

**Shorebird Monitoring and Management at
Cape Cod National Seashore
2007**



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Abstract:

This report summarizes the 2007 shorebird nesting season for Cape Cod National Seashore (Seashore). Piping plover (*Charadrius melodus*) nesting and brood-rearing were monitored on 18 beaches from Provincetown to Orleans. Observations of piping plovers began mid-March. Egg-laying began in the fourth week of April. Peak nesting occurred during the first week of June. A total of 85 nesting pairs attempted 113 nests, 67 of which were successful. A total of 143 chicks fledged for a productivity of 1.68 chicks fledged/nesting pair. A total of 46 nests failed before hatching. American crows (*Corvus brachyrhynchos*) and coyotes (*Canis latrans*) were the main egg predators before exclosures were installed. Predator exclosures were erected around 79 nests. Thirty-four nests were not exclosed. Of the 34 unexclosed nests, 24 failed to hatch. Least tern (*Sterna antillarum*) colonies continued to decline on Seashore beaches. A total of 86 pairs of least terns nested in five small colonies from Eastham to Provincetown. Predators and overwash were the major causes of nest loss. Productivity was higher than in past years, but still low, approximately 0.45 chicks/pair. Eight pairs of common terns (*Sterna hirundo*) nested unsuccessfully on New Island, Orleans. A total of five pairs of American oystercatchers (*Haematopus palliatus*) nested in Eastham and Wellfleet, fledging a total of three chicks.

Dogs were prohibited on all south district beaches where nesting shorebirds were present. During daily patrols, 245 dogs were observed off leash, most frequently on oceanside beaches in Eastham and Wellfleet. Thirty-five pairs of plovers nested within the Off-Road Vehicle (ORV) corridor in the North District of the park. These 35 pairs hatched 91 chicks, 36 of which fledged. The corridor remained open to vehicles until chicks hatched, at which time beaches were totally or partially closed to vehicles until the chicks could fly. Sections of beach that were temporally closed to vehicles include portions of beach between Head of the Meadow and High Head, Race Point North, and Race Point South, between the Race Point South exit and the High Head exit.

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 enabling legislation (Public Law 87-126), this unit of the National Park System was established, in part, to protect the area's outstanding natural resources including federal and 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, listed by the Massachusetts Division of Fisheries and Wildlife (MDFW) as a species of special concern, and the American oystercatcher, a species listed as high concern by the U.S. Shorebird Conservation Plan (Brown et. al 2001).

In 2007, shorebirds were monitored on 18 beaches in the Seashore from Provincetown to Eastham, encompassing approximately 43.4 miles of beach. For staffing and operational purposes, these beaches are divided into two districts. The North District includes all NPS beaches located in Provincetown and Truro (Wood End/Long Point, Race Point North, Race Point South, High Head, and Ballston). The South District includes all NPS beaches located in Eastham and Wellfleet (Coast Guard, Nauset Light Beach, Marconi Beach, Marconi Station, LeCount Hollow, White Crest, Cahoon Hollow, Newcomb Hollow, Bound Brood, Duck Harbor, Great Island and Jeremy Point) and New Island in Orleans.

Cape Cod National Seashore follows the monitoring and protection methods for nesting piping plovers outlined in Erwin et al. (2003) and the U.S. Fish and Wildlife Service Piping Plover Atlantic Coast Population Revised Recovery Plan (1995). Erwin et al. (2003) and Blodget and Melvin (1996) also provide details on the monitoring methods for nesting terns and oystercatchers. Readers are referred to these sources for more detailed information on monitoring and management methods.

During the nest location phase, Seashore monitors searched the beach for plovers, nest scrapes, and plover 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 off-road vehicle (ORV) corridor where vehicles are allowed to pass nesting areas until chicks hatch. All nests along the ORV corridor and nearly all other nests throughout the Seashore were monitored daily. To determine the actual date of hatching and ensure that chicks are found as immediately as possible after hatching, nests along the ORV corridor are checked twice daily starting 25 days after nest completion. All chicks were monitored daily, noting their movements, location and number in each brood. Broods near open ORV corridor 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. The estimated breeding population of piping plovers is based on the number of pairs found with a nest and any pairs that exhibited courtship and territorial behaviors (scraping, aerial calls) for longer than two weeks.

POPULATION AND PRODUCTIVITY

PIPING PLOVERS

Nest Search and Incubation Monitoring

Results

Eighty five pairs of piping plovers were monitored on 18 beaches in the Seashore in 2007 (Table 1, Appendix A). Piping plovers were first observed on Seashore beaches on 22 March and most beaches had plovers present by mid-April. Plovers continued to arrive into mid-June. The first nest was found on 29 April. Peak nesting for the Seashore occurred during a two week period from 27 May to 9 June (Figure 1). A total of 113 nests were found during the 2007 nesting season. Of these, 67 hatched at least one chick and 46 failed (Table 2). The most frequent cause of nest loss was overwash (18 nests), followed by abandonment of exclosed nests (11), predation (10), becoming sanded over (3), abandonment of unexclosed nests (2), and adult mortality (2).

The 113 piping plover nests contained a total of 368 eggs. Of these, 233 eggs hatched. The remaining 135 were lost to various causes, primarily overwash, predation, and abandonment of exclosed nests (Table 3). Although overall hatching success was 63%, this varied among beaches, ranging from zero at Marconi Beach and New Island to 100% at LeCount Hollow and Duck Harbor (Table 1).

Circular and canopy style predator exclosures were installed around 79 of the 113 nests (Table 4). Of the 79 exclosed nests, 29% failed to hatch. The main causes of loss of exclosed nests include abandonment and overwash. Exclosed nests were monitored more often to increase detection of potential complications associated with the exclosures such as exclosure-related mortalities or predators keying into exclosures. A total of 34 nests were not exclosed. Of those nests, 71% were unsuccessful.

There were two cases of adult mortality in the Seashore in 2007 believed to be exclosure-related. On 9 June, a dead adult was found inside a circular exclosure on Wood End/Long Point. The adult had a single puncture wound to the chest. No predator tracks led up to or circled the exclosure. The puncture wound and the lack of predator tracks indicates the mortality was caused by an avian predator. The second adult was observed in the area but did not continue incubating the eggs and the nest was abandoned. On 31 May, a dead adult was found outside a canopy exclosure on Race Point South. Coyote tracks led up to and around the exclosure and under the canopy. The coyote tracks led away from the exclosure and to the immediate area where the dead adult was found. Puncture wounds were located along the chest and back of the plover. The second adult did not continue to incubate and the nest was abandoned.

Most nests were located along the upper beach in open sandy habitat. However, a few pairs nested in more vegetated or interior locations and not all of these nests could be located. In these cases staff observed pairs courting and feeding along the beach and watched for signs that the birds were nesting at a separate site (e.g. flying away from the site upon disturbance and

exhibiting all signs of nesting except for egg laying). Whenever possible, plovers were tracked away from the beach using auditory and visual cues. However, these plovers were not tracked into dense vegetation to avoid accidentally crushing the nests. Using these methods we determined that six pairs of piping plovers successfully hatched chicks from nests that were not located. Four of these were at Wood End/Long Point. One to two day old broods were found associated with these pairs and it is believed they nested within a densely vegetated interior section of the peninsula. A pair on Race Point South also used the beach as feeding and courting habitat but no nest was found along the upper beach. The area where this pair was observed is the seaward edge of the large parabolic dune field in Truro where plovers have nested in past years. A one to two day old brood was observed with this pair later in the season. On Race Point North, a pair was observed courting and feeding along the beach early in the season. This area was regularly and heavily used by feeding plovers. A one to two day old brood was found with this pair later in the season. The adults were moving the brood back and forth between the access road (to the Race Point lighthouse) and the beach. It is believed that this pair nested interiorly within a blowout, cobble field, or heavy vegetation.

Discussion

Based on recent trends (2000 – 2007) in piping plover nesting at Cape Cod National Seashore, 2007 was a better than average year for plover productivity. The number of pairs (85), nests (113), eggs laid (368), and successful nests (67) are relatively close to the middle of the range of values recently recorded for these parameters. However, both the nest success rate (59%) and hatching rate (63%) were relatively high (both were third highest during this period) and the proportion of renests (25%), was the third lowest indicating that more first nests were successful. The net result of these relatively high rates of success was that in 2007, as in 2006 (when these parameters were also high), a record number of 233 hatchlings were produced (Table 5).

Over the past eight years, the three main factors affecting nest and egg loss were overwash, predation, and abandonment of nest after being exclosed. On average, 48% of nests were lost each year, mainly to these factors. In 2007 nest loss was only 41% and in 2006 it was 27%.

Overwash was the main cause of nest and egg loss in 2007, and in most recent years it has been among the top two causes. Overwash affects complete and incomplete nests equally, whereas predators generally prey on incomplete nests and are less able to prey on nests once they are exclosed. As a result, nest loss to overwash can represent a greater loss of reproductive effort. The high incidence of overwash loss may be related to changes in beach morphology - several long-term nesting beaches have become very narrow creating habitat that is more susceptible to overwash by tides and storms. In 2007, two nor'easters, on May 18th and June 13th, resulted in a total of 17 nests being sanded or washed over. The June storm had the greatest impact because it hit so late in the season and set back nesting chronology so that re-nesting pairs had to contend with the increased levels of human activity that occur during the summer. The narrowing of beaches may also explain the lack of nesting activity in 2007 on some beaches that have historically supported nesting plovers, such as the beaches from the north end of LeCount Hollow to Newcomb Hollow. Although a pair was observed at Newcomb Hollow early in the season exhibiting courtship behavior, they eventually moved to Ballston Beach. There was also no nesting activity between the north end of Ballston Beach and Coast Guard Beach - Truro.

Predators, mainly crows and coyotes, were the second main cause of egg loss in 2007. Observations in 2007 suggest that crows posed the greatest threat. Crows are opportunistic and adaptable feeders and over the past several years, their population appears to have increased. Groups of crows were commonly observed foraging along beaches. Their tracks blanketed the sand, and on several occasions active scrapes with numerous plover tracks had fresh crow tracks right up to the scrape suggesting that crows took the egg(s) before the nests were found. Because crows were such a threat, finding nests soon after the first egg was laid was a high priority so that predator exclosures could be immediately installed. In conjunction with a shift from circular to canopy exclosures in recent years, this aggressive use of exclosures may be why the percent of renests in 2006 and 2007 (23% and 25%, respectively) was below the mean of 29%, and are the second and third lowest in recent years (Table 5).

Coyotes are also a major predator on plover eggs, especially on Race Point North. In 2006 and 2007, adult mortalities occurred as a result of coyote predation. Coyotes are observed on a regular basis walking the beach during the early morning hours and they are often reported walking through the Self-Contained Vehicle (SCV) areas. We suspect that coyotes in the Race Point North area may be attracted by smells of garbage, food storage, and food cooking associated with the SCV areas. The increased number of fish remains left on the beach by fishermen using the open ORV corridor may also encourage coyote use of these beaches. On other beaches, including Coast Guard Beach - Eastham and Jeremy Point, there seems to be an increase in coyote activity and predation of plover nests coinciding with the onset of least tern nesting. Most likely, coyotes are attracted to tern colonies due to the concentration and abundance of eggs, and then expand their foraging area where they encounter plover nests.

Brood Monitoring and Productivity

Results

Hatching dates of piping plovers ranged from 4 June to 1 August. Fledging dates ranged from 6 July to 29 August. Of the 233 plover chicks hatched, 143 survived to fledge resulting in an overall fledging success of 61%. By beach, fledging success ranged from 0.00 % at Marconi Beach and New Island to 87% at Bound Brook. Parkwide, productivity was 1.68 chicks fledged/nesting pair (143 chicks fledged from 85 pairs) and ranged from 0.67 at Ballston Beach and Marconi Station to 3.25 chicks/pair at Bound Brook. For the third consecutive year, Coast Guard Beach - Eastham had more than 2.0 chicks fledge per pair. (Table 1, Figure 1).

Chick mortality factors were extremely difficult to assess. In the majority of cases when chicks are lost, there was no evidence as to why. A chick was presumed dead if it was not seen for the remainder of the season. A brood was considered lost when there was no sign of the chicks after seven consecutive days of searching. As in years past, most chick mortality occurred within the first 10 days after hatching. In 2007, there was evidence to suggest mortality factors for four of the 90 chicks lost. On 10 July, three chicks hatched at High Head while the fourth egg was still pipping. The adults left the nest with the three hatched chicks on 11 July. On 15 July, the fourth chick was found dead just outside the exclosure. In this case, mortality may have resulted from the lack of parental care. On 16 June at LeCount Hollow, four recently hatched chicks were

observed just outside the enclosure, laying low in the sand and not moving. The next day, three chicks disappeared. Fresh crow tracks were observed all around the enclosure. This suggests that these three chicks were predated by crows.

Discussion

Based on recent trends (2000 – 2007) at the Seashore, 2007 was a very good year for chick survival. The number of fledglings (143) was the second highest during this period and the fledging rate (61%) was the third highest. The resultant productivity (1.68 fledglings/nesting pairs), was the second highest during this recent period (Table 5), but much less than during the period from 1990 through 1994 when productivity exceeded 2.0 chicks fledged per pair each year (Figure 1). It is uncertain why productivity has declined since the early 1990's, but it may be due to increased numbers of crows, coyotes, and beach recreation. A more detailed analysis of these trends is needed.

Bound Brook south to Duck Harbor had the highest fledging success and productivity in the park. These beaches were also among the most productive plover nesting sites in Massachusetts in 2007. This area had no documented pairs of nesting plovers from the late 1990's until 2002. In 2003 through 2006, two to four pairs of plovers began nesting along these beaches and in 2007 there were six nesting pairs. The high productivity experienced at Bound Brook and Duck Harbor may be due to its relatively remote location and the abundance of wrack, often a foot high, which accumulates along the shoreline and supports the marine invertebrates that piping plovers feed on. The chicks also blend in with the cobble found on sections of these beaches, making them more difficult for predators to see.

As in most years, brood monitoring was challenging. Chicks are highly mobile and difficult to locate, especially in dense vegetation. Differentiating specific broods was sometimes difficult when several broods came together. This occurred on Coast Guard Beach - Eastham, when four broods were often observed forming a "super brood" of nine to eleven chicks feeding together on Nauset Marsh, often with no adult present.

Another factor affecting brood monitoring was human disturbance which often causes broods to disperse. Young chicks are extremely reactive to human disturbance and observations of chicks running away from humans were common. On several occasions, adult 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.

In general, most piping plover chicks fledge at 25 to 27 days (Blodget and Melvin 1996). However, in 2007, 26 of 67 broods took much longer (30–43 days) to fledge. Twenty four of these 26 were in the ORV corridor. Reasons for this slow rate of growth and development are probably food-related. Whether this reflects a lack of food or an inability to feed due to high levels of human disturbance is uncertain. When humans are present in feeding areas, chicks are forced to feed in suboptimal habitat. Burger (1994) found that time devoted to vigilance (when they are not searching for food) is directly related to the number of people near them, and the overall human use of that habitat. Burger also suggests that in habitat with fewer people plovers spend 90% of their foraging time actively searching for prey and feeding, whereas on beaches

with many people they may spend less than 50% of their foraging time in direct feeding behaviors. Another factor may be timing of chick hatching. Nests that hatch later in the season (after the first week in July) also seem to have delayed fledging. This could be related to prey availability, time spent shading during peak temperature periods, and increased human disturbance (July receives the largest number of beach users). Delayed growth negatively affects chicks by increasing the number of days they are vulnerable to predation.

Population Trends

Results

Eighty five pairs of piping plovers were monitored on 18 beaches in the Seashore in 2007. Piping plovers were first observed on Seashore beaches on 22 March and most beaches had plovers present by mid-April. Plovers continued to arrive into mid-June. Most plovers left Seashore beaches by late August.

Discussion

In 1985 when the Seashore began a piping plover monitoring and protection program, only 18 pairs nested on beaches managed by the Seashore. Productivity (number of chicks fledged per nesting pair) in 1985 was less than 1 chick fledged per pair (Figure 2). Over the next several years, numbers of plovers nesting in the Seashore decreased while numbers of plovers nesting in the state remained relatively stable. Eventually, numbers of nesting plovers rose markedly, both at the Seashore and throughout Massachusetts. Productivity at the Seashore rose from 0.3 in 1986 to a high of 2.6 fledged chicks per pair in 1991. For the next 15 years (1992 -2007) the number of nesting plovers has risen and although productivity fluctuates, it has generally met or come close to the federal recovery goal of achieving a five year average productivity of 1.5 fledged chicks/pair. In 2007, the Seashore saw an increase in population of 11 pairs from the previous year. This may be due to offspring from 2006, a year with relatively good productivity, returning to nest at the Seashore in 2007.

LEAST TERNS

Population and Productivity

Results

Least terns returned to the Seashore during the first week of May. Egg laying began the last week in May, with most least terns on eggs by mid-June. A total of 86 pairs nested in five small colonies from Eastham to Provincetown. The numbers of pairs in each colony were estimated during two standardized periods defined by MDFW (“A-count” from June 5 – 20 and “B-count” after 20 June). During the A-count, a total of 80 pairs were estimated in four small colonies; 42 pairs at Race Point North and 12 to 14 pairs per site at Coast Guard - Eastham, Marconi Station, and Jeremy Point. A colony of approximately 6 pairs on Wood End/Long Point was counted during the B-count.

Predators were a major cause of nest loss. Tracks indicated canids to be the main predator; gull (*Larus sp.*), crow, and red fox (*Vulpes vulpes*) tracks were also observed in colonies. On Race Point South, a small colony of approximately 24 pairs was present until the first week of June when coyotes moved through the colony and predated all of the nests. This colony did not return to the area. Nests were also frequently lost to astronomic high tides and storms. A major storm on 13 June washed over most nests at Coast Guard - Eastham, Marconi Station, and Jeremy Point. Renesting attempts continued through late August.

The first chick hatched on 23 June at Race Point North. The last chicks hatched the third week of August at Marconi Station. Jeremy Point and Marconi Station had the greatest number of fledglings (estimated at 10-15 and 8-12, respectively). Race Point North fledged 10 chicks and Wood End/Long Point fledged six. Coast Guard - Eastham had the lowest with only one or two fledglings. It is difficult to determine what killed the chicks. Productivity at this site was estimated at 0.45 chicks fledged per pair.

Discussion

Least tern colonies continue to decline on Seashore beaches. Since 2003, least terns have had poor productivity (.035 chicks/pair) and the number of nesting pairs has declined sharply (Figure 3). Reasons for this decline include the narrowing of beaches causing frequent overwash of nests and intense predation on eggs and chicks, especially by coyotes. Human disturbance is also strongly implicated.

Increased human activities affect coastal nesting species directly by disturbing incubating and brooding birds (Erwin et al.1981; Faanes 1983). Terns are especially vulnerable to human disturbances during courtship and territory establishment. Stationary human activity such as picnicking, sunbathing or camping too close to nesting terns keep the birds agitated and away from their nests (Blodget and Melvin 1996). In addition to interfering with behaviors that defend the colony from predation, persistent human disturbance can cause colony abandonment.

Remote areas that once supported least tern colonies, including Wood End/Long Point, the southern tip of Jeremy Point, and the southern tip of Coast Guard - Eastham beach have seen a steady decline in the number of nesting pairs or no longer have colonies present. This decline coincides with increased human presence associated with increasing numbers of recreational boaters landing in these areas, and a commercial shuttle to Long Point that now brings many people ashore there.

Although productivity was slightly higher than previous years, it continues to be very low on Seashore beaches. It is difficult to determine causes of tern chick mortality, especially at Coast Guard - Eastham where plover productivity was high. However, since there were no dead chicks found, which usually occurs when death is due to severe weather or disease; it is presumed that most mortality was due to predation.

COMMON TERNS

Population and Productivity

Results

Common terns were first sighted on 11 May at Jeremy Point. In 2007, approximately eight pairs nested on New Island, Orleans in early June. These nests disappeared by late June. Predators including coyotes, gulls and striped skunks (*Mephitis mephitis*) were the probable source of egg predation. No chicks were ever observed.

The Seashore is an important staging and resting area for migrating common terns. A conservative estimate of 500 to 1250 immature and post-breeding adults were observed mid-July through September utilizing the extensive saltmarsh and mudflats of Nauset Marsh, Jeremy Point, and Hatches Harbor for staging and resting.

Discussion

Over the past nine years, a few pairs of common terns (five or fewer) have nested within or near least tern colonies at Jeremy Point, Race Point North, and Wood End, but the majority of nesting has historically occurred on New Island, Orleans (Figure 4). In 1999, 2176 pairs nested on this small island. This number declined by over 50% in both 2000 and 2001 (1078 and 495, pairs respectively) and productivity was low due to intense egg predation from coyotes, gulls, striped skunks, and ants. As the number of common terns nesting on New Island declined during these two years, Monomoy National Wildlife Refuge in Chatham, Massachusetts gained thousands of nesting pairs, presumably including some of the New Island birds.

In 2002, for the first time in 20 years (Trull pers. comm) there were no nesting common terns on New Island. Is it clear that predator pressure is the main reason for the decline of common tern and other shorebird nesting on New Island. Over the past five years, shifting sand has connected New Island to Nauset Beach and during low tide this "island" is more accessible to variety of mammals. Electric fencing may be an effective tool to reduce mammalian predation but not practical due to limited staff and the logistics of access. In 2005, after three years, a small colony of approximately eight pairs returned to New Island. Only one chick was observed and it is unknown if it fledged. Predators were believed to be the cause of egg and chick loss. In 2006 and 2007 small colonies continued to nest on New Island (4 pairs and 8 pairs respectively). In both years, all nests were predated by late June.

Other sites that have supported nesting common terns include Coast Guard - Eastham and Race Point North. In 2002, a colony of 112 pairs formed at the southern tip of Coast Guard - Eastham and one pair attempted to nest on Race Point North. The birds from the two sites were likely from the New Island colony and fared no better at these other locations. Gulls, skunks and coyotes predated all nests.

The last nesting attempts on Race Point North occurred in 2003 and 2004. In both years, one pair nested and was likely predated by a coyote.

ROSEATE TERNS

There were no nesting pairs of roseate terns (*Sterna dougallii*) at the Seashore in 2007. In mid to late August, approximately 100 immature and post-breeding adult roseate terns were observed on the mudflats of Nauset Marsh and Jeremy Point (10-50 individuals) from late July through August. In late July through August mixed species tern flocks frequently containing 5-20 post-breeding adult and juvenile roseate terns were observed along Race Point North beaches including Hatches Harbor.

AMERICAN OYSTERCATCHERS

Population and Productivity

Results

The first American oystercatchers (four) were observed on 14 April 2007 at the southern tip of Coast Guard - Eastham. The first nest was laid 2 May. A total of five pairs nested; two at Jeremy Point, two on New Island, and one at Coast Guard - Eastham.

Both pairs at Jeremy point lost their first nest; one to overwash and the other to an unknown predator. Both pairs renested and successfully hatched two chicks. One pair lost both chicks (at 10 and 16 days old) and the other fledged two chicks.

The pair at Coast Guard - Eastham hatched two eggs. On 7 June one recently hatched chick and one egg was observed in the nest. On 8 June, the egg was still being incubated by the adult and the chick was just outside of the nest. On 10 June, only one chick was observed (the second egg or recently hatched chick was gone). The one remaining chick fledged.

Both nests at New Island were lost to an unknown predator.

Discussion

Oystercatchers were first recorded nesting on Seashore beaches in 2002, with two pairs at Jeremy Point and one pair at Coast Guard - Eastham. All three pairs were unsuccessful in fledging any chicks. From 2002 through 2005, the number decreased to two pairs, both at Jeremy Point. During these years, most eggs were lost to predation or overwash. A few hatched, but the chicks disappeared less than one week after hatching. In 2006, the number of nesting pairs doubled to four, including one nest at New Island. Productivity was better, with one chick fledging from Jeremy Point and one from New Island. Productivity in 2007 was still low (0.6/pair), but better than past years.

The North American population of American oystercatchers is estimated at only 7,500 birds Brown et al. (2001). Like plovers and terns, this species is also vulnerable to disturbance from human recreational use of shoreline habitats. The U.S. Shorebird Conservation Plan designates American oystercatcher as a "Species of High Concern," due to low relative abundance, threats

on non-breeding grounds, and rather restricted non-breeding distribution. Because of this, great effort was made in 2007 to reduce human disturbance during incubation and chick rearing (see section IV Beach Management, Protection and Restrictions) including public outreach through personal contacts and signage.

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 2007, two predator exclosure designs were used:

1. *Circular Exclosure* – This design has been used at the Seashore since the early 1990's. The circular exclosure is 10 feet' in diameter and 3 feet high, constructed of 2 x 4 inch wire fencing. A ½ inch plastic mesh bird netting is secured to the top.
2. *Canopy Exclosure* - This design uses 2 x 4 inch fencing to create a 4 x 4 foot square exclosure, 3 feet high. A heavy gauge plastic 2 x 2 inch deer netting is secured over the top and extends for 4 feet from all sides creating a canopy. The canopy is secured with wooden and steel posts. An additional 4 x 6 foot piece of fencing is attached to two of the sides creating a second, domed top.

With concurrence from the MDFW (Melvin, pers. comm.) the majority of incomplete clutches were exclosed to reduce the chance of predation on eggs. If the nest was then abandoned, the 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 exclosed when they were: (1) located in thick vegetation, (2) located on the side of a dune or cliff that precluded us from installing an exclosure due to slope or nest location; or (3) when a group of exclosed nests were abandoned on a single day at a particular site and there were concerns regarding adult plover mortality associated with exclosure use.

Results

Predator exclosures were installed around 79 of the 113 piping plover nests (Table 4). Twenty seven nests had circular exclosures and 52 had canopy exclosures. Of all the exclosed nests, 57 (71%) successfully hatched young. Nest success rates were 69% for canopy and 78% for circular exclosures.

Most pairs accepted the exclosures, but nine incomplete nests were abandoned within a day or two after exclosure installation, presumably a response to placement of the exclosure. These pairs were monitored closely and eventually re-nested. To minimize the risk of a second nest abandonment, exclosures were not placed around nests until birds were actively incubating eggs. At this time, an exclosure was placed around the nest and was left up if birds were observed returning inside the exclosure. Four of these pairs did not accept the exclosure and the exclosures were removed. Of these four unexclosed nests, three were lost; two to coyote predation and one to overwash. At the fourth nest, additional attempts were made to install an exclosure over a two week period, but the birds continued to reject the structure. Finally, twenty-one days into incubation, an exclosure was reinstalled, accepted by the adults, and the pair fledged two chicks.

There were two instances of exclosed nests (one circular and one canopy) being abandoned within a week of predicted hatching. The eggs were examined after abandonment was confirmed (eggs were 45 days old). Seven of the eight eggs had fully-formed chicks inside. No adults from these two pairs were seen again and re-nesting was not observed. The fate of these two pairs is undetermined, but we speculate that one or two of the adults in each pair may have been killed (which may or may not be exclosure related).

In addition to the loss of eggs and nests to predators, there were two documented adult mortalities due to predation, one at a circular exclosure and one at a canopy exclosure. This year, the rate of adult mortality associated with circular exclosures was twice that of canopy exclosures, 4% and 2% respectively (Table 7). Since 2000, the adult mortality rate at circular exclosures has been 1.79%. However, for the past four years when both exclosure types have been in use (2004-2007), adult mortality rates have been 3.31% for circular and 0.87% for canopy exclosures.

Discussion

Review of the past several years' weekly district reports suggests that crows are the greatest threat to plover eggs. Most weeks, the reports note groups of crows (especially during April and May) hunting within plover nesting areas. Most weekly reports also discuss the abundance of crow tracks in nesting areas. However, in 2007, the number of nests lost to crow predation was lower than in past years, four nests total. This low number can be attributed to predator exclosures being quickly installed around nests soon after they were discovered. These nests were often incomplete, before the plovers were actively incubating the eggs.

Based on rates of nest predation from previous years, we believe more nests would have been lost to predators in 2007 if they had not been exclosed and that the benefit of exclosing early (before clutch is complete) outweighs the risk of abandonment. However, while early placement of exclosures is an effective method for protecting eggs, exclosure use has also resulted in adult mortality. Since 2002, there have been at least seven adult mortalities associated with the use of circular exclosures at the Seashore. In an attempt to reduce loss of adults, and with prior approval of the Massachusetts and Federal endangered species coordinators, in 2004 the Seashore began to increase use of canopy exclosures. Although exclosure-related adult mortalities decreased at the Seashore following introduction of this new exclosure design,

plovers continued to be found dead in or near circular exclosures, and in 2007, the first canopy exclosure-associated adult mortality occurred. Most of these deaths were predator related.

Although the number of adult deaths seems low considering that hundreds of nests were exclosed during these years, the loss of breeding adults has a much greater impact on the population than the loss of eggs or chicks. Thus, there is a conflict in that action taken to protect eggs place adults at greater risk. At Crane's Beach in Ipswich, Massachusetts, where canopy exclosures were developed, the new canopy design was initially successful in reducing adult mortality that occurred with the use of circular exclosures. However, after a few years adult mortality associated with canopy exclosures increased dramatically. Plover managers concluded that the level of adult mortality was more damaging than the loss of unprotected nests, and the use of exclosures was discontinued (Inglefinger, pers. com.). With the first loss of an adult associated with the use of a canopy exclosure in 2007, the Seashore may soon be facing a similar situation.

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) leaves. As colony size has decreased over the past several years along Seashore beaches, this behavior has become ineffective and predators appear undeterred by the few birds defending the nesting area.

In 2007, thirty-two tern shelters were distributed throughout three colonies (Coast Guard - Eastham, Marconi Station and Jeremy Point) when the chicks hatched to provide shade and protection from predators. The triangular shelter is approximately 25 x 8 x 8 inches and made of plywood. There is a small 7 x 8 inch opening for the chicks to enter the shelter. Shelter design was taken from the U.S. Fish and Wildlife Service Tern Management Handbook, Coastal Northeast United States and Atlantic Canada (2004).

Chicks were often observed inside shelters. It is difficult to determine if these shelters increased chick survival, but productivity was higher this year at Marconi Station and Jeremy Point (approximately 18-27 fledged) than in the past six years when on average there were fewer than five chicks fledged per year in colonies located in Eastham and Wellfleet.

Other Predator Management Considerations

Predator exclosures only protect plover eggs and do not reduce predation on adults, flightless chicks, or other ground nesting shorebirds. Further, as discussed above, the effectiveness of exclosures varies through time as predators learn to circumvent changes in design. Similarly, tern shelters only protect tern chicks when the chicks are inside, and do not reduce predation on eggs or chicks outside the shelters. Electric fencing has been shown to be an effective method of protecting tern colonies from mammalian predation, but it doesn't restrict avian predators from entering the colony. Electric fencing is very costly and labor intensive to maintain, and would be difficult to use at Seashore tern colony locations. Further, electric fencing is infeasible for protecting dispersed beach-nesting species such as plovers and oystercatchers.

In 2007 the Seashore began exploring direct predator management as a long term means of reducing predation pressure on plovers and terns. In July 2007, a team from the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service made a site visit to Coast Guard - Eastham, and Race Point to discuss selective predator removal (crows and possibly coyotes) at these sites. Following the visit, USDA prepared a proposal and cost estimates for selective predator removal at the Seashore. No action is planned at present; however, we are evaluating the USDA proposal and will continue to monitor the impacts of predation on tern and plover population and productivity.

RECREATION MANAGEMENT

Habitat Protection

Historic shorebird nesting habitat was posted with symbolic fencing and signs 1 April on Race Point North and Race Point South, and by the third week of April on Coast Guard - Eastham, Great Island, New Island, and Jeremy Point. Symbolic fencing was placed around all other areas where nests and active scrapes were found, and where shorebirds were observed exhibiting courtship behavior. Symbolic fencing is used to identify and protect shorebird nesting habitat. Five foot wooden posts were placed 40'-50' apart and connected by a line of cotton twine to delineate nesting habitat. Plastic and wooden "Area Closed- Bird Use Area" informational signs are affixed to every second or third post. A variety of shorebird and natural resource informational and regulatory signs were also posted at the entrance to most beaches and nesting sites.

Kites

When kites are flown in or near nesting habitat, plovers exhibit the same behaviors as when avian predators are present (Hoopes et al. 1992). As it is every year, Coast Guard - Eastham was closed to hand held kites on 1 April and kite flying is prohibited on all beaches within 500 feet of any shorebird nesting site.

In recent years, hang gliding and paragliding have become increasingly popular at White Crest Beach in Wellfleet. The tall bluff at the town's parking lot has become a platform for the gliders to launch from. NPS staff has observed these gliders disturbing nesting plovers and terns when the gliders fly low along the coastline directly over nesting areas. In response to these observations, NPS requested the town seasonally ban this activity during the nesting season. In 2007, the Wellfleet board of selectman unanimously voted to prohibit the launching of para/hang gliders 15 April through Labor Day at White Crest Beach, citing human safety concerns as well as protection of nesting shorebirds along the beachfront.

Bayside beaches in Wellfleet, especially at the "Gut" (NPS and town owned beach), are becoming a popular launching site for kite surfing. These large kites range in size from 7 to 69 square feet and include multiple 80 to 100 foot long lines to attach the kite. They are launched from the beach on windy days and used to pull a kite surfer over the water on a small board. On 4 May 2007, a plover nest was located on NPS property just south of the 175 feet of town-owned

beachfront at the Gut. To protect this nest, the Town of Wellfleet agreed to the park's request to temporarily ban the launching of kites for kite surfing on the north side of this beach. Signs were posted informing visitors of this closure. The beach was re-opened to the launching of kites on 21 June, when the chicks relocated to a remote section of Duck Harbor.

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. As it is every year, Coast Guard Beach - Eastham was closed to pets on 1 April. Sections of bay and ocean beaches in Eastham and Wellfleet were also temporarily closed to pets as needed to protect nesting areas. The pet restriction was necessitated by low compliance with the leash law, combined with the narrowness of the beach, which increased the chance of dog/plover conflict. Signs informing visitors of pet closures were installed and moved as necessary to reflect the closures in effect at any one time. Sections of beach were closed until all chicks fledged. Beaches that did not have nesting shorebirds remained open to leashed pets. A press release was submitted to local media to inform the public of these temporary restrictions.

A total of 245 dogs off leash were recorded in the park from 5 April to 26 August by shorebird monitors. Although this number is still high, field observations seem to suggest that more visitors were keeping their pets leashed than in past years. Unleashed dogs were encountered most frequently on the oceanside beaches in Eastham and Wellfleet (Nauset Light Beach, LeCount Hollow, Coast Guard - Eastham, as well as bayside beaches in Wellfleet (Great Island and Duck Harbor). Dogs off leash were also frequently observed on Race Point South, Wood End/Long Point, and High Head.

In 2007, shorebird monitors began handing out dog biscuits to pets that were observed on leash. This provided an opportunity to talk with the pet owner about the importance of keeping their pets leashed and thank them for complying with park regulations. Pet owners appeared to appreciate the recognition and positive feedback from park personnel and seemed more willing to keep their pets leashed after the encounter. Increased enforcement and the closure of Race Point North and Race Point South to vehicles may have decreased the number of dogs off leash on these beaches.

Pedestrians and Boat Landing

Winter storm erosion continues to narrow beaches in the South District. Where beaches were extremely narrow, it was not always possible to provide sufficient buffer within the symbolic fencing (especially at high tide) to prevent pedestrian disturbance of nesting birds. At sites where this was a problem, beaches were closed at times of high tide or small sections of beach were completely closed. Where possible, detours were established to allow visitors access to other sections of beach. Informational/directional signs were erected informing visitors of these closures. These closures have been very effective with high visitor compliance.

The west side of the north end of Jeremy Point (north of the overwash area) was closed at high tide from 27 May to 18 August. At low tide, there was adequate exposed beach between the

nesting birds and the pedestrians. However, at high tide, the symbolic fencing often extended into the water making it impossible for pedestrians to pass. The east side of Jeremy point remained open. A 0.1 mile section along the southern tip of Jeremy Point (south of the overwash) was closed at high tide (10 June – 28 June) to pedestrians, boat landing and pets to protect a pair of American oystercatchers nesting on this narrow section of beach. A press release was issued to inform visitors of this closure. This beach was reopened when the chicks hatched and interpretive signs were placed requesting that people not linger near the nesting area to reduce chick disturbance.

Approximately 200 feet of the southern tip Coast Guard - Eastham (Nauset Marsh side) was closed at high tide (25 May - 10 June) to protect a pair of nesting American oystercatchers. The nest was located low on the beach, near the high tide line. Because of its location relative to high tide, symbolic fencing could not be extended far enough to provide an adequate buffer between the nest and pedestrians. An alternative route to Nauset Marsh was available to visitors.

Some isolated nests occurred on remote narrow beaches where human disturbance was minimal. In these cases, pedestrians were allowed to pass under the symbolic fencing at high tide. Signs explained the need to move quickly and to stay as close to the water's edge as possible. All nests were exclosed so there was no threat of a visitor accidentally stepping on the nest.

Off-Road Vehicles

Off-road vehicle (ORV) access is permitted along a designated beach corridor in Provincetown and Truro. Management of ORV access along the corridor is guided by a negotiated rule established in 1998, and the 2006 Environmental Assessment: Options for Managing ORV Access (DOI-NPS 2007).

Symbolic fencing along with informational and regulatory signs were posted on Race Point North and South prior to opening the corridor to ORV use on 1 April. Symbolic fencing was placed around all other areas where shorebirds were observed exhibiting courtship behavior and where active scrapes and nests were observed. Vehicles were allowed access to the corridor during the egg laying and incubating phase of the nesting season in areas where there was an adequate protective buffer between the incubating adult plovers and vehicles. To provide accurate predictions of hatching dates, beaches were monitored daily to find nests before clutch completion. To determine the actual date of hatching and ensure that chicks are found as immediately as possible after hatching, nests along the ORV corridor were checked twice daily starting 25 days after nest completion. As nests hatched, sections of the beach were closed to vehicles to protect the flightless chicks. These vehicle closures typically extended about 0.2 miles from the nest location. However, actual closure limits for each brood were adjusted based on beach morphology, brood behavior, or other conditions as appropriate to ensure the chicks were protected. All chicks were monitored daily, noting their movements, location, and number in each brood. Broods adjacent to ORV corridor closures were often monitored twice a day, in the mornings and evenings, to ensure that there was an adequate protective buffer between the flightless chicks and ORVs. Vehicle closures were lifted once broods demonstrated repeated and sustained flight.

Thirty-five pairs of plovers nested within the ORV corridor in 2007. Thirteen pairs nested within the 2.2 mile section of Race Point North, and five pairs nested on Race Point South, north of Exit 8. Seven pairs nested in the 4.9-mile section of Race Point South between Exit 8 and High Head, and ten pairs nested between Head of the Meadow and High Head. Sections of corridor that were temporarily closed to vehicles include portions of beach between Head of the Meadow and High Head for 46 days, Race Point North for 69 days, and Race Point South, between the Race Point South exit and the High Head exit for 67 days. By 28 August all ORV corridors that could be opened under the negotiated rule were opened. Nest distribution, hatching success, and productivity are summarized in Table 1. ORV corridor closings and openings are summarized in Table 6. Additional information on ORV management can be found in the 2007 Off-Road Vehicle Activity Report (CCNS 2007).

EDUCATION, OUTREACH, AND PUBLIC INVOLVEMENT

Educating the public about natural and human impacts threatening nesting piping plovers is important for gaining local support of piping plover management and facilitating their recovery. In 2000, an outreach program featuring a slide presentation and interactive activity demonstrating the impacts of disturbance to plovers was initiated. This program was based on an existing lesson plan from the U.S. Fish and Wildlife Service. Since 2000, in early March through the first week in April, this program has been presented to over 4,000 individuals (mostly elementary grade students and youth groups) throughout the Lower Cape. In 2007, a total of 13 programs were given (32 classes, 620 individuals).

Volunteers donated a total of 322 hours to CACO shorebird management program. Volunteers worked closely with Shorebird Biological Technicians and Student Conservation Association interns (SCAs) in field operations from April through August.

FUTURE MANAGEMENT CONSIDERATIONS

1. Dogs off leash continue to be a chronic problem in the park. Ground nesting birds like plovers and terns are extremely vulnerable to disturbance and predation by unleashed dogs. Increased patrols, enforcement and citations issued by Resource and Visitor Protection Rangers are needed to ensure compliance with the leash law.

In 2008, ocean and bayside beaches in Eastham and Wellfleet should continue to be seasonally closed to pets as soon as plovers exhibit breeding behaviors (scraping, copulating) and sections re-opened when chicks fledge.

The south side of Coast Guard - Eastham and Marconi Beach (if nesting shorebirds are present) should remain closed to pets from 1 April until all chicks have fledged.

In 2008, similar seasonal pet closures should be implemented on beaches in Truro and Provincetown including the Hatches Harbor marsh area from 1 April through the end of August. This closure should include the Dike Road and parking lot accessible from Province Lands Road.

Hatches Harbor is an important feeding area for migrating and staging plovers, terns and other water and shorebirds during the spring and fall migrations. The Hatches Harbor marsh is an important nursery area for Race Point North plover broods.

The Seashore should continue to record incidents of dogs off leash in 2008.

2. In late summer, thousands of migrating shorebirds and terns, including the federally endangered roseate tern, congregate on the mudflats and beaches of Nauset Marsh/Coast Guard - Eastham, Jeremy Point, and Hatches Harbor to feed and rest. These areas are one of the most important staging and roosting areas for these birds on Cape Cod (Hadden 1999, Trull et al. 1999). To reduce disturbance to these birds along these important staging areas, the park should consider extending the pet closure at these sites until Columbus Day.

3. Kite surfing is becoming increasingly popular at the "Gut" on the bayside in Wellfleet (NPS and town owned beach) and at Duck Harbor. It is also gaining popularity along Wood End/Long Point. Presently, the Seashore follows the recommendation of the U.S. Fish and Wildlife Service's Recovery Plan and prohibits kite flying within 500 feet of a plover nesting area. Kites are perceived as predators flying/hovering over the incubating plover, disturbing the bird off the nest and/or causing abandonment. Five hundred feet may be adequate for hand held kites, but this distance is likely inadequate to prevent the plovers from flushing off the nest when the larger surf kite is launched.

In 2007, field observations suggest this sport is becoming more of a threat to nesting shorebirds. On several occasions, shorebird monitors observed the kites being launched very near plover nests. Even when kites were initially launched away from a nest, some kite surfers were observed to capsize away from their launch site, dragging their gear onto the nearest shoreline to re-launch their kite. In some cases, this was observed up to 0.25 miles from the launch site and near nesting shorebirds.

We recommend that the Seashore seasonally ban kite surfing from 1 April until the last chick fledges on all bayside beaches in Wellfleet and Wood End/Long Point in Provincetown. This would include working with and getting the continued support from the Town of Wellfleet and Provincetown.

4. In addition to impacting nesting shorebirds, the setting up and launching of these kites does not appear to be compatible with other beach activities and resource concerns. On several occasions in 2006 and 2007, a kite surfer lost control while trying to launch the kite in the high winds and the kite came close to beachgoers or landed up in the dune or cliff. The owners then had to retrieve the kite causing erosion.

There are also conflicts after launching. In 2007, a kite surfer was observed at the Gut cutting in and out between sandbars, at great speed, approaching dangerously close to the main beach. At one point, he cut into a pool where several children were swimming, coming within ten feet of them. Several surf fishermen have also voiced their concerns over this activity because kite surfing parallel to shore can interfere with and tangle up surf fisherman's lines.

We recommend that park management and staff from the Resource and Visitor Protection and Natural Resource Management Divisions evaluate this activity for compatibility with other park uses, resource concerns, and visitor safety. Other areas where kite surfing would be in conflict with park management goals should be identified, and closures implemented as appropriate. If possible, areas where kite surfing could occur safely and in a manner consistent with park management goals should also be identified.

4. For many years, the south side of Coast Guard - Eastham and Marconi Beach in Wellfleet were closed to pets and hand-held kites on 15 April to protect nesting shorebirds. Since plovers return to these beaches in late March, there were several weeks when pets and kites were permitted on these beaches when plovers were present. In 2006, the southern side of Coast Guard was closed earlier in the season (1 April) to hand-held kites and pets to better reflect the arrival date of the plovers. It is recommended that the date to restrict kites and pets be evaluated on a yearly basis by the Chief of Natural Resources and shorebird biological technicians. A press release should be issued to inform visitors of these closures dates.

5. The distal tips of barrier spits have long been important sites for piping plovers and colonial nesting shorebirds. Their physical features and sparse vegetation provide high quality nesting and roosting habitat. Even more importantly, the distant ends of peninsulas provide a high degree of protection from land based predators, and because they are often distant from centers of human activity, have traditionally provided beach nesting birds with some of the least disturbed sites available. Historically, the southern tips of Coast Guard - Eastham and Jeremy Point, and the eastern tip of Long Point have received little visitation because they were difficult to get to, requiring individuals to hike several miles in the sand. These narrow peninsulas provide important nesting and foraging habitat for piping plovers and other shorebirds. The remoteness of these areas ensured a rare sanctuary free of most human disturbances and a “wild” beach experience for adventuresome visitors.

In recent years, these once remote beaches have become a popular destination for boaters. Now, on any given day in the summer, it is not uncommon to see motor boats, kayaks and canoes lining the shoreline with 50 to 100 or more people on the beach barbecuing, picnicking, playing sports, and sun bathing. Pets often accompany boaters and are brought onto the beach, and food scraps that could attract predators are often left on the beach. In addition, once onshore, boaters' activities tend to be focused around one location for an extended period of time resulting in prolonged periods of disturbance to nesting shorebirds in contrast to the short-term transient disturbance associated with walkers and hikers. Aggravating the disturbances from increased recreational use is the narrowing of these beaches over the last several years, making it even more difficult for the Seashore to provide an adequate buffer between the birds and beach-goers, especially at high tide.

Although posted with regulatory and informational signs, closed area violations appear to be greater where boaters are recreating, as there are generally more bare footprints inside closed nesting areas where boaters are recreating than along other posted areas on the beach. In 2007, Seashore staff presence at these sites was limited even during times of high visitation. At most, Shorebird Biological Technicians and SCA Interns were present daily for 30-minute to one-hour and Resource and Visitor Protection Rangers were present once per week

The following measures should be implemented to better protect nesting shorebirds and terns using these habitats:

- To increase compliance with shorebird protection measures, Resource and Visitor Protection Ranger patrols should occur at a higher frequency in areas where boat landing is allowed, particularly during the high visitation months of June, July, and August. If possible, daily patrols should occur before and during the Memorial Day and Fourth of July holidays. In 2008, that would include Friday, May 23 through Monday, May 26, and Thursday, July 3 through Monday, July 7.
- Due to the increasing difficulty of providing an adequate buffer between visitors and nesting shorebirds, the southern end of Coast Guard - Eastham should be closed to boat landing while nesting shorebirds are present.
- Similarly, the northernmost section of Jeremy Point should be closed to boat landing during the nesting season. Over the last several years, shorebird nesting has not occurred on the southern end of Jeremy Point; furthermore, the southern tip appears to be a preferred location for boaters to land. Boat landing should continue to be allowed on this southern portion of Jeremy Point.
- Implementation of the Special Use Permit for the Flyer's Boat Rental shuttle service to Long Point should be monitored to determine if the provisions of the permit adequately protecting the shorebirds nesting on Long Point.

It is important to note that other NPS sites including Gateway, NRA, Breezy Point District and Assateague Island National Seashore have successfully limited boat landing on beaches to protect nesting shorebirds.

6. The rapid decline in least terns, common terns, and laughing gulls needs to be evaluated both by the park and by Massachusetts and Federal endangered species coordinators. The use of decoys and electric fencing should be investigated to reestablish historical nesting colonies by these species.

7. In 2008, buffer areas (areas free of Self-Contained Vehicles) should be expanded between plover nests and established SCV areas on North District beaches. These buffers are to reduce disturbance to nesting plovers from dogs and visitors that are present overnight in SCV areas. Dogs that are present overnight contribute an increased level of disturbance due to nighttime barking, an increased incidence of dogs off leash within the area and an increased level of dog presence overall. Visitors present within the SCV areas also increase the level of disturbance through overall increased pedestrian traffic; specifically during important foraging times of early evening hours, night hours, and early morning hours. The presence of campfires, lanterns, and other lights may also disturb nesting plovers.

8. The Seashore should begin planning for improved predator management. This planning effort should follow the procedures required by the National Environmental Policy Act (NEPA) and the NPS implementing guidelines. Actions to consider should include continued use of exclosures, improved management of beach trash and fish carcass disposal, electric fencing, predator deterrence measures, and targeted predator removal. A preferred alternative would likely include a combination of these measures. USDA Wildlife Services should be invited to be

a cooperating agency in this effort. Parallel to planning, the Seashore should pursue increased funding to support improved predator management.

9. An approved U. S. Fish and Wildlife Service /Massachusetts Division of Fish and Wildlife Standard Operating Procedures (SOP) for shorebird management is needed.

10. To accomplish the monitoring and management necessary to successfully fulfill the requirements of the U.S. Fish and Wildlife Service Piping Plover Atlantic Coast Population Revised Recovery Plan (1995), reliable 4x4 vehicles and ATVs need to be consistently available. These vehicles are required to access beaches, haul equipment, and transport staff. Vehicles that are regularly used for beach purposes degrade more rapidly and become unavailable due to mechanical repairs more frequently than other vehicles. New vehicles should be purchased more frequently or additional vehicles should be available for the shorebird monitoring and management program.

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Table 5. Summary of piping plover nesting parameters at Cape Cod National Seashore, 2000-2007.

Year	# Pairs	# Nests	# Eggs Laid	# Successful Nests	# Hatched	# Fledged	Nest Success Rate	% Renests	Hatch Rate	Fledge Rate	Productivity
2000	64	121	415	48	154	73	40%	47%	37%	47%	1.14
2001	78	88	317	61	223	155	69%	11%	70%	70%	2.04
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
mean	80.56	114.13	389.63	58.13	198.75	115.25	52%	29%	53%	57%	1.44
median	81.00	116.50	396.50	58.00	204.50	123.00	48%	28%	51%	55%	1.50

Table 7. Summary of adult mortality by exclosure type, 2000-2007.

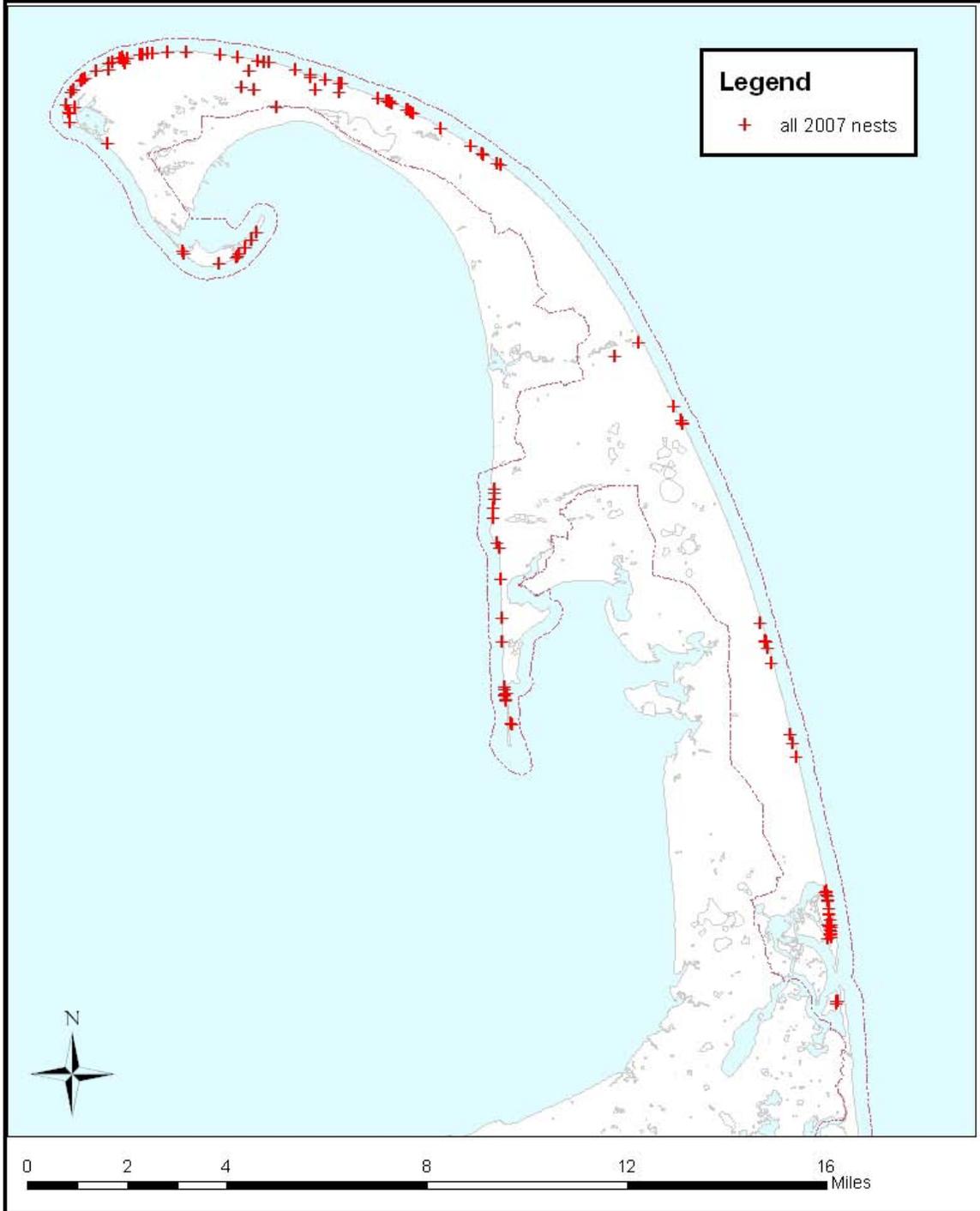
Year	# Circular	# Deaths	Rate	# Canopy	# Deaths	Rate
2000	92	0	0.00%	0	0	
2001	70	0	0.00%	0	0	
2002	77	1	1.30%	0	0	
2003	57	2	3.51%	0	0	
2004	57	3	5.26%	5	0	0.00%
2005	35	0	0.00%	12	0	0.00%
2006	32	1	3.13%	46	0	0.00%
2007	27	1	3.70%	52	1	1.92%
Overall	447	8	1.79%	115	1	0.87%

APPENDIX A

Maps of 2007 Piping Plover and American Oystercatcher Nest Sites at Cape Cod National Seashore

Piping Plover Nests 2007

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Piping Plover Nests 2007

New Island, Orleans

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

-  Piping Plover Nests



Piping Plover Nests 2007

Coast Guard Spit Eastham

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

- Piping Plover Nests



Piping Plover Nests 2007

Marconi Beach, Wellfleet

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

- Piping Plover Nests



Piping Plover Nests 2007

LeCount Hollow - Marconi Station, Wellfleet

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

○ Piping Plover Nests



Piping Plover Nests 2007

Bound Brook Island - Duck Harbor, Wellfleet

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

○ Piping Plover Nests



Piping Plover Nests 2007

Great Island, Wellfleet

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

- Piping Plover Nest Sites



Piping Plover Nests 2007

Jeremy Point, Wellfleet

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

-  Piping Plover Nests



Piping Plover Nests 2007

Ballston Beach

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Piping Plover Nests 2007

High Head (South), Truro

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

Piping Plover Nests

- Piping plover nest
- ▲ Beach access



Piping Plover Nests 2007

High Head, Truro

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

Piping Plover Nests

- Piping plover nest
- ▲ Beach access



Piping Plover Nests 2007

Race Point (south - 2)

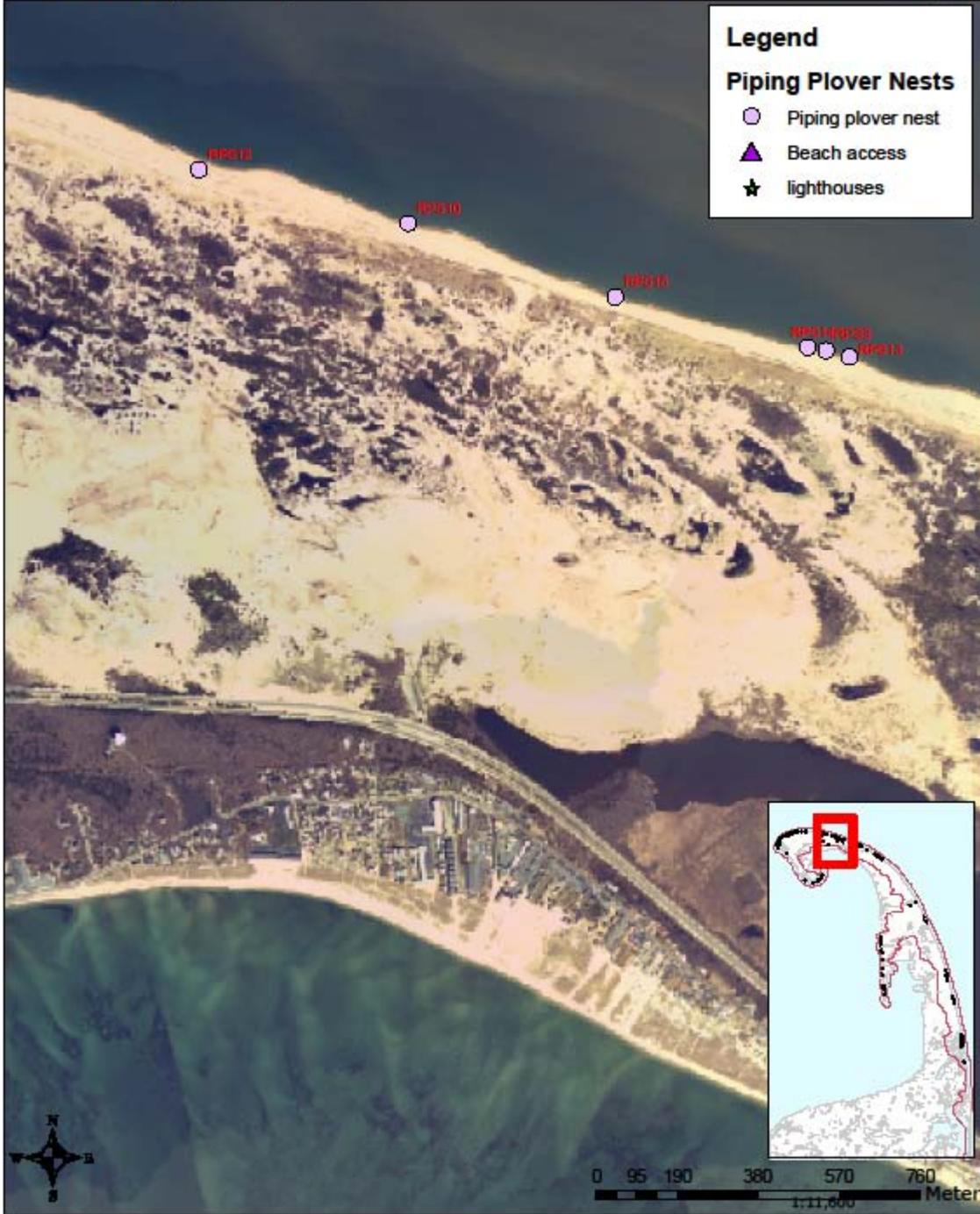
Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

Piping Plover Nests

- Piping plover nest
- ▲ Beach access
- ★ lighthouses



Piping Plover Nests 2007

Race Point (North)

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior



Legend

Piping Plover Nests

- Piping plover nest
- ▲ Beach access
- ★ lighthouses



American Oystercatcher Nests 2007

Coast Guard Beach and New Island, Eastham MA

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior

Legend

-  American Oystercatcher Nests



American Oystercatcher Nests 2007

Jeremy Point

Cape Cod National Seashore
National Park Service
U. S. Department of the Interior

Legend

 American Oystercatcher Nest

