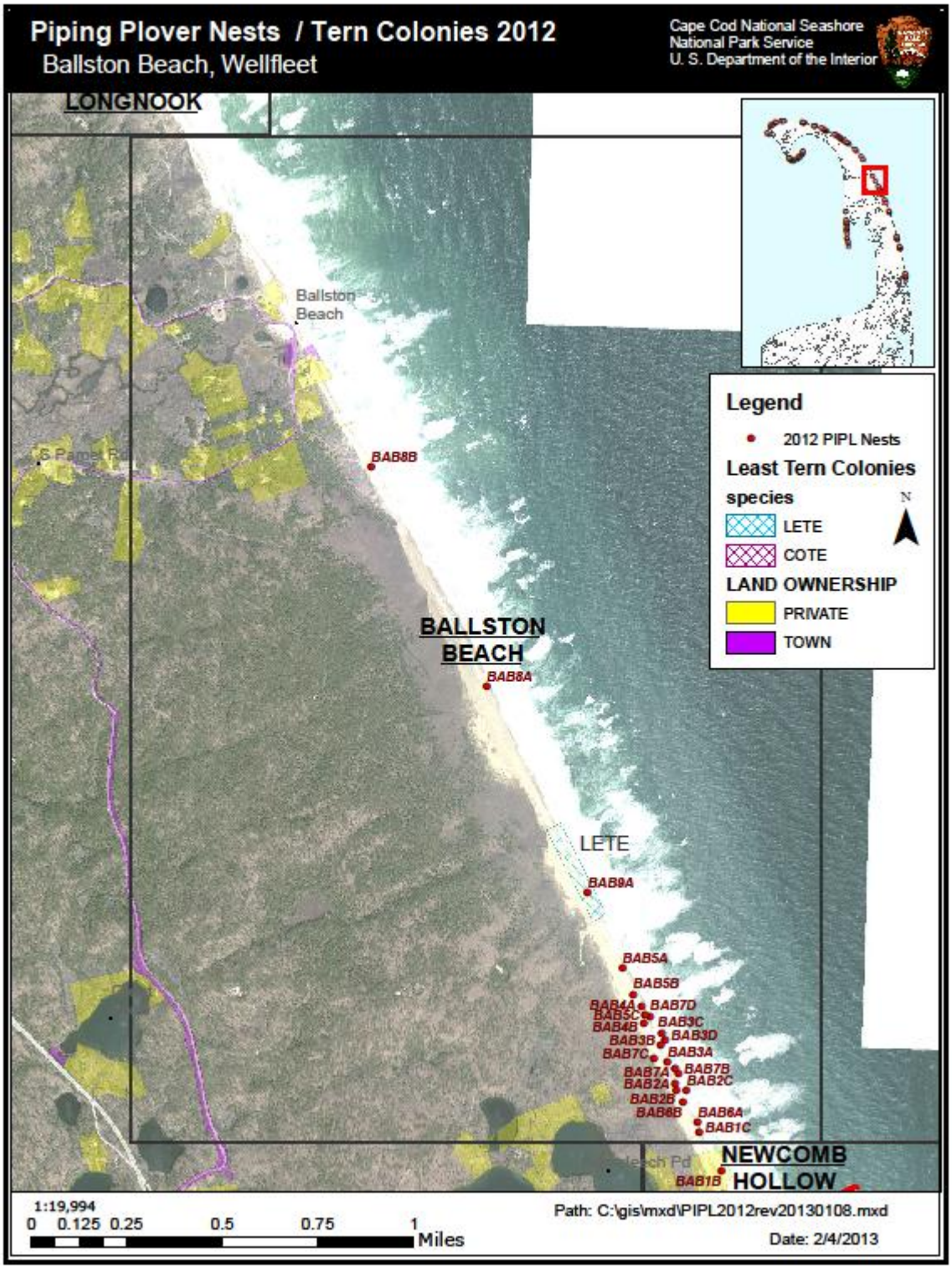
Piping Plover Nests / Tern Colonies 2012
Ballston Beach, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
LONGNOOK
Ballston Beach
BAB8B
BALLSTON BEACH
BAB8A
LETE
BAB9A
BAB5A
BAB5B
BAB4A
BAB7D
BAB5C
BAB3C
BAB4B
BAB3D
BAB3B
BAB3A
BAB7C
BAB7B
BAB7A
BAB2C
BAB2A
BAB2B
BAB6B
BAB6A
BAB1C
BAB1B
NEWCOMB HOLLOW
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
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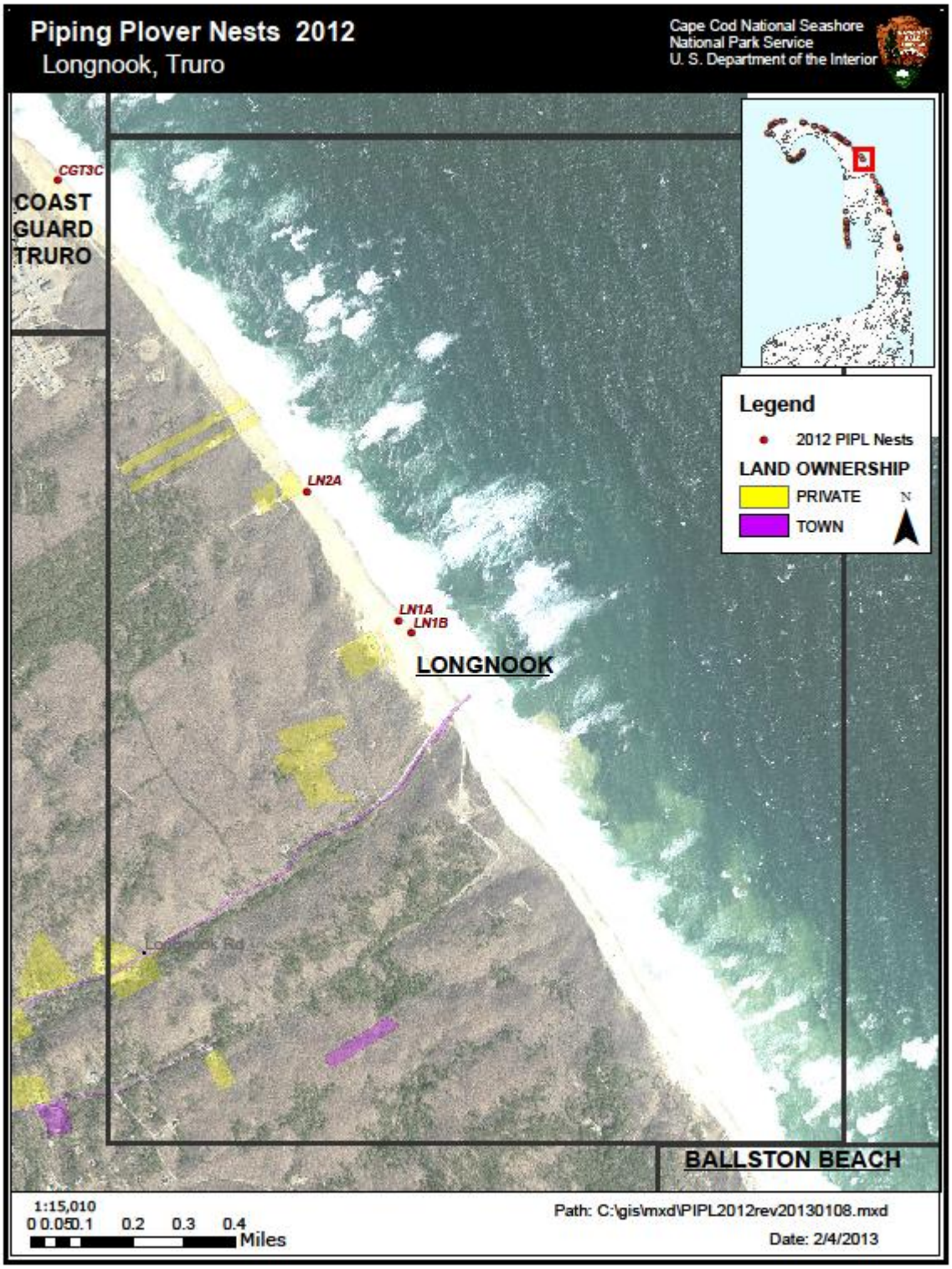
Piping Plover Nests 2012
Longnook, Truro
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
CGT3C
COAST GUARD TRURO
LN2A
LN1A
LN1B
LONGNOOK
BALLSTON BEACH
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
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Miles
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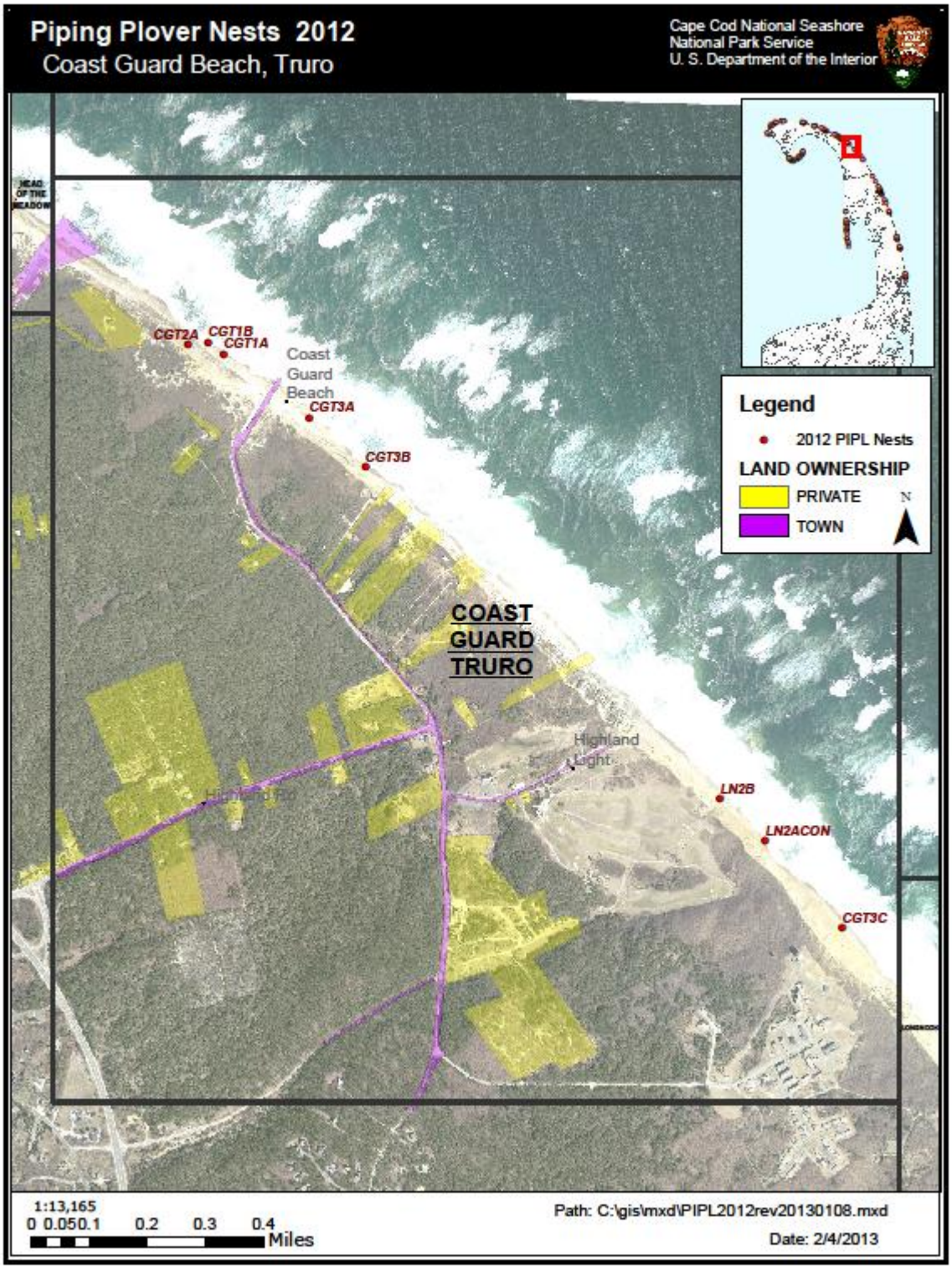
Piping Plover Nests 2012
Coast Guard Beach, Truro
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
CGT2A
CGT1B
CGT1A
Coast Guard Beach
CGT3A
CGT3B
COAST GUARD TRURO
Highland Light
LN2B
LN2ACON
CGT3C
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
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0 0.05 0.1 0.2 0.3 0.4
Miles
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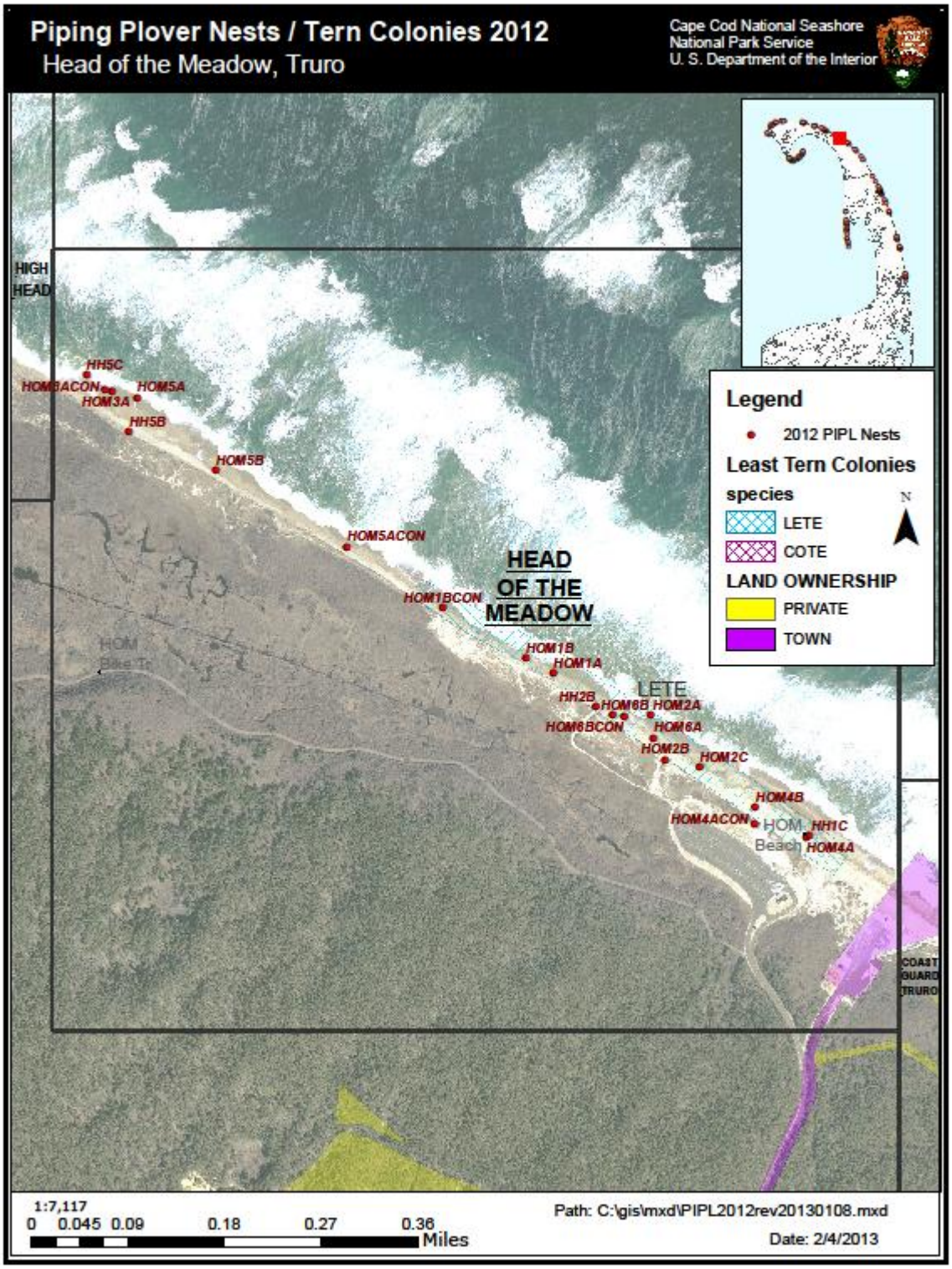
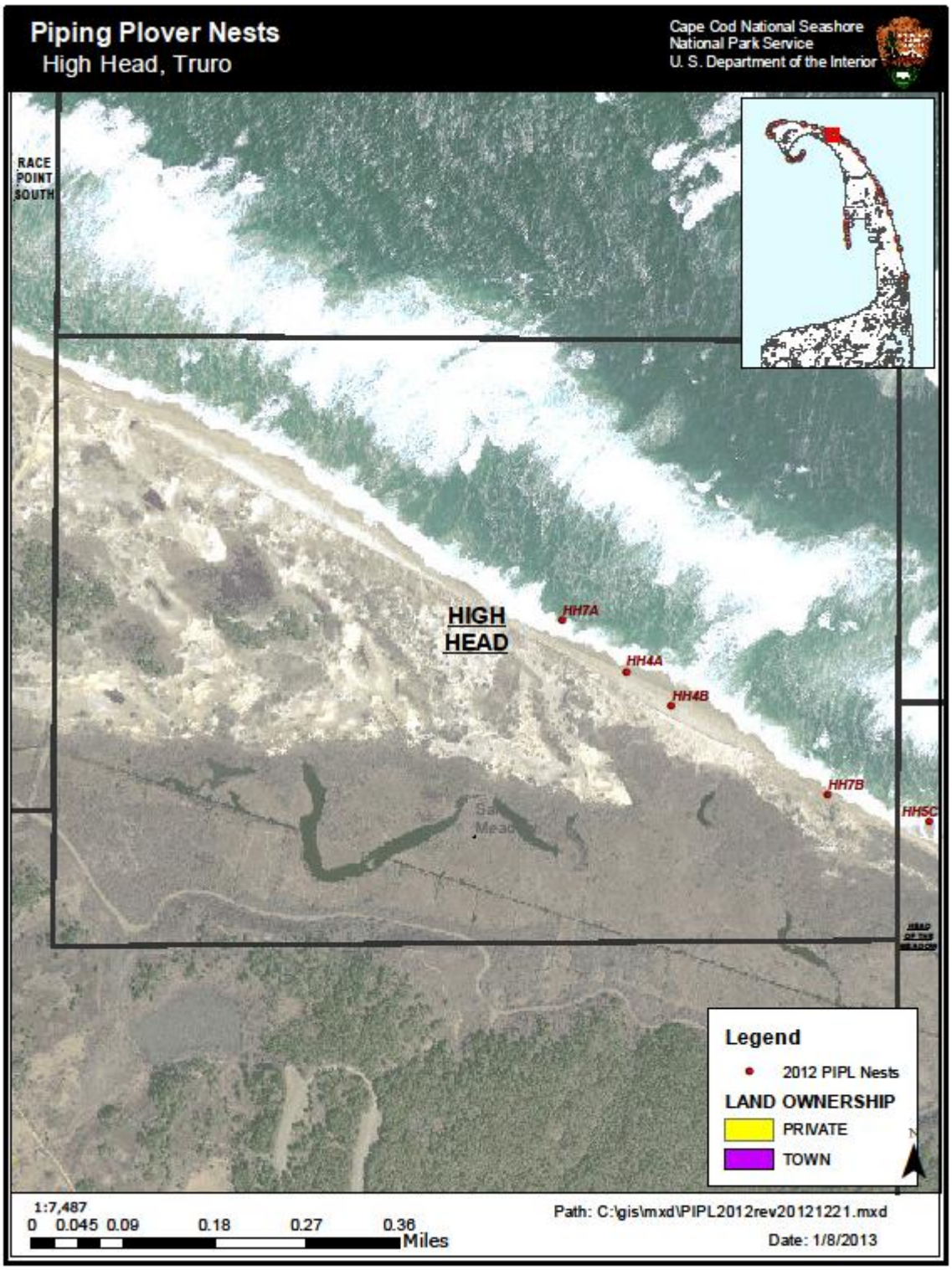

Piping Plover Nests / Tern Colonies 2012
Head of the Meadow, Truro
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
HIGH HEAD
HH5C
HOM3ACON
HOM5A
HOM3A
HH5B
HOM5B
HOM5ACON
HEAD OF THE MEADOW
HOM1BCON
HOM1B
HOM1A
LETE
HH2B
HOM6B
HOM2A
HOM6BCON
HOM6A
HOM2B
HOM2C
HOM4B
HOM4ACON
HOM
Beach
HH1C
HOM4A
COAST GUARD TRURO
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:7,117
0 0.045 0.09 0.18 0.27 0.36
Miles
Path: C:\gis\mxd\PIPL2012rev20130108.mxd
Date: 2/4/2013


Piping Plover Nests
High Head, Truro
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
RACE POINT SOUTH
HIGH HEAD
HH7A
HH4A
HH4B
HH7B
HH5C
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
1:7,487
0 0.045 0.09 0.18 0.27 0.36
Miles
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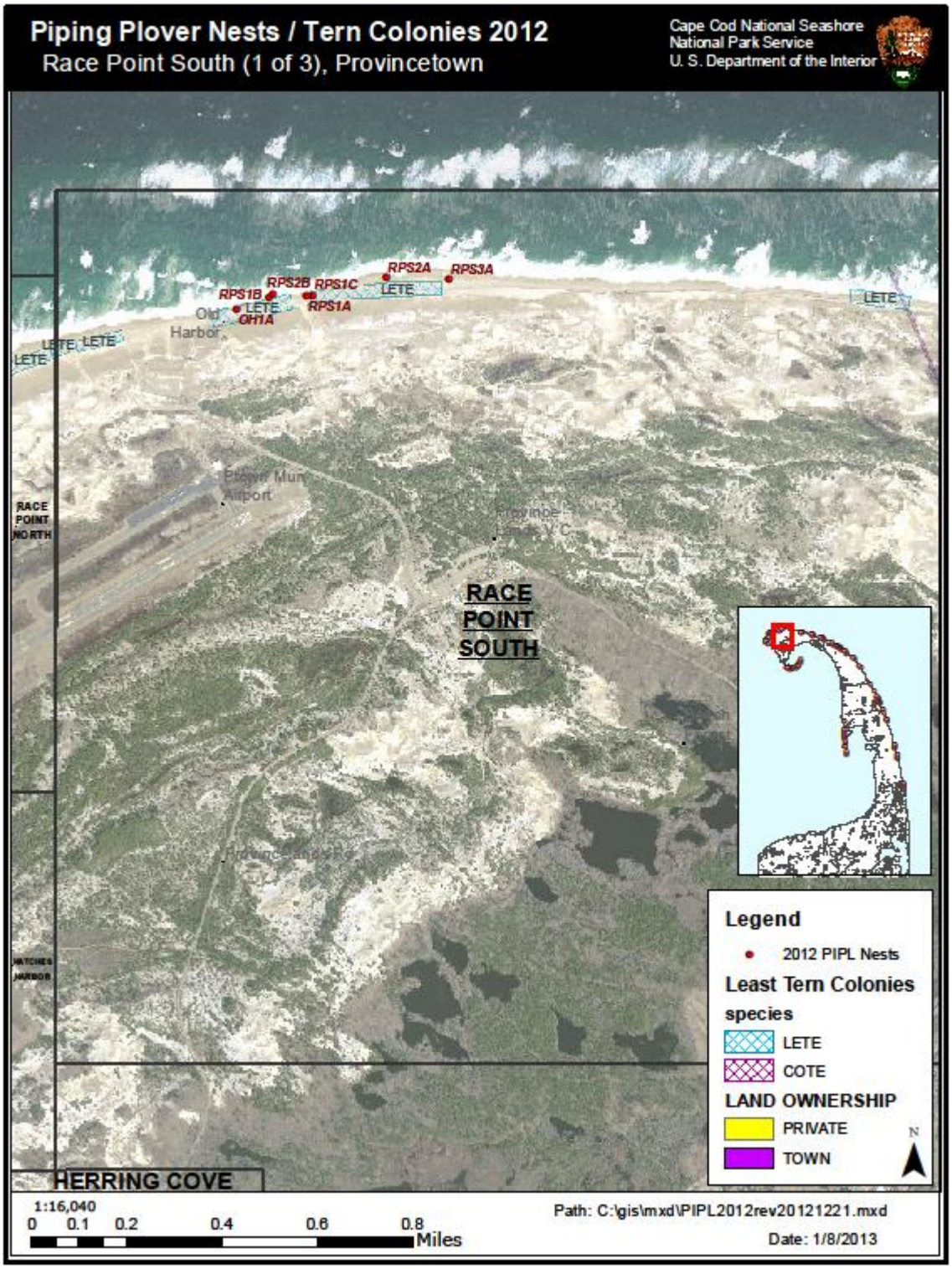
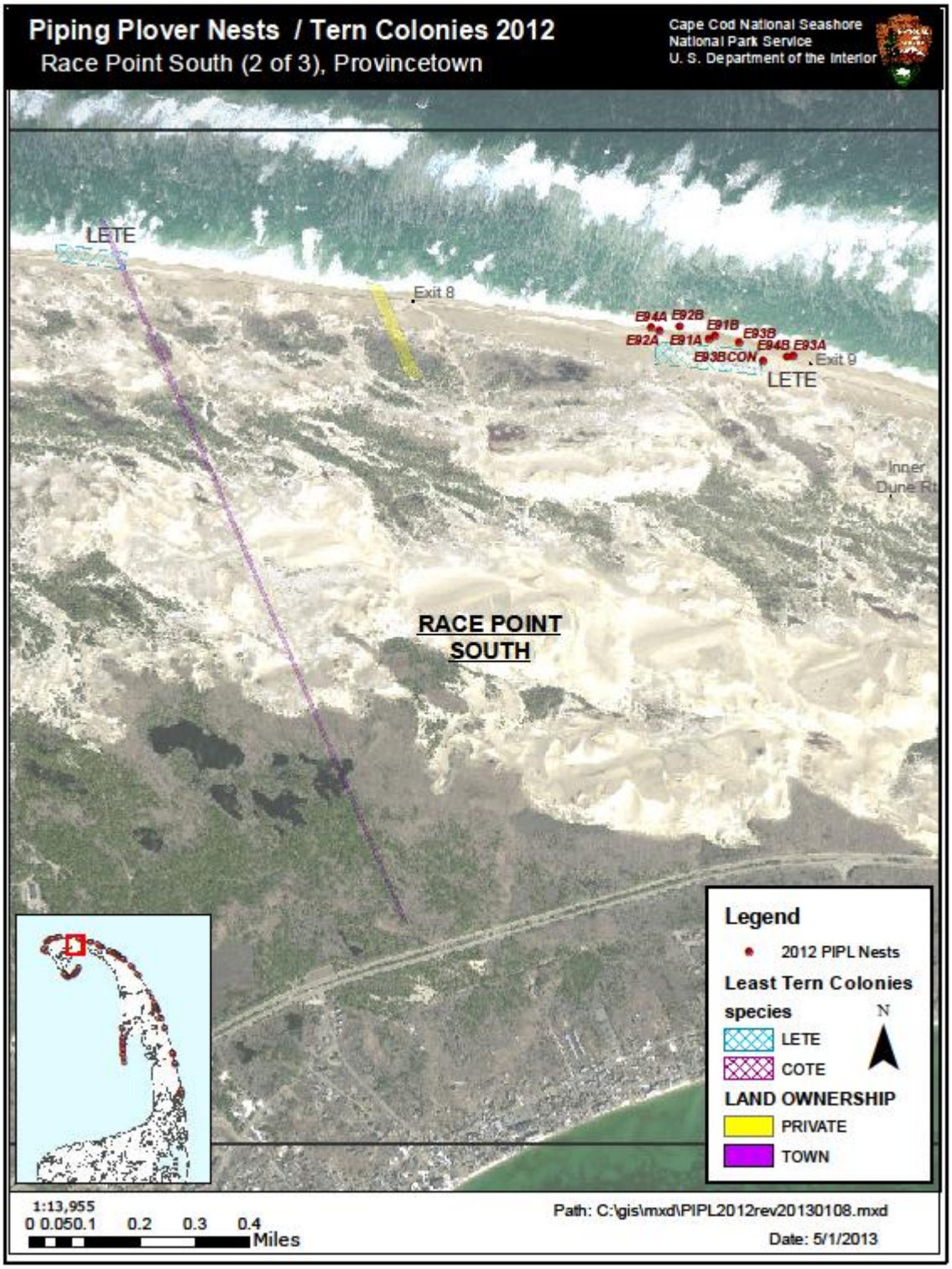
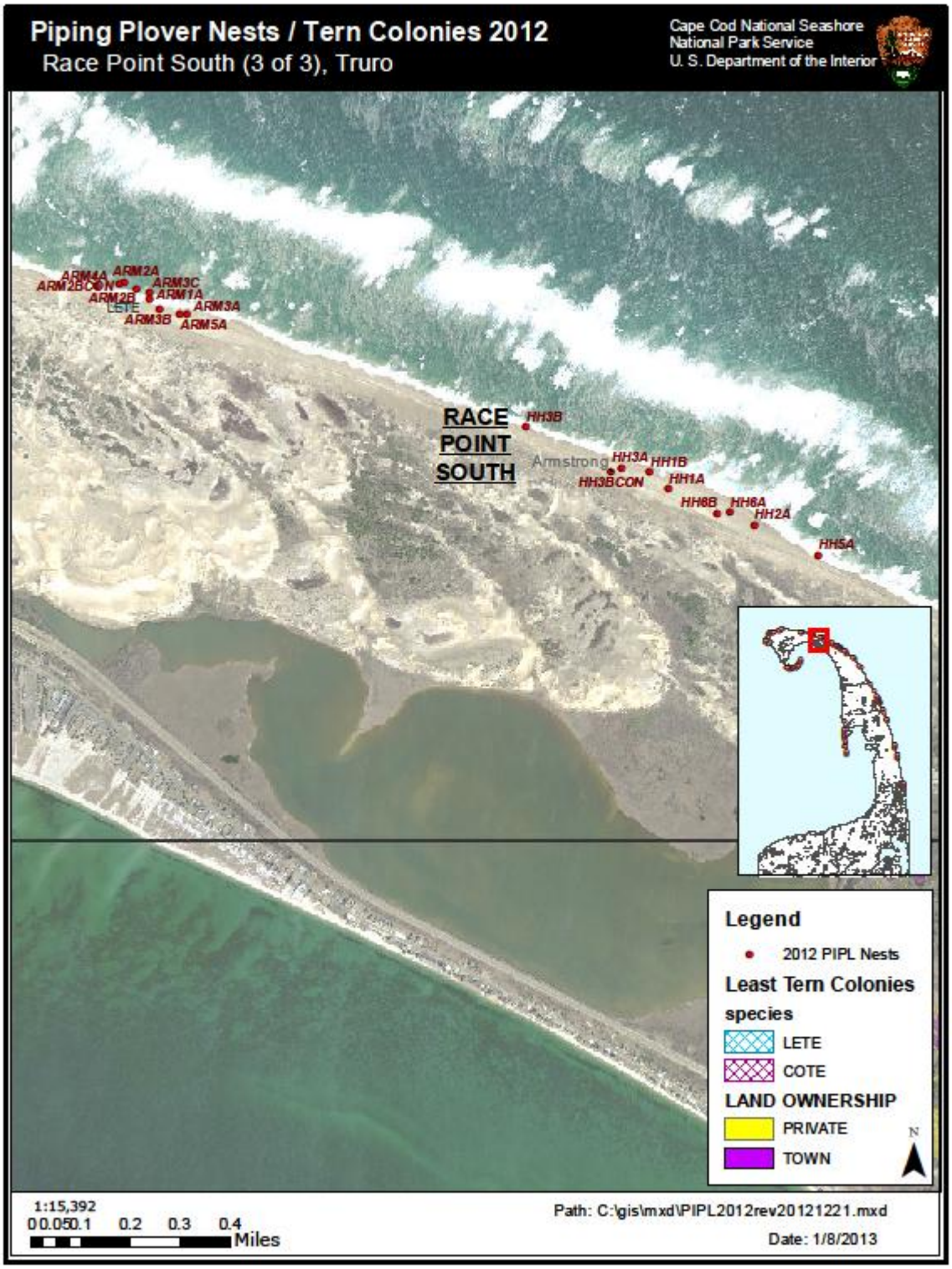
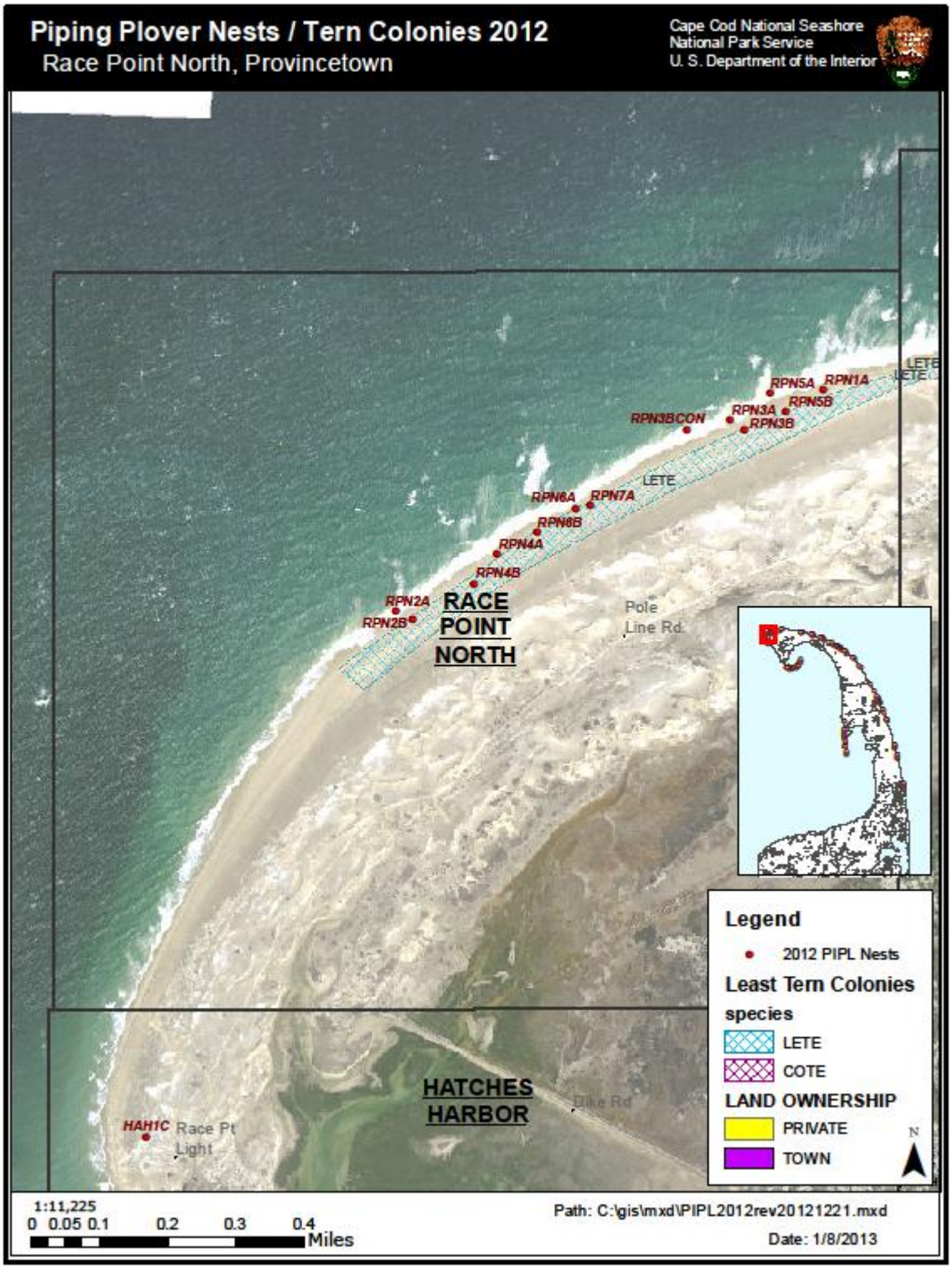
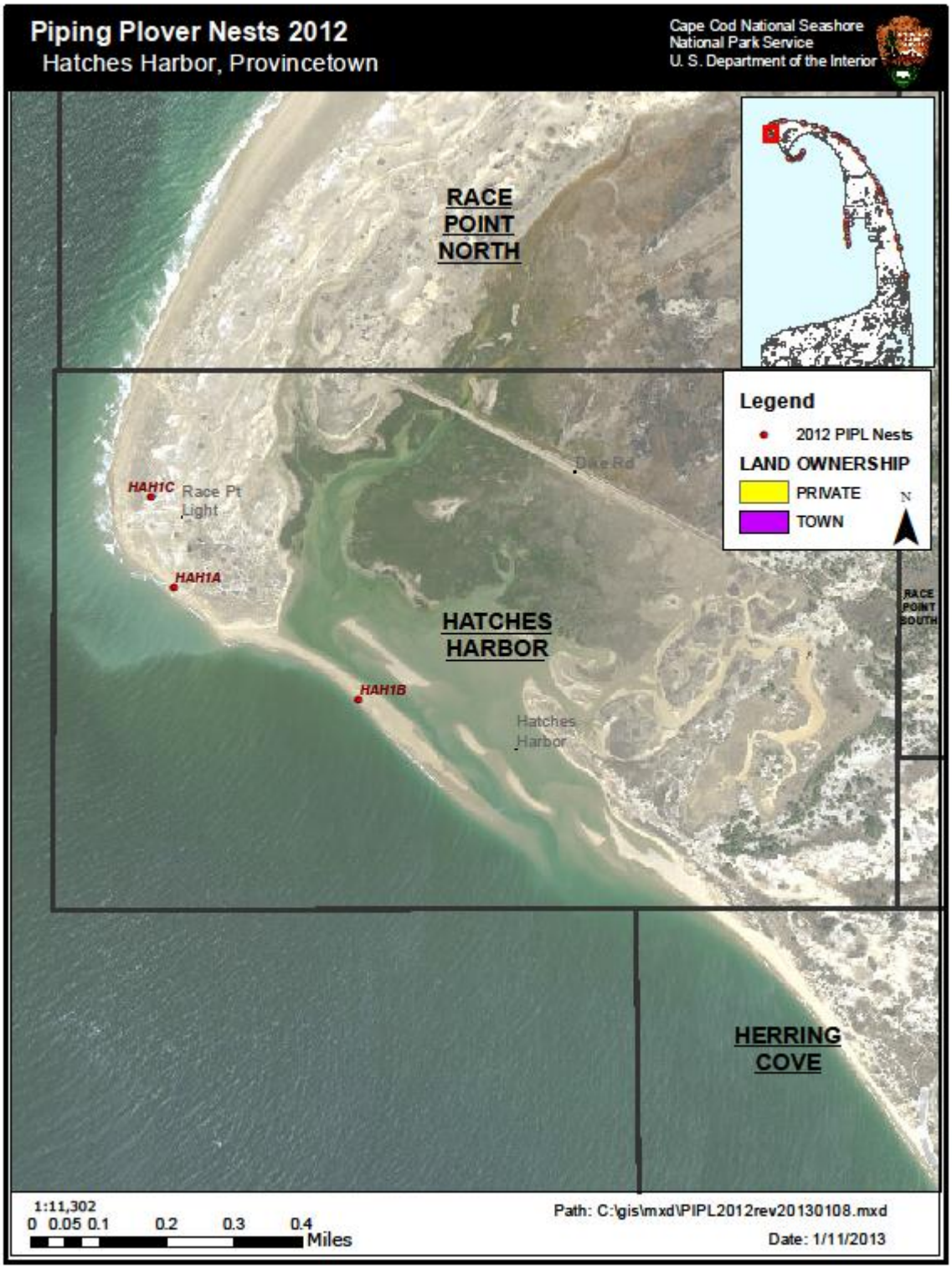
Date: 1/8/2013


Piping Plover Nests / Tern Colonies 2012
Race Point South (1 of 3), Provincetown
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
RPS2A
RPS3A
RPS2B
RPS1C
RPS1B
RPS1A
OH1A
LETE
Old Harbor
Provincetown Municipal Airport
RACE POINT NORTH
RACE POINT SOUTH
HATCHES HARBOR
HERRING COVE
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:16,040
0 0.1 0.2 0.4 0.6 0.8 Miles
Path: C:\gis\mxd\PIPL2012rev20121221.mxd
Date: 1/8/2013

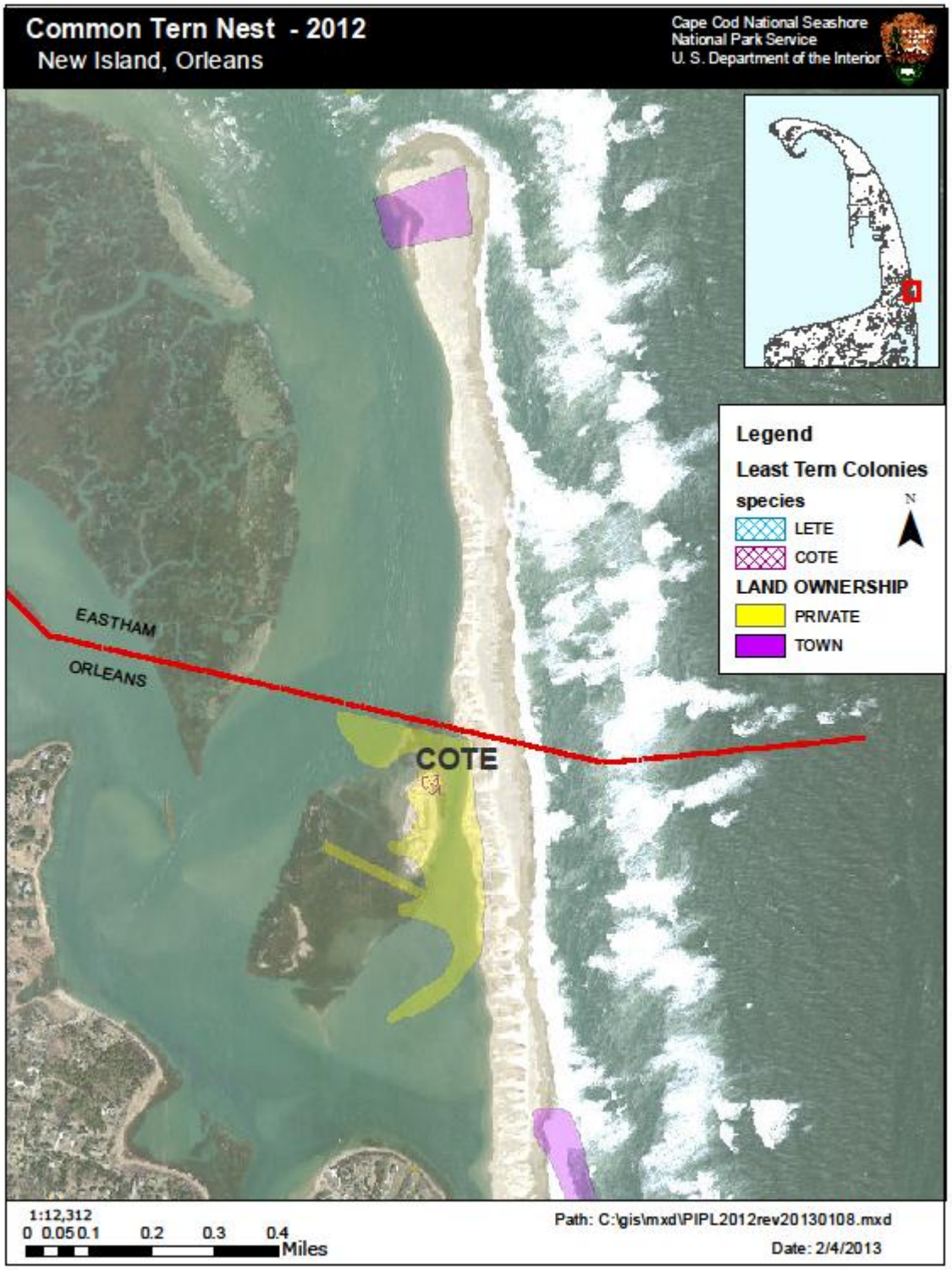

Piping Plover Nests / Tern Colonies 2012
Race Point South (2 of 3), Provincetown
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
LETE
Exit 8
E94A E92B
E91B
E92A E91A
E93B
E94B E93A
E93BCON
Exit 9
LETE
Inner
Dune Rd
RACE POINT
SOUTH
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
N
LAND OWNERSHIP
PRIVATE
TOWN
1:13,955
0 0.050.1 0.2 0.3 0.4
Miles
Path: C:\gis\mxd\PIPL2012rev20130108.mxd
Date: 5/1/2013


Piping Plover Nests / Tern Colonies 2012
Race Point South (3 of 3), Truro
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
ARM4A
ARM2A
ARM2BCON
ARM3C
ARM2B
ARM1A
LETE
ARM3A
ARM3B
ARM5A
RACE POINT SOUTH
HH3B
Armstrong
HH3A
HH1B
HH3BCON
HH1A
HH6B
HH6A
HH2A
HH5A
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:15,392
0 0.05 0.1 0.2 0.3 0.4
Miles
Path: C:\gis\mxd\PIPL2012rev20121221.mxd
Date: 1/8/2013

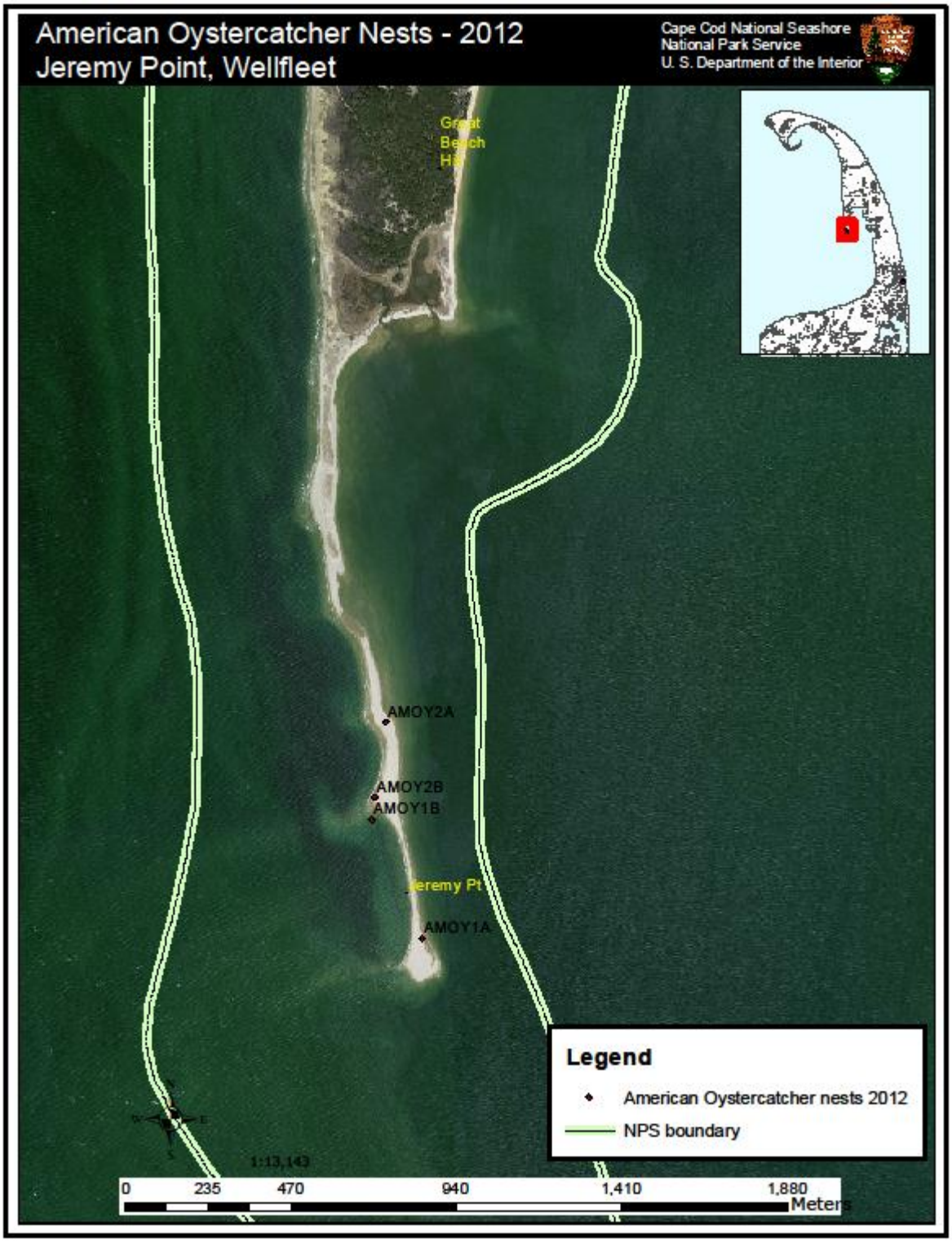

Piping Plover Nests / Tern Colonies 2012
Race Point North, Provincetown
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
RPN5A
RPN1A
RPN5B
RPN3A
RPN3B
RPN3BCON
LETE
RPN6A
RPN7A
RPN6B
RPN4A
RPN4B
RPN2A
RPN2B
RACE POINT NORTH
Pole Line Rd.
HATCHES HARBOR
Dike Rd
HAH1C
Race Pt Light
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:11,225
0 0.05 0.1 0.2 0.3 0.4 Miles
Path: C:\gis\mxd\PIPL2012rev20121221.mxd
Date: 1/8/2013


Piping Plover Nests 2012
Hatches Harbor, Provincetown
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
RACE POINT NORTH
Legend
2012 PIPL Nests
LAND OWNERSHIP
PRIVATE
TOWN
N
Dike Rd
HAH1C
Race Pt Light
HAH1A
HATCHES HARBOR
HAH1B
Hatches Harbor
RACE POINT SOUTH
HERRING COVE
1:11,302
0 0.05 0.1 0.2 0.3 0.4 Miles
Path: C:\gis\mxd\PIPL2012rev20130108.mxd
Date: 1/11/2013

Piping Plover Nests / Tern Colonies 2012
Wood End / Long Point, Provincetown
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
HERRING COVE
WOOD END
LONG POINT
LETE
WELP14BCON
WELP14B
WELP1C
WELP12A
WELP11A
WELP1A
WELP11B
WELP1B
WELP6A
WELP12B
WELP9B
WELP12C_12CCON
WELP9BCON
WELP10A
WELP9A
WELP9B
WELP6B
WELP6BCON
WELP10B
WELP3A
WELP8A
WELP13A
WELP13B
WELP2C
WELP2B
WELP2A
WELP4A
WELP4C
WELP4B
WELP5A
WELP7B
WELP14A
WELP7A
Legend
2012 PIPL Nests
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
1:24,357
0 0.15 0.3 0.6 0.9 1.2
Miles
Path: C:\gis\mxd\PIPL2012rev20130108.mxd
Date: 5/1/2013


Common Tern Nest - 2012
New Island, Orleans
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
Legend
Least Tern Colonies
species
LETE
COTE
LAND OWNERSHIP
PRIVATE
TOWN
N
EASTHAM
ORLEANS
COTE
1:12,312
0 0.05 0.1 0.2 0.3 0.4
Miles
Path: C:\gis\mxd\PIPL2012rev20130108.mxd
Date: 2/4/2013

American Oystercatcher Nests - 2012
New Island, Orleans MA
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
AMOY3A
AMOY3B
Legend
American Oystercatcher nests 2012
NPS boundary
1:10,456
0
185
370
740
1,110
1,480
Meters


American Oystercatcher Nests - 2012
Jeremy Point, Wellfleet
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior
Great Beach Hill
AMOY2A
AMOY2B
AMOY1B
Jeremy Pt
AMOY1A
Legend
American Oystercatcher nests 2012
NPS boundary
1:13,143
0
235
470
940
1,410
1,880
Meters