Monitoring and Management of Piping Plovers and Colonial Waterbirds at Cape Cod National Seashore 2000

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Monitoring plovers at Cape Cod National Seashore is a large and ever increasing task. While each district has personnel devoted to shorebird management, these personnel often work between districts as needs shift and problems arise.

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ABSTRACT

This report summarizes the 2000 Piping Plover and waterbird nesting season for Cape Cod National Seashore (CACO). Piping Plover nesting and brood-rearing were monitored at 8 beaches in Cape Cod National Seashore from Provincetown to Orleans. Observations of Piping Plovers began late March. Sixty-four pairs of plovers were monitored at these 8 sites. Egg-laying began on 22 and 23 April in the North and South districts, respectively. Peak nesting occurred during the last week of May and first week of June. Peak hatching occurred in the last week of June. Hatching success was 37%. Fledging success was 47%. Productivity was 1.1 fledged chicks/pair. Sixteen percent of all nests initiated failed to hatch at least 1 chick. Overwash and crow predation were the leading causes of nest loss. Over 50% of all nests laid were lost due to overwash, most of these during one storm event in early June. For the first time on record at Cape Cod National Seashore, there was an incident where a human intentionally destroyed a plover nest. Of 92 exclosed nests, 48 (51%) successfully hatched young. Of the 44 exclosed nests that did not hatch, 36 (75%) failed due to overwash. Of the 29 unexclosed nests, 28 (97%) failed to hatch. Of these 28 nests, 10 (36%) were lost to crows, 8 (29%) were lost to unknown causes, and overwash, abandonment, gull, and skunks caused at least 1 nest failure each. Berm habitat was used for nesting 58% of the time. This was the third year the 1995 negotiated rule for ORV management was in effect. At various times during the season, more areas were available to ORV travel. Sixteen pairs of plovers nested within the ORV corridor, however, all but 5 of these pairs nested either in the 4-mile section of Race Point South Beach that was closed from 1 April to at least 22 July or the area 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 0.6 miles of the South Beach and 1.0 mi of the North Beach were closed for 4-6 weeks. By 17 August, all of the ORV corridor that could legally be opened under the negotiated rule was opened. The ORV access at Head of the Meadow was also available to ORV use this year, the first time since 1985.

INTRODUCTION

The Piping Plover (*Charadrius melodus*) is a Nearctic shorebird endemic to central and eastern North America. Three distinct populations exist - Great Lakes, Northern Great Plains, and Atlantic Coast. Both the Northern Great Plains and Atlantic Coast populations were federally listed in 1986 as threatened (Federal Register 1985). The Great Lakes population was listed as endangered.

Plovers on the Atlantic coast traditionally nest from the Maritime provinces of Canada south to the North Carolina - South Carolina state line. The Atlantic coast population is currently estimated at nearly 1400 pairs, up significantly from the 790 pairs estimated in 1985. It is believed that prior to listing the population had declined significantly since the 1940's, mostly due to loss of habitat from development, increased human recreational use of the coastal zone, and, to a lesser extent, natural habitat loss (U.S. Fish and Wildlife Service 1986).

The first concerted efforts to monitor Piping Plovers on the Atlantic coast were initiated in 1985. At that time, there were 139 pairs estimated nesting in the Commonwealth of Massachusetts. Also in 1985, the National Park Service (NPS) began a plover monitoring program and 18 pairs nested on Cape Cod National Seashore beaches managed by the NPS. Productivity 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 2000, 64 pairs representing approximately 15% of the state total, nested on beaches managed by the NPS. Productivity (number of chicks fledged per pair) at Cape Cod National Seashore rose from 0.3 in 1986 to a high of 2.6 fledged chicks per pair in 1991.

This report summarizes the 2000 nesting season at Cape Cod National Seashore. A variety of factors are discussed including seasonal chronology, productivity, limiting factors, and nesting habitat.

STUDY AREA

Piping Plover nesting and brood-rearing were monitored at 8 beaches in Cape Cod National Seashore from Provincetown to Orleans. These study beaches were divided among two districts:

North (Wood End/Long Point, Race Point Beach North, Race Point Beach South, High Head, and Ballston) and South (Great Island/Jeremy Point, Marconi Beach, and Coast Guard Beach). These sites were described in Meisel (1991), Brown (1992), and Brown and Hoopes (1993).

METHODS

Daily observations of Piping Plovers began on 1 April just after plover arrival and just before territory establishment began and continued through August when plovers are observed in their southward migration. In April, during the period of the plovers' arrival and courtship, most beaches were visited three to four times per week. Exceptions were Great Island, monitored every 3-6 days and Wood End/Long Point, and Ballston, Beach, that were monitored every 6-8 days. Once nests were established, all beaches were visited almost daily ($\geq$ 5 times per week) except for Long Point and Ballston, which were visited 4 times per week and Great Island which was visited only twice per week. During each visit to a beach, monitors searched for new nests until the end of the first week in July. A variety of information was collected at each site and included: 1) sex of bird incubating the nest, 2) signs of predation, 3) locations and behavior of adults and chicks, and 4) number and location of chicks in each brood.

The 8 beaches where plover monitoring occurred are dispersed over approximately 70 km (30 mi) of beach. To access these sites, varying methods were used. 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.

Each nest or nesting area was protected by symbolic fencing. Predator exclosures were installed around plover nests after clutch completion. All exclosures were topped with fruit netting (1/4” mesh).

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 were not observed on Ballston Beach until late April. Plovers continued to arrive at the sites 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 third week of April in the North District and last 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 23 June at Ballston Beach. This nest fledged 2 chicks in mid August. Peak nesting for the Seashore this year is consistent with the patterns exhibited in past years. However, prior to the use of exclosures, peak nesting typically occurred 1 - 2 weeks later in the season (MacIvor et al. 1987a).

Peak hatching for the Seashore occurred during the last week of June. Hatching dates ranged from 30 May to 23 July. Fledging dates ranged from 18 June to 15 August. These dates are comparable to those reported over the past several years.

Productivity

Sixty-four pairs of Piping Plovers were monitored at 8 sites in Cape Cod National Seashore (Table 1). This represents approximately 15% of the total breeding population of Massachusetts. Numbers of nesting plovers at the 8 sites monitored decreased by 13% from 1999. This decrease is most likely due to decreased productivity from Outer Cape beaches in 1999. The greatest decrease in numbers of nesting pairs from 1999 occurred at Race Point South Beach, where numbers fell from 19 to 14 pairs.

Hatching success (total number of eggs hatched/total number of eggs laid) for all sites combined was 37% and ranged from 28% to 47% (Table 1). Overall, hatching success was 42% lower than in 1999. High Head (47%), Great Island (47%), and Wood End/Long Point (45%) had the highest hatching success; while Coast Guard (28%), Race Point North (31%), and Race Point South

(36%) had the lowest hatching success (Table 1). Hatching success throughout the park and state were extremely low this year due to a major storm that hit many beaches on 6 June. This storm was responsible for severe nest and egg losses (74% and 80%, respectively; Table 5).

Sixteen 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 47% and ranged from 13% to 75% (Table 1). Overall, fledging success decreased 8% from 1999. High Head (75%), Great Island (65%), and Wood End/Long Point (60%) had the highest fledging success; while Race Point North (13%), Marconi Beach (40%), and Coast Guard Beach (33%) had the lowest fledging success (Table 1). Fledging success at High Head is high consistently, but represents few nests. Coast Guard Beach fledging success was 20% lower than in 1999, and is typically lower than other sites but represents more nesting pairs.

Productivity (number of chicks fledged/nesting pair) for all sites was 1.14 (73 chicks fledged from 64 pairs) and ranged from 0.20 to 3.00 (Table 1). Overall, productivity decreased significantly from 1999 (1.71 fledged chicks per pair). High Head (3.00), Wood End/Long Point (1.80), and Great Island (1.58); while Race Point North (0.20), Coast Guard Beach (0.69), and Race Point South (1.07) had the lowest productivity (Table 1). It is important to note that productivity greater than 1.5 is required for maintaining the population at current levels. Productivity at Cape Cod National Seashore may have slightly exceeded productivity statewide but is far below the 1.5 needed for population maintenance. Therefore, it is expected that there will be at best no loss of breeding pairs next year, although it is likely a small decrease will be realized in total numbers of nesting pairs both at the seashore and statewide.

Nest Loss

Sixty percent (73 of 121 nests) of all nests initiated failed to hatch at least 1 chick (Table 2). All beaches had at least one nest lost in 2000. Overwash (n=38), crows (n=11), and unknown predators (n=9) were the leading causes of nest loss, accounting for 58 (79%) of the 73 nests lost (Table 2). All of the sites except Wood End/Long Point had overwash as the leading cause of nest failure. Race Point South and Coast Guard beaches had the highest numbers of nests lost, 18 and 19 nests, respectively. Sixty percent of the losses at these sites were attributable to overwash. Most of these losses occurred during the 6 June storm.

Predator Exclosures

Predator exclosures were installed around 92 of the 121 (84%) nests. Of the 92 exclosed nests, 48 (51%) successfully hatched young. Of the 44 exclosed nests that did not hatch, 36 (75%) failed due to overwash. (Table 3). While nest loss of this magnitude is hard on productivity, it is a natural cause of mortality that usually only occurs ever few years, at least on this scale. More disconcerting is the first recorded (for the Park) intentional taking of a plover nest by human hand. This occurred on the night of 1-2 June on Race Point North Beach. A plover nest that would have closed a significant portion of the beach to ORV's was intentionally destroyed inside a predator exclosure. On the morning of 2 June, we found the eggs smashed and irrefutable evidence that someone had walked up to the exclosure, inserted a long stick and smashed and scattered the eggs. The Park's Criminal Investigator and several North District law enforcement rangers conducted a full investigation and notice was given to U.S. Fish and Wildlife Service Special Agent, Chris Dowd. Further, a $5000.00 reward was offered to anyone who could provide information leading to the arrest and conviction of the person(s) involved. Unfortunately, no one was apprehended and the case remains open. Of the 29 unexclosed nests, 28 (97%) failed to hatch. Of these, 10 (36%) were lost to crows, 8 (29%) were lost to unknown causes, 3 (11%) nests were lost to each of the following causes; overwash and abandonment, 2 (7%) were sanded over, and 1 (4%) nest was lost to each of the following gull and skunk. Twenty-three of the 28 unexclosed nests were lost prior to clutch

completion. The remaining nests were unexclosed 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, or; 2) were located on the side of a dune that precluded us from installing an exclosure due to slope or nest location.

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 8 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. However, the 6 June storm delayed chick hatching by approximately 2-3 weeks. Just as peak hatching was starting an extended period of cold, wet, and rain occurred for much of July (approximately 2 weeks). We believe this weather may have contributed to significant chick loss. Many chicks and broods that were between 1 and 11 days old were lost during this period.

Nesting Habitat

Nesting habitat for 119 nests was categorized according to the macrohabitat types defined by MacIvor (1990). Berm habitat was used for nesting 55% of the time (Table 4). The next most utilized habitat for nesting was foredune (27%, Table 4). It is interesting to note that all but 3 pairs on Race Point Beach South nested in the area that was closed starting 1 April by the negotiated rule.

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 third year of the negotiated rule of 1995. We observed no direct negative impacts to Piping Plover adults and chicks in 2000.

Plover management - This year, 19 pairs of plovers nested along the ORV corridor (4 less pairs than in 1999). While most of these nests were in the area closed by the rule during the first part of the season, there were several 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. Approximately 0.6 mi. of the North Beach was closed for 50 days while unfledged chicks were in the area. The South Beach was closed between Exit 8 and Leo's for nearly 4 weeks starting on 15 July while several broods of unfledged chicks were in the area. As chicks fledged, portions of the ORV corridor that could be opened, were. By 17 August, the entire ORV corridor was reopened to vehicles. Approximately 0.6 mi. of beach from High Head ORV access south was opened on 1 July. Additionally, the park re-opened the Head of the Meadow ORV access. The Head of the Meadow access could not be opened until 16 August due to the presence of unfledged plover chicks. The entire stretch of beach between Head of the Meadow and High Head was open for a 2-week period from 16-31 August. For a more detailed account of ORV corridor management, see Table 1 in the report written in fulfillment of requirements of the negotiated rule.

COLONIAL WATERBIRDS

Least Terns

The Least Tern returned to Cape Cod National Seashore during the first week in May. Egg-laying began on the first week of June. Most nests were lost to overwash by the 6 June storm. Some shifting of nesting location took place prior to the second nesting attempt. A total of 389 nests were counted on eight beaches (Table B.1). Compared to 1999, this was an increase of 99 pairs and 2 additional nesting locations.

Most Least Tern pairs were on eggs by 15 June and the first chicks were observed by 29 June. Peak hatching occurred during the first two weeks in July. Due to additional washovers, pairs at Marconi Beach renested several times extending the nesting season well into the latter half of August. Visual estimates of fledglings at colony sites suggest the Least Tern had a relatively productive year.

Common Terns

Common Terns were first sighted on Jeremy Point on 30 April. 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 six people walking in tandem through the colony. A series of transects were established and the number of eggs and nests found in each was recorded. A total of 1,016 pairs were counted on this date (Table B1). This is 1,160 pairs less than recorded in 1999. It is probable that most of these 1,160 moved over to Momomoy Island to nest in 2000. There seems to be 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. The Lincoln marking showed that some nests were overlooked and the colony size was underestimated by 5.3 %. The total corrected population estimate, using the Lincoln Index, was 1,073 nests.

To estimate productivity on New Island, six random 5 x 5 m quadrates were placed throughout the colony on 16 June. Total number of eggs and chicks were counted in each plot. Site visits were made every 7-10 days.

On 28 June there were 25, 1-3 day old chicks as well as chicks in the process of hatching out in the plots. Other chicks the same age were observed throughout the colony. On this date, there were also several dead chicks and eggs (with just the peephole opening) swarming with small ants.

On a visit made on 8 July, you would expect to see many young Common Terns running around the colony. Instead, we found empty nests, dead 1-7 day old chicks and dead chicks in the process of hatching out. Ants were observed on some of the dead chicks and inside the eggs of the emerging chick. In one instance, we observed one live chick with swarms of ants all over it. Only 7 live chicks were observed on the island.

This scenario continued throughout the season. There were no >2 week old Common Tern chicks ever observed on any site visit. On 19 July two juvenile Common Terns were observed on the mudflats north of the colony but they made have come from the Monomoy Island colony. Due to these observations, it is safe to say that productivity was extremely low or non-existent on New Island in 2000.

What is less certain is the cause(s) of this low productivity. Ants seem to be the major factor and have been documented in decimating other colonies in the past (Blodget pers. comm). Additional factors may include starvation (lack of baitfish), weather or disease.

In addition to New Island, five Common Terns nested in with the Least Terns at Jeremy Point. Common Terns have not nested in this location for several years. Productivity was undetermined at this site.

Roseate Terns

A total of four pairs of Roseate Terns nested on the southeast corner of New Island (Table B1). Two pairs successfully hatched chicks, none of which fledged. It is believed that two 1-2 day-old chicks from one nest was depredated by ants. The fate of the other nest/chick was undetermined. The

remaining two nests were abandoned. It is uncertain what caused the abandonment and if the eggs were ever viable.

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 B1). Two of the nests hatched but no chicks were ever observed. The third nest was active but had not hatched out on the last site visit and was probably non-viable. No Arctic Tern fledglings were ever observed. This site represents the southernmost nesting location of Arctic Terns in the United States.

Black Skimmers

Five pairs of Black Skimmers nested on New Island. Although a relatively low number, this represents one of only two nesting sites active in the state (the other being Monomoy Island) and the largest colony in the state. It is believed that there was some exchange of pairs between New Island and Monomoy when nests were lost in either location. Some renesting occurred. Only one nest with three < 1 week old chicks were observed. All other nests were lost to unknown causes or never hatched any chicks. No fledglings were ever observed on the island. 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 721 Laughing Gulls nests were counted (Table B1). The Lincoln Index marking technique (see Common Tern section for methodology) reveled that we underestimated nesting pairs by 6.7 %. The total corrected population estimate was 773 pairs. This colony has stayed relatively constant in size for several years.

Like the Common Tern, Laughing Gull eggs and chicks were depredated by ants but to a lesser extent. Still, mortality of chicks seemed higher then in past years. It was not uncommon to

observe more dead Laughing Gull chicks than living ones on each site visit. Although relatively low, some chicks did fledged from this site. A total of 42 juveniles were counted on the periphery of the island on 2 August. Some or most of these may have come from the Monomoy Island Laughing Gull colony which reported a high fledge rate in 2000.

MANAGEMENT RECOMMENDATIONS

1. 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.
2. NPS access to GI and JP via the Duck Harbor access must be re-established. Accessing GI and JP via the interior route is not practical and is not environmentally sound.
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 increased 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 15 May.

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Figure 1. Number of Piping Plover breeding pairs and nest productivity on beaches managed by the National Park Service, Cape Cod National Seashore, 1985-2000

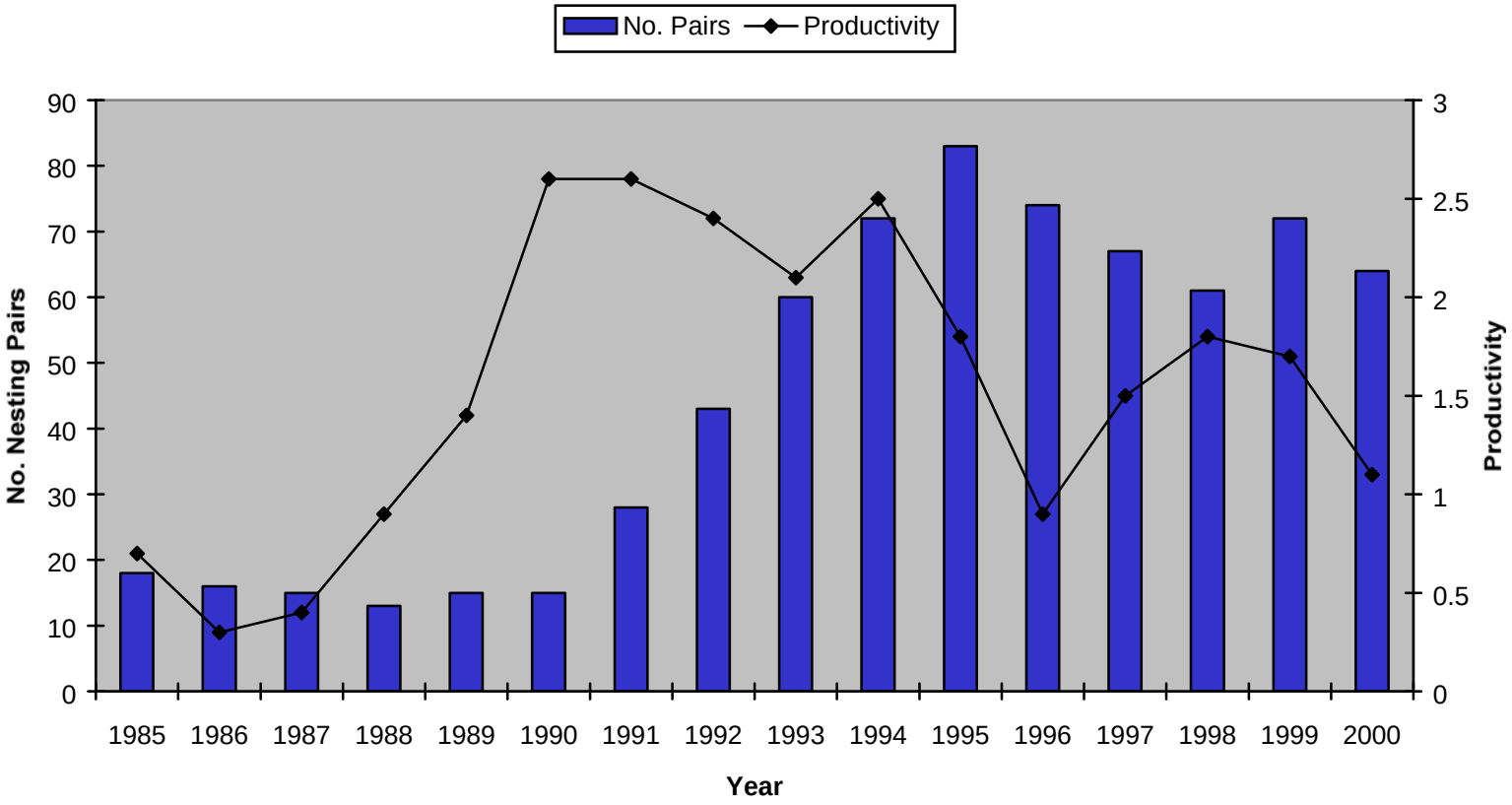


Figure 2. Nesting chronology of active nests in the North and South districts and in total, Cape Cod National Seashore, 2000

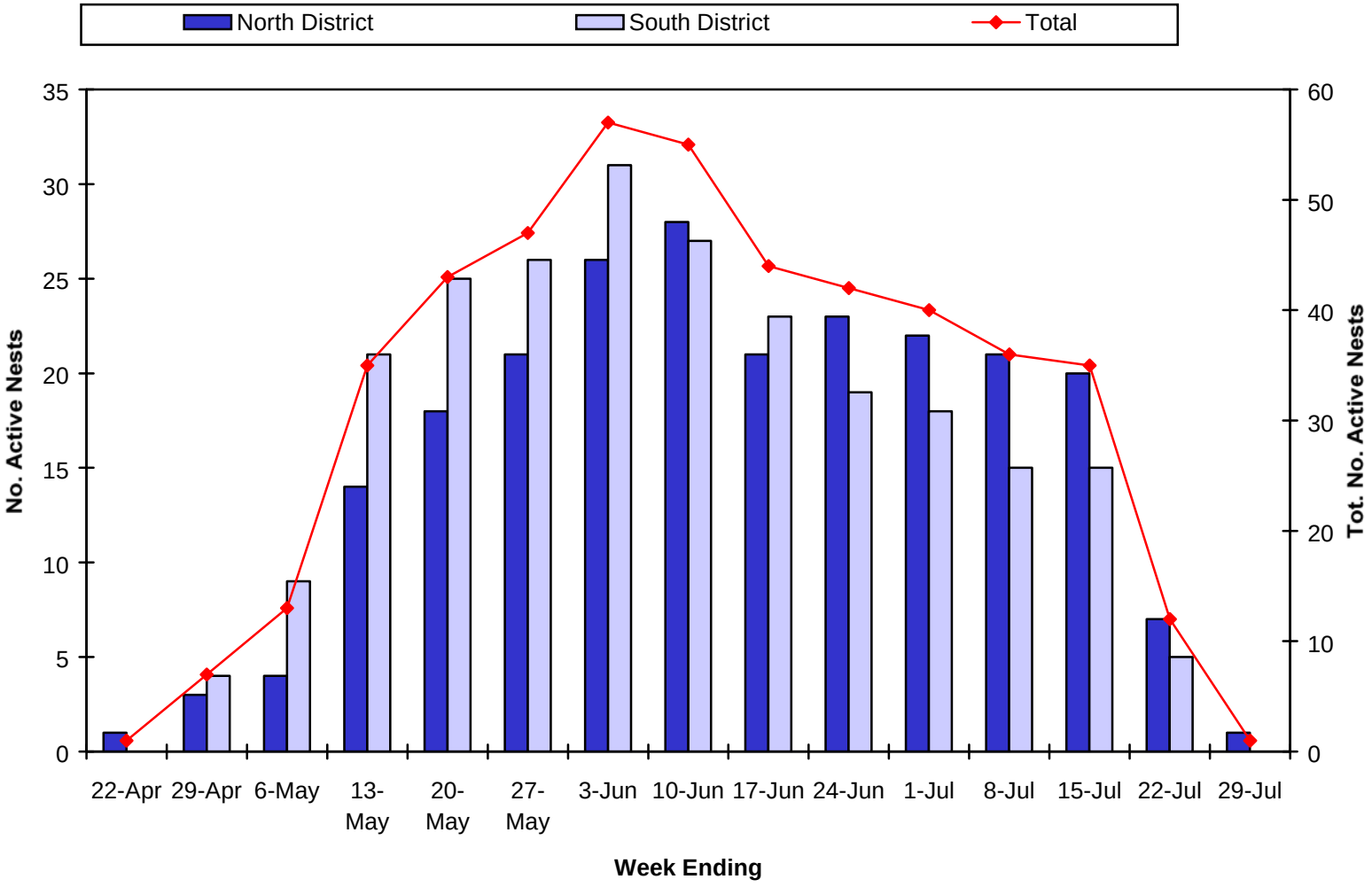


Table 1. Number of Piping Plover breeding pairs, hatching and fledging success, and nest productivity, by site, Cape Cod National Seashore, 2000

Site	No. Pairs	No. Nests[1]	No. Eggs Laid	No. Eggs Hatched	Total. No. Chks. Flgd.	Hatching Success[2]	Fledging Success[3]	Prod.[4]
Coast Guard Beach	13	28	98	27	9	0.28	0.33	0.69
Marconi Beach	8	17	55	20	8	0.40	0.40	1.14
Great Is./Jeremy Point	12	16	61	29	19	0.47	0.65	1.58
Ballston Beach	5	10	34	14	6	0.41	0.43	1.20
High Head	2	4	17	8	6	0.47	0.75	3.00
Race Point Beach South	14	28	91	33	15	0.36	0.45	1.07
Race Point Beach North	5	7	26	8	1	0.31	0.13	0.20
Wood End/Long Point	5	11	33	15	9	0.45	0.60	1.80
Total	**64**	**121**	**415**	**154**	**73**	**0.37**	**0.47**	**1.14**

[1] Includes renests
[2] Total number of eggs hatched/total number of egss laid
[3] Total number of chicks fledged/total number of egss 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, 2000

Site	No. nests	No. Nests Lost	Cause	No. lost	% Lost
Coast Guard Beach	28	19	Overwash	11	58
			Unknown predator	4	21
			Sanded	1	5
			Abandoned	1	5
			Crow	1	5
			Infertile	1	5
Marconi Beach	17	11	Overwash	5	45
			Crow	4	36
			Unknown Predator	2	18
Great I./Jeremy Point	16	6	Overwash	4	67
			Unknown Predator	1	16
			Abandoned	1	16
Ballston Beach	5	0	Overwash	3	50
			Crow	2	33
			Abandoned	1	17
High Head	4	2	Overwash	2	100
Race Point Beach South	28	18	Overwash	11	61
			Crow	3	17
			Gull spp.	1	6
			Unknown Predator	1	6
			Terr. w/ other pair	1	6
			Sanded	1	6
Race Point Beach North	7	5	Abandoned	1	20
			Overwash	1	20
			Intentional Taking[1]	1	20
			Skunk	1	20
			Aband. - skunk	1	20
Wood End/Long Point	11	6	Abandoned	2	33
			Overwash	1	17
			Crow	1	17
			Unknown Predator	1	17
			Sanded	1	17

Table 2. Causes of Piping Plover nest failures, by site, Cape Cod National Seashore, 2000 (Cont'd.)

Site	No. nests	No. Nests Lost	Cause	No. lost	% Lost
TOTAL	121	73	Overwash	38	53
			Crow	11	16
			Unknown Predator	9	12
			Abandoned	6	8
			Sanded	3	4
			Infertile	1	1
			Gull spp.	1	1
			Terr. w/ other pair	1	1
			Skunk	1	1
			Aband. - skunk	1	1
			Intentional Taking	1	1

[1] See discussion

Table 3. Fates of exclosed and unexclosed Piping Plover nests, Cape Cod National Seashore, 2000

	Total	Successful (%)	Not Successfull (%)	Cause of Failure	No. Lost (%)
Exclosed	91	47 (52)	44 (48)	Overwash	36 (75)
				Unknown Predator	2 (5)[1]
				Abandoned	2 (5)
				Infertile	1 (2)
				Terr. w/ other pair	1 (2)
				Aband. - skunk	1 (2)
				Intentional Taking[2]	1 (2)
Unexclosed	29	1 (3)	28 (97)	Crow	10 (36)
				Unknown Predator	8 (29)
				Overwash	3 (11)
				Abandoned	3 (11)
				Sanded	2 (7)
				Skunk	1 (4)
				Gull spp.	1 (4)

[1] 1 nest of 4 eggs had 3 eggs lost to unknown predator and remaining egg did not hatch, nest loss counted in unknown category only

2 See discussion

Table 4. Nesting habitat of Piping Plovers in the North District, Cape Cod National Seashore, 2000

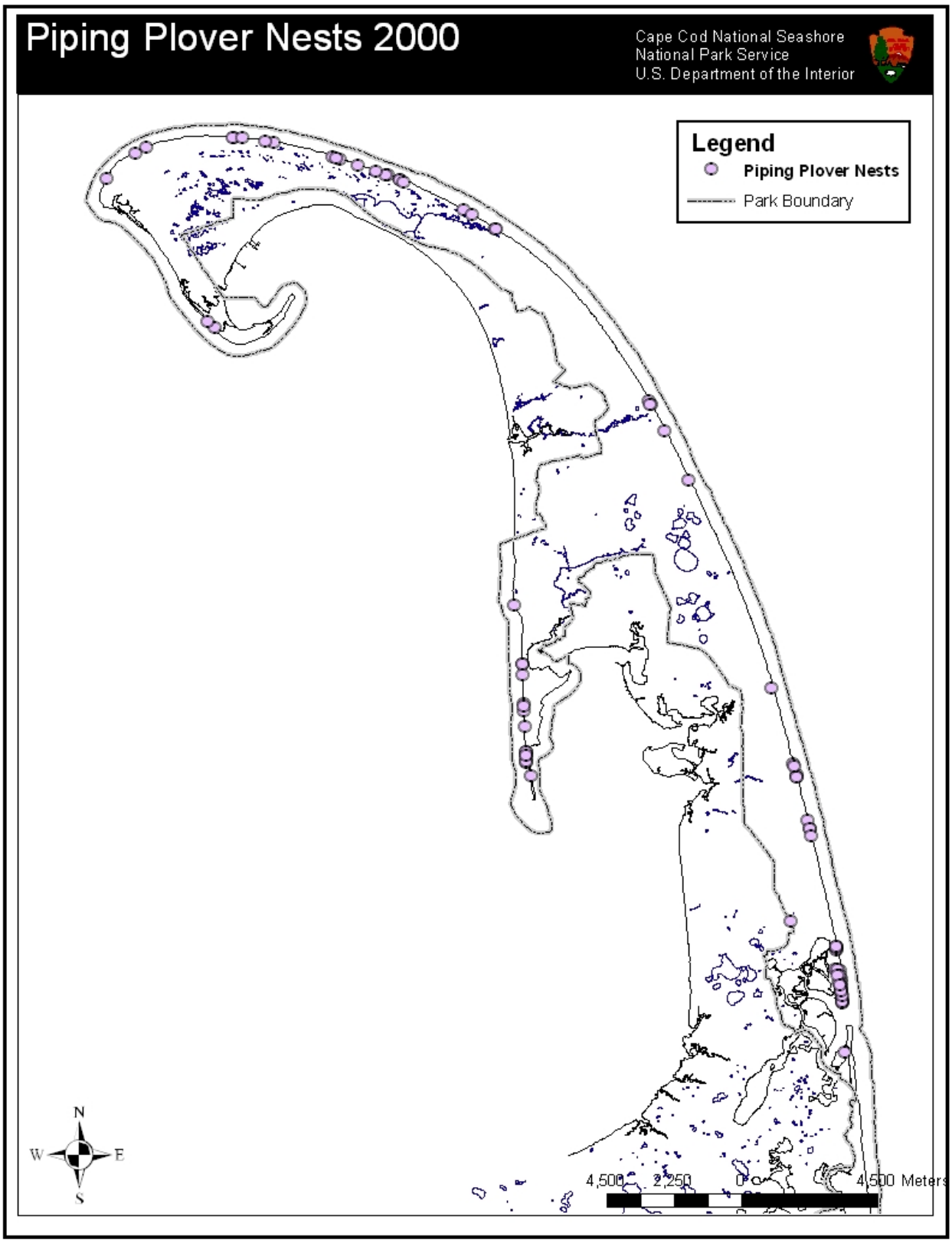
	Habitat					
Site	Berm	Foredune	Interdune	Dune	Overwash	Total
Wood End/Long Point	8	3	0	0	0	11
Race Point Beach North	0	5	2	0	0	7
Race Point Beach South	17	11	0	0	0	28
High Head	4	0	0	0	0	4
Ballston Beach	6	2	0	2	0	10
Great Island/Jeremy Point	9	4	1	0	2	16
Marconi Beach	13	2	0	0	0	15
Coast Guard Beach	8	5	7	0	8	28
Total	65	32	10	2	10	119

Table 5. Number of nests and eggs lost during the 6 June 2000 storm

Site	**No. Nests Lost**	**No. Eggs Lost**	**Total Active Nests on 6/5/00**	**Total No. Eggs on 6/5/00**	**% Nests Lost**	**% Eggs Lost**
Coast Guard Beach	10	38	11	42	91	90
Marconi Beach	5	19	6	22	83	86
Great Island/Jeremy Pt.	3	12	9	23	33	52
Ballston Beach	2	7	2	7	100	100
High Head	2	8	2	8	100	100
Race Pt. South Beach	11	31	12	33	92	94
Race Pt. North Beach	1	4	2	8	50	50
Wood End/Long Pt.	2	7	5	15	40	47
Total	36	126	49	158	74	80

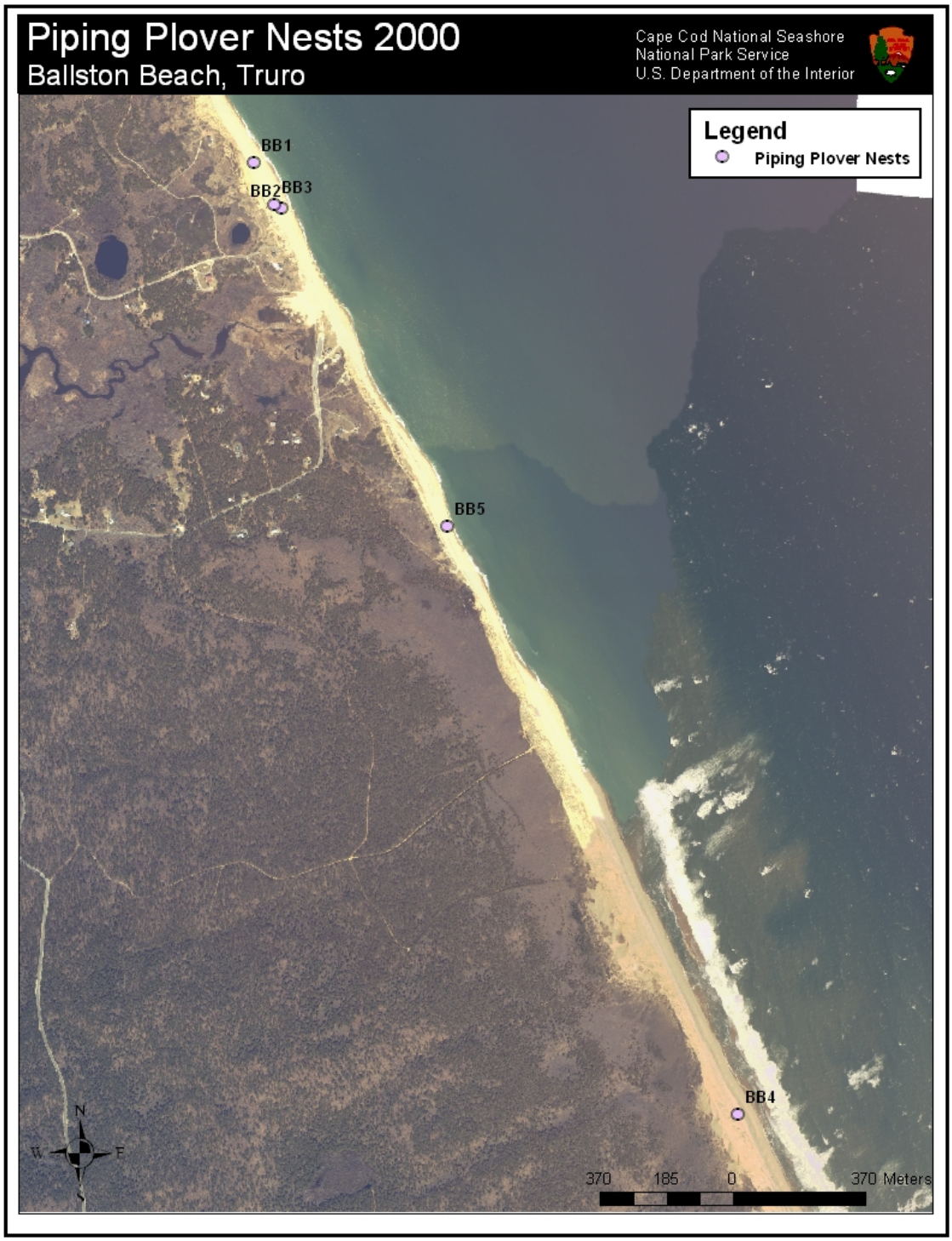
Appendix A

Map of Piping Plover Nest Locations, Cape Cod National Seashore, 2000

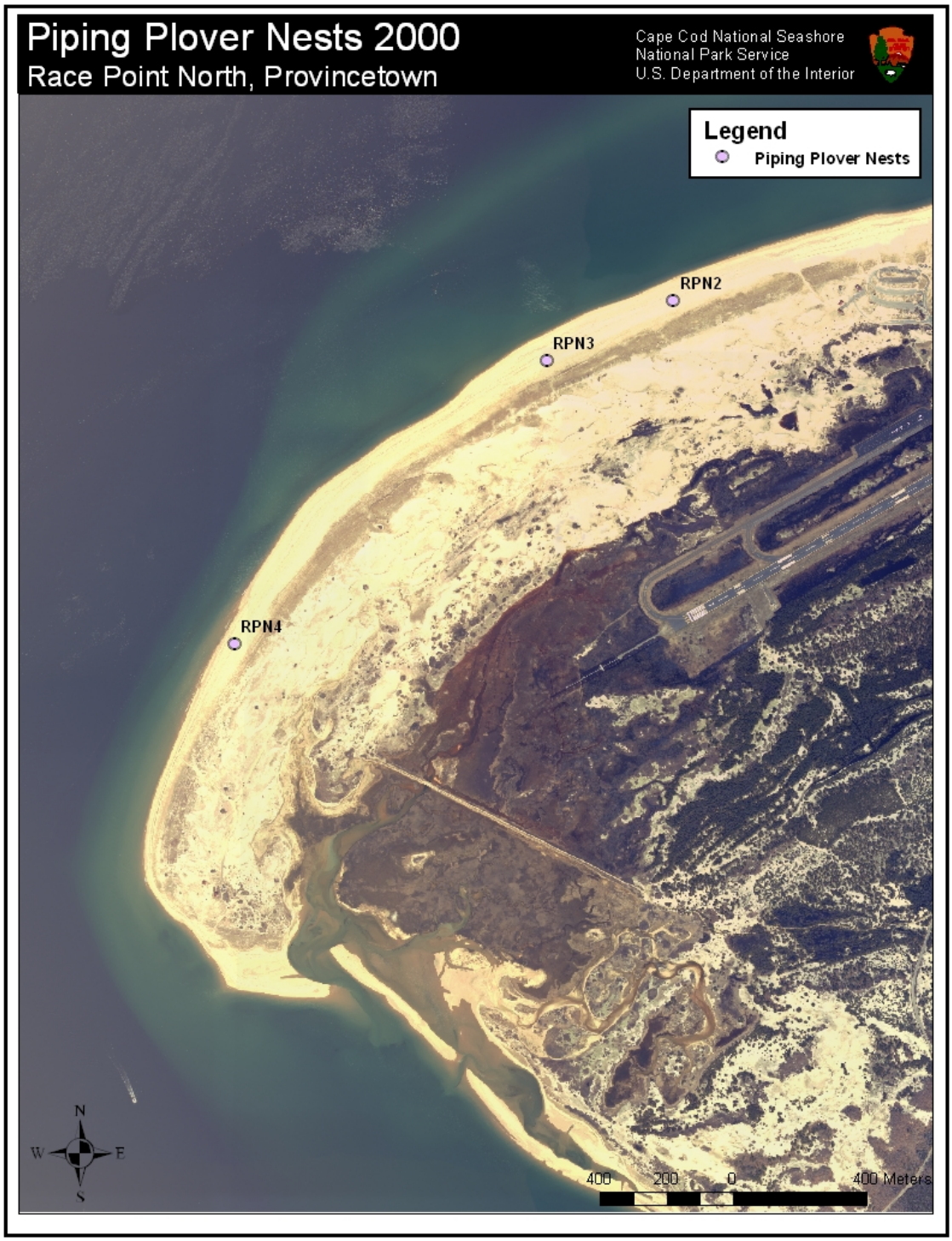

Piping Plover Nests 2000
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
Park Boundary
N
W
E
S
4,500
2,250
0
4,500 Meters

Appendix B

Maps of Cape Cod National Seashore, North District 2000 Piping Plover Nest Sites


Piping Plover Nests 2000
Ballston Beach, Truro
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
BB1
BB2
BB3
BB5
BB4
N
W
E
S
370
185
0
370 Meters

Piping Plover Nests 2000
High Head, Truro
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
HH2
HH4
HH1
HH3
N
W
E
S
180
90
0
180 Meters


Piping Plover Nests 2000
Race Point North, Provincetown
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
RPN2
RPN3
RPN4
N
W
E
S
400
200
0
400 Meters

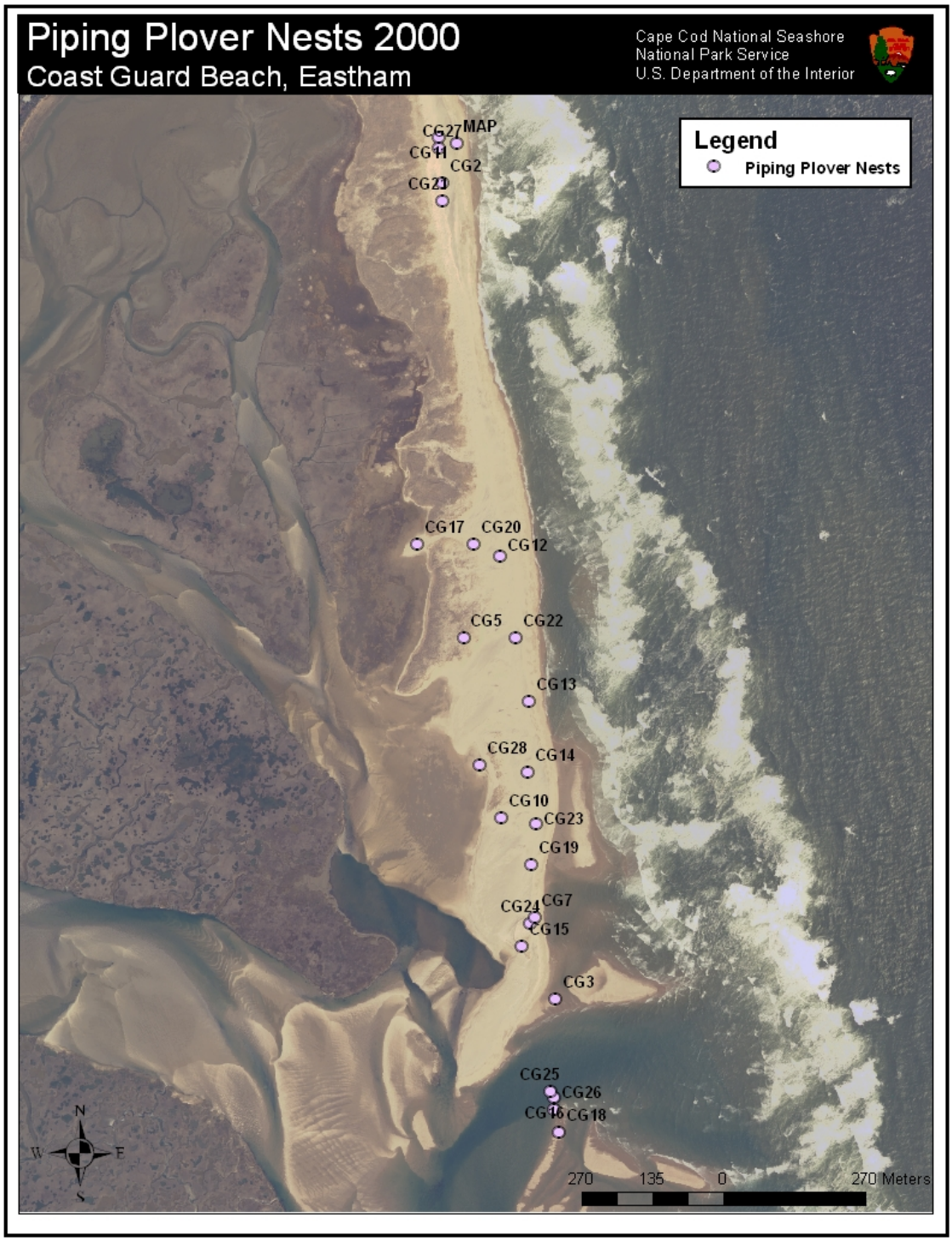
Piping Plover Nests 2000
Race Point South, Provincetown (part 1)
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
RPS13
RPS3
RPS4
RPS12
RPS10
N
W
E
S
320
160
0
320 Meters

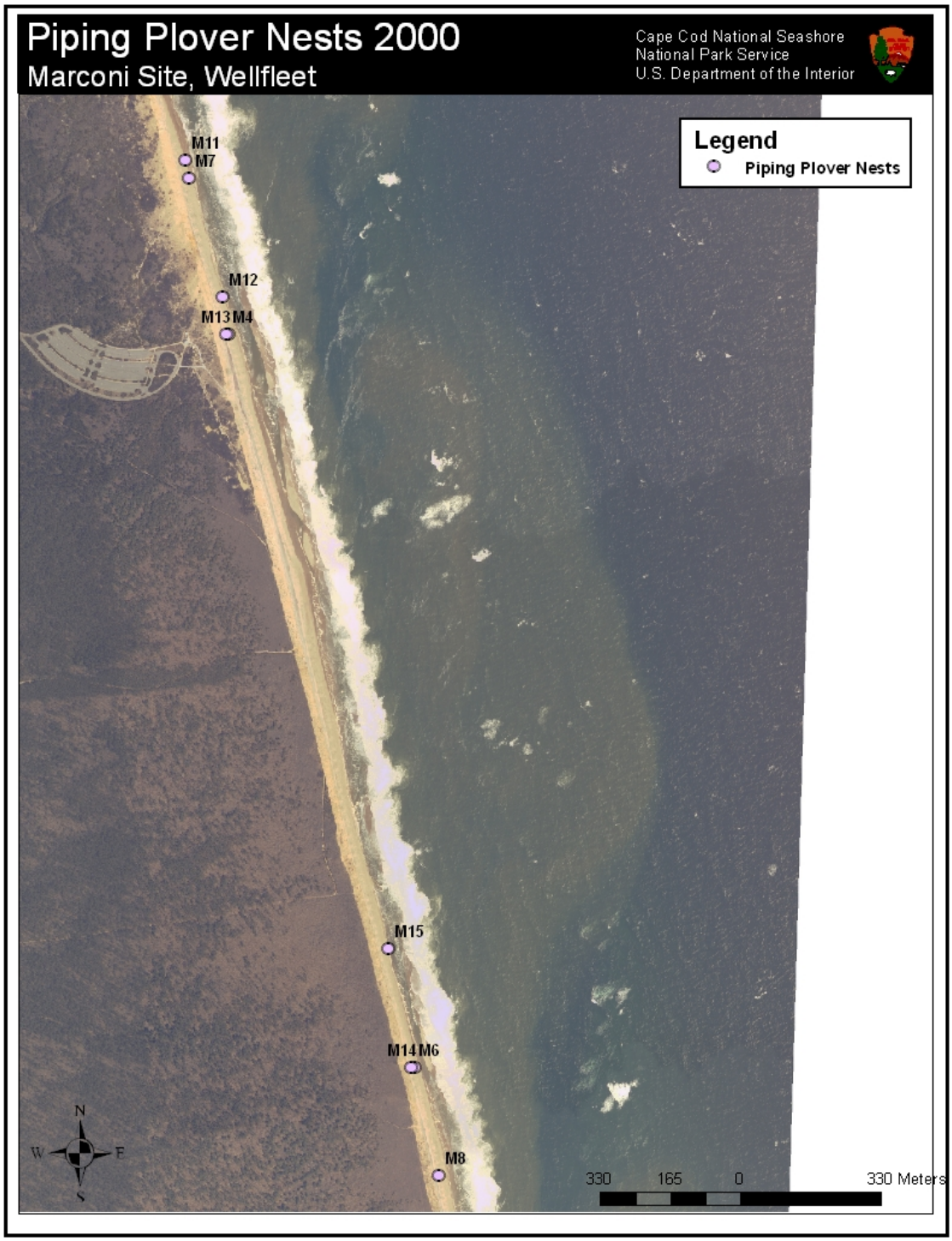
Piping Plover Nests 2000
Race Point South, Provincetown (part 2)
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
RPS11
RPS9
RPS16
RPS1
RPS8
RPS7
RPS23
RPS209
RPS27
N
W
E
S
410
205
0
410 Meters

Piping Plover Nests 2000
Wood End, Provincetown
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
WE02
WE01
N
W
E
S
240
120
0
240 Meters

Appendix C

Maps of Cape Cod National Seashore, South District 2000 Piping Plover Nest Sites


Piping Plover Nests 2000
Coast Guard Beach, Eastham
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
MAP
CG27
CG11
CG2
CG21
CG17
CG20
CG12
CG5
CG22
CG13
CG28
CG14
CG10
CG23
CG19
CG24
CG7
CG15
CG3
CG25
CG26
CG16
CG18
N
W
E
S
270
135
0
270 Meters


Piping Plover Nests 2000
Marconi Site, Wellfleet
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
M11
M7
M12
M13 M4
M15
M14 M6
M8
N
W
E
S
330
165
0
330 Meters

Piping Plover Nests 2000
LeCount Hollow, Wellfleet
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
L2
N
W
E
S
140
70
0
140 Meters

Piping Plover Nests 2000
Great Island, Wellfleet
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
GI10
GI12
GI14
GI13
GI11
GI4
GI2
GI15
N
W
E
S
580
290
0
580 Meters

Piping Plover Nests 2000
Jeremy Point, Wellfleet
Cape Cod National Seashore
National Park Service
U.S. Department of the Interior
Legend
Piping Plover Nests
JP8
JP16
JP7
JP9
JP1
JP6
JP5
N
W
E
S
180
90
0
180 Meters