

**Monitoring and Management of Piping Plovers and
Colonial Waterbirds at Cape Cod National Seashore
2001**



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ABSTRACT

This report summarizes the 2001 Piping Plover and waterbird nesting season for Cape Cod National Seashore (CACO). Piping Plover nesting and brood-rearing were monitored at 9 beaches in Cape Cod National Seashore from Provincetown to Orleans. Observations of Piping Plovers began mid March. Seventy-six pairs of plovers were monitored at these 9 sites. Egg-laying began in the third week of April in the North District and the fourth week of April in the South District. Peak nesting occurred during the last week of May and first week of June. Peak hatching occurred in the last week of June, first week of July. Hatching success was 70%. Fledging success was 70%. Productivity was 2.04 fledged chicks/pair. Thirty-one percent of all nests initiated failed to hatch at least 1 chick. Abandonment and unknown predators were the leading causes of nest loss. Of 70 exclosed nests, 58 (83%) successfully hatched young. Of the 12 exclosed nests that did not hatch, 10 (83%) failed due to abandonment. Of the 18 unexclosed nests, 13 (72%) failed to hatch. Of these 13 nests, 7 (54%) were lost to unknown predators, 2 (15%) were lost to gull, and 2 (15%) were lost to crow depredations. This was the fourth year the 1995 negotiated rule for ORV management was in effect. Twenty-four pairs of plovers nested within the ORV corridor. Sixteen of these pairs nested in the 4-mile section of Race Point South Beach (closed 1 April to at least 22 July) and between Head of the Meadow and High Head. Additional beach-closings, beyond those imposed by the negotiated rule were required. As a result, all but approximately 0.9 miles of the South Beach was closed for approximately 35 days and 0.6 miles of North beach was closed for 45 days. By 6 August, all ORV corridors that could legally be opened under the negotiated rule were opened. For the second year, the ORV access at Head of the Meadow was available to ORV use.

INTRODUCTION

Cape Cod National Seashore (CACO) was authorized by congress in 1961 as a unit of the National Park Service. The Park preserves approximately 44,600 acres of uplands, wetland and tidal lands located on Outer Cape Cod. As reflected in CACO's enabling legislation (Public Law 87-126), this unit of the National Park System was established, in part, to protect the area's outstanding Natural Resources including Federal and/or State listed rare animals.

The Seashore provides miles of prime feeding, nesting and roosting habitat for beach-nesting birds, including the Piping Plover (*Charadrius melodus*). This species was federally listed in 1986 as threatened (Federal Register 1985). At that time, there were 139 pairs estimated to be nesting in the Commonwealth of Massachusetts.

In 1985, CACO began a Piping Plover monitoring/protection program and 18 pairs nested on beaches managed by the Seashore. Productivity (number of chicks fledged per pair) that year was less than 1 chick fledged per pair (Figure 1). Over the next several years, numbers of plovers nesting in the Seashore decreased while numbers of plovers nesting in the state remained relatively stable. Eventually, numbers of nesting plovers rose significantly, both at Cape Cod National Seashore and throughout Massachusetts. In 2001, 76 pairs, representing approximately 15% of the state total, nested on CACO beaches. This report summarizes the results of the 2001 Piping Plover/Colonial Waterbird monitoring and management program at Cape Cod National Seashore.

STUDY AREA

Piping Plover were monitored on 9 beaches in Cape Cod National Seashore from Provincetown to Eastham encompassing approximately 70 km (30 mi) of beach. These study beaches were divided among two districts. The North District which included all NPS beaches in Provincetown and Truro (Wood End/Long Point, Race Point Beach North, Race Point Beach South, High Head, and Ballston) and South District located in Eastham and Wellfleet (Great Island/Jeremy Point, Bound Brook, LeCount Hollow, Marconi Beach, and Coast Guard Beach).

PRE-SEASON ACTIVITIES

To ensure protection of nesting Piping Plovers, Coast Guard Beach and Marconi Beach were closed to pets and kite flying on 20 April 2001. Kite flying was also prohibited in the North District near any potential plover nesting sites. Large signs were installed to inform beachgoers of these restrictions, and a press release was submitted to the local media.

Historic plover nesting sites (Coast Guard, Marconi, and Jeremy Point) were closed with symbolic fencing/signs, installed by the second week of April. Various plover/tern informational and regulatory signs were posted at the entrance of most beaches and at the nesting site.

METHODS

Daily observations of Piping Plovers began on 1 April, just after the plover's arrival and continued through August when plovers are observed in their southward migration. In April, during the period of arrival and courtship, most beaches were visited three to four times per week. The exception was Great Island, monitored every 2-4 days. Once nests were established, all beaches were visited almost daily (≥ 5 times per week) except for Great Island/Jeremy Point which was visited 2-3 times/week.

During the nest location phase, monitors searched the beach for the presence of plovers, nests scrapes and plover tracks in the sand. All active scrapes (potential nests) were marked with a few pieces of driftwood approximately 1 m away from the nest so that the scrape could easily be found on return visits. A concentrated area of plover tracks often meant a plover nest/ or potential nesting site was nearby, as did any plover exhibiting the "broken-wing" behavior. Nests were also found by searching for birds sitting low in the sand, incubating a nest. A signed closure was placed around all active scrapes and nests.

To provide accurate predictions of hatching dates, efforts were made to find nests before clutch completion. The ability to predict hatching date is especially important in managing and protecting the plovers along the ORV corridors. Sections of beach are closed to vehicles in the

corridor when chicks hatch out. Nest searching continued through mid-July. Signs and symbolic fence protected each nest or nesting area.

Predator exclosures were installed around most nests upon clutch completion, although there were some exceptions. With permission from the State, some incomplete clutches were exclosed if the chance of predation on eggs was imminent (as we experienced at Marconi Beach in 2000).

Several nests were not exclosed because they were either: (1) located in thick vegetation and adults were prone to fly off the nest when disturbed, creating a potential for entanglement in the exclosure top; (2) were located on the side of a dune that precluded us from installing an exclosure due to slope or nest location; (3) the pair abandoned their first nest which may have been caused by the presence of the exclosure.

In the North District, four-wheel-drive (4WD) vehicles and all-terrain vehicles (ATV's) were used to access all sites. Once chicks hatched out, however, ATV's were the preferred conveyance for most beaches especially Wood End/Long Point. In the South District, Great Island was accessed by 4WD vehicle and on foot. Marconi and Coast Guard beaches were accessed primarily by foot.

RESULTS AND DISCUSSION

Seasonal Chronology

Plovers were first observed on Cape Cod National Seashore beaches on 16 March and most beaches had plovers present by mid-April. Plovers continued to arrive into mid-June. It is likely that some of these later arriving birds may have lost nests at other sites before moving to Seashore beaches.

Egg-laying began in the fourth week of April in the North District and the fifth week of April in the South District. Peak nesting for the Seashore occurred during the last week of May and the first week of June (Fig. 2). The last nest was initiated on 10 June at Great Island. This nest fledged one chick on 10 August. Peak nesting for the Seashore this year was consistent with the patterns exhibited in years past. However, prior to the use of exclosures, peak nesting typically occurred 1-2 weeks later in the season (MacIvor et al. 1987a).

Greatest number of chicks occurred during the last week of June and first week of July (Fig. 3). Hatching dates ranged from 31 May to 12 July. Fledging dates ranged from 25 June to 10 August. These dates are comparable to previous years.

Productivity

Seventy-six pairs of Piping Plovers were monitored at 9 sites in Cape Cod National Seashore in 2001 (Table 1). This represents approximately 15% of the total breeding population in Massachusetts. Number of nesting plovers at the 9 sites monitored increased by 14 % from 2000. The greatest increase in number of nesting pairs from 2000 occurred at Great Island/Jeremy Point, where numbers rose from 12 to 19 pairs. For the first time in recent history, a pair nested on the beach at Bound Brook. Coast Guard Beach, Marconi Beach, and Ballston Beach decreased by only one pair per site. All other sites monitored increased in total number of pairs.

Hatching success (total number of eggs hatched/total number of eggs laid) for all sites combined was 70% and ranged from 49% to 100% (Table 1). Overall, hatching success was 89% higher than in 2000. High Head (100%), Ballston Beach (100%), Race Point North (96%), Wood End/Long Point (96%) and LeCount (87%) had the highest hatching success; while Marconi (68%), Great Island/Jeremy Point (57%), and Coast Guard (49%) had the lowest hatching success (Table 1). Hatching success throughout the park and state increased this year. This increase was probably due to the absence of any strong storms such as last year's June 6 storm (which devastated the entire state) or extreme hot or cold temperatures.

Fifteen percent of the nests that hatched left at least 1 egg in the scrape. This is considerably less than in the mid-'90's when 20 -35% of nests failed to hatch 1 or 2 eggs. Partially hatched clutches may be reflective of younger, less experienced birds' attempts at nesting. The reason for the differences in numbers of unhatched eggs between years is unknown.

Fledging success (total number of chicks fledged/total number of eggs hatched) for all sites combined was 70% and ranged from 53% to 100% (Table 1). Overall, fledging success increased 49% from 2000. High Head (100%), Race Point South (82%), and Marconi (80%) had the highest fledging success; while Great Island/Jeremy Point (57%), LeCount (57%), and Coast Guard Beach

(53%) had the lowest fledging success (Table 1). Fledging success at High Head is consistently high, but represents few nests.

Productivity (number of chicks fledged/nesting pair) for all sites was 2.04 (155 chicks fledged from 76 pairs) and ranged from 1.10 to 4.00 (Table 1). The North District has the highest productivity of any single site in the state (2.61 chicks/pair). The South District was less successful and fledged 1.53 chicks/pair. Overall, productivity increased significantly, rising 79% from 2000 when only 1.14 chicks fledged/pair. Determining the factors that influenced this increase in productivity is difficult but may include favorable weather conditions such as: (1) the absence of any major storms or extremely high tides during the egg laying phase, allowing many of the first nesting attempts to be successful and (2) a relatively cool summer with average rainfall.

High Head (4.00), Ballston Beach (3.00), and Race Point North (2.71) had the highest productivity; while Great Island / Jeremy Point (1.50) and Coast Guard Beach (1.10) had the lowest productivity (Table 1). It is important to note that productivity greater than 1.25 is required for maintaining the population at current levels. The goal of the Atlantic Coast Piping Plover Recovery Plan is to maintain productivity at a minimum of 1.5. Productivity at Cape Cod National Seashore significantly exceeded productivity statewide, which is just above the 1.25 needed for population maintenance. Therefore, it is expected that there will be no substantial loss of the breeding pairs next year and it is likely a slight increase in total nesting pairs will occur both at the Seashore and statewide.

Nest Loss

Thirty one percent (27 of 88 nests) of all nests initiated failed to hatch at least 1 chick (Table 2). This is a 48 % decrease from 2000 when 73 of 121 nests were lost; the majority due to overwash. Three of the four South District beaches lost at least one nest; while only one beach in the North District lost at least one nest in 2001 (Table 2). Abandonment after the nest was exclosed (n=10), unknown predators (n=8), and gull depredation before an exclosure was installed (n=3) were the leading causes of nest loss, accounting for 21 (78%) of the 27 nests lost (Table 5).

Predator Exclosures

Predator exclosures were installed around 70 of the 88 (80%) nests. Of the 70 exclosed nests, 58 (83%) successfully hatched young. Of the exclosed nests that did not hatch, 10 (83%) failed due to abandonment (Table 6). Of the 18 unexclosed nests, 13 (72%) failed to hatch. Of these, 7 (54%) were lost to unknown predators, 2 (15%) were lost to gulls, and 2 (15%) were lost to crows (Table 6). Ten of the 18 unexclosed nests were lost prior to clutch completion.

Nest abandonment in exclosed nests accounts for the single greatest loss of nests in 2001. Compared to 2000, the South District experienced over a 20% increase in nest abandonment in exclosed nests (Table 7). Coast Guard Beach and Great Island/Jeremy Point both had 27% of all exclosed nests abandoned. Some of these abandonment can be explained, but most cannot (Table 7). Although some exclosures were placed around an incomplete nest, most nest abandonment occurs several days to weeks after clutch completion and acceptance of the exclosure by the pair was observed.

One exclosure at Great Island was taken down immediately after it was installed around a four-egg nest. The pair was exhibiting distress behavior (running in and out of the exclosure) and did not resume incubation. When exclosure was removed, the female sat back on the nest.

Mortality

Chick mortality factors are extremely difficult to assess. Most of the time chicks are lost; there is no evidence as to why. A chick was presumed dead only when it was never seen again before the remainder of the chicks in the brood fledged. A brood was considered lost only when there was no sign of the chicks after five consecutive days of searching. Most chick mortality at the 9 sites occurred within the first 10 days after hatching. This pattern is consistent with data from previous years (MacIvor 1990, Brown and Hoopes 1993). This year, we could not directly attribute chick mortality to any specific factor.

Implementation of the Negotiated Rule

ORV Management -- ORV management, as it relates to plover management at Cape Cod National Seashore, is a dynamic process. This was the fourth year of the negotiated rule of 1995. We observed no direct negative impacts to Piping Plover adults and chicks in 2001.

Plover management -- This year, 24 pairs of plovers nested along the ORV corridor (5 more pairs than in 2000). While 16 of these nests were in the area closed by the Negotiated Rule during the first part of the season, there were 10 nests that were in areas open to ORV traffic. As these nests hatched, affected sections of the ORV corridor were closed to vehicles. Closures were imposed only when eggs hatched and were kept in effect through the chick-rearing stage until fledging. The North Self Contained area was moved once due to an expected hatching. On 5 June approximately 0.8 miles of the North Beach was closed due to a nest hatching, leaving 0.8 miles open. On 20 June an additional 0.2 miles was closed due to nest hatching, closing 1 mile of the North Beach and leaving 0.6 miles open. The presence of Piping Plover chicks caused the closure to ORV traffic on portions of the North Beach for a total of 45 days while unfledged chicks were in the area. On 6 August the entire North Beach oversand route was opened to ORV traffic due to the absence of Piping Plover chicks and the seasonal widening of the beach to the Race Point Light area. The South Beach was closed between Exit 8 and south of the South Self Contained approx. 1.3 miles for 35 days, starting on 5 June, while 3 broods of unfledged chicks were in the area. As chicks fledged, portions of the ORV corridor that could be opened, were. Approximately 0.3 miles of beach from High Head ORV access south was opened on 1 July. Additionally, the park opened 0.1 miles at Head of the Meadow ORV access. The entire stretch of beach between Head of the Meadow and High Head was open for a 5 plus week period beginning 26 July. By 6 August, the entire ORV corridor was reopened to vehicles. For a more detailed account of ORV corridor management, see Table 10 written in fulfillment of requirements of the negotiated rule.

COLONIAL WATERBIRDS

Least Terns

The Least Tern returned to Cape Cod National Seashore during the second week of May. Egg laying began the last week of May, with most Least Terns on eggs by 15 June. The first chick was observed on 16 June in the North District.

A total of 145 pairs nested on four beaches in the South District (Table 9). Approximately 80% of the first nesting attempts were predated by 20 June. Tracks indicate coyote and skunk to be the major predators. Most pairs re-nested with some shifting of nesting locations. Egg predation continued. It was not uncommon to walk through a colony and observe many nests, only to return a week later to find empty scrapes. This pattern continued through the season. A total count of 8 chicks was observed in the entire District. Productivity was almost non-existent.

The North district fared much better. A total of 130 pairs nested on five beaches (Table 9). Some minor egg predation by coyote and other unidentified predators occurred, especially at Wood End and Long Point. Visual estimates of the fledglings suggest a relatively productive year.

Common Terns

Common Terns were first sighted on 10 May. A lone pair at Jeremy Point laid the first nest on 7 June. Other sites with only one nesting pair include Coast Guard Beach, Eastham and Wood End. New Island continues to support the majority of nesting pairs. As outlined in the Waterbird Monitoring Protocol (Erwin and Cook 1999) a nest count was conducted on 15 June by a team of nine people walking a breast through the colony. A series of transects were established and the number of eggs and nests found in each was recorded. A total of 482 nests were counted on this date. This is the second consecutive year where we experience a dramatic decline in nesting pairs (Table 8). However, Monomy NWR in Chatham, MA gained thousands of nesting Common Terns in 2001. Presumably, some of the nesting pairs that were present on New Island over the past several years relocated to this site. There is probably a constant exchange of birds between these two areas throughout the season and on a yearly basis.

To estimate the efficiency of the nest count, the team marked all nests found in two of the seven transects with red Popsicle sticks. They then retraced their path (from the opposite direction) and recorded the number of nests the second time that were marked versus unmarked and applied the Lincoln Index. This showed that some nests were overlooked and the colony size was underestimated by 2.2 %. The total corrected population estimate, using the Lincoln Index, was 493 nests.

Weekly visits were made to monitor nesting pairs. On 4 July, birds were still incubating eggs and no chicks were observed. Over 20 eggs were found predated; most with 1-2 small liner puncture holes. This bite hole patterning is probably due to some avian predator. Coyote tracks were also a common sight.

On 8 July, we found only nests with eggs. Eggs were warm and viable. Since the majority of Common Terns nesting in the state had hatched out by this date (Mostello per. comm.), we had expected to see many young Common Terns running around the colony.

By 12 July, only two chicks were observed peeping out of their egg. Many nests (15+) looked abandoned (eggs disheveled in the nest and cold) and 30+ eggs were scattered throughout the colony with the same puncture hole patterning observed on previous visits.

This scenario continued throughout the season. Only five Common Tern chicks were ever observed on the island, none of them older than 1 week. These chicks disappeared on follow-up visits. Many eggs also disappeared, were left in the nest, or eaten. For the second consecutive year, productivity was non-existent on New Island.

Ant predation on eggs and young chicks seemed to be the major factor for low productivity in 2000. This year, avian predation on Common Tern eggs seems to be the major factor. The specific avian predator is unknown.

In addition to its direct impacts, predation may also influence incubation period. Disturbance by crepuscular or nocturnal predators would cause the incubating terns to fly off the nest and leave the colony for several hours or overnight, leaving the eggs exposed and easily predated. Not only does this lead to high egg predation, several studies have correlated this nighttime nest abandonment with prolonged incubation periods. Nisbet and Welton (1984) found that the incubation period at Monomoy

extended up to 7 days longer with heavy nocturnal disturbance. If in fact incubation was extended, it would increase the chance of egg depredation by various predators and reduces the chance of an egg successfully hatching out.

Coyotes may have also played a part in egg and chick predation and their impact on the colony will probably increase in years to come. Now, at low tide, a coyote or other mammal (including beachgoers) can easily gain access to the eastern side of New Island as it continues to accrete and connect with Nauset Beach, Orleans.

Roseate Terns

A total of four pairs of Roseate Terns nested on the southeast corner of New Island (Table 8). One pair successfully hatched one chick. This 1-2 day old chick was observed only once, never to be seen again. Eggs were predated in two nests and one nest was abandoned. It is uncertain what caused the abandonment or if the eggs were ever viable. No renests were ever found.

Arctic Terns

Three pairs of Arctic Terns have nested on the southwest corner of New Island for 25 years (Trull pers. comm.). This year was no exception. Three nests were found and monitored throughout the season (Table 8). By 29 June two of the nests were predated. The third nest was gone, presumably predated by 4 July. No chicks were ever observed. This site represents the southernmost nesting location of Arctic Terns in the United States.

Black Skimmers

Three pairs of Black Skimmers nested on New Island. Although a relatively low number, this represents the only nesting site in the state. On 12 June, a four-egg nest had only one egg remaining in the scrape. This egg was predated and had a small puncture hole similar to that observed in Common Tern eggs. An additional one-egg nest was also predated. This egg had a somewhat larger hole left by the predator. The third remaining two-egg nest lost one egg at a time over a period of 1

week to some unknown predator. No renesting occurred. New Island is the northernmost nesting location of the Black Skimmer in the United States.

Laughing Gulls

The largest Laughing Gull colony in the state is found on New Island. On 15 June, a total of 466 Laughing Gulls nests were counted (Table 8). The Lincoln Index (see Common Tern section for methodology) revealed that we underestimated nesting pairs by 9 %. The total corrected population estimate was 517 pairs, a decrease of 204 pairs from 2000. Number of nesting pairs has slowly declined over the past three years (Table 8).

Like the Common Tern, Laughing Gull eggs and chicks were depredated. On 29 June, no chicks were observed and few eggs were found predated. The first chicks were observed on 4 July. On this date, 5 nests had 1-3 day old chicks. There were also 3 dead chicks in two nests in close proximity to each other along with several broken eggs that were predated. Coyote tracks were observed throughout.

On 7 July, nine nests with 1-2 day old chicks were observed. None of the older chicks from 4 July were observed.

This pattern continued. On 12 July, three nests with 1-2 day old chicks were observed. No older chicks from 7 July were observed. Ten < 1-week-old chicks were observed dead in and out of the nests and scattered throughout the colony. Many eggs were out of their nests with the familiar punctures made by a predator.

On 3 August, four 1-2 week old chicks were observed in the colony and may represent the only individuals that could have possibly fledged from this site.

Avian predators are probably the cause of most of the egg predation. Cause of chick mortality is unclear.

Conclusion

As in most years, we have more questions than answers as to causes of such low productivity for all species nesting on New Island. In 2002, staff will continue to monitor the site. Nighttime observation of the colony is needed.

MANAGEMENT RECOMMENDATIONS

1. Several nests on Jeremy Point were located on very narrow sections of beach. To provide the necessary buffer between the incubating plover and pedestrians, 0.2 miles of beach were closed to pedestrians until all eggs hatched. This practice was effective, well received by the public and should continue if needed in 2002.
2. The Great Island (GI) and Jeremy Point (JP) area has been one of the most productive nesting areas for Piping Plovers and Least Terns, largely because it is remote. In order to get to JP, visitors must walk nearly 4 miles from the closest parking lot. Along with hikers, it is common to see a small cluster of boats coming ashore to spend the day at the tip of JP. Presently, human activity in this area is low. However, there is concern about increased use of this area in the future, especially by boaters. Because of JP's narrowness, nesting shorebirds are especially vulnerable to human disturbance. In order to better protect nesting shorebirds while providing access to this area, park managers should consider designating specific boat landing areas north of the spit between 1 May and 31 August.
3. Because many of the Protection Rangers are certified motor boat operators, water-based, rather than vehicle, patrols should be initiated around the GI and JP area, especially during times when heavy human use of the area is anticipated (e.g., Memorial Day, July 4th weekends).
4. Every effort should be made to bring SCA's on by 1 May.

Figure 1. Number of Piping Plover breeding pairs and nest productivity on beaches managed by the National Park Service, Cape Cod National Seashore, 1985-2001.

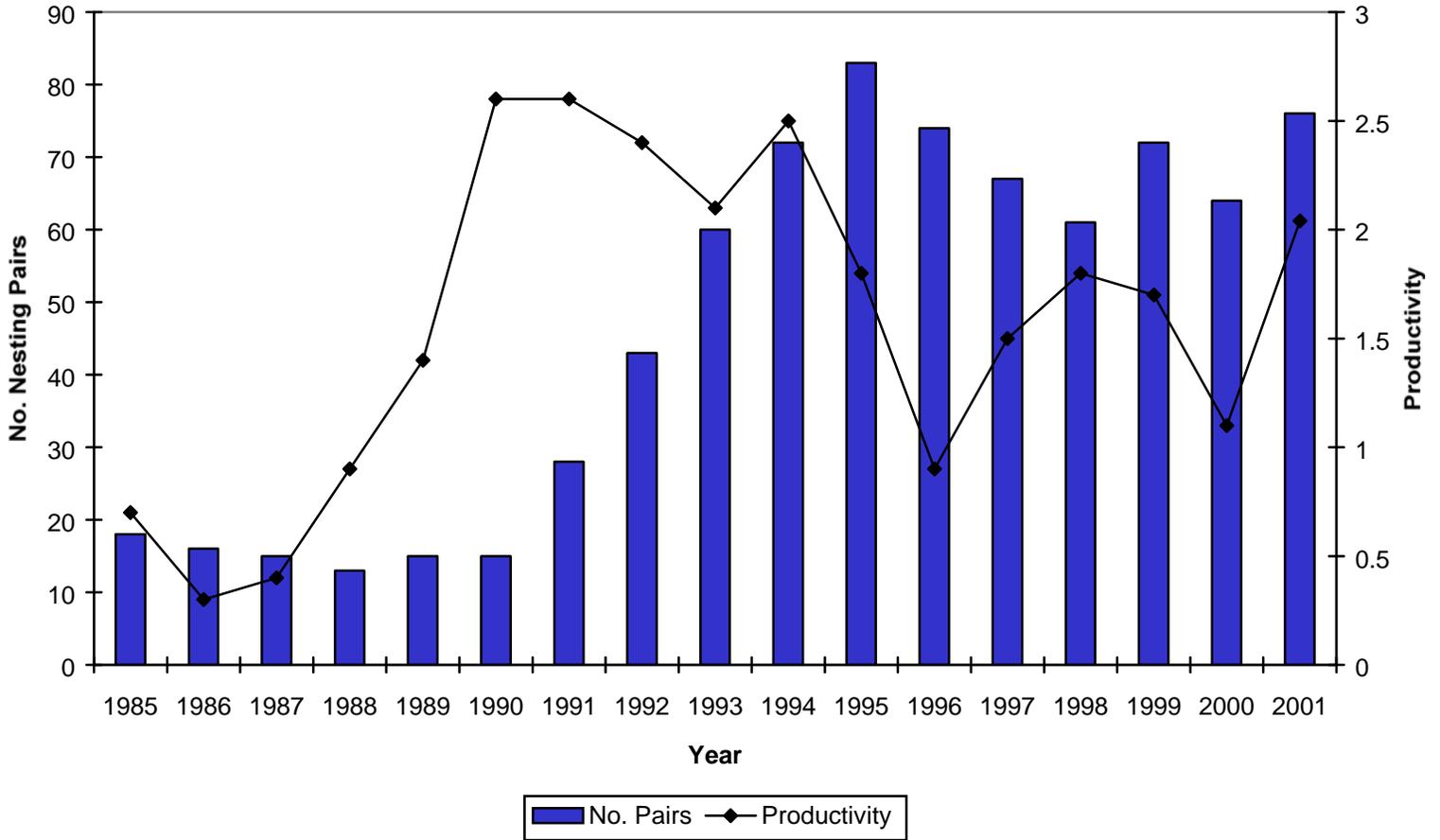


Figure 2. Nesting chronology of active nests in the North and South districts and in total, Cape Cod National Seashore, 2001.

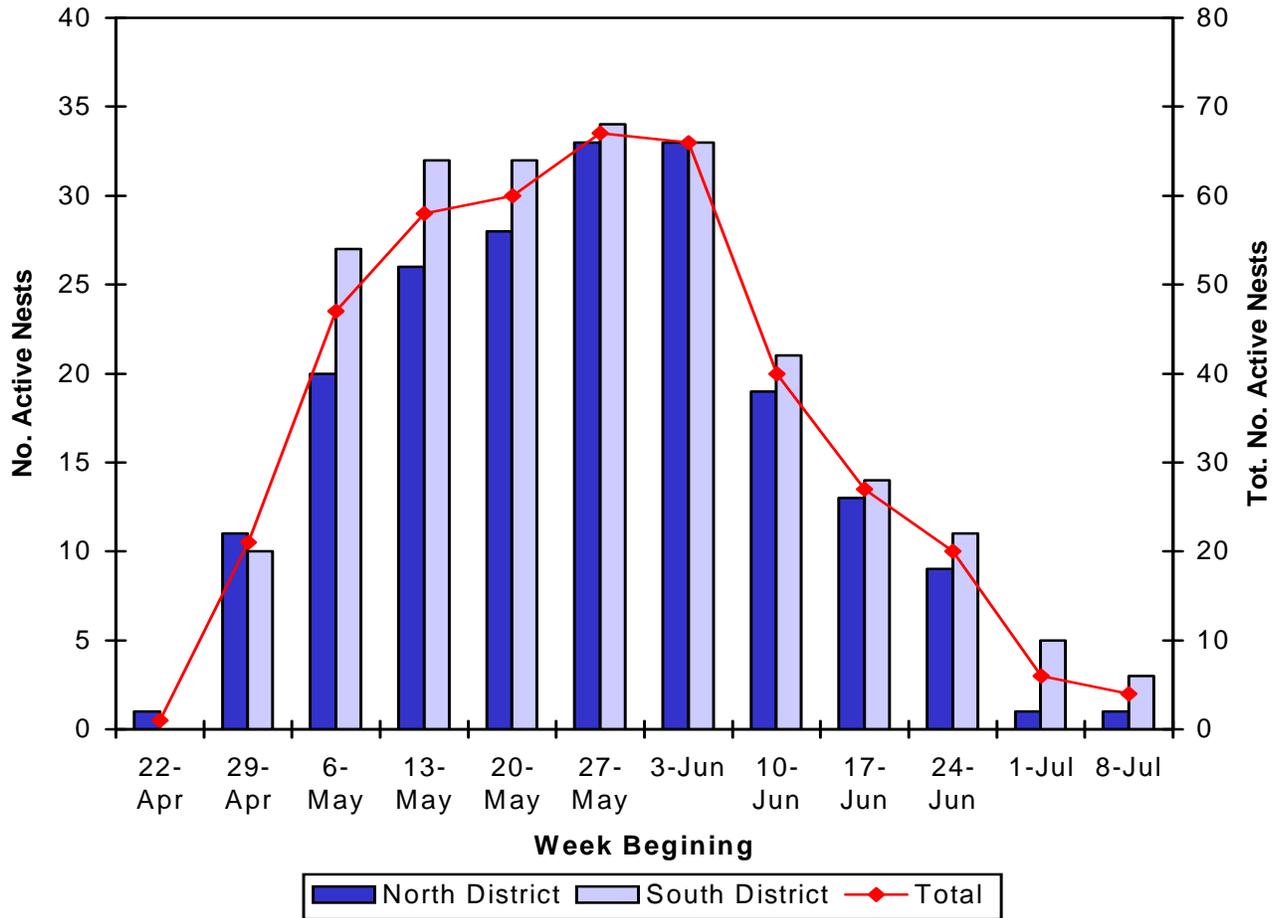


Figure 3. Chronology of Piping Plover Chicks in the North and South districts and in total, Cape Cod National Seashore, 2001.

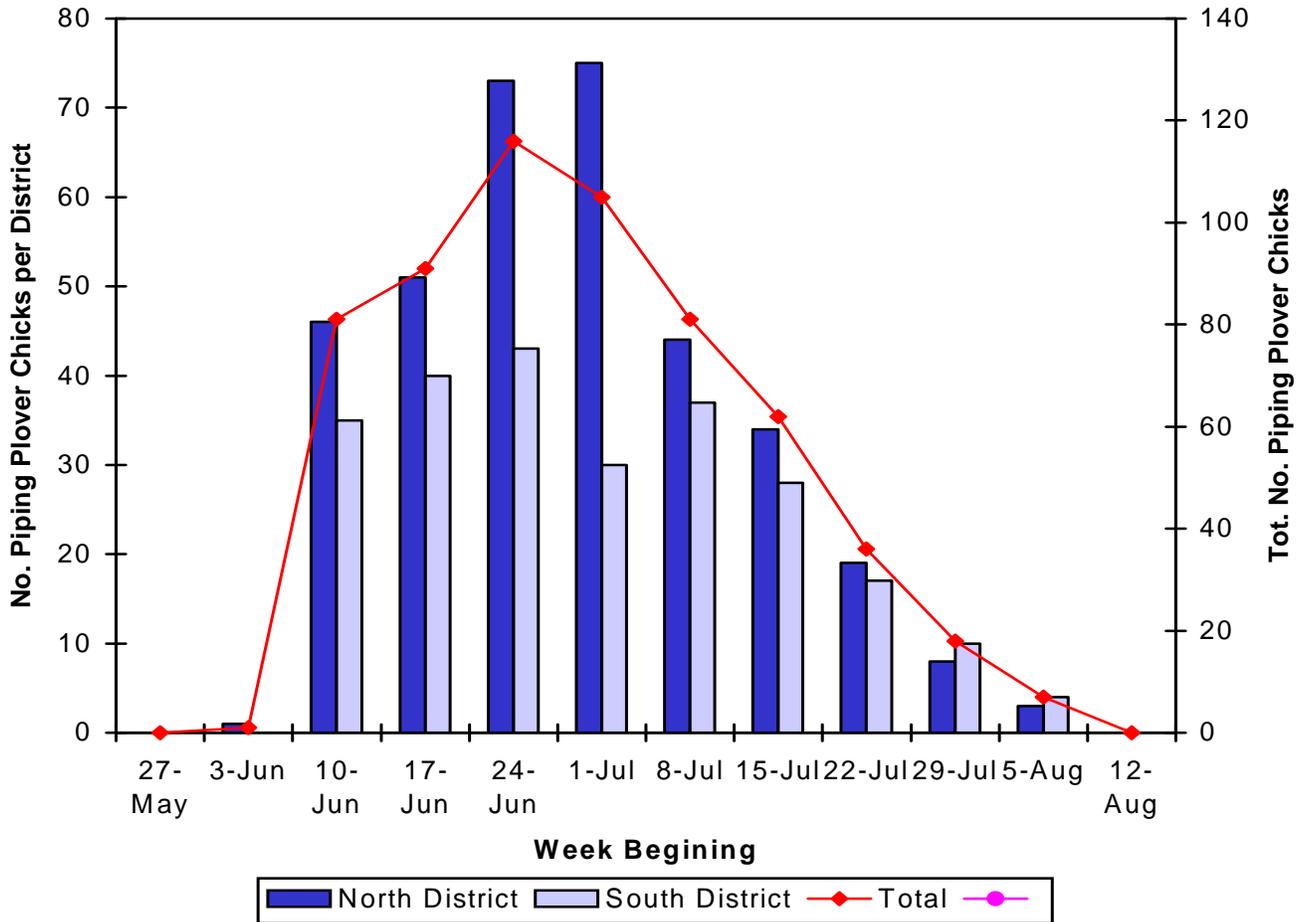


Table 1. Number of Piping Plover breeding pairs, hatching and fledging success, and nest productivity, by site, Cape Cod National Seashore, 2001.

Site	No. Pairs	No. Nests ¹	No. Eggs Laid	No. Eggs Hatched	Total No. Chicks Fledged	Hatching Success ²	Fledging Success ³	Prod. ⁴
Coast Guard Beach	14	17	61	30	16	0.49	0.53	1.10
Marconi Beach	5	6	22	15	12	0.68	0.80	2.40
Great Is./Jeremy Point	19	26	90	51	29	0.57	0.57	1.50
Le Count	2	2	8	7	4	0.87	0.57	2.00
Ballston Beach	4	4	16	16	12	1.00	0.75	3.00
High Head	3	3	12	12	12	1.00	1.00	4.00
Race Point South	14	16	52	38	31	0.73	0.82	2.21
Mission Bell (RPS)	4	4	15	13	11	0.87	0.85	2.75
Peaked Hill (RPS)	3	4	12	11	10	0.92	0.91	3.33
Armstrong Area (RPS)	7	8	25	14	9	0.56	0.64	1.29
Race Point North	7	7	28	27	19	0.96	0.70	2.71
Wood End/Long Point	8	7	28	27	20	0.96	0.74	2.50
Total	76	88	317	223	155	0.70	0.70	2.04

¹ Includes renests

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

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

⁴ Total number of chicks fledged/total number of pairs

Table 2. Causes of Piping Plover Nest Failures, by site, Cape Cod National Seashore, 2001.

Site	NESTS			Cause	PER SITE	
	Total No.	No. Lost	% Lost		No. Lost	% Lost
Coast Guard Beach	17	9	53	Crow	1	11
				Unknown Predator	5	56
				Abandoned after excl.	3	33
Marconi Beach	6	1	17	Unknown Predator	1	100
Great I./Jeremy Point	26	13	50	Overwash	2	15
				Crow	1	8
				Gull (before exclosed)	1	8
				Unknown Predator	2	15
				Abandoned after excl.	6	46
			Infertile	1	8	
Le Count	2	0				NA
Ballston Beach	4	0				NA
High Head	3	0				NA
Race Point Beach South	16	4	25	Gull (before exclosed)	2	50
				Abandoned pre excl.	1	25
				Abandoned after excl.	1	25
Race Point Beach North	7	0				NA
Wood End/Long Point	7	0				NA
TOTAL	88	27	31			

Table 3. Fate of Piping Plover Eggs, by site, Cape Cod National Seashore, 2001.

Site	No. Nests	No. Eggs Total	No. Eggs Lost	% Lost Per Site	Cause	No. Eggs Lost
Coast Guard Beach	17	61	28	46%	Crow	4
					Unknown Pred (not excl.)	12
					Abandoned after excl.	10
					Infertile	2
Marconi Beach	6	22	7	32%	Unknown Pred (not excl.)	4
					Infertile	3
Great I./Jeremy Point	26	90	39	43%	Overwash	8
					Crow	4
					Gull (before exclosed)	3
					Abandoned after excl.	17
					Infertile	4
Unknown Pred (not excl.)	3					
Le Count	2	8	1	13%	Infertile	1
Ballston Beach	4	16	0	0%		
High Head	3	12	0	0%		
Race Point South	16	51	13	25%	Unknown Pred (excl.)	3
					Gull (before exclosed)	3
					Abandoned pre excl.	1
					Abandoned after excl.	4
					Infertile	2
Race Point North	7	28	1	4%	Infertile	1
Wood End/Long Point	7	28	1	4%	Infertile	1
TOTAL	88	316	90	NA		NA

Table 4. Egg Loss Totals, Cape Cod National Seashore, 2001.

No. Nests	Eggs			Cause	Per Cause	
	No. Total	No. Lost	Total % Lost		No. Eggs Lost	% Lost
88	316	90	28			
				Overwash	8	9
				Crow	8	9
				Infertile	14	16
				Gull (before exclosed)	6	7
				Unknown Pred (excl.)	3	3
				Unknown Pred (not excl.)	19	21
				Abandoned pre excl.	1	1
				Abandoned after excl.	31	34

Table 5. Nest Loss Totals, Cape Cod National Seashore, 2001.

Total No.	Nests			Cause	Per Cause	
	No. Hatched	No. Lost	% Lost		No. Lost	% Lost
88	61	27	31			
				Overwash	2	7
				Crow	2	7
				Infertile	1	4
				Gull (before exclosed)	3	11
				Unknown Predator	8	30
				Abandoned pre excl.	1	4
				Abandoned after excl.	10	37

Table 6. Fates of Exclosed and Unexclosed Piping Plover Nests, Cape Cod National Seashore, 2001.

	Total	Successful (%)	Not Successful (%)	Cause of Failure	No. Lost (%)
Exclosed	70	58 (83)	12 (17)	Overwash Abandoned	2 (17) 10 (83)
Unexclosed	18	5 (28)	13 (72)	Crow Unknown Predator Abandoned Skunk Gull	2 (15) 7 (54) 1 (8) 1 (8) 2 (15)

No nests were totally infertile; some had 1 or 2 eggs in the nest.

Table 7. Frequency of Nest Abandonment in Exclosed Nests, Cape Cod National Seashore, 2001.

Location	Total Number of Nests Aband.	No. of Eggs	Avg. No. of days nest was aband. after being Exclosed	Reason for Aband.	% Aband. in Exclosed Nests	% Aband. in Exclosed Nests Per Area
Coast Guard	3	10	12.3 Days	Unknown - 2 Duck roosting on top of netting - 1	18% 9%	27%
Great Island / Jeremy Point	6	17	10.7 Days	Unknown - 4 Gull walking around excl - 1 Boat washing up to exclosure - 1	18% 4.5% 4.5%	27%
Race Point South	1	4	4 Days	Unknown - 1	6%	6%
Marconi / Le Count	0				NA	
Wood End/Long Pt.	0				NA	
Race Point North	0				NA	
High Head	0				NA	
Ballston Beach	0				NA	
Total	10	31				

Table 8. 1999-2001 Pairs of Colonial Waterbirds on New Island, Orleans, MA.

Species	YEAR			TRENDS	
	1999	2000	2001	1999-2000	2000-20001
Common Tern	2176	1073	493	-50.7%	-54.1%
Roseate Tern	3	4	4	33.3%	0%
Arctic Tern	3	3	3	0%	0%
Black Skimmer	0	5	3	NA	-40.0%
Laughing Gull	784	721	517	-8.0%	-28.3%

Table 9. Number of Pairs of Other Waterbirds Nesting at Cape Cod National Seashore, 2001.

SITE	LETE	COTE	ROST	ARTE	BLSK	LAGU	AMOY	WILL	CAGO
New Island	0	493	4	3	3	517	0	2	1
Nauset (Eastham)	84	1	0	0	0	0	0	0	0
Marconi	16	0	0	0	0	0	0	0	0
Jeremy Point	34	1	0	0	0	0	1	0	0
Great Island	11	0	0	0	0	0	0	0	0
Race Point South	72	0	0	0	0	0	0	0	0
Race Point North	47	0	0	0	0	0	0	0	0
Wood End/Long Pt.	13	1	0	0	0	0	0	0	0
Total	277	496	4	3	3	517	1	2	1

LETE = Least Tern
 COTE = Common Tern
 ROST = Roseate Tern
 ARTE = Arctic Tern
 BLSK = Black Skimmer
 LAGU = Laughing Gull

AMOY = American Oyster Catcher
 WILL = Willet
 CAGO = Canada Goose

Table 10. 2001 North District Off Road Vehicle Corridor Openings and Closures.

Date	Beach	Open/Closed	Mileage	Reason	Total Mileage	
					Open	Closed
5-Jun	North	Closed	0.8	RPN # 2 Hatched	0.8	0.8
5-Jun	South	Closed	0.3	RPS # 8 Hatched	1.8	0.3
6-Jun	South	Closed	0.6	RPS # 4 Hatched	1.2	0.9
8-Jun	South	Closed	0.2	RPS # 7 Hatched	1.0	1.1
13-Jun	South	Closed	0.2	Chicks moving from RPS # 7	0.8	1.3
20-Jun	North	Closed	0.2	RPN # 3 Hatched	0.6	1
1-Jul	HH	Opened	0.3	Negotiated rule	0.3	1.3
1-Jul	HOM	Opened	0.1	Negotiated rule	0.1	1.3
3-Jul	HH	Opened	0.4	HH # 2 Chicks Fledged	0.7	0.9
5-Jul	HH	Opened	0.5	HH # 1 Chicks Fledged	1.2	0.4
9-Jul	South	Opened	1.3	RPS # 7 Chicks Fledged	2.1	0
19-Jul	North	Opened	0.6	RPN # 3 Chicks Fledged	1.4	0.2
21-Jul	South	Opened	1.8	Negotiated rule	3.5	1.6
21-Jul	South	Opened	1.6	RPS # 14 Chicks Fledged	5.1	0
26-Jul	HH	Opened	0.4	HH # 3 Chicks Fledged	1.6	0
* 6-Aug	North	Opened	0.7	RPN # 5 Chicks Fledged	2.2	0

* On 6-Aug the Pole-line (emergency) route to Race Point Light was closed due to the full opening of the North Beach.

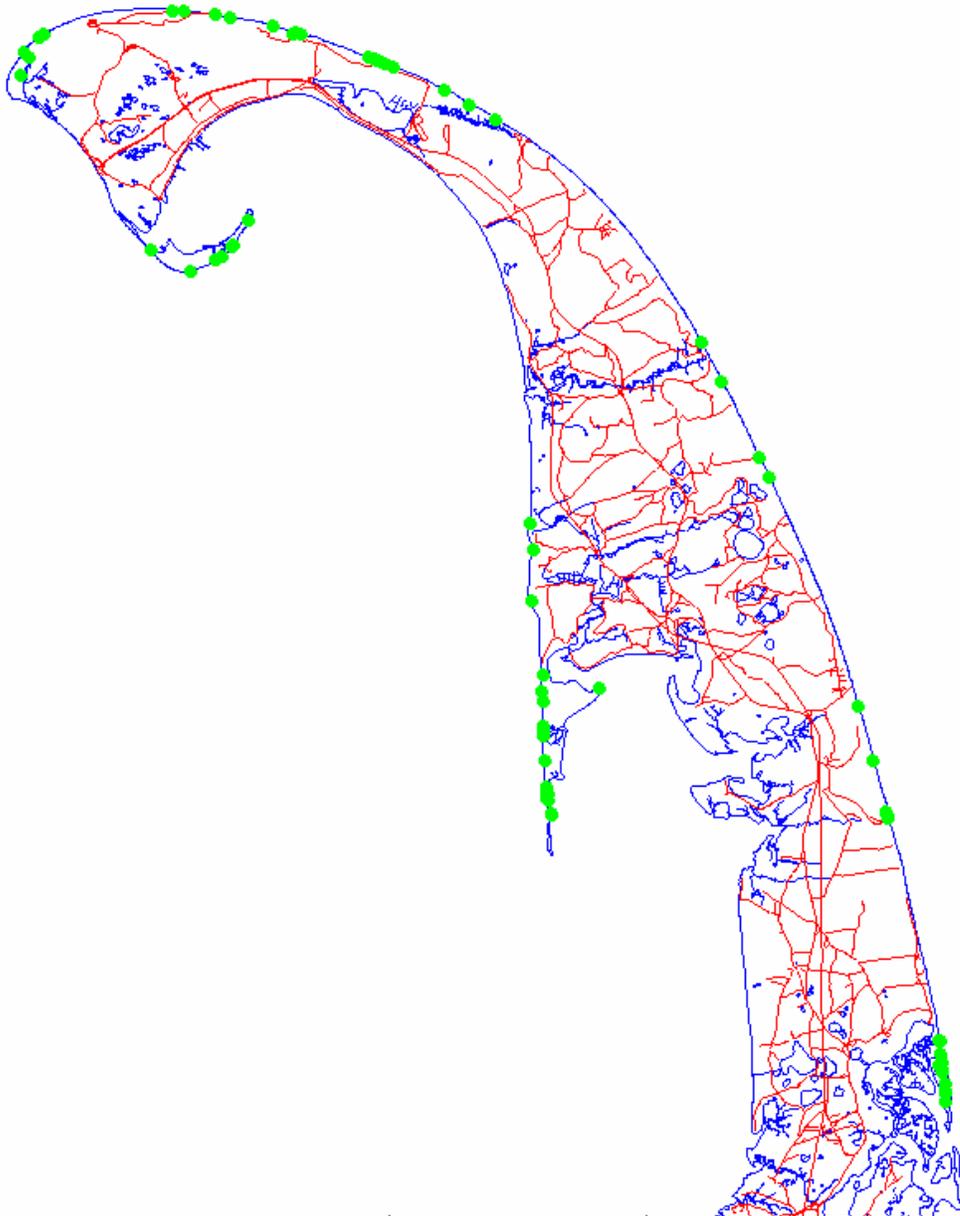
North = Race Point North
 South = Race Point South
 HH = High Head
 HOM = Head of the Meadow

Appendix A

Maps of Cape Cod National Seashore 2001 Piping Plover Nest Sites

Cape Cod National Seashore

2001 Piping Plover Nests



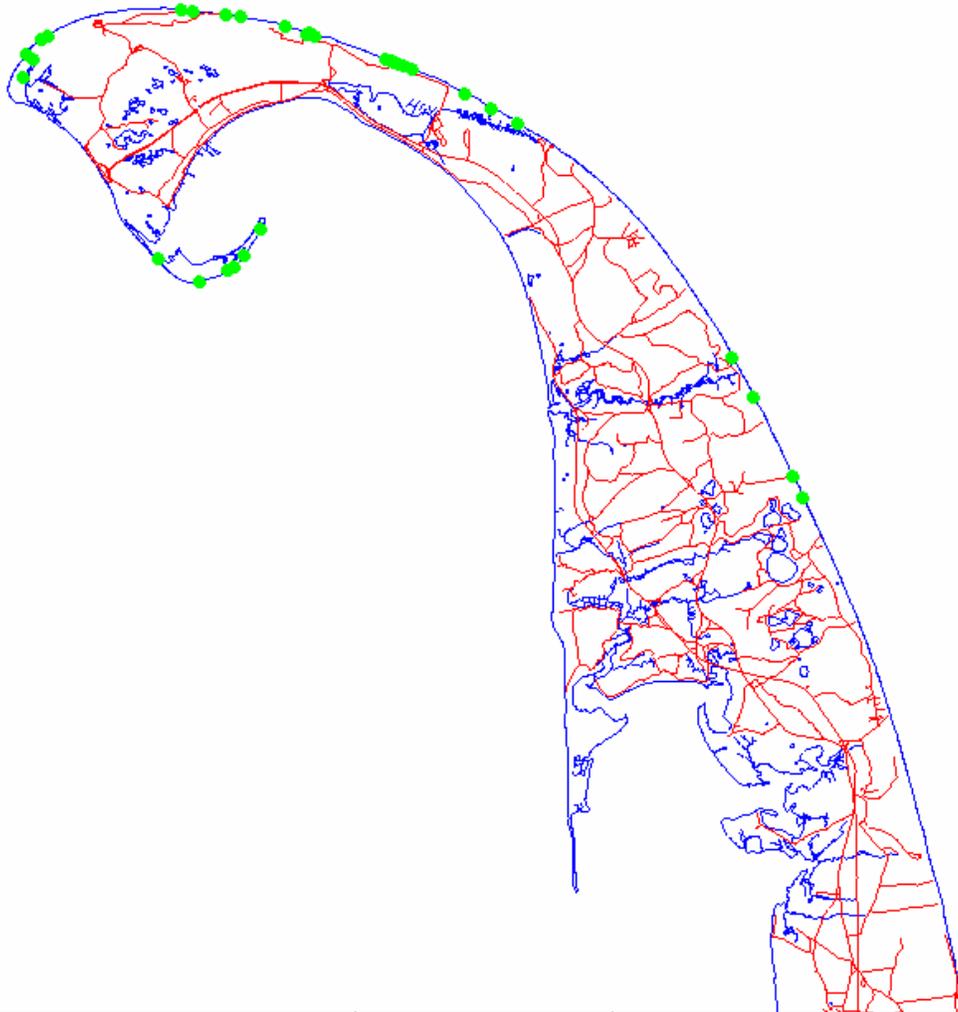
<ul style="list-style-type: none"> ● Piping Plover Nests — Roads — Water 	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <div style="display: flex; align-items: center; justify-content: center;"> <div style="margin-right: 10px;">3</div> <div style="flex-grow: 1; border-bottom: 1px solid black; position: relative;"> <div style="position: absolute; left: 0; top: -5px;">3</div> <div style="position: absolute; right: 0; top: -5px;">3 Miles</div> </div> <div style="margin-left: 10px;">1 : 212,148 1 inch = 3 miles</div> </div> <div style="display: flex; justify-content: space-between; align-items: center; margin-top: 5px;">   </div>
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Appendix B

**Maps of Cape Cod National Seashore, North District
2001 Piping Plover Nest Sites**

North District 2001 Piping Plover Nest Sites

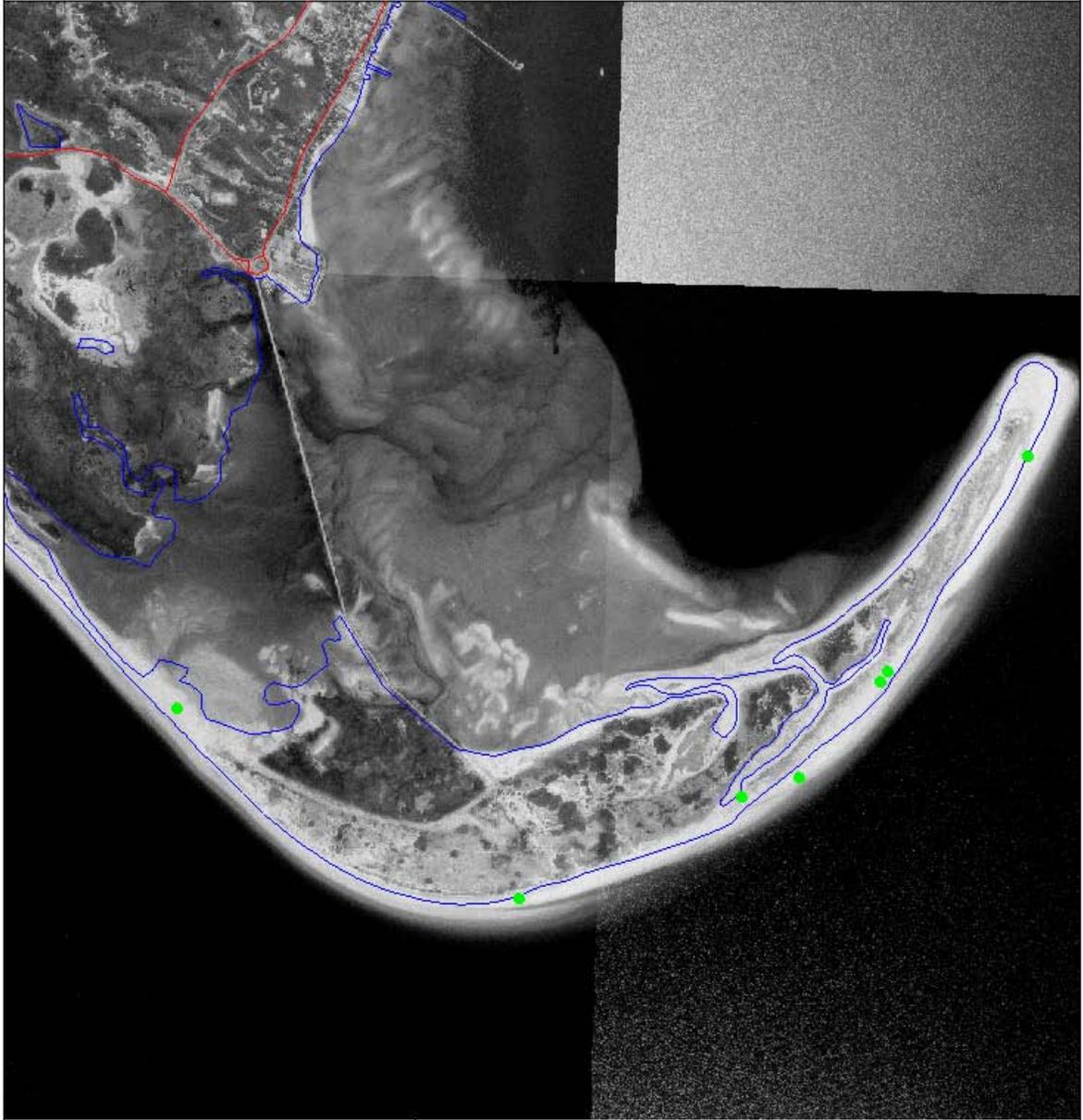


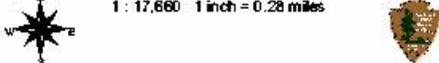
 Piping Plover Nests  Roads  Water	Map Location 	National Park Service Cape Cod National Seashore GIS Team  1 : 164,468 1 inch = 3 miles  
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Wood End / Long Point

2001 Piping Plover Nest Sites

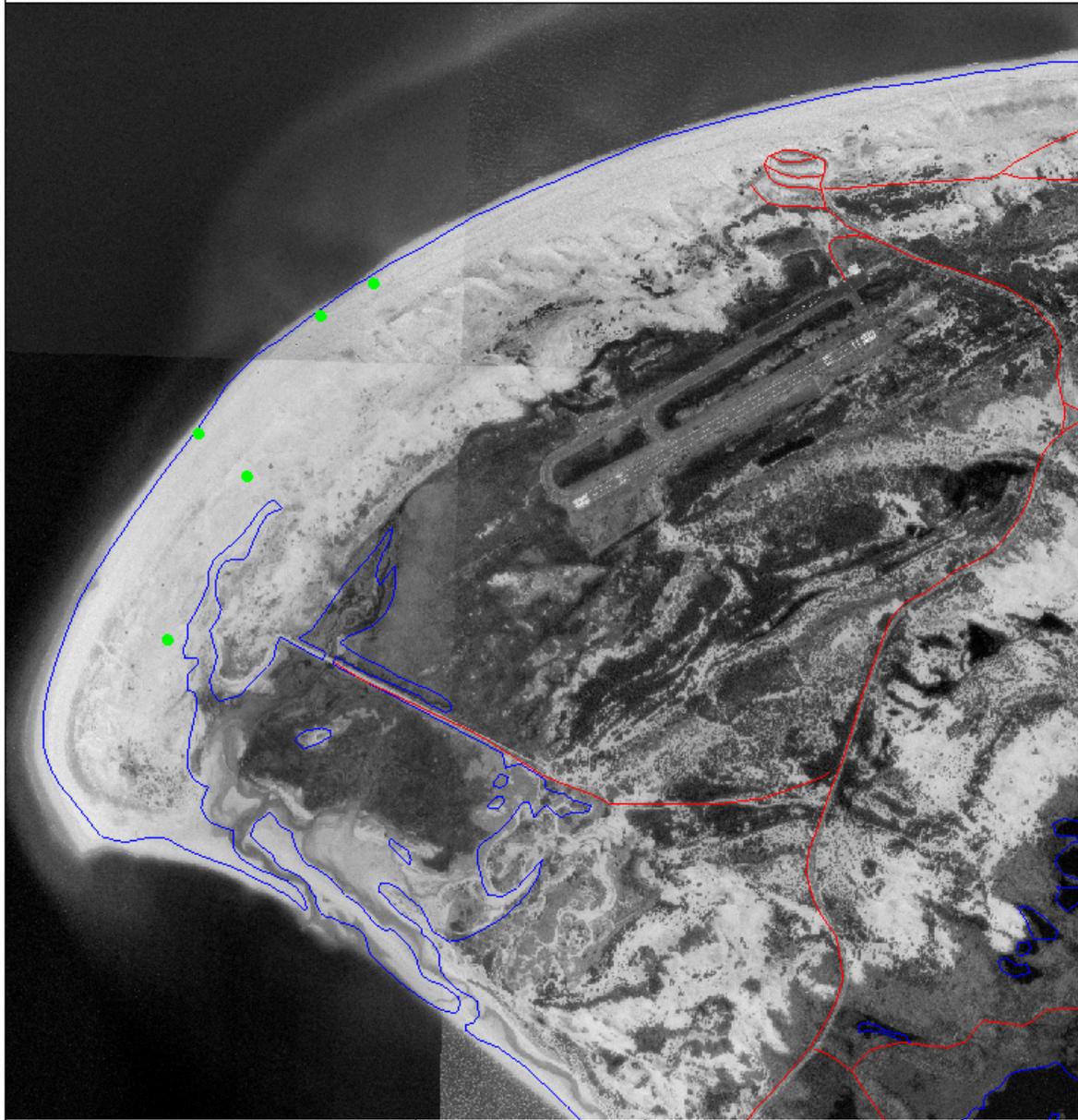


<ul style="list-style-type: none"> ● Piping Plover Nests — Roads — Water 	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <p>0.2 0 0.2 0.4 Miles</p> <p>1 : 17,660 1 inch = 0.28 miles</p> 
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Race Point North

2001 Piping Plover Nest Sites

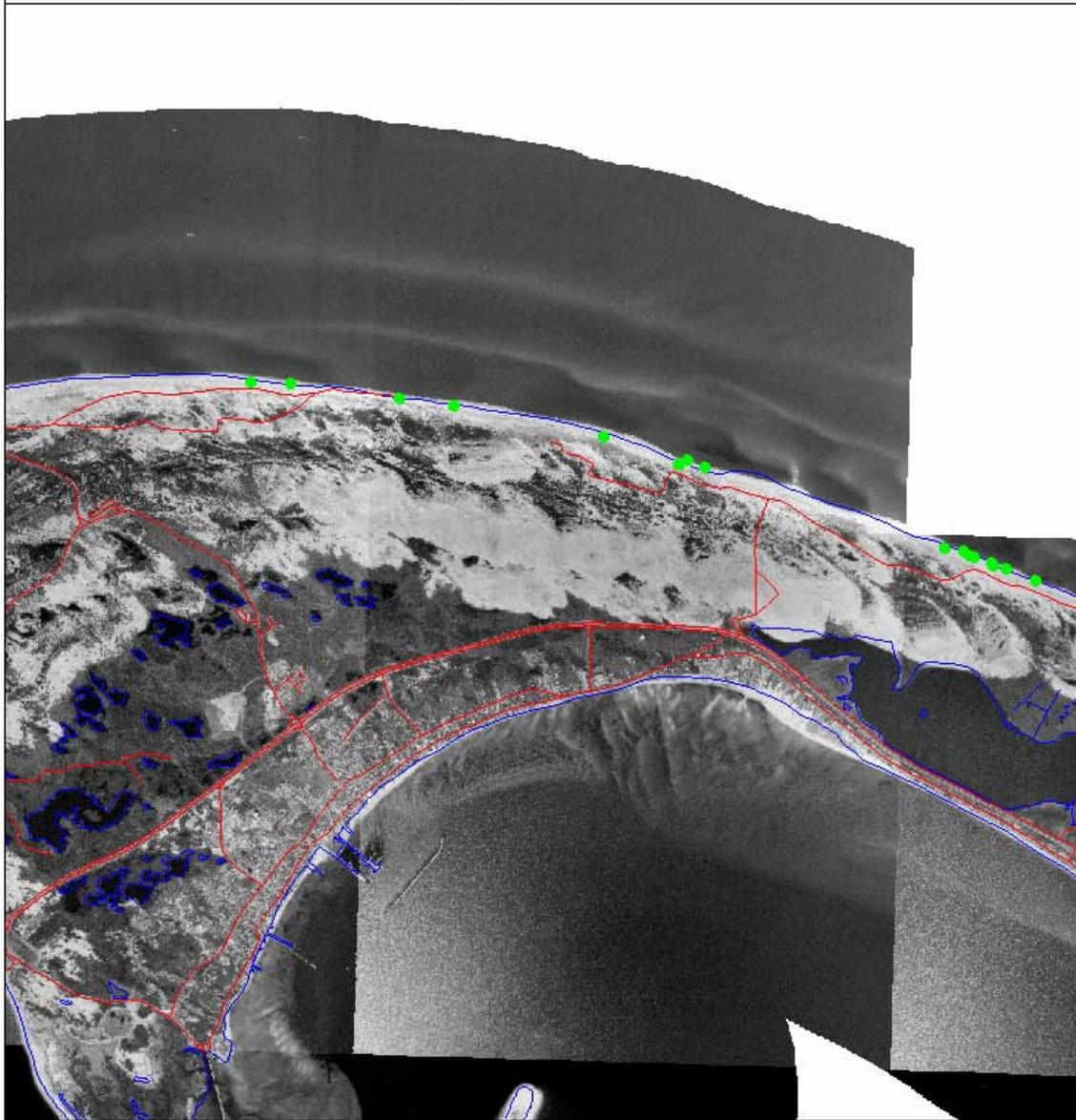


 <p>Piping Plover Nests</p>	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p>
 <p>Roads</p>  <p>Water</p>		 <p>1 : 17,680 1 inch = 0.28 miles</p>  

Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Race Point South

2001 Piping Plover Nest Sites

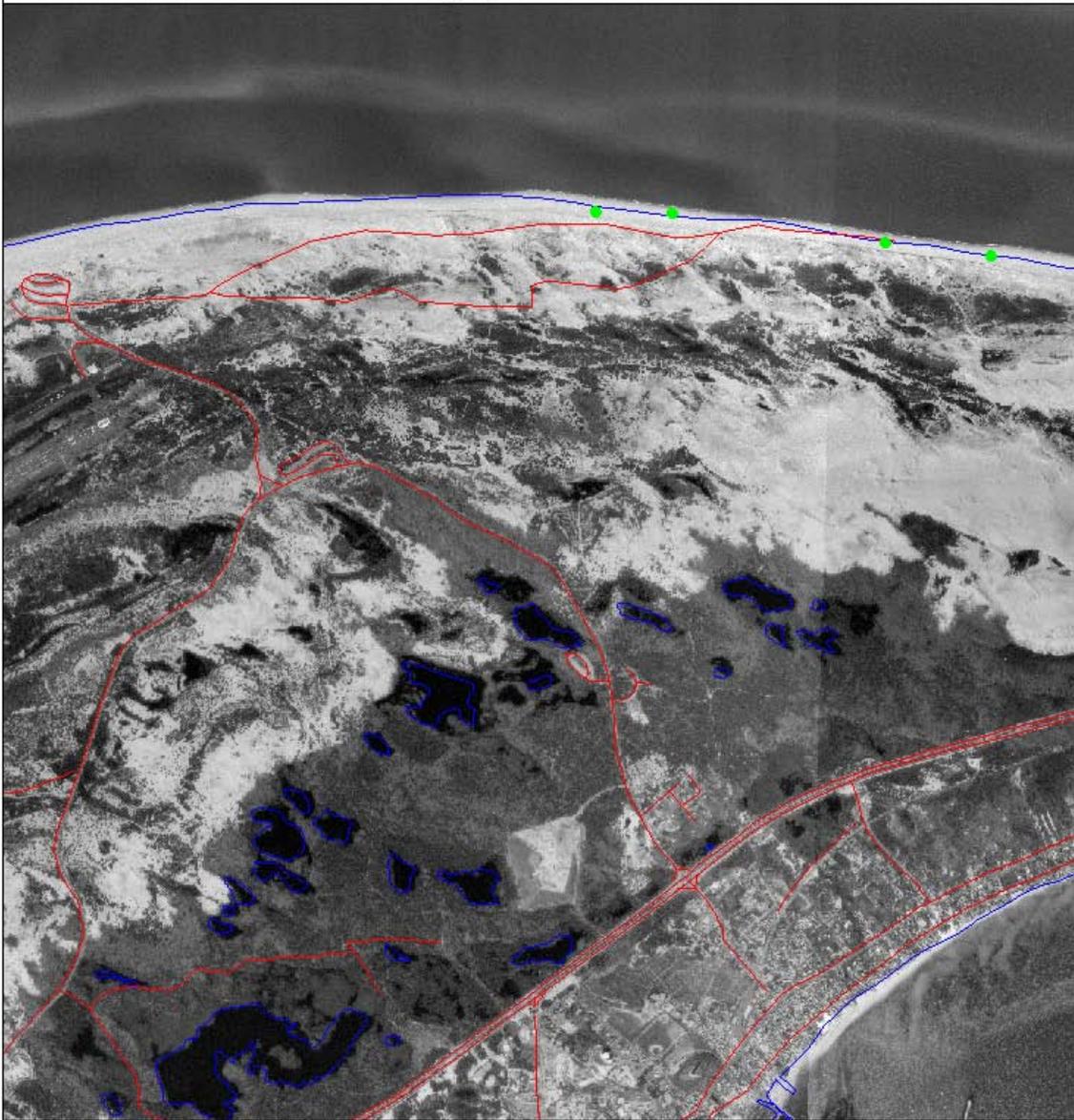


 Piping Plover Nests	Map Location 	National Park Service Cape Cod National Seashore GIS Team
 Roads		
 Water		 1 : 43,114 1 inch = 0.68 miles 

Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Mission Bell (RPS)

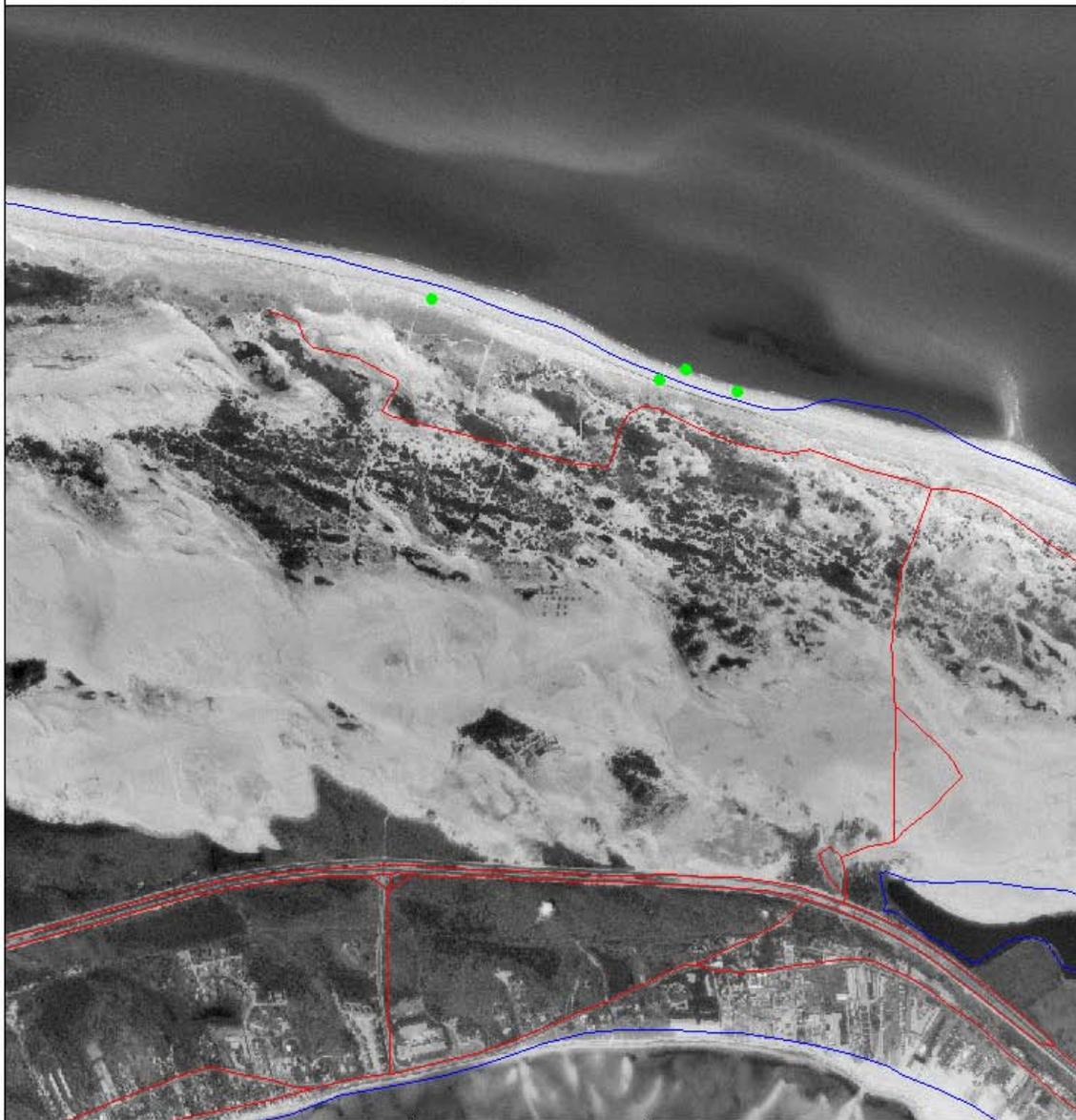
2001 Piping Plover Nest Sites

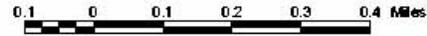


 Piping Plover Nests	Map Location	National Park Service Cape Cod National Seashore GIS Team
 Roads		0.3 0 0.3 Miles
 Water		1 : 22,075 1 inch = 0.35 miles 

Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

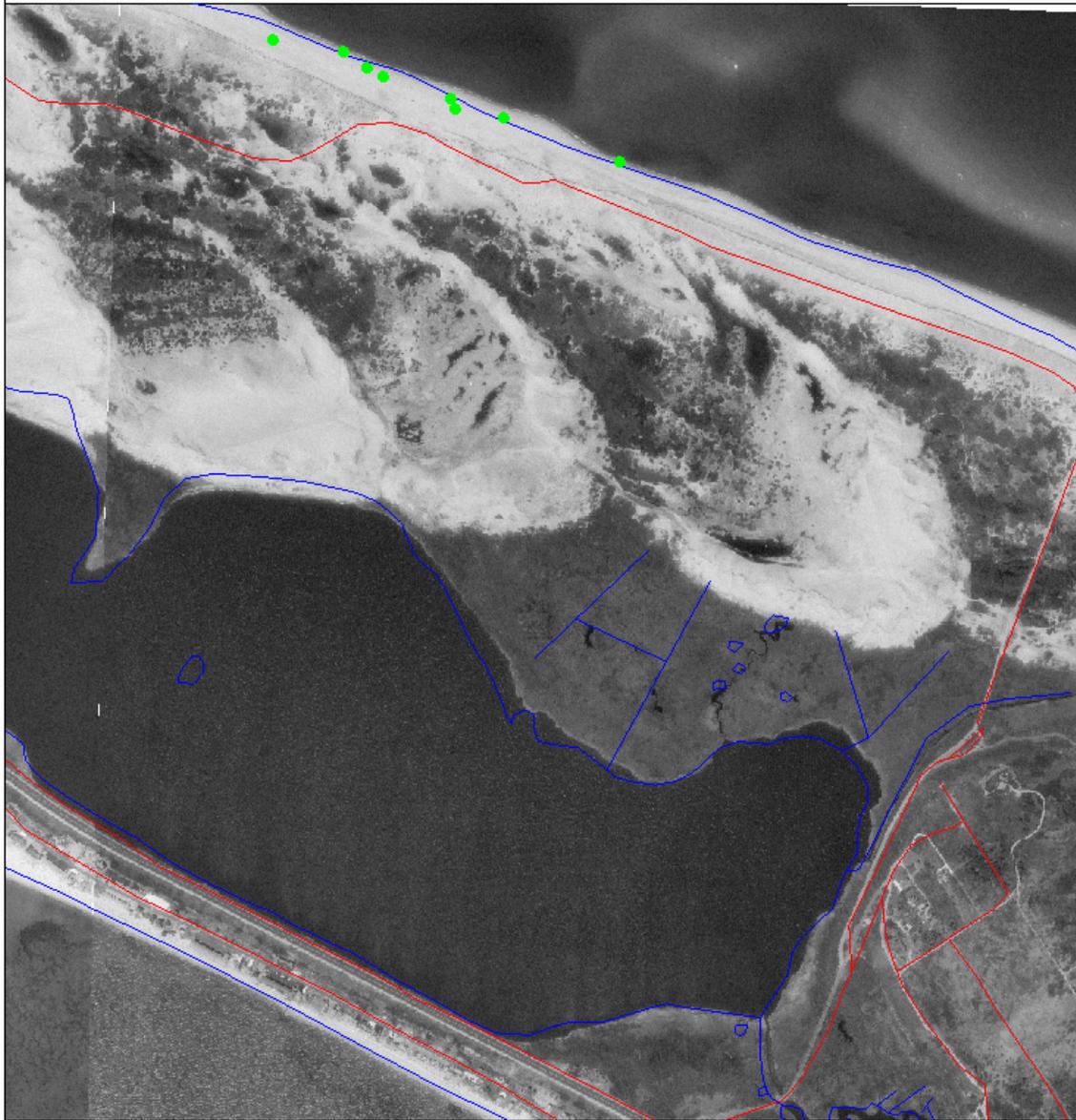
Peaked Hill (RPS) 2001 Piping Plover Nest Sites

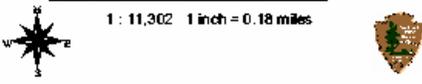


 Piping Plover Nests	Map Location 	National Park Service Cape Cod National Seashore GIS Team
 Roads		
 Water	 1 : 14,128 1 inch = 0.22 miles 	

Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Armstrong Area (RPS) 2001 Piping Plover Nest Sites

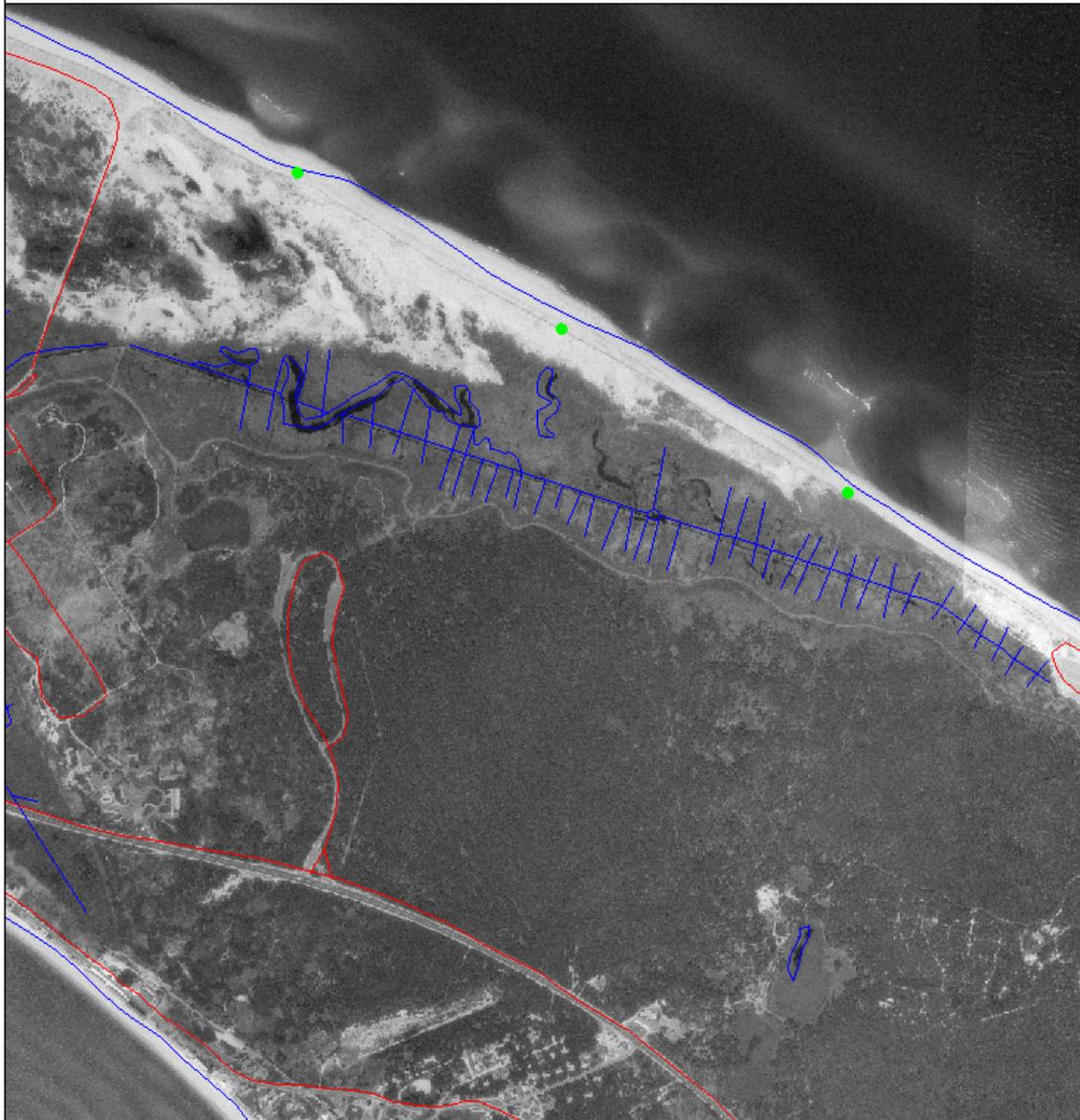


<ul style="list-style-type: none"> ● Piping Plover Nests — Roads — Water 	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <p>0.08 0 0.08 0.16 0.24 Miles</p> <p>1 : 11,302 1 inch = 0.18 miles</p> 
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

High Head

2001 Piping Plover Nest Sites

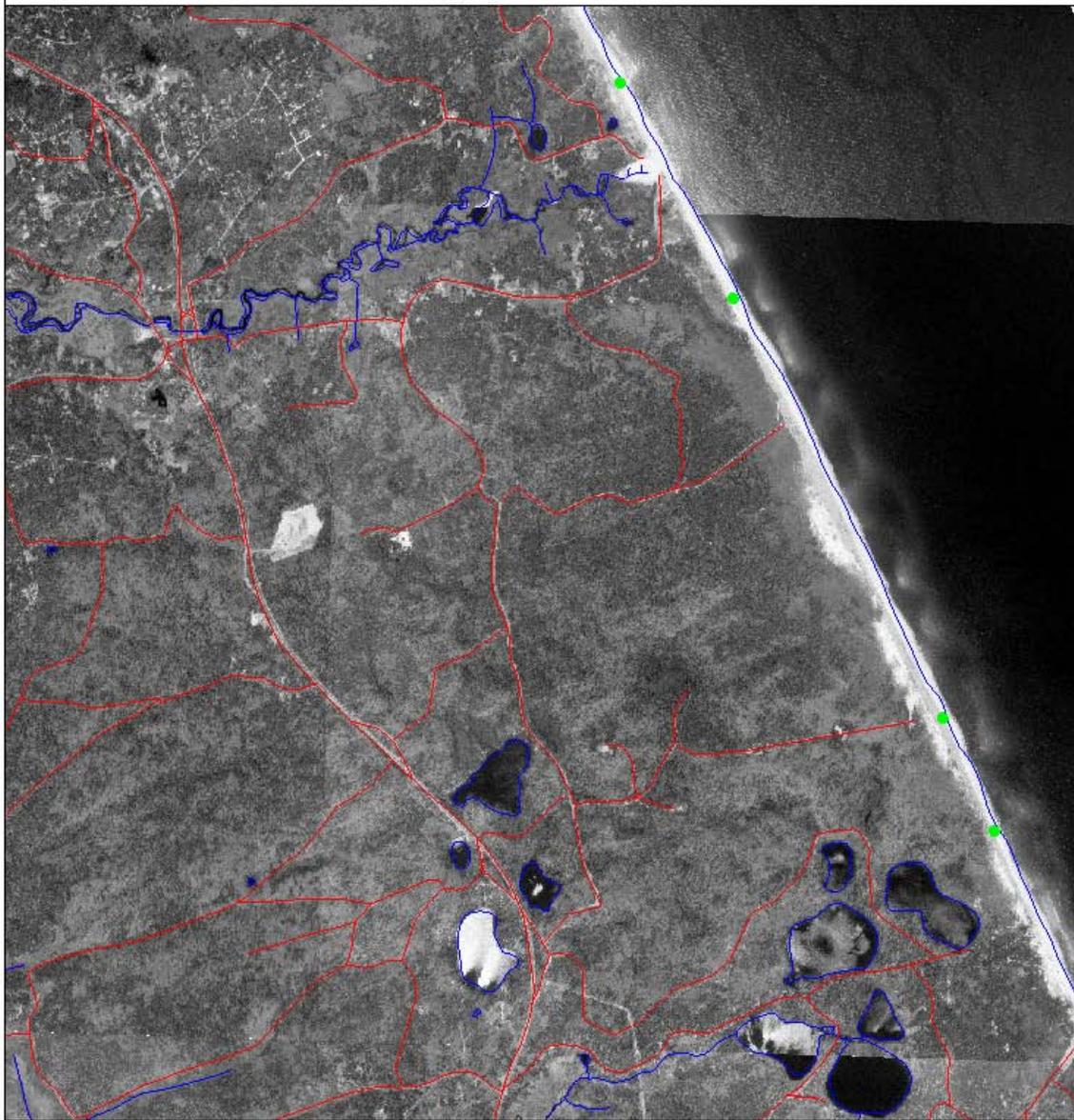


<ul style="list-style-type: none"> Piping Plover Nests Roads Water	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <p>0.1 0 0.1 0.2 0.3 0.4 Miles</p> <p>1 : 14,128 1 inch = 0.22 miles</p>  
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Ballston Beach

2001 Piping Plover Nest Sites



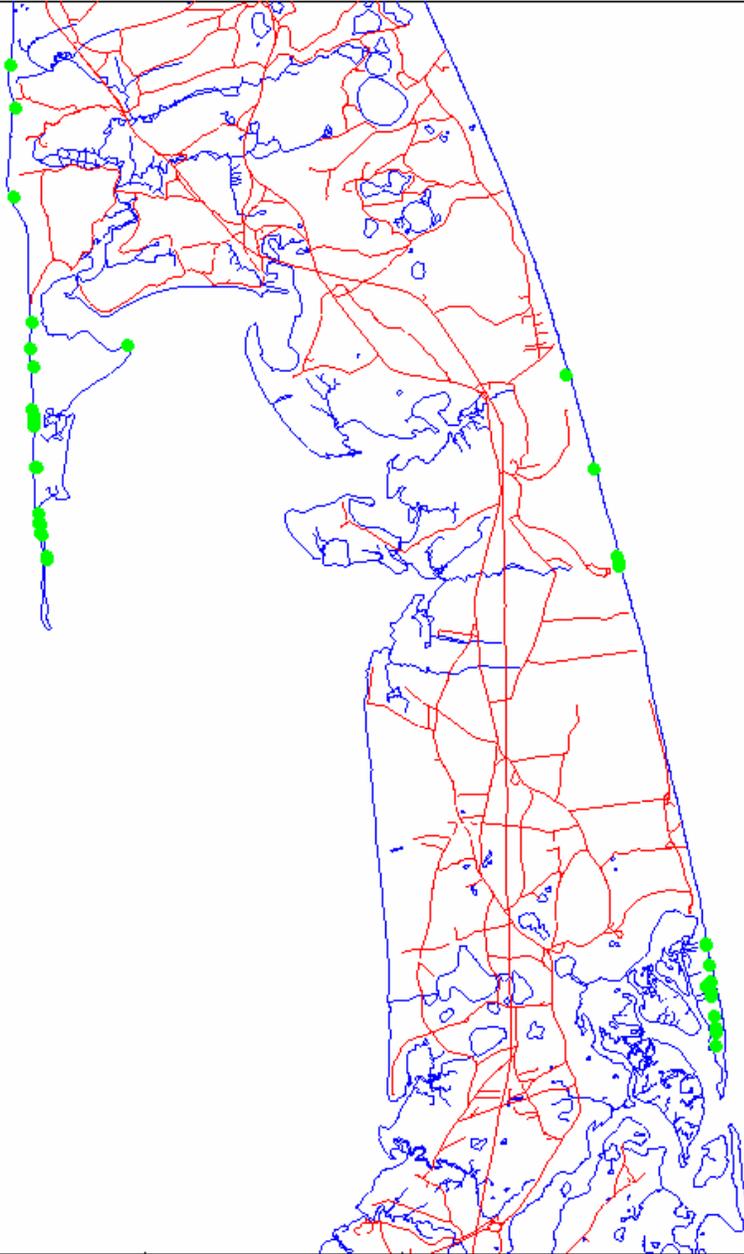
 Piping Plover Nests	Map Location	National Park Service Cape Cod National Seashore GIS Team
 Roads		 1 : 34,482 1 inch = 0.54 miles
 Water		

Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Appendix C

**Maps of Cape Cod National Seashore, South District
2001 Piping Plover Nest Sites**

South District 2001 Piping Plover Nest Sites



- Piping Plover Nests
- Roads
- Water

Map Location



National Park Service
Cape Cod National Seashore
GIS Team

1 0 1 2 Miles

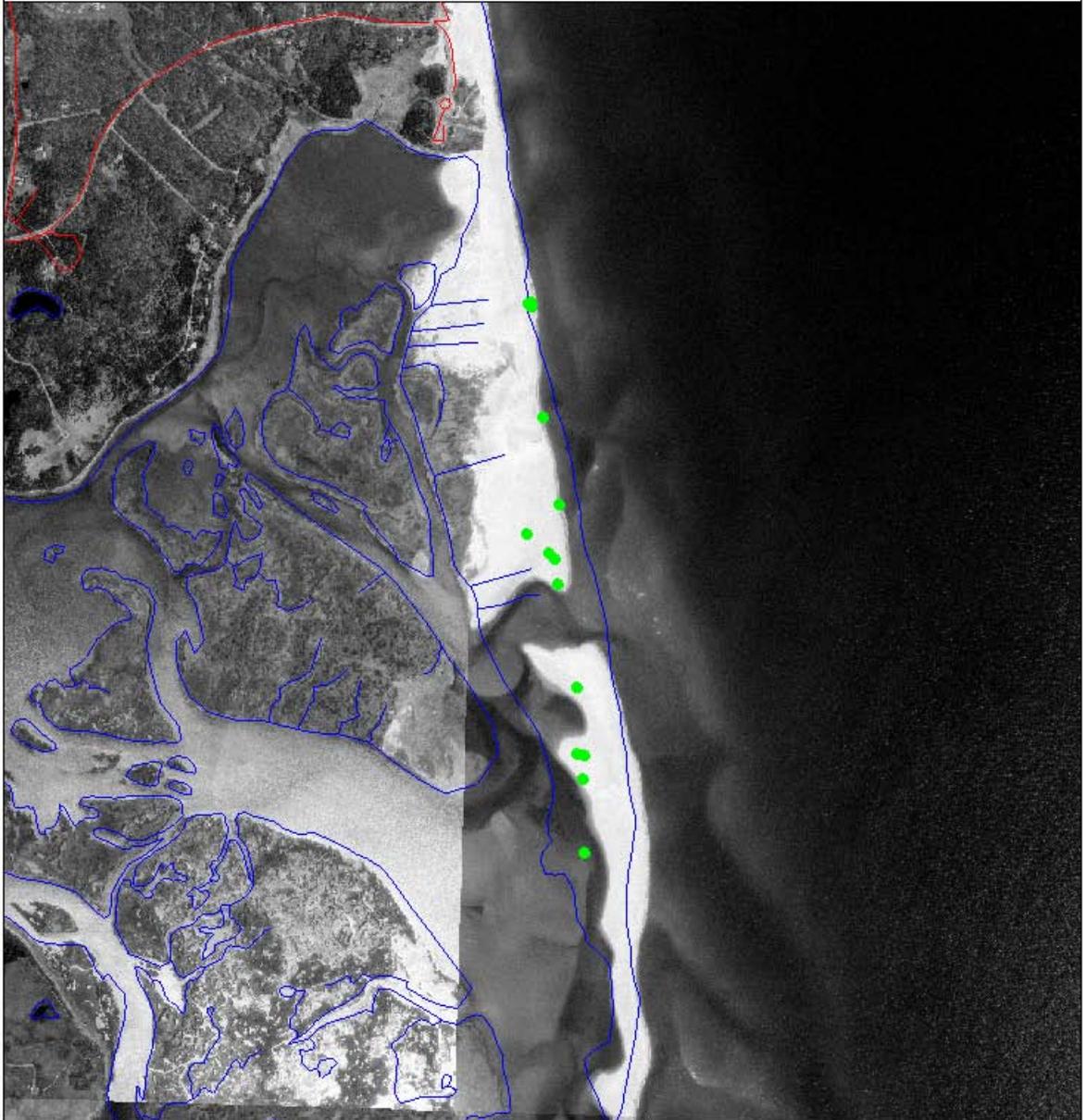


1 : 157,728 1 inch = 2 miles



Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Coast Guard 2001 Piping Plover Nest Sites

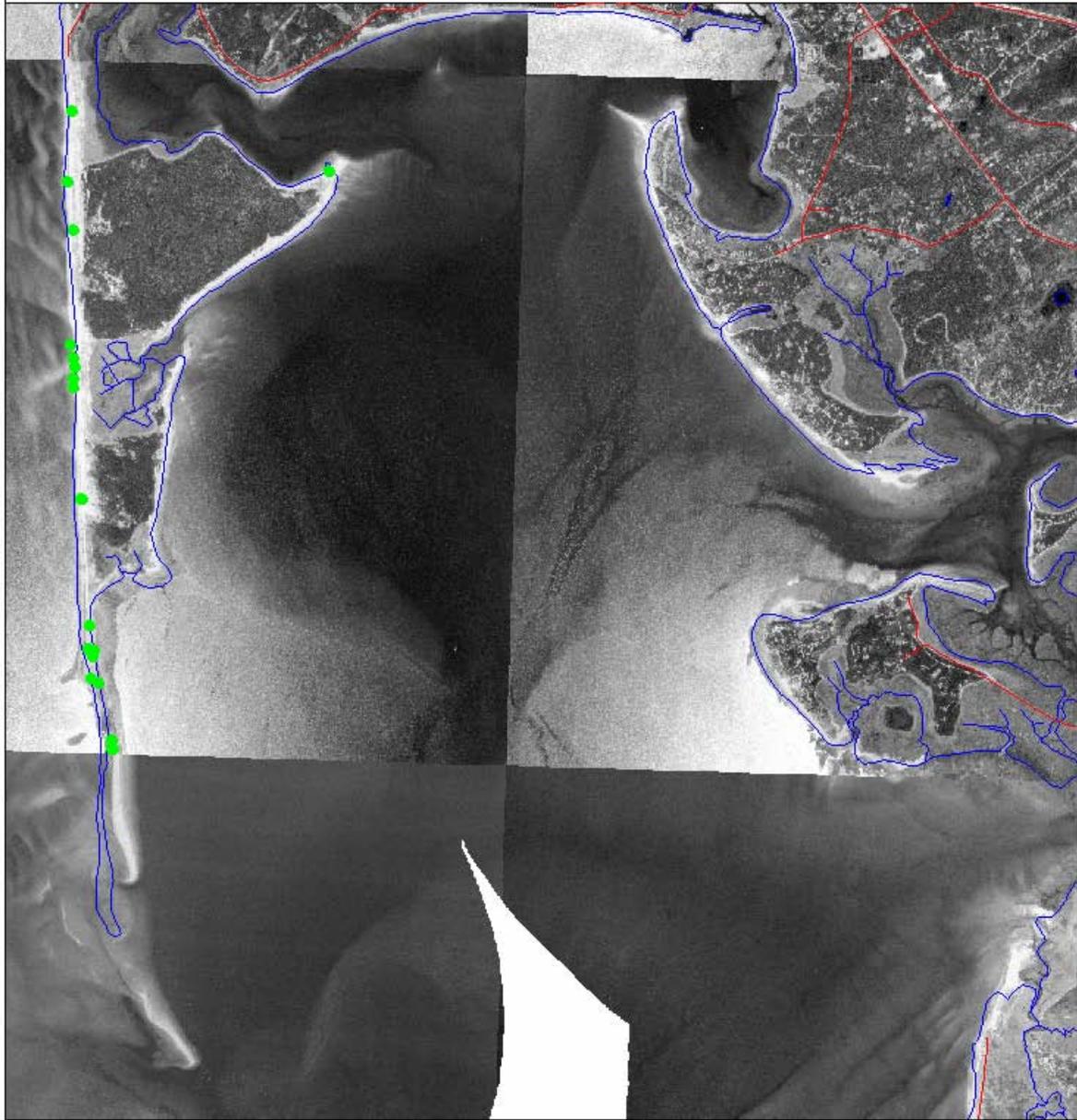


<ul style="list-style-type: none">● Piping Plover Nests— Roads— Water	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <p>0.1 0 0.1 0.2 0.3 0.4 Miles</p> <p>1 : 17,453 1 inch = 0 miles</p>  
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Great Island / Jeremy Point

2001 Piping Plover Nest Sites



-  Piping Plover Nest
-  Roads
-  Water

Map Location



National Park Service
Cape Cod National Seashore
GIS Team

0.6 0 0.6 Miles



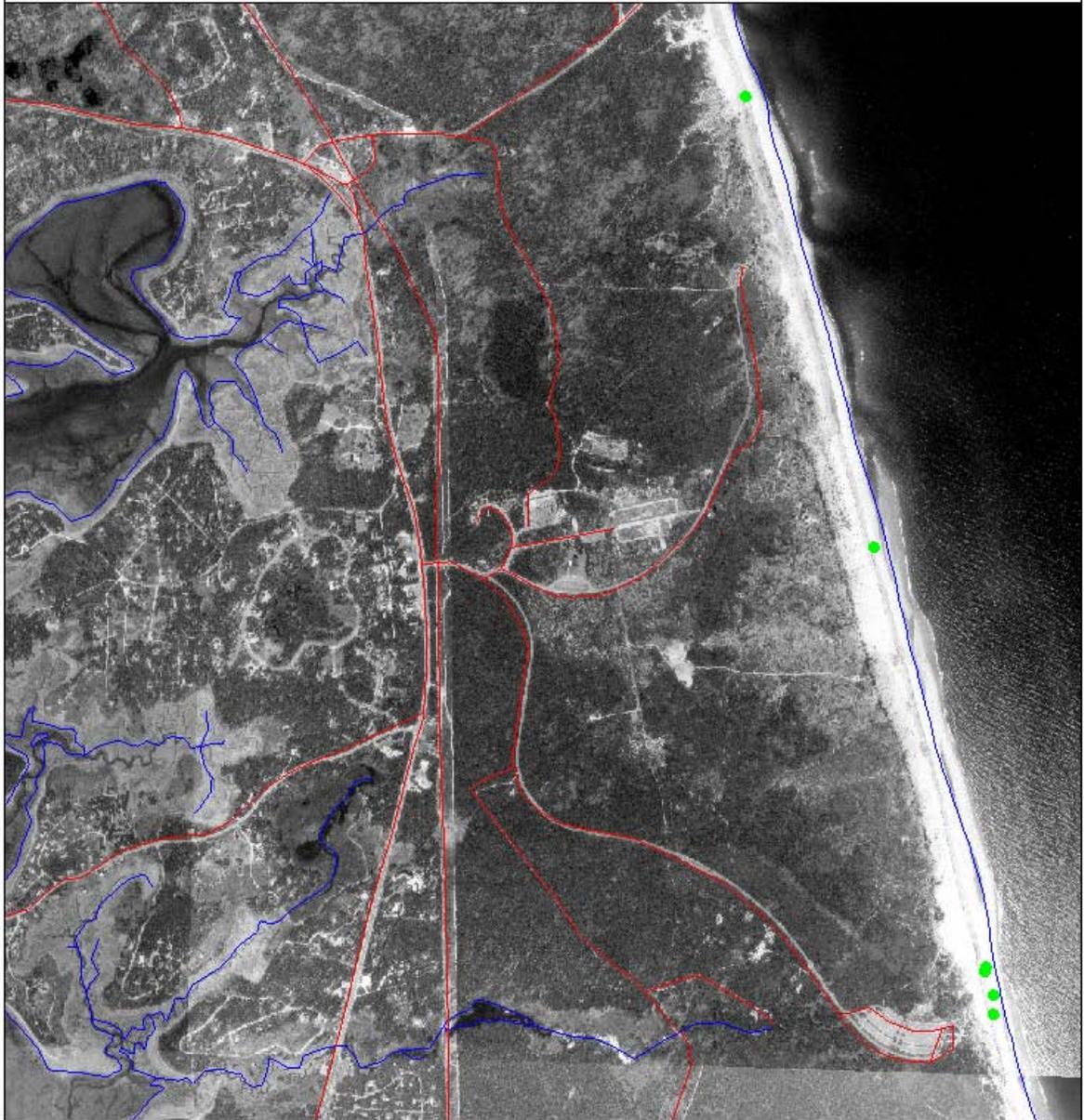
1 : 33,426 1 inch = 1 miles

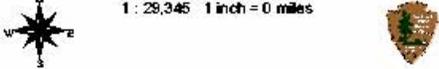


Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Marconi / LeCount Hollow

2001 Piping Plover Nest Sites

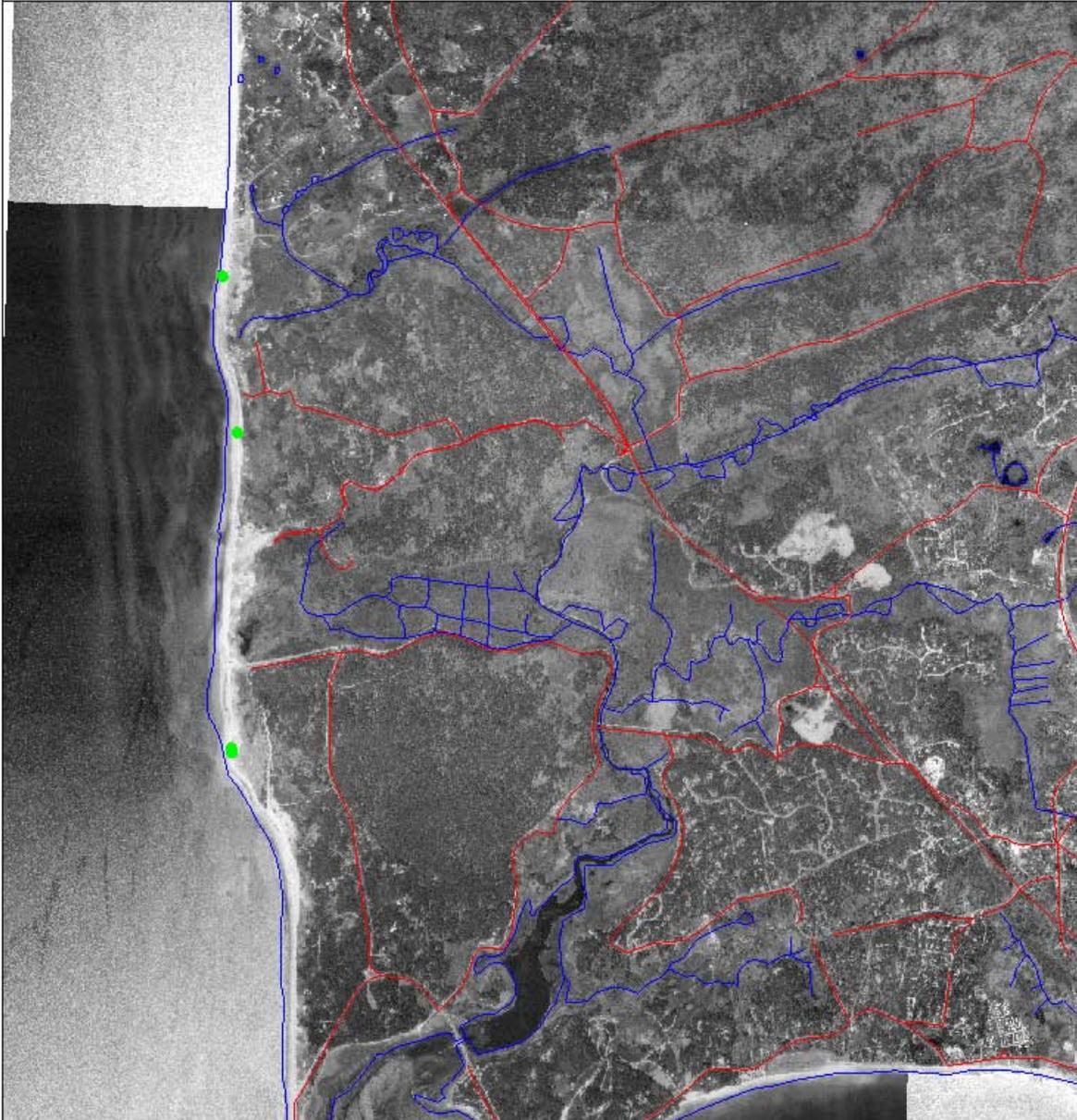


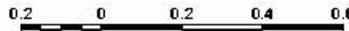
<ul style="list-style-type: none"> ● Piping Plover Nests — Roads — Water 	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <p>0.2 0 0.2 0.4 Miles</p> <p>1 : 28,345 1 inch = 0 miles</p> 
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

Bound Brook / Duck Harbor

2001 Piping Plover Nest Sites



<ul style="list-style-type: none"> ● Piping Plover Nests — Roads — Water 	<p>Map Location</p> 	<p>National Park Service Cape Cod National Seashore GIS Team</p> <div style="display: flex; justify-content: center; align-items: center;"> <div style="margin-right: 10px;">  </div> <div style="margin-right: 10px;"> <p>0.2 0 0.2 0.4 0.6 Miles</p> </div> <div style="margin-right: 10px;">  </div> <div style="margin-right: 10px;"> <p>1 : 29,869 1 inch = 0 miles</p> </div> <div>  </div> </div>
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Plot date: August 27, 2001 g:\projectfiles\plover_2001_backup.apr

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