

**BREEDING ECOLOGY OF PIPING PLOVERS NESTING AT
CAPE COD NATIONAL SEASHORE, 1997**

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CACO Natural Resource Report 97-01

Cape Cod National Seashore

Wellfleet, MA 02667

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ACKNOWLEDGEMENTS

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.

Piping Plovers were monitored this year by: John O'Neill (Shorebird Ranger, North District), Bob Irish (Park Ranger, North District), Nora Kenneway (Biological Technician, South District), Randy Follett (Shorebird Ranger, South District), Chip Foster (Student Conservation Assistant, South District), and Monica Sasse (Volunteer-In-Park). All of these individuals' assistance was greatly appreciated. North and South district supervisory Park Rangers Gene Valli and Dennis St. Aubin provided logistic and monitoring assistance throughout the season. Thanks are also due L. K. Jones (Biologist) and Mike Reynolds (Chief of Natural Resources) for their logistic support. I would also like to recognize Mike Minerath and Scott Amirault for their assistance in installing predator exclosures.

Finally, I would like to mention 2 people who deserve special recognition for their time dedicated to the shorebird program here at CACO. John O'Neill has the dubious honor of having the most consecutive years spent as Shorebird Ranger -- 5 and counting. Gene Valli has spent many years working with terns and plovers, and has gone above and beyond his normal responsibilities as a supervisory Park Ranger in helping to make the program the success it is.

ABSTRACT

This report summarizes the 1997 nesting season at Cape Cod National Seashore. 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 on 6 April. Sixty-seven pairs of Piping Plovers were monitored at 8 sites in Cape Cod National Seashore. Egg-laying began in the first week of May. Peak nesting occurred during the first week of June. Peak hatching occurred twice during the season, in the second week of June and second week of July. Peak hatching was bimodally distributed this year due to a severe overwash event in June. Hatching success was 47%. Fledging success 61%. Productivity was 1.5 chicks fledged/pair. 49% of all nests initiated failed to hatch at least 1 chick. Overwash was the leading cause of nest loss. Of 72 exclosed nests, 45 (63%) successfully hatched young. Of the 27 exclosed nests that did not hatch, 15 (56%) failed due to overwash. Of the 35 unexclosed nests, 25 (71%) failed to hatch. Berm habitat was used for nesting 41% of the time. This year, 15 pairs of plovers nested along the ORV corridor. For the second year in a row, the North Beach remained open throughout the plover nesting season. The South Beach was closed, except for 0.5 mi at the extreme southern end of the route, and 1.0 mi at the extreme northern end of the route, and remained closed for approximately 1 month. By 13 August, the entire ORV corridor was reopened to vehicles.

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 1350 pairs, up significantly from the 790 pairs estimated in 1985. It is believed that the population has 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 1996).

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 (Table 1, App. 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 1997, 67 pairs of nesting plovers were recorded on beaches managed by the NPS (representing 14% of the state total). Productivity (number of chicks fledged per pair) at Cape Cod National Seashore ranged from 0.3 to 2.6 fledged chicks per pair during the same time period. Productivity this

year was 1.54 fledged chicks per pair, up significantly from 1996 but still down from the early 1990s.

This report summarizes the 1997 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 (includes Head of the Meadow and Coast Guard Beach, Truro), and Ballston) and South (Great Island/Jeremy Point, Marconi Beach, and Coast Guard Beach). These sites were described in Meisel (1991) and Brown and Hoopes (1993).

METHODS

Observations of Piping Plovers began on 6 April at the time of plover arrival and territory establishment 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 Wood End/Long Point, Ballston, and Great Island, which were monitored every six to eight days. Once nests were established, all beaches were visited almost daily (≥ 5 times per week) except for Long Point, which was visited 4 times 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. Locations of adults and chicks were reported relative to nest locations.

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 ATV's, 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 generally within 1 day of clutch completion. Tops of most exclosures were covered with fruit netting (1/4" mesh) at the time the exclosure was installed. At beaches where repeated predation was causing nest loss prior to clutch completion, some exclosures were installed around incomplete nests (i.e., 2 or more eggs). This was only done when there was a clearly demonstrated situation of repeated egg loss prior to clutch completion.

Since the U.S. Fish and Wildlife Service banding moratorium in 1989, numbers of color-banded plovers observed at Cape Cod National Seashore have decreased. This year, no banded plovers nested at the 8 study beaches.

RESULTS AND DISCUSSION

Seasonal Chronology

Plovers were first observed on Cape Cod National Seashore beaches on 14 March and most study beaches had plovers present by mid-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 first week of May for both North and South districts. Peak nesting for the Seashore occurred

during the first week of June (Fig. 1). The last nest was initiated on 20 June at Coast Guard Beach. Peak nesting for the Seashore this year is consistent with the patterns exhibited in past years (Hoopes 1995). However, prior to the use of exclosures, peak nesting typically occurred 2 - 3 weeks later in the season (MacIvor et al. 1990).

Peak hatching for the Seashore occurred twice during the season, in the second week of June and second week of July (Fig. 2). Hatching dates ranged from 1 June to 22 July. Peak hatching was bimodally distributed this year due to a severe overwash event on 5-6 June that destroyed 18 nests. Fledging dates ranged from 28 June to 17 August. These dates are comparable with other years.

Productivity

Sixty-seven pairs of Piping Plovers were monitored at 8 sites in Cape Cod National Seashore (Table 2). This represents approximately 14% of the total breeding population of Massachusetts. Preliminary figures estimate the state population in 1997 was approximately 475 pairs. Numbers of nesting plovers at the 8 sites monitored decreased by 14% from 1996 but increased 372% since monitoring began in 1985. Coast Guard and Marconi beaches had the same numbers of pairs as last year, while numbers of nesting pairs at Ballston Beach significantly increased (4 pairs in 1996, 7 pairs in 1997). Further, this year a new nest site was used 0.5 mi south of Newcomb Hollow Beach. At High Head numbers of nesting pairs decreased by 2 pairs. This decrease is not significant and simply reflects annual changes in nest distribution. However, numbers of nesting pairs on Race Point North and South beaches and Wood End/Long Point significantly declined this year. This decrease is most likely due to the heavy and persistent levels of predation that occurred at these sites last year.

Hatching success (total number of eggs hatched/total number of eggs laid) for all sites combined was 47% and ranged from 20% to 85% (Table 2). Overall, hatching

success was similar to those reported between 1990 and 1995. Wood End/Long Point (85%) and Coast Guard Beach (60%) had the highest hatching success; while Race Point Beach North (20%) and High Head (30%) had the lowest hatching success (Table 2). The relatively low hatching success recorded at Race Point Beach North was attributable to a low number of nesting pairs and crow predation and at High Head to the number of renests caused by overwashes during the 5-6 June storm. Twenty-four percent (13 of 55) of the nests that hatched left 1, 2, or 3 eggs in the scrape. This is more than previously recorded. Partially hatched clutches may be reflective of younger, less experienced birds' attempts at nesting or may be due to environmental conditions at the time the eggs were produced or during incubation.

Fledging success (total number of chicks fledged/total number of eggs hatched) for all sites combined was 61% and ranged from 50% to 100% (Table 2). Overall, fledging success increased from 1996 and was the same as in 1995. Race Point Beach North (100%) and Wood End/Long Point (71%) had the highest fledging success; while Marconi (50%) and Coast Guard beaches (52%) had the lowest fledging success (Table 2). Fledging success at Race Point Beach North is somewhat biased as only 1 pair contributed to the calculation. Coast Guard Beach typically has had lower fledging success than other study sites.

Productivity (number of chicks fledged/nesting pair) for all sites was 1.5 (103 chicks fledged from 67 pairs) and ranged from 1.0 to 2.4 (Table 2). Overall, productivity increased from 1996 and equalled average productivity reported at Cape Cod National Seashore since 1985. Wood End/Long Point (2.40) and Race Point Beach South (1.73) had the highest productivity; while Marconi Beach (1.00) and Race Point Beach North (1.33) had the lowest productivity (Table 2). Productivity greater than 1.4 is required for the population to increase (USFWS 1996). Productivity at Cape Cod National Seashore slightly exceeded productivity statewide. Preliminary data estimate 1997 productivity for the state was 1.4 (S. Melvin, pers. comm.).

Nest Loss

Forty-nine percent (52 of 107 nests) of all nests initiated failed to hatch at least 1 chick (Table 3). Overwash was the leading cause of nest loss, accounting for 18 (35%) of all nests lost (Table 3). Abandonment was the next leading cause of nest loss. All sites except Race Point Beach North had one of the above factors as the leading cause of nest failure. Marconi and Coast Guard beaches had the highest numbers of nests lost, 12 and 11, respectively. The 18 nests (35% of all nests lost) lost to overwash occurred during one storm event on 5-6 June. Most (15 of 18) of the nests lost in this storm were within 7 days of hatching. While overwash losses can be severe, there is nothing that can be done to curb these losses. Of greater concern is the level of abandonment that occurred this year. Abandonment does not usually account for such large percentages of nest lost. However, this year 27% of all nests lost (n = 14) were abandoned. Reasons for this high level of abandonment are not understood.

Predator Exclosures

Predator exclosures were installed around 72 of the 107 (67%) nests. Of the 72 exclosed nests, 45 (63%) successfully hatched young. Of the 27 exclosed nests that did not hatch, 15 (56%) failed due to overwash, 9 (33%) were abandoned, and 3 (11%) were presumed infertile (Table 4). Hatching success of exclosed nests would have been substantially increased (83%, 60 of 72 nests) if overwash was not a factor in nest lost. Of the 35 unexclosed nests, 25 (71%) failed to hatch. Of these, 7 (28%) were lost to unknown causes, 5 (20%) were lost to crow, 5 (20%) were abandoned, and 8 (32%) were lost to other factors. In most of these cases, nests were lost prior to clutch completion. Every effort should be made to exclose nests on the day the clutch is completed. Weather played a major role in delaying exclosure installation this year, especially in the early part of the season.

Mortality

Chick mortality factors were 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 three consecutive days of searching. Most chick mortality at the 8 sites occurred within the first 10 days after hatching (Table 5). This pattern is consistent with data from previous years (Meisel 1991, Brown and Hoopes 1993, Hoopes 1994). Three chicks were found dead, presumed to have died of exposure. In contrast to previous years, raptors (e.g., American Kestrels, *Falco sparverius*, and Merlins, *F. columbarius*) did not appear to be a factor in chick mortality. In fact, few raptors were observed on the beaches during the chick-rearing stage.

There was one known case of adult mortality at Cape Cod National Seashore this year. A female was found dead inside an enclosure at Peaked Hill on 10 July. The bird was sent to the National Wildlife Health Lab, Madison, WI for necropsy. Unfortunately, the bird was not found until it had been dead for as much as 22 hours. As a result, internal organs were in a state of autolysis before being frozen. The official cause of death was determined to be unknown predation (Appendix B). Subsequent conversations with the veterinary pathologist could not determine the type of predator that caused the death. However, field investigations could find no evidence of predators in the immediate area. Further, given the circumstances under which the bird was found, field personnel believed at the time the injuries were the result of flying into the enclosure. Therefore, I believe the official cause of death for this bird should be listed as unknown, rather than predation or enclosure-related, pending further information. This bird's mate tended the nest for approximately 4 days but eventually abandoned the nest.

Nesting Habitat

Nesting habitat for 107 nests was categorized according to the macrohabitat types defined by MacIvor (1990). Berm habitat was used for nesting 41% of the time (Table 6). The next most utilized habitats for nesting were foredune (23%) and overwash (23%, Table 6). Overwash continued to be the primary nesting habitat of Piping Plovers at Coast Guard Beach. This trend has continued throughout the 10 years that monitoring has been conducted at that site. Interdune habitat was used for the majority of the nesting attempts by Piping Plovers at Race Point Beach North. This maybe due in part to the high level of predator activity at this site last year.

ORV Management

ORV management, as it relates to plover management at Cape Cod National Seashore, is a dynamic process. This year, 15 pairs of plovers nested along the ORV corridor. As these nests hatched, affected sections of the ORV corridor were closed to vehicles (Appendix C). Closures were imposed only when eggs hatched and were kept in effect through the chick-rearing stage until fledging. For the second year in a row, the North Beach remained open throughout the plover nesting season. The few pairs of plovers that nested on the North Beach either did not successfully hatch any eggs or nested in areas that did not affect the corridor. The South Beach was closed, except for 0.5 mi at the extreme southern end of the route, and 1.0 mi at the extreme northern end of the route, and remained closed for approximately 1 month. The beaches began opening up to ORV traffic again in late July and early August. As chicks fledged, portions of the ORV corridor that could be opened, were. By 13 August, the entire ORV corridor was reopened to vehicles.

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Table 1. Number of Piping Plover breeding pairs and nest productivity on beaches managed by the National Park Service, Cape Cod National Seashore, 1985-1997.

Year	No. Pairs	Productivity
1985	18	0.7
1986	16	0.3
1987	15	0.4
1988	13	0.9
1989	15	1.4
1990	15	2.6
1991	28	2.6
1992	43	2.4
1993	60	2.1
1994	72	2.5
1995	83	1.8
1996	74	0.9
1997	67	1.5

Productivity = Number of chicks fledged per pair

Table 2. Number of Piping Plover breeding pairs, hatching and fledging success, and nest productivity, by nesting beach, Cape Cod National Seashore, 1997.

Site	Number Breeding Pairs	Number Nests	Number Eggs/Site ¹	Number Eggs Hatched ¹	Number Chicks Fledged	Hatching Success ²	Fledging Success ³	Productivity ⁴
Coast Guard Beach	14	23	73	44	23	0.60	0.52	1.64
Marconi Beach	10	18	61	20	10	0.33	0.50	1.00
Great Island / Jeremy Point	7	9	30	15	10	0.50	0.67	1.43
Ballston Beach	7	11	39	17	10	0.44	0.59	1.43
High Head	6	12	43	13	9	0.30	0.69	1.50
Race Point South ⁵	15	22	74 ⁶	39 ⁶	26	0.53	0.67	1.73
Race Point North ⁵	3	6	20 ⁶	4 ⁶	4	0.20	1.00	1.33
Long Point / Wood End	5	6	20	17	12	0.85	0.71	2.40
Total	67	107	266	126	104	0.47	0.83	1.55

¹ Includes renests

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

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

⁴ Number of chicks fledged/number of breeding pairs

⁵ Total number of nests includes 1 nest with unknown number of eggs laid and hatched.

⁶ Does not include nest that had unknown number of eggs laid and hatched

Table 3. Causes of Piping Plover nest failures, by nesting beach, Cape Cod National Seashore, 1997.

Site	Total No. Nests	Cause of Failure	No. (%) Failed	Total No. Failed	% Total Failed ¹
Coast Guard	23	Abandoned	4 (36)	11	48
		Unknown	3 (27)		
		Crow	2 (18)		
		Overwash	1 (9)		
		Poss. Red Fox	1 (9)		
Marconi	18	Overwash	6 (50)	12	67
		Infertile	2 (17)		
		Unknown	2 (17)		
		Abandoned	1 (8)		
		Crow	1 (8)		
Great Island	9	Abandoned	2 (50)	4	44
		Unknown	1 (25)		
		Crow	1 (25)		
Ballston Beach	9	Overwash	4 (100)	4	36
High Head	12	Overwash	4 (57)	7	58
		Infertile	1 (14)		
		Abandoned	1 (14)		
		Prob. Crow	1 (14)		
Race Pt. South	22	Abandoned	4 (44)	9	41
		Overwash	2 (22)		
		Unknown	1 (11)		
		Crow	1 (11)		
		Prob. Crow	1 (11)		
Race Pt. North	6	Prob. Crow	2 (50)	4	67
		Abandoned	1 (25)		
		Overwash	1 (25)		
Wood End/Long Pt.	6	Abandoned	1 (100)	1	17
Total	107	Overwash	18 (35)	52	49
		Abandoned	14 (27)		
		Unknown	7 (13)		
		Crow	5 (10)		
		Prob. Crow	4 (8)		
		Infertile	3 (6)		
Prob. Red Fox	1 (2)				

¹ percent total of failed nests at that site

Table 4. Fates of exclosed and unexclosed Piping Plover nests, Cape Cod National Seashore, 1997

Status	No. Nests	No. (%) Hatched	No. (%) Unhatched	Reason For Failure	No. (%) Failures
Exclosed	72	45 (63)	27 (37)	Overwash	15 (56)
				Abandoned	9 (33)
				Infertile	3 (11)
Unexclosed	35	10 (29)	25 (71)	Unknown	7 (28)
				Crow	5 (20)
				Abandoned	5 (20)
				Prob. crow	4 (16)
				Overwash	3 (12)
				Prob. fox	1 (4)

Table 5. Life table of Piping Plover chick survival, Cape Cod National Seashore, 1997

Age (Days)	s	d	q
0-5	155	31	.20
6-10	124	13	.10
11-15	111	6	.05
16-20	105	1	.01
21-25	104	0	.00
26-30	104	0	.00

s = number of chicks alive at end of each time period
d = number of chicks that died during each time period
q = d/s

Table 6. Nesting habitat of Piping Plovers, Cape Cod National Seashore, 1997

Site	Habitat Type						Total
	Berm	Foredune	Interdune	Overwash	Parking Lot	Bluff	
Coast Guard Beach	2	1	3	17			23
Marconi Beach	15	2				1	18
Great Island / Jeremy Point	3	2	2	2			9
Ballston Beach	3	8					11
High Head	10	1			1		12
Race Point South	9	10	3				22
Race Point North		1	4	1			6
Long Point / Wood End	2			4			6
Total	44	25	12	24	1	1	105 ¹

¹ Total does not equal 107 nests because two broods appeared on the beach without nest being detected.

Figure 1. Peak nesting of Piping Plovers at Cape Cod National Seashore, 1997

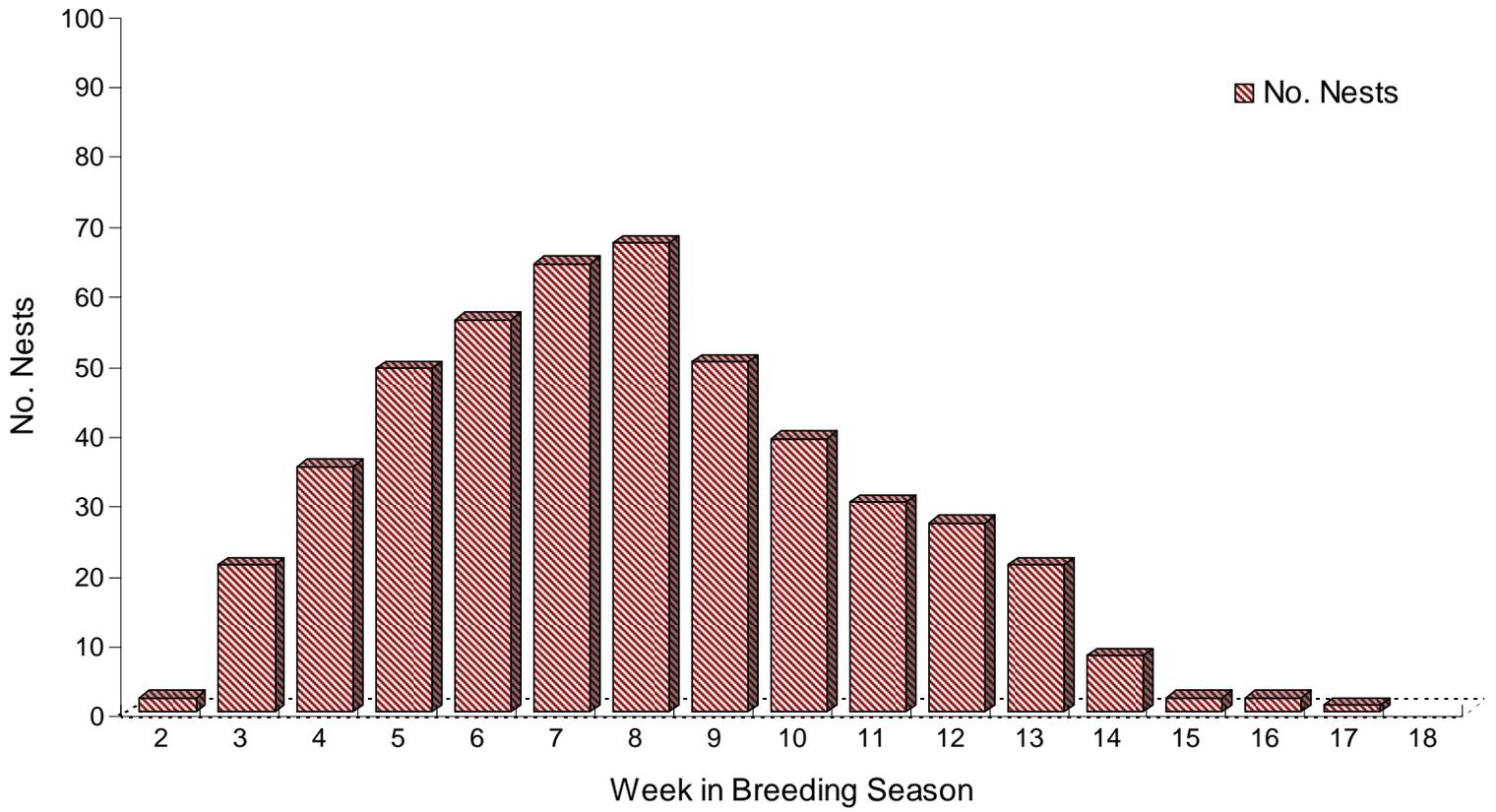
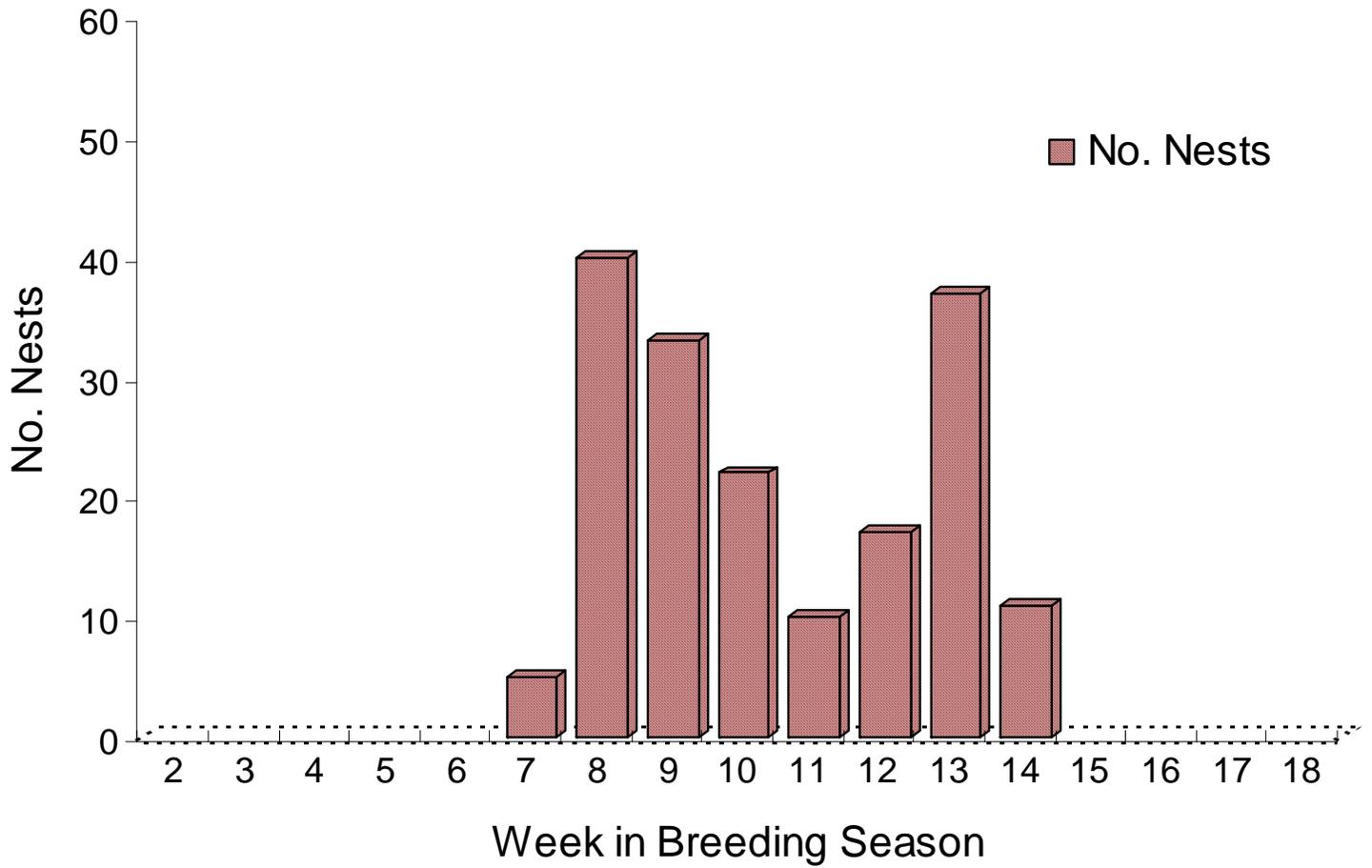
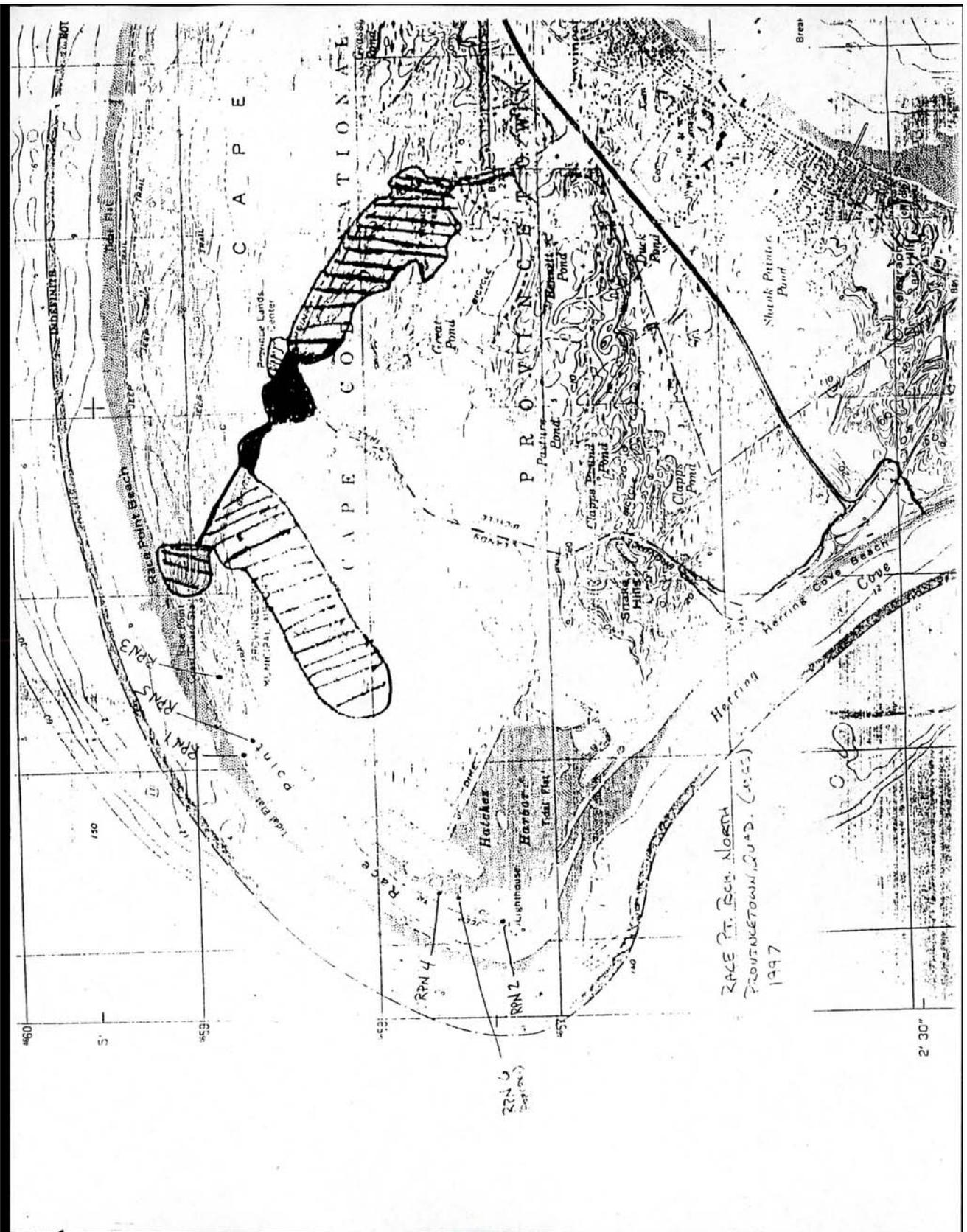


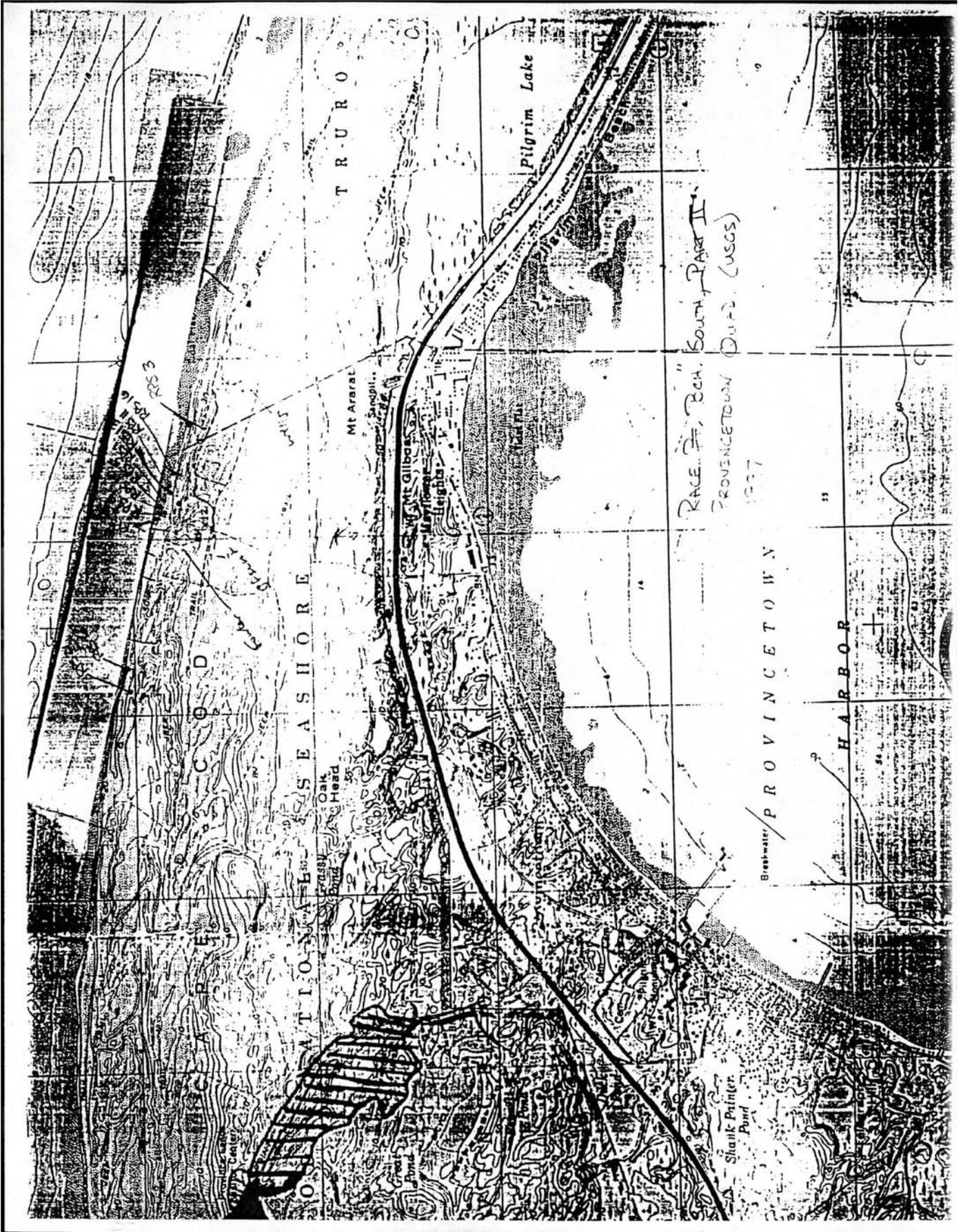
Figure 2. Peak hatching of Piping Plovers, Cape Cod National Seashore, 1997

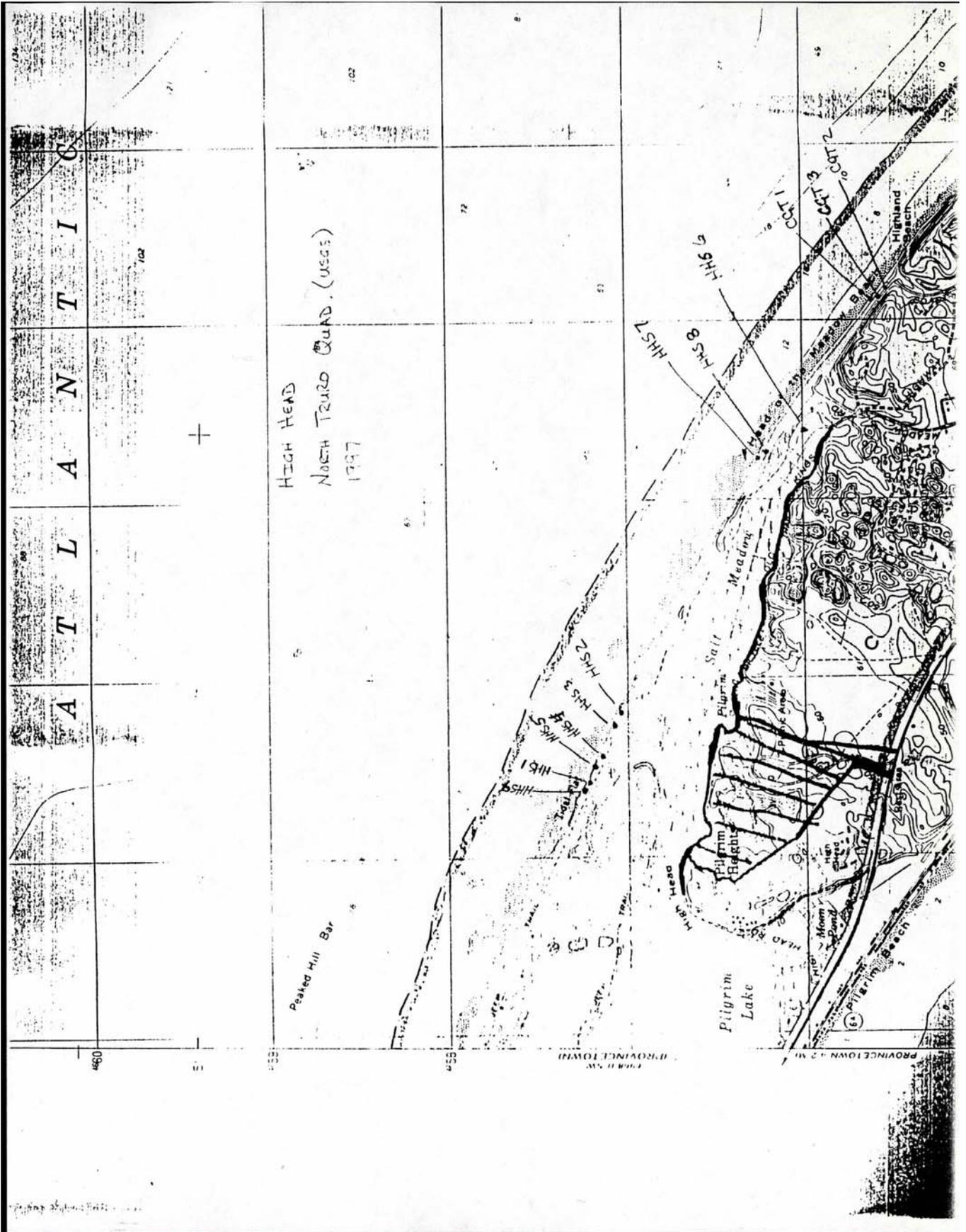


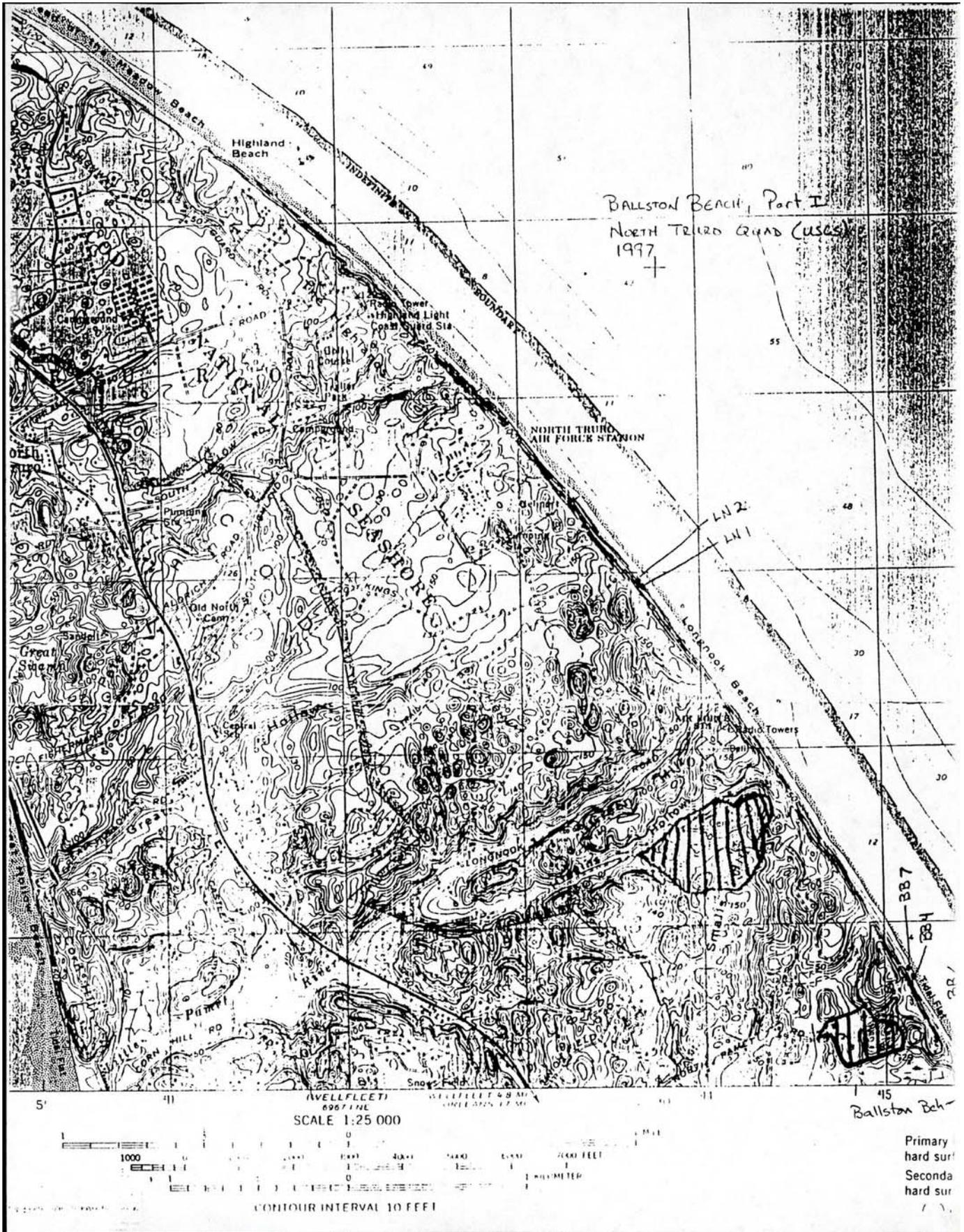
APPENDIX A

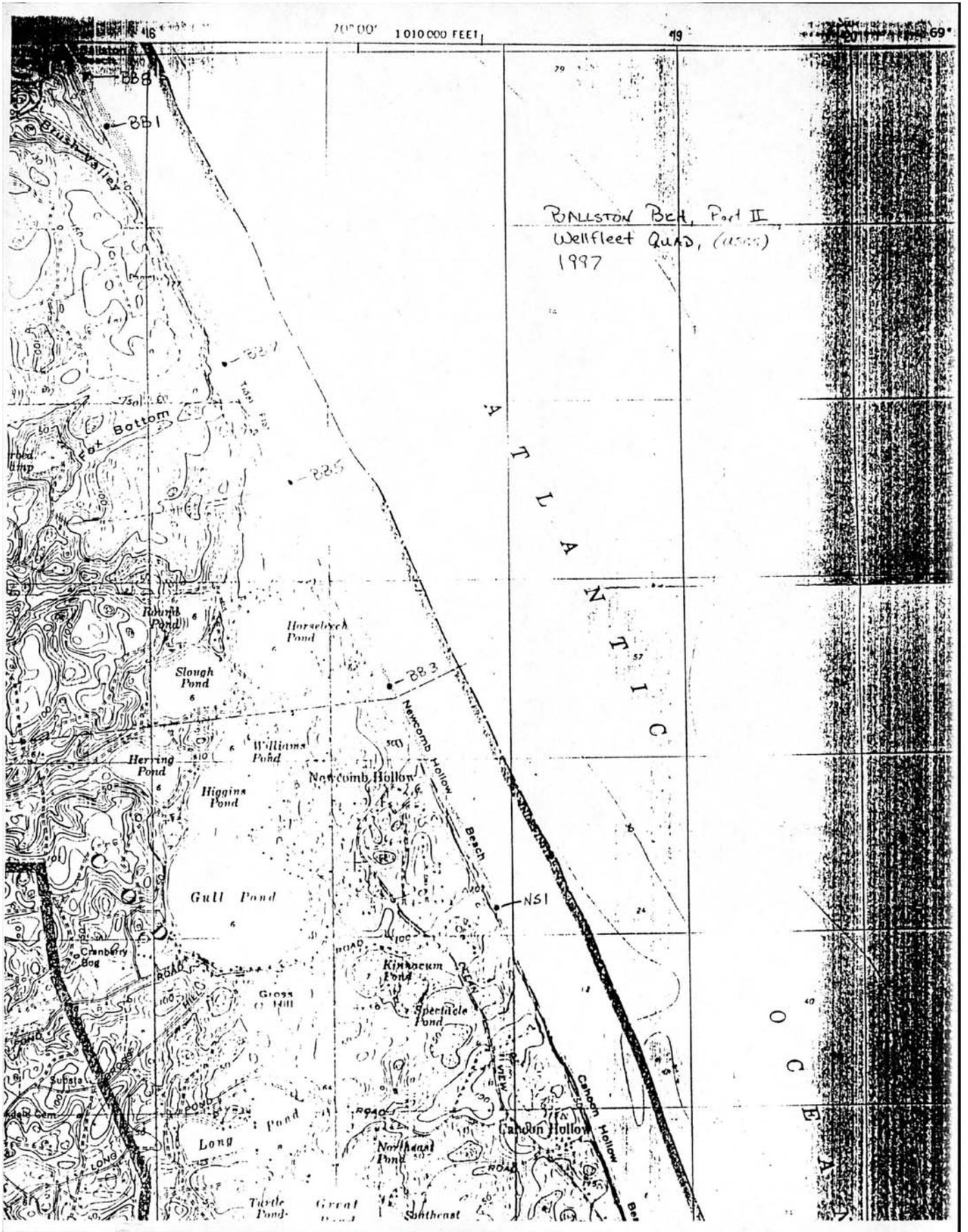
Piping Plover nest locations, by site, Cape Cod National Seashore, 1997

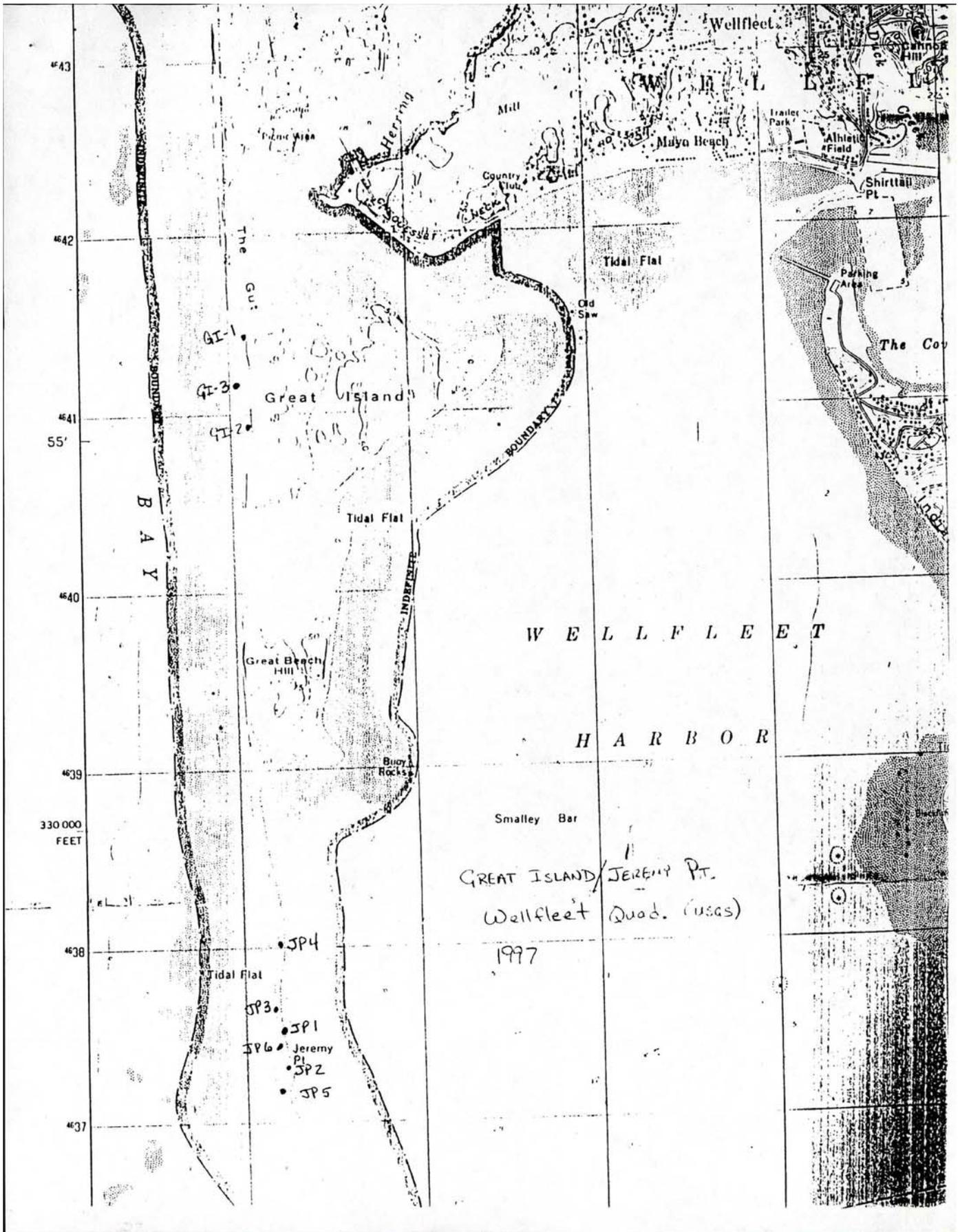


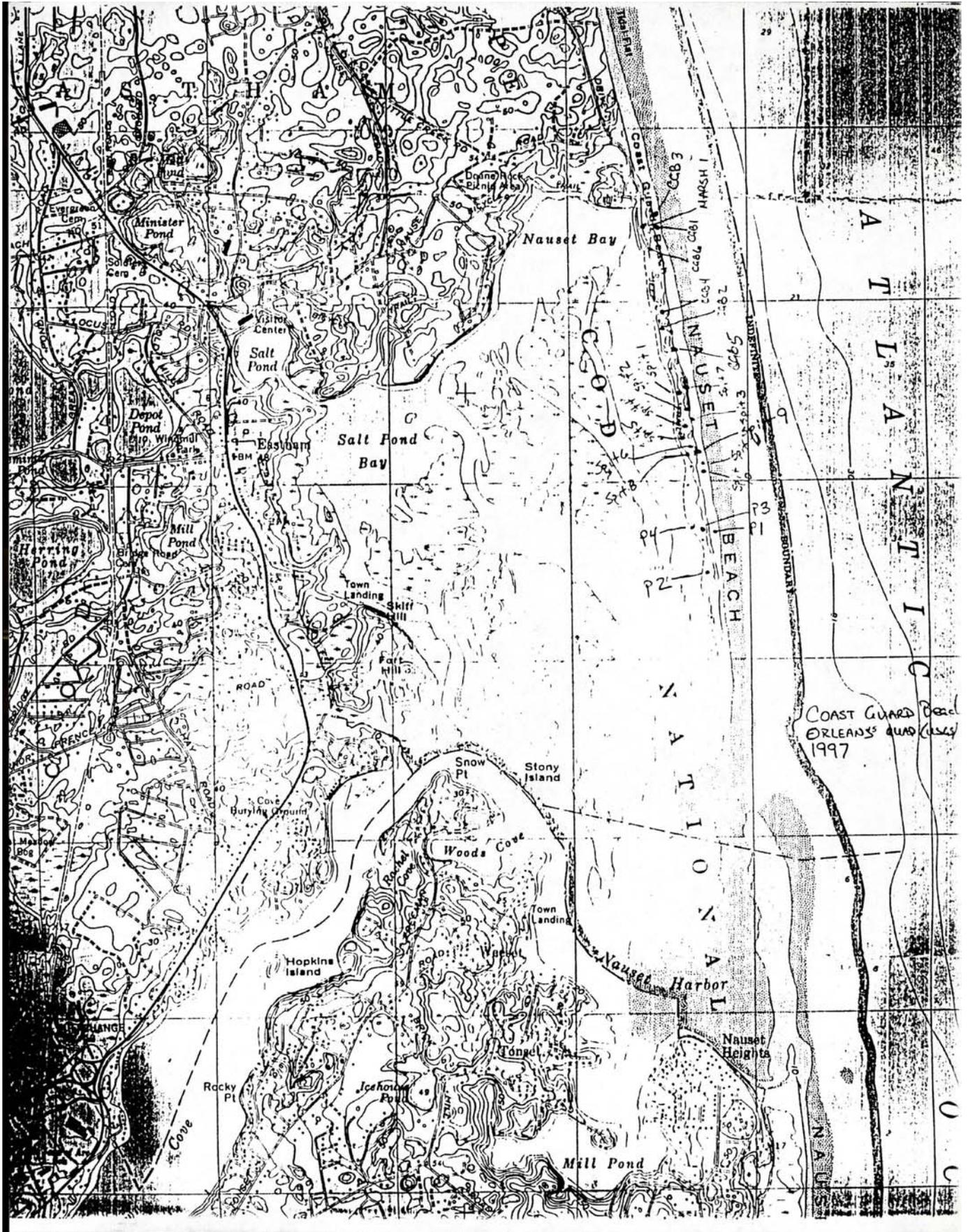












APPENDIX B

Necropsy report on Piping Plover found dead on Race Point Beach South

USGS-BIOLOGICAL RESOURCES DIVISION
NATIONAL WILDLIFE HEALTH CENTER
6006 Schroeder Road
Madison, Wisconsin 53711-6223
608-271-4640 (FAX 608-264-5431)

DIAGNOSTIC SERVICES CASE REPORT

Case: #14881, 001

Epizoo: -

RHT: KJM

Submitter:

Ed Hoopes
Cape Cod NS
99 Marconi Site Road
Wellfleet, MA 02667

Specimen description/identification:

Piping Plover

Date Submitted: 07/16/97

Location: Cape Cod NS, Barnstable Co.,
MA

General Diagnosis: Predation

Comments: Three minute punctures were found in areas of hemorrhage in the skull. The wounds were 6 and 10 mm apart and were positioned behind the left eye, in the midline of the top of the skull, and behind the right ear. This bird was otherwise in good body condition with no indication of a predisposing health problem. Microscopic examination of major organs will be done in the near future; if this yields significant findings, a supplementary report will be done. The carcass and heart will be sent to Sue Haig for genetics studies.

Final Report (07/17/97)
date

See attached necropsy records for individual specimen observations.

Note: Copies of this report have been sent to:

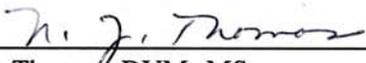
USFWS Regional Office (RO-5)

Attention:

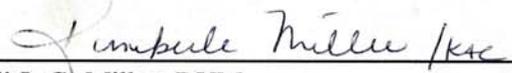
Migratory Bird Coordinator

F & W Enhancement: Endangered Species

F & W Enhancement: Environmental Contaminants Coordinator


Pathologist: Nancy J. Thomas, DVM, MS

Diplomate, American College of Veterinary Pathologists


If you have questions regarding this case, contact: Kimberli J. G. Miller, DVM
at 608-271-4640. Include above Case Number. Diagnostic findings may not be used for publication without the pathologist's knowledge and consent.

NATIONAL WILDLIFE HEALTH CENTER
NECROPSY REPORT

Submitter's Name, Affiliation Address

Ed Hoopes
Cape Cod NS
99 Marconi Site Road
Wellfleet, MA 02667

LEGAL: NO

Case: 14881
Accession: 001
Collected: 7/10/97
Exam Date: 7/17/97
Pathologist: N. Thomas
Prosecutor: N. Thomas njt

Species: Piping Plover

Specimen: Carcass

Bandtype: (N) Ref/Band No.: ()

Euth: (N) Weight (Gm): (56.9)

History Summary: This female was found inside the predator enclosure around her nest. This bird was found in the vicinity of Peaked Hill Beach on the Cape Cod National Seashore.

EXTERNAL/INTERNAL OBSERVATIONS - LABORATORY RESULTS

External: Sand is present in the left conjunctival sac and clotted blood fills the right conjunctival sac. A thick blood clot is adhering to feathers over the right ear and blood is present in the right ear canal. When the clot is removed, three minute cutaneous perforations are found immediately caudal to the ear canal orifice. The skin on the right side of the head is diffusely dark purple. The skin over the right thorax, and right stifle region is also discolored purple. There is faint pink-brown discoloration of feathers over the left pectoral region and the right lateral stifle region. The keel is mildly prominent. The abdomen has a soft texture. A small amount of tan feces clings to feathers near the vent.

Internal: There is abundant subcutaneous and abdominal fat. The pectoral muscles are well developed. There is bruising in the right inguinal region and in the subcutaneous tissue along the right lateral thigh, but no skin wounds are evident. There is bruising in the muscles and subcutaneous tissue on the right side of the head. Three minute pinpoint puncture wounds are found in the skull. One puncture is located immediately caudal to the right ear. The margins of this fracture mildly protrude. The second wound is found 1 cm away on the dorsal midline at the top of the cerebrum. The third is located 6 mm to the left of the midline and lies caudal to the left orbit. Hemorrhage is seen in the upper aspect of the brain beneath the dorsal cerebral wound. The lungs and abdominal surfaces are diffusely grey (autolysis). The lungs are mildly heavy and wet. The ovary has follicles enlarged to 2 mm in diameter. Adrenal glands are bright yellow. The kidneys have a grey surface, but pink cut aspect. The liver is pink and mildly prominent. The spleen is small and brown. The esophagus and proventriculus are empty. The ventriculus contains a small amount of fine, tan and grey sand. The intestine is autolyzed, thin-walled and gas distended; its contents are scant. The ceca are also thin-walled and gas distended. A small amount of white feces are present in the cloaca. No lesions are seen in the skeletal system with the exception of the skull, skeletal muscle, heart, pericardial sac, heart valves, trachea, lungs, air sacs, liver, gastrointestinal mucosa, ovary, oviduct, kidneys, adrenal glands, thyroid glands, spleen or pancreas.

Preliminary Diagnosis: _____ Exam Type: (GO)
Sex (F) Age (A)/() Body Cond. (G) Postmortem State (F) Giz. Lead (0)/()

Laboratory Tests/Samples Saved:

1. HISTOPATHOLOGY: Brain, liver, kidney, lung, heart.
2. Saved frozen: Liver - Vitamin A control data; heart - Sue Haig (genetics).
3. Carcass saved for Sue Haig (genetics).

Final Diagnosis (in order of importance)

	topog.	morph.	etiol.	funct.	disease	link
1. <u>Trauma-predation</u>	(T10101)	(M14310)	(E49230)	()	()	()
2. _____	()	()	()	()	()	()
3. _____	()	()	()	()	()	()

Diagnostic findings may not be used for publication without the pathologist's knowledge and consent.

COD (09)

APPENDIX C

Off-road vehicle management actions taken during the Piping Plover nesting season, Cape Cod National Seashore, 1997

Date	Beach	Action
4/15/99	Both	ORV corridor open for season. 0.3 mi of beach on outside around Race Point Light closed due to beach configuration.
6/9/99	South	2.0 mi of beach closed in the vicinity of Charlies. 0.1 mi open from High Head access, north. 4.0 mi open from South Beach entrance, south.
6/19/99	South	5.0 mi of beach closed. 0.1 mi open from High Head access, north. 1.4 mi open from South Beach entrance, south.
7/10/99	South	4.9 mi of beach closed. Opened 0.1 mi of beach on north end of closure. 0.1 mi open from High Head access, north. 1.5 mi open from South Beach entrance, south.
7/19/99	South	4.4 mi of beach closed. Opened 0.5 mi on south end of closure. 0.6 mi of beach open from High Head access, north. 1.4 mi open from South Beach entrance, south.
7/23/99	South	2.5 mi of beach closed. Opened 1.9 mi on north end of closure. 0.6 mi of beach open from High Head access, north. 3.4 mi of beach open from South Beach entrance, south.
8/8/99	South	1.5 mi closed. Opened 1.0 mi of beach on north end of closure. 0.6 mi of beach open from High Head access, north. 4.4 mi of beach open from South Beach entrance, south.
8/13/99	South	Entire beach open.