

BREEDING ECOLOGY OF PIPING PLOVERS NESTING AT
CAPE COD NATIONAL SEASHORE, 1995

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ACKNOWLEDGEMENTS

Monitoring plovers at Cape Cod National Seashore is a large and ever increasing task. As a result, cooperative efforts between a variety of organizational divisions is essential. While each district has personnel devoted to shorebird management, these personnel often work between districts as needs shift and problems arise. This was especially true in 1995, since a record number of nesting pairs were managed by 25% less personnel.

Piping Plovers were monitored this year by: John O'Neill (Shorebird Ranger, North District), Jennifer Hannon (Student Conservation Assistant, North District), Nora Sulzman (Biological Technician, South District), Lloyd Oja (Shorebird Ranger, South District), Maura (Student Conservation Assistant, South District), Leytham (Student Conservation Assistant, South District), and Kelly Chapman (Volunteer-In-Park). All of these individuals' assistance was greatly appreciated. Additionally, Janet Barricman provided assistance in the early and later stages of the season. North and South district supervisory Park Rangers Gene Valli and Dennis St. Aubin provided logistic and monitoring assistance throughout the season. Special thanks to Gene Valli for his nest-finding skills and for hiring a particularly good group of SCA's. Thanks are also due Lewis K. Jones (Biologist) and Mike "I'm not sure I'm ready for my first plover nesting season yet" Reynolds (Chief of Natural Resources) for their logistic support. I would also like to recognize the following people for their assistance in installing predator exclosures: Missy Carter, Bob Grant, Walter Greim, Mike Minerath, Gene Valli, Frank Wdowiak.

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 -- 3 and counting. Not bad for a New York City Boy! Gene Valli has spent many years working with terns and plovers, and has seen this program grow from a small band of all volunteers in the 1970's to a program used as a model for the Atlantic Coast today. Throughout this time Gene has gone above and beyond his normal responsibilities as a supervisory Park Ranger in helping to make the program the success it is.

ABSTRACT

Piping plovers were monitored at 8 study beaches managed by the National Park Service at Cape Cod National Seashore. Observations of plovers began in early April and continued through August. Egg-laying began the fourth week of April and peak nesting occurred in mid-June. This year, 83 pairs of plovers were observed at the 8 beaches. This represents an increase of 11 (15%) pairs from 1994. Thirty and 53 pairs of plovers were observed in the South and North districts, respectively. Hatching success was 61% (range 36% - 97%). Fledging success was 61% (range 44% - 80%). Productivity was 1.77 fledged chicks/pair (range 1.0 chicks/pair to 3.0 chicks/pair). Thirty-eight percent of all nests initiated (n = 111) failed to hatch at least 1 egg. Overwash was the leading cause of failure, accounting for 26% (n = 12) of all nests lost. Predator exclosures were installed around 73% (n = 84) of all nests. Seventy-six percent (n = 64) of exclosed nests successfully hatched. IN contrast, 20% (n = 6) of unexclosed nests successfully hatched. Berm habitat was used as nesting habitat by plovers 51% (n = 59) of the time. This year, 33 pairs of plovers nested in the off-road vehicle (ORV) corridor. As these nests hatched, affected sections of the ORV corridor were closed. Maximum closures occurred in late June, when the majority of the Race Point North (85%) and South (95%) beaches were closed to ORVs. By 28 July, the entire ORV corridor was opened, 9 days earlier than in 1994.

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 approximately 1200 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 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 (Table 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 1995, a record number of nesting plovers were recorded (83 pairs, representing 18% of the state total, nested on beaches managed by the NPS). Productivity (number of chicks fledged per pair) at Cape Cod National Seashore ranged from 0.7 to 2.6 fledged chicks per pair during the same time period. Productivity this year was 1.8 fledged chicks per pair. This was the lowest productivity realized since 1989.

This report summarizes the 1995 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 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

Observations of Piping Plovers began on 2 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 ten days. Once nests were established, all beaches were visited almost daily (≥ 5 times per week) except for Long Point and Ballston, which were 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 based on a grid system (50 m intervals) set up at each study beach.

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 within 1 day of clutch completion. There were two modifications from previous years' methods of installing exclosures (Meisel 1991, Brown 1992). Tops of all exclosures were strung at the time the exclosure was installed (stringing process described in Brown and Hoopes 1993) rather than waiting a day or two after installation. 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, however, when there was a clearly demonstrated situation of repeated 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, 3 banded plovers nested at the 8 study beaches (Appendix A).

RESULTS AND DISCUSSION

Seasonal Chronology

Plovers were first observed on Cape Cod National Seashore beaches on 16 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. This is most certainly the case for sites such as Marconi Beach.

Egg-laying began in the fourth week of April for both North and South districts. In April, 6 nests were located, 4 in the North and 2 in the South district. Of these, 1 successfully fledged young and the rest were lost to overwash (4) or predated prior to clutch completion (Appendix B). Peak nesting for the Seashore occurred during mid-June (Fig. 1). The last nest was initiated

on 18 June at Wood End. 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 (Fig. 2). Hatching dates ranged from 31 May to 16 July. Peak hatching in each district followed a similar pattern to that of the Seashore. Fledging dates ranged from 28 June to 13 August. These dates are comparable between districts and years.

Productivity

Eighty-three pairs of Piping Plovers were monitored at 8 sites in Cape Cod National Seashore (Table 2). This represents approximately 18% of the total breeding population of Massachusetts. Preliminary figures estimate the state population in 1995 was approximately 450 pairs. Numbers of nesting plovers at the 8 sites monitored increased by 14% from 1994 and 461% 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 Great Island, Ballston, Race Point South and Race Point North beaches all increased. At High Head and Long Point, numbers decreased by 2 pairs. This decrease is not significant and simply reflects annual changes in nest distribution. The greatest increase in numbers of nesting pairs since 1994 occurred at Race Point North Beach, where numbers rose from 10 to 16 pairs; and at Great Island and Race Point South Beach, where numbers rose by 4 pairs each.

Hatching success (total number of eggs hatched/total number of eggs laid) for all sites combined was 61% and ranged from 36% to 97% (Table 2). Overall, hatching success was similar to 1994. High Head (97%) and Ballston Beach (75%) had the highest hatching success; while Coast Guard (36%) and Long Point (40%) had the lowest hatching success (Table 2). The relatively low hatching success recorded at Coast Guard was attributable to predation and at Long Point to the great number of renests caused by overwashes. Fifteen percent (11 of 71) of the nests that hatched left 1, 2, or 3 eggs in the scrape. This is less than in 1994 when 19% of

nests failed to hatch at least 1 egg (Hoopes 1994). 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 44% to 80% (Table 2). Overall, fledging success decreased by 18% from 1994. High Head (80%) and Marconi Beach (76%) had the highest fledging success; while Ballston Beach (44%) and Coast Guard (45%) had the lowest fledging success (Table 2). Fledging success at Ballston Beach typically has been high. However, this year 1 brood was lost to unknown causes over July 4th weekend thus significantly reducing fledging success for that site. Coast Guard Beach fledging success was 8% lower than in 1994, and typically has had lower fledging success than other sites.

Productivity (number of chicks fledged/nesting pair) for all sites was 1.8 (149 chicks fledged from 83 nests) and ranged from 1.0 to 3.0 (Table 2). Overall, productivity decreased from 1994. In fact, it is the lowest productivity figure reported at Cape Cod National Seashore since 1989. High Head (3.00) and Marconi Beach (2.50) had the highest productivity; while Coast Guard (1.00) and Ballston Beach (1.33) had the lowest productivity (Table 2). Productivity greater than 2.0 is considered outstanding. Productivity at Cape Cod National Seashore slightly exceeded productivity statewide. Preliminary data suggests 1995 productivity for the state was 1.5 (S. Melvin, pers. comm.).

Nest Loss

Thirty-eight percent (43 of 111 nests) of all nests initiated failed to hatch at least 1 chick (Table 3). Overwash was the leading cause of nest loss, accounting for 8.5 (20%) of all nests lost (Table 3). Unknown predators and crows were the second and third leading causes of nest loss, respectively. All sites had one of the above factors as the leading or second leading cause of nest failure, except for Great Island. Long Point and Coast Guard had the highest numbers of nests lost, 11 and 9 respectively. Approximately 30% of the losses at these sites were

attributable to overwash. Over 50% (5 of 9) of the nests lost at Coast Guard Beach were lost to crows or probable crows. Coast Guard Beach has a history of fox presence (Hoopes et al. 1987), but was not a major factor in nest loss this year. However, foxes were a major problem at Nauset Heights Orleans (M. Gennaris pers. comm.). Red fox activity at Great Island and Race Point North and South beaches was much higher than recent years with foxes using these beaches nightly. Increased red fox activity on these beaches may be due in part to the absence of the Eastern coyote (*Canis latrans*) that had established red fox territories. Coyotes and coyote tracks were not observed on study beaches where they had been observed in previous years.

Predator Exclosures

Predator exclosures were installed around 84 of the 114 (73%) nests. Of the 84 exclosed nests, 64 (76%) successfully hatched young. Of the 20 exclosed nests that did not hatch, 7 (35%) failed due to overwash, 5 (25%) were lost to unknown factors, 3 (15%) were lost to probable crow, and 2 (13%) were abandoned (Table 4). In the one case where an exclosed nest was lost to red fox, the fox tunneled under the exclosure. The nest lost to grackles had a slightly larger spacing between 2 strings and it is believed that this was the point of entry. Hatching success of exclosed nests would have been substantially increased (80%, 71 of 84 nests) if overwash was not a factor in nest lost. Of the 30 unexclosed nests, 24 (80%) failed to hatch. Of these, 6 (25%) were lost to unknown causes, 4 (17%) were lost to crow, 4 (17%) were lost to overwash, and 6 (25%) 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. At Race Point South Beach, red foxes were suspected as a major cause of chick mortality. Red fox tracks were routinely observed on the north end of this site. 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 portion of a females bill from the HC 1 nest was found next to the exclosed nest. The cause of this death is unknown but is suspected to have been a hawk or owl. This birds mate tended the nest for approximately 25 days but eventually abandoned the nest.

Nesting Habitat

Nesting habitat for 103 nests was categorized according to the macrohabitat types defined by MacIvor (1990). Berm habitat was used for nesting 43% of the time (Table 6). The next most utilized habitats for nesting were foredune (27%) 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. It is interesting to note that foredune habitat was used for 52% and 83% of the nesting attempts by Piping Plovers at Race Point Beach South and Race Point Beach North, respectively (Table 6). This maybe due in part to off-road-vehicle (ORV) activity at those sites. A majority (80%) of the nests in berm habitat at these sites were established either before regular ORV traffic was allowed in the area or after ORV activity was ceased. These patterns are consistent with those found by MacIvor et al. (1987b) at the North Beach/South Beach Island complex in Chatham.

ORV Management

ORV management, as it relates to plover management at Cape Cod National Seashore, is a dynamic process. This year, 22 pairs of plovers nested along the ORV corridor (1 more pair than in 1993). 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. When the outer beach at Race Point Beach North was closed on 1 June, the powerline route was opened for vehicle access to the Race Point Light area. The north self-contained area was moved once due to beach closures this year. The entire North Beach was closed for approximately 1.5 months due to asynchronous hatching of nests. The South Beach was closed, except for 0.5 mi at the extreme southern 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 8 August, the entire ORV corridor was reopened to vehicles. This was 9 days earlier than in 1993.

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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, 1985-1995.

Year	No. Pairs	Productivity ¹
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

¹ 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, 1995.

Site	No. Breed. Pairs	No. Nests	No. Eggs/Site ¹	No. Eggs Hatch ¹	Chicks Fledge	Hatch Succ. ^{1,2}	Fldg. Succ. ³	Prod. ⁴
CGB	9	15	55	20	9	0.36	0.45	1.00
MAR	10	16	52	33	25	0.63	0.76	2.50
GI/JP	11	13	43	30	20	0.69	0.67	1.82
BB	3	3	12	9	4	0.75	0.44	1.33
HH	8	9	31	30	24	0.97	0.80	3.00
RPBS	17	22	74	51	24	0.69	0.47	1.41
RPBN	16	17	63	43	25	0.68	0.58	1.56
WE/LP	9	19	65	26	16	0.40	0.62	1.78
TOTAL	83	114	395	242	147	0.61	0.61	1.77

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 Number of chicks fledged per pair

Table 3. Causes of Piping Plover nest failures, by nesting beach, Cape Cod National Seashore, 1995.

Site	Tot. No. Nests	Cause of Failure	No. (%) Failed	Tot. No. Failed	% Tot. Failed
Coast Guard	15	Prob. crow	3 (33)	9	60
		Crow	2 (22)		
		Overwash	2 (22)		
		Red Fox	1 (11)		
		Unk. Pred.	1 (11)		
Marconi	16	Unk. Pred.	5 (83)	6	38
		Crow	1 (17)		
Great Island	13	Abandoned	2 (40)	5	38
		Prob. fox	2 (40)		
		Overwash	1 (20)		
High Head	9	Crow	1 (100)	1	11
Race Pt. South	22	Unk. Avian	3 (50)	6	27
		Crow	1 (17)		
		Red Fox	1 (17)		
		Abandoned	1 (17)		
Race Pt. North	17	Unk. Pred.	2 (40)	5	29
		Abandoned	2 (40)		
		Com. Grackle	1 (20)		
Wood End/Long Pt.	19	Overwash	5.5 (50)	11	58
		Crow	2 (18)		
		Striped Skunk	1 (9)		
		Unknown	1 (9)		
		Abandoned	1 (9)		
		Unk. Avian	0.5 (5)		
Total	111	Overwash	8.5 (20)	43	38
		Unk. Pred.	8 (19)		
		Crow	7 (16)		
		Abandoned	6 (14)		
		Unk. Avian	3.5 (8)		
		Prob. Crow	3 (7)		
		Red Fox	2 (5)		
		Prob. Red Fox	2 (5)		
		Com. Grackle	1 (2)		
		Striped Skunk	1 (2)		
		Unknown	1 (2)		

¹ Percent total of failed nests at that site

² One nest suspected of abandoning due to Red Fox repeatedly circling nest/exclosure, almost nightly, for 1 week prior to abandonment

³ One nest was overwashed, adults collected 2 of 4 eggs outside exclosure and incubated for 1 more day before remaining 2 eggs were taken by an unknown avian predator

⁴ Does not include Ballston Beach. There were no nests lost at that site

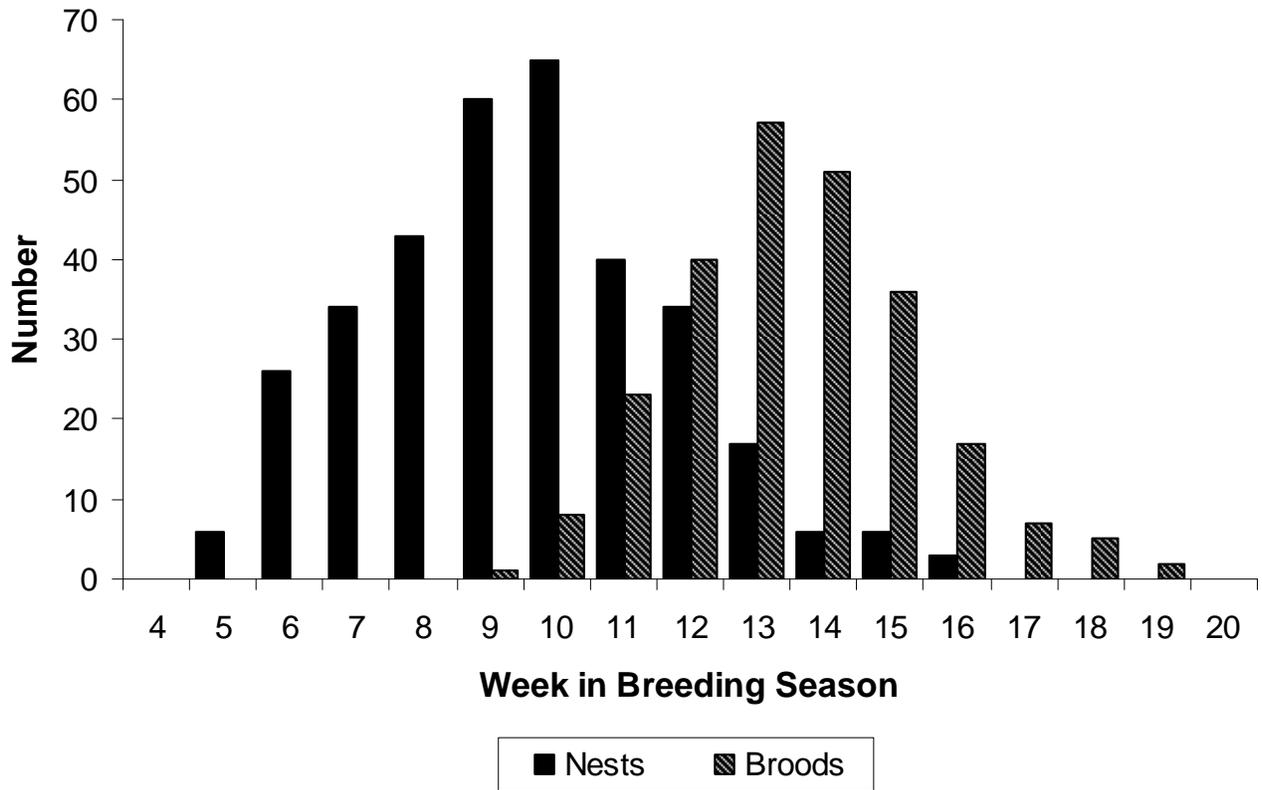
Table 4. Fates of exclosed and unexclosed Piping Plover nests, Cape Cod National Seashore, 1995.

Status	No. Nests	No. (%) Hatched	No. (%) Unhatched	Reason for Failure	No. (%) Failures
Exclosed	84	64 (76)	20 (24)	Overwash	7 (35)
				Unknown	5 (25)
				Prob. crow	3 (15)
				Abandoned	2 (13)
				Com. Grackle	1 (5)
				Red Fox	1 (5)
				Infertile	1 (5)
				Unexclosed	30
				Crow	5 (21)
				Overwash	4 (17)
				Abandoned	3 (13)
				Red Fox	2 (8)
				Sandblown	1 (4)
				Str. Skunk	1 (4)
				Prob. crow	1 (4)
				Prob. fox	1 (4)

Table 5. Nesting habitat of Piping Plovers, Cape Cod NationalSeashore, 1995.

Site	Habitat					Total
	Berm	Foredune	Overwash	Interdune	Blowout	
Long Point/Wood End	3	6	7	3	0	19
Race Point North	5	7	0	4	1	17
Race Point South	13	8	0	0	1	22
High Head	6	3	0	0	0	9
Ballston Beach	1	2	0	0	0	3
Marconi Beach	13	1	0	2	0	16
Great Island/Jeremy Point	9	1	0	3	0	13
Coast Guard Beach	9	0	6	0	0	15
Total	59	28	13	12	2	114

Figure 1. Peak nesting and hatching of Piping Plovers nesting on beaches managed by the National Park Service, Cape Cod National Seashore, 1995.



APPENDIX A

Color-banded Piping Plovers nesting on beaches
managed by the National Park Service,
Cape Cod National Seashore, 1996

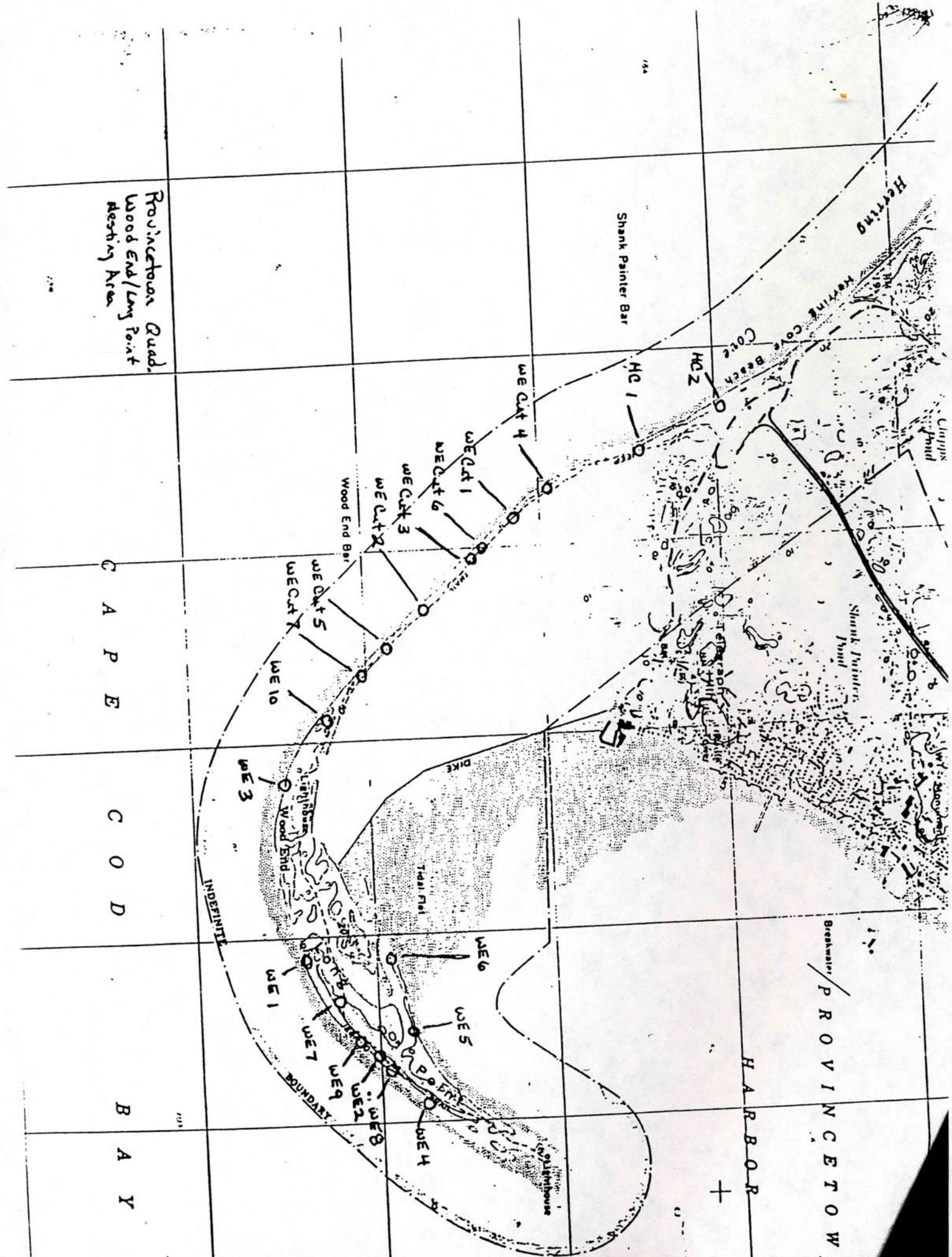
The birds' left leg bands are read first, top to bottom, then the right leg bands are read, top to bottom. Adults and chicks were color-banded at Cape Cod National Seashore, and elsewhere throughout the state, from 1985 through 1988. Therefore, these 3 birds are at least 7 years of age.

S: USFWS aluminum band
B: Black
_: no band

Color-bands	Sex	Nest Location	Nest Name
SB:_	M	Coast Guard Beach	M1
		Coast Guard Beach	M2
		Plover Island	P19
S:_	M	Great Island	GI2
B:S	M	Marconi Beach	MB1
		Marconi Beach	MB5

APPENDIX B

Piping Plover nest locations on beaches managed
by the National Park Service,
Cape Cod National Seashore, 1995



Provincetown Quad.
Wood End/Long Point
Mooring Area

C A P E

C O D

B A Y

INDEFINITE
BOUNDARY

H A R B O R

Breakwater / P R O V I N C E T O W N

Shank Painter Bar

Herring

Shank Painter Pond

Tidal Flat

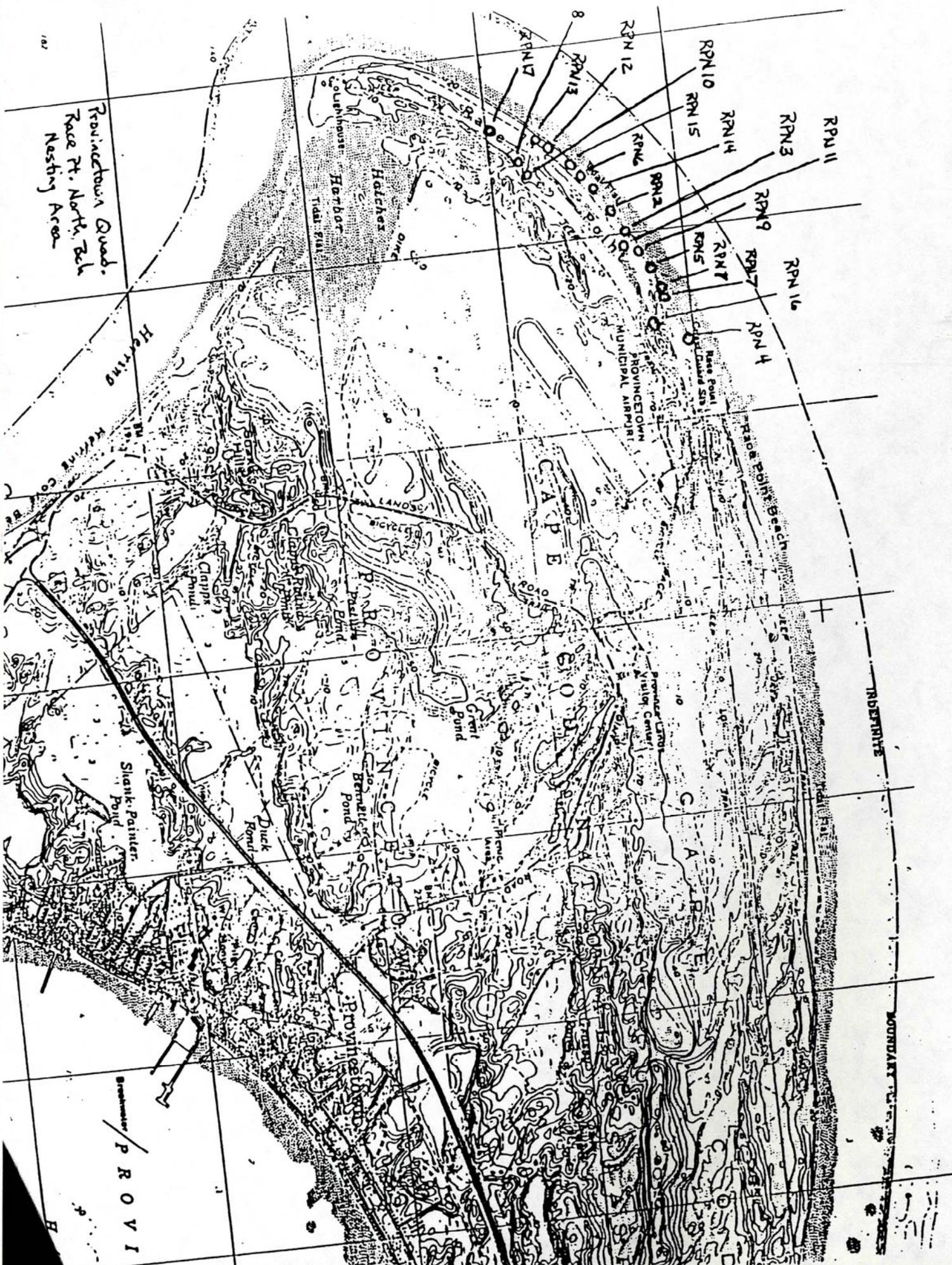
Wood End Bar

Wood End

Shank Painter Pond

Clay pits

+



Provincetown Quad.
Race Pt. North, Bell
Nesting Area

Herring

Colubhouse
Harbor
Tidal Flat

Hatches

CAPE

PROVINCETOWN
MUNICIPAL AIRPORT

Race Point Beach

INDEFINITE

BOUNDARY

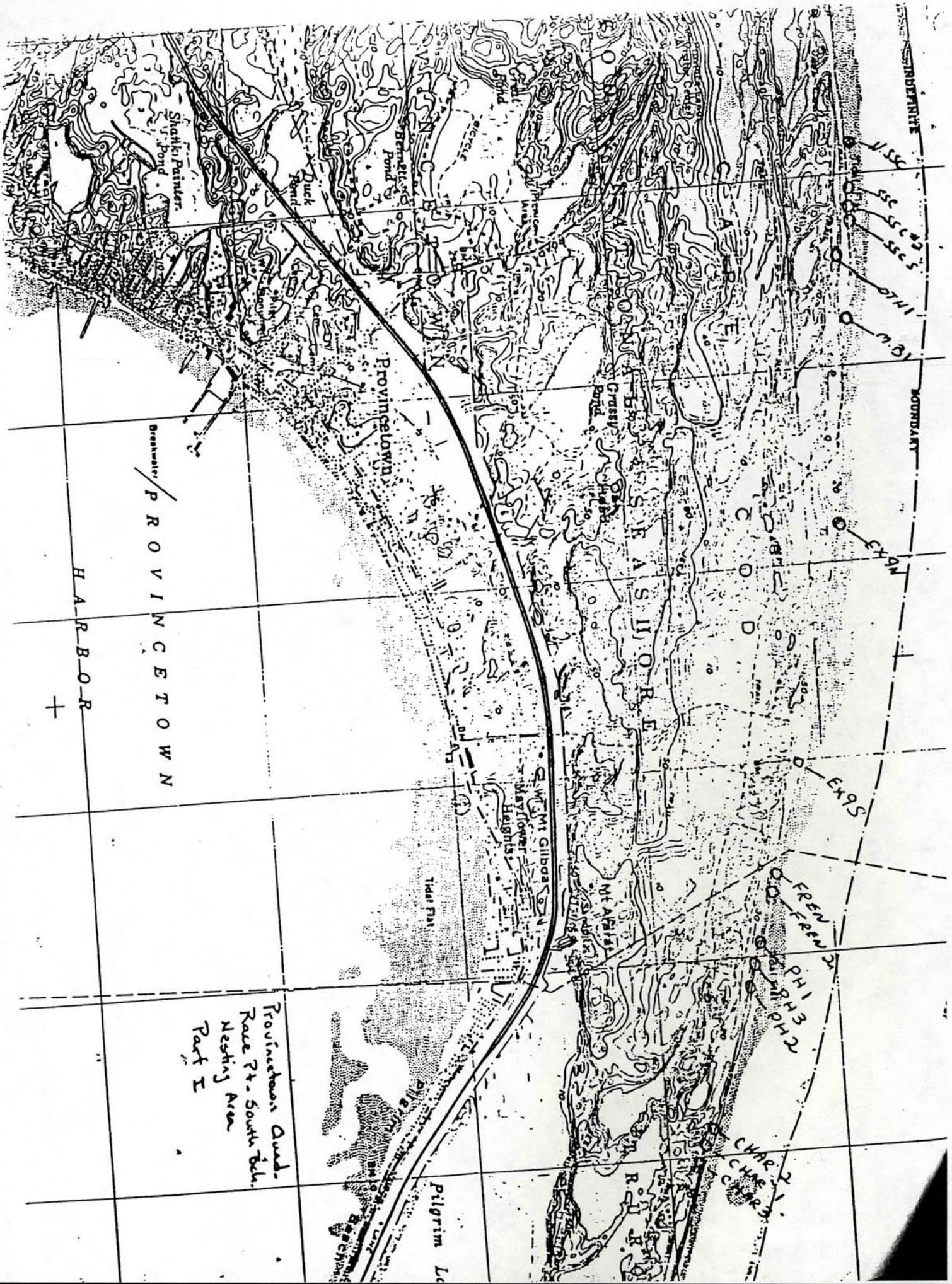
Slank Painter's Pond

Duck Pond

Bernice Pond

Provincetown

PROVINCETOWN



Breakwater / PROVINCETOWN

HARBOR +

Provincetown Dune.
Race Pt. South Blk.
Nesting Area
Part I

Pilgrim Land

CHAR 2
CHAR 1
CHAR 3

PH1
PH2
PH3

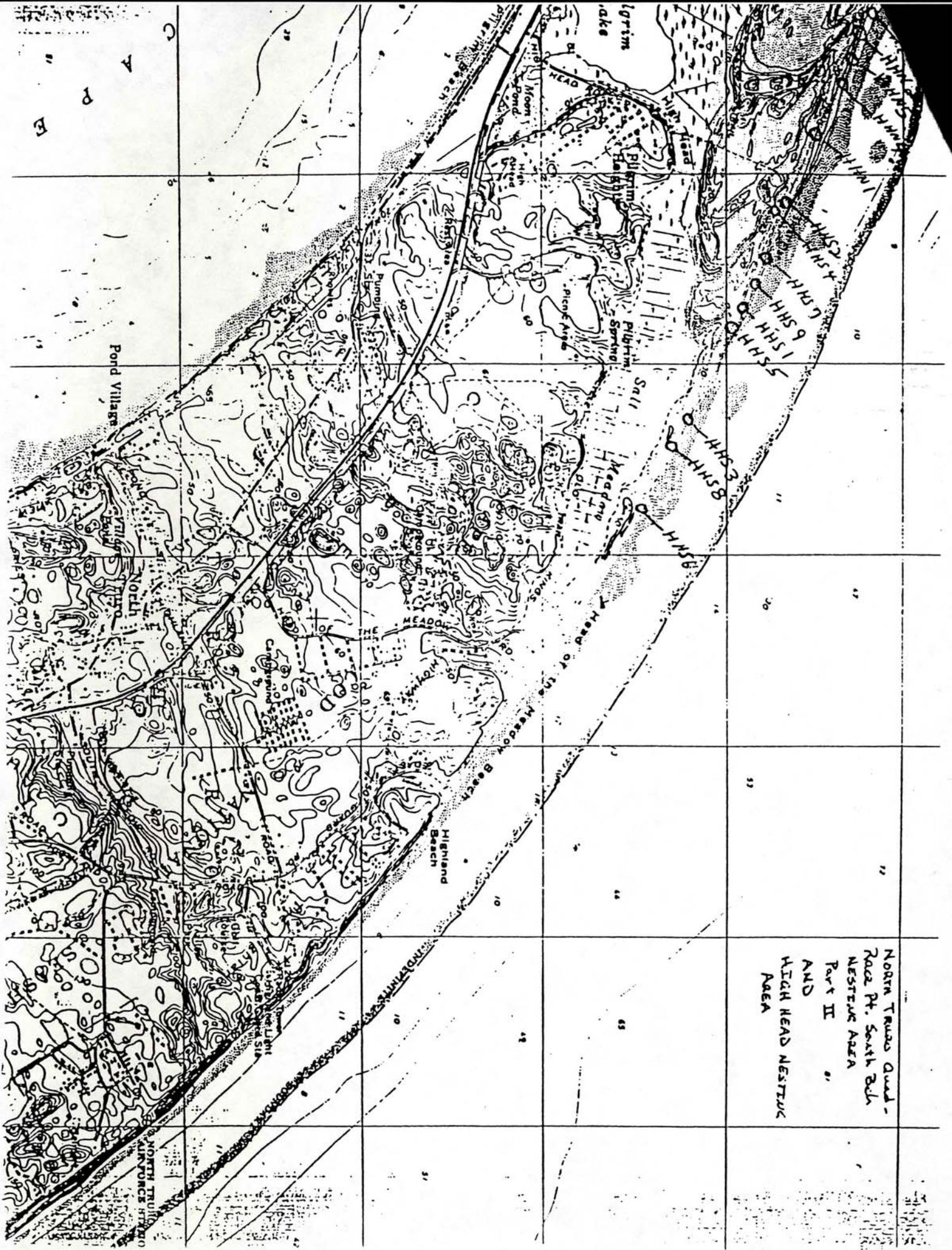
FREN
FRAN 2

EXPS

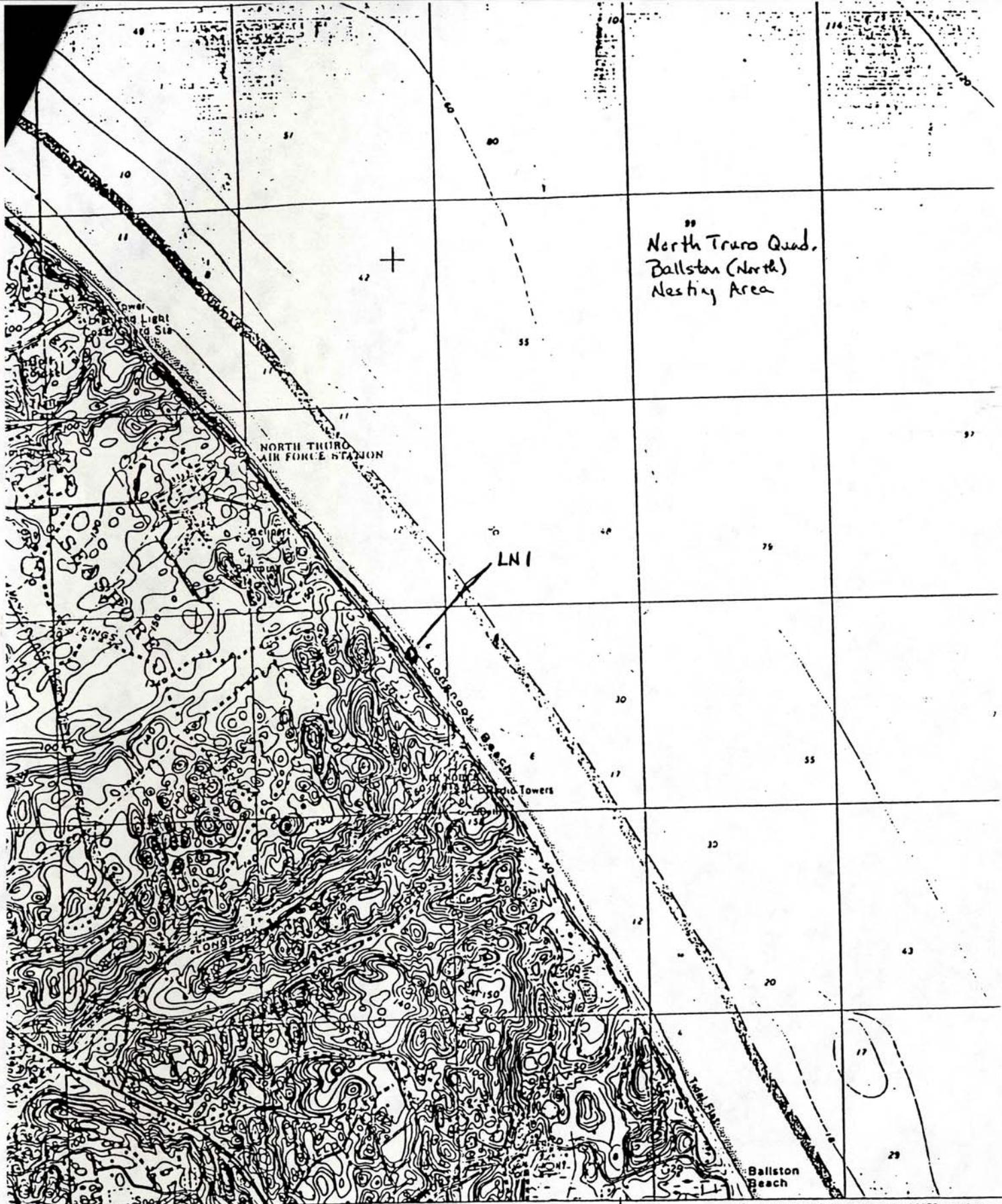
EXAM

BOUNDARY

SANDSTONE



NORTH TRUSS QUAD -
 Race Pt. South Rd
 NESTLEK AREA
 Part II
 AND
 HIGH HEAD NESTLEK
 AREA



North Truro Quad,
Ballston (North)
Nesting Area

NORTH TRURO
AIR FORCE STATION

LNI

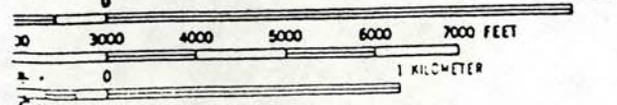
Ballston
Beach

WELLFLEET 69671 NE
WELLFLEET 4.8 MI.
ORLEANS 17 MI.

2° 30' 44" 415

INTERIOR-BIOLOGICAL SURVEY, RESTON, VIRGINIA
416000m E

SCALE 1:25 000



ROAD CLASSIFICATION

- | | |
|--|---|
| Primary highway,
hard surface _____ | Light-duty road, hard
improved surface _____ |
| Secondary highway,
hard surface _____ | Unimproved road _____ |

INTERVAL 10 FEET

Wellfleet Quad.
Ballston Bch. Area



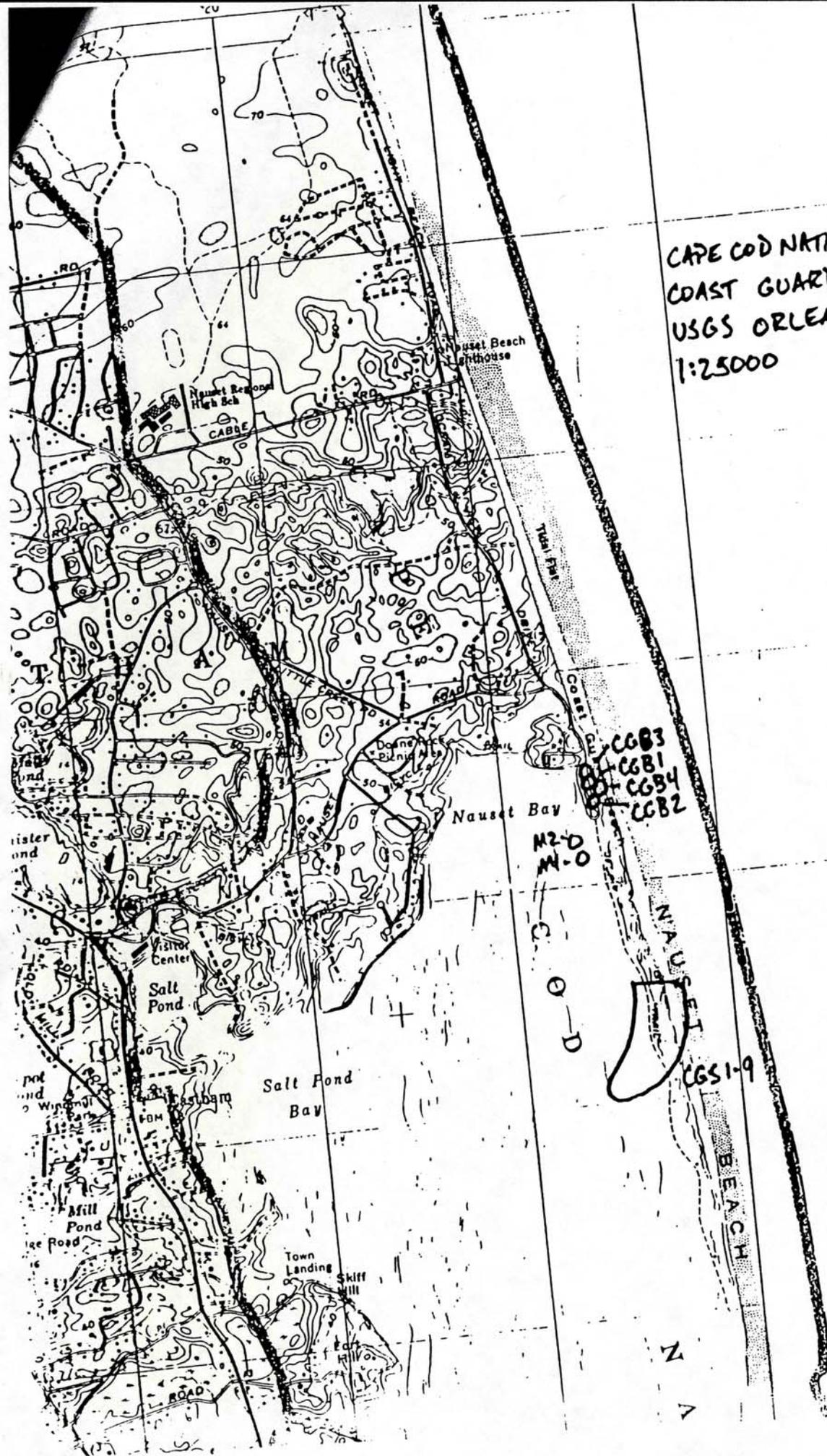
BB 1

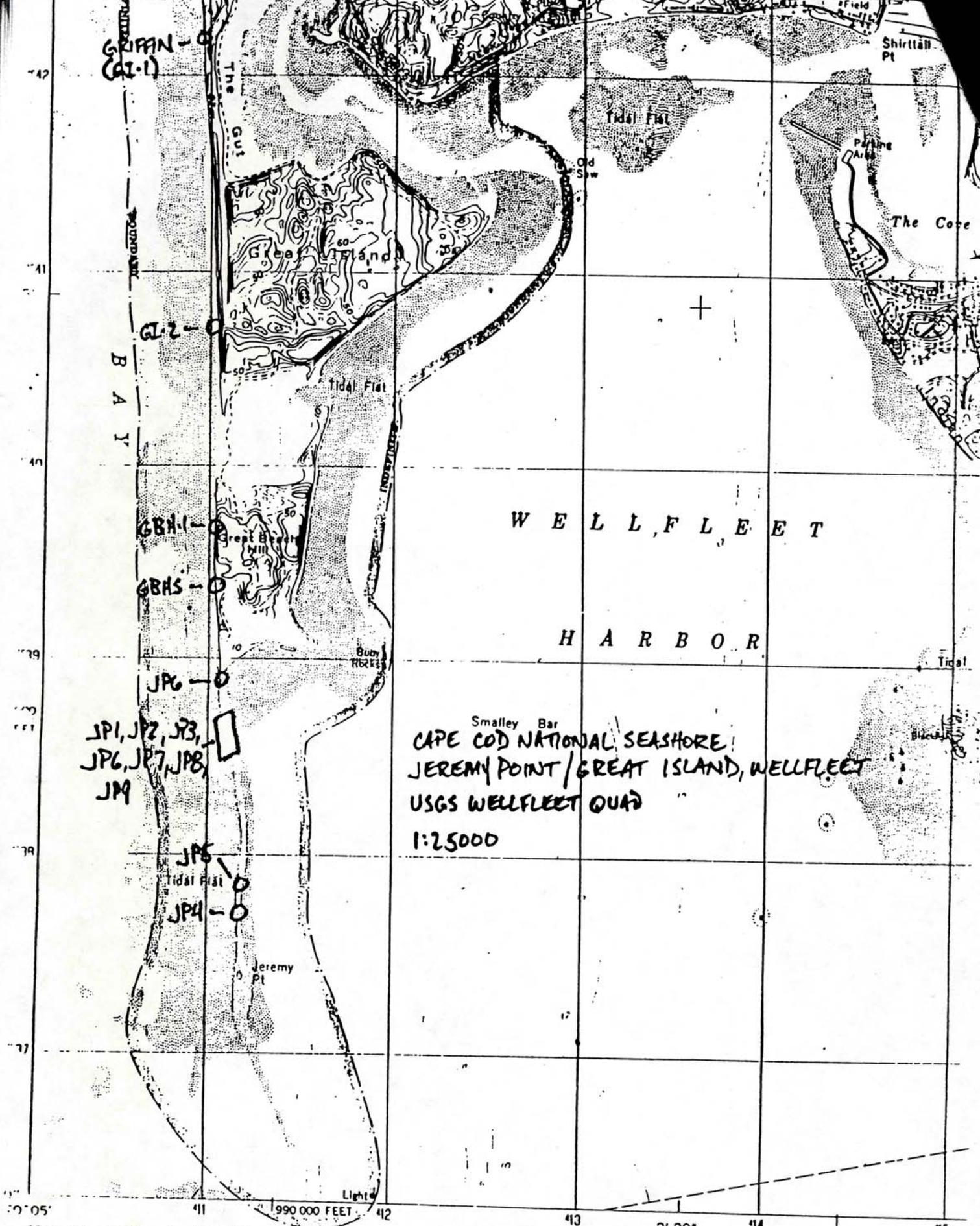
NN 1

E

CAPE COD NATIONAL SEASHORE
COAST GUARD BEACH, EASTHAM
USGS ORLEANS QUAD
1:25000

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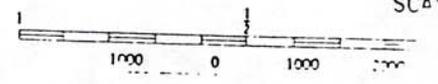




GB1-1
 GB2-2
 GBH-1
 GBH-2
 JPC-3
 JPI, JP2, JP3, JP6, JP7, JP8, JP9
 JPS
 JP4-4

CAPE COD NATIONAL SEASHORE
 JEREMY POINT / GREAT ISLAND, WELLFLEET
 USGS WELLFLEET QUAD
 1:25000

Mapped, edited, and published by the Geological Survey
 Control by USGS, USCGS, and Massachusetts Geodetic Survey
 Planimetry by photogrammetric methods from aerial photographs

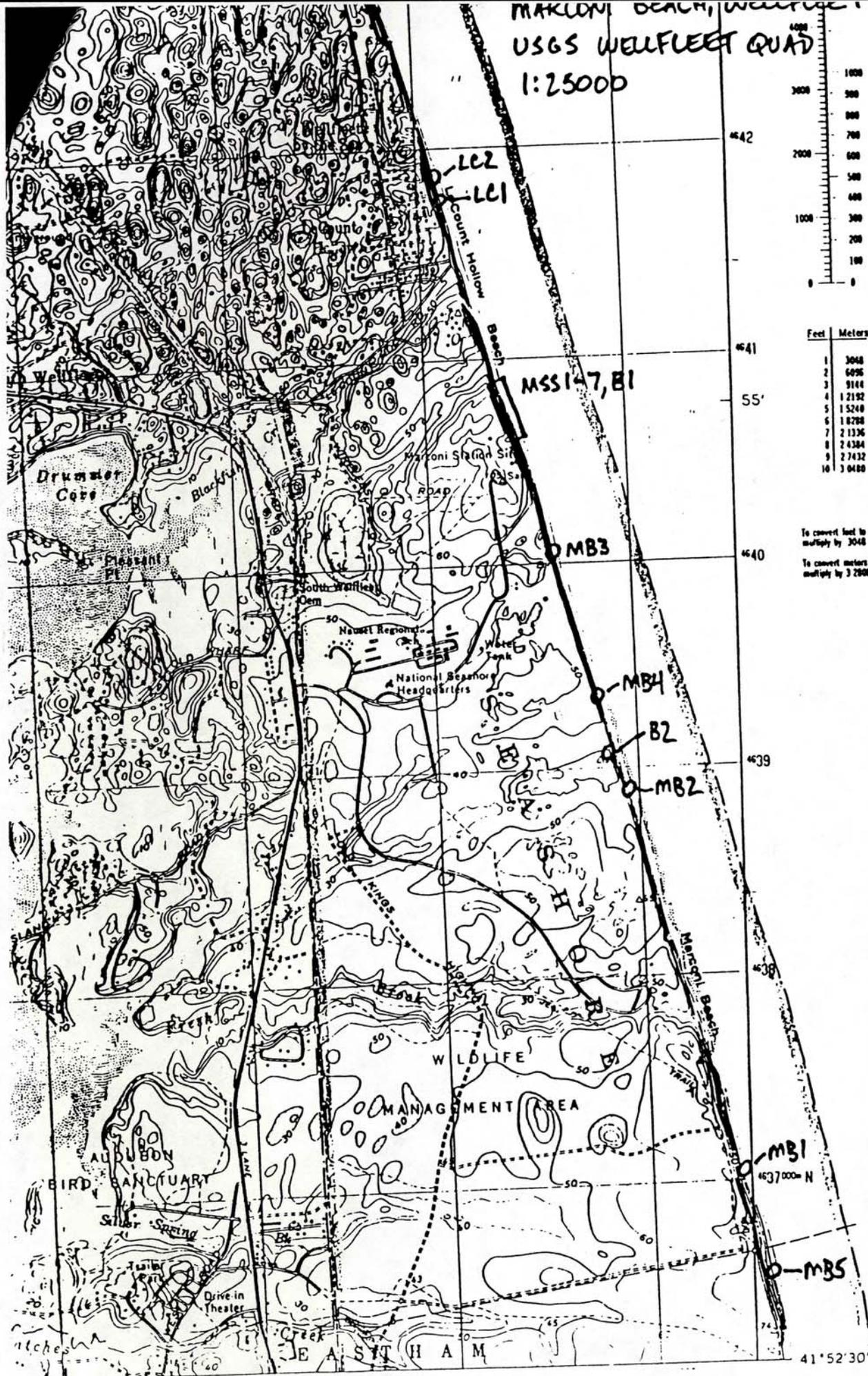


MARKON BEACH, WELFLEET
 USGS WELFLEET QUAD
 1:25000



Feet	Meters
1	3048
2	6096
3	9144
4	12192
5	15240
6	18288
7	21336
8	24384
9	27432
10	30480

To convert feet to meters
 multiply by 3048
 To convert meters to feet
 multiply by 3.2808



41° 52' 30"

APPENDIX C

Dates of ORV corridor openings and closures,
Race Point North and South Beaches,
Cape Cod National Seashore, 1995

Date	Beach	Action
15-Apr	Both	North and South beaches opened for the season. 0.1 mi of corridor around Race Point Light closed due to impassable beach configuration. North self-contained area set up at entrance to North Beach.
31-May	South	1.9 mi closed between Exit 8 and Peaked Hill.
2-Jun	North	0.9 mi closed on outer beach. Powerline route opened for access to Race Point Light area.
10-Jun	South	Beach closed except for 0.6 mi from High Head north and 0.2 mi from Race Point South entrance south. Dune tours enter and exit beach from Exit 8 or Exit 9 but are not allowed access between exits on outer beach.
11-Jun	North	Outer beach access only from Powerline route and emergency route at Race Point Light. Approximately 0.3 mi open on northern section of outer beach and 0.3 mi open at Hatches Harbor. Self-contained vehicles allowed access at yellow-brick road, to approximately 0.3 mi of camping area.
12-Jun	South	Dune tours prevented from entering beach at Exit 9. Allowed access to beach only at Exit 8, no through travel.
18-Jun	North	Entire outer beach closed except for Hatches Harbor area where approximately 0.3 mi are open.
18-Jun	South	Chicks from High Head South moved north to High Head access forcing complete closure of beach except for 0.3 mi at northern end of South Beach.
20-Jun	South	Last portion of beach closed due to chicks from N SSC nest moving into open area.
1-Jul	South	0.6 mi of beach opened from Race Point South entrance.
6-Jul	South	Additional 0.3 mi of beach opened from Race Point South entrance. Total of 0.9 mi open to ORV traffic. South self-contained area opened.
14-Jul	North	1.2 mi opened. 0.3 mi still available at Hatches Harbor.
21-Jul	South	0.6 mi opened from High Head north.
22-Jul	North	Entire beach opened. Powerline route closed.
24-Jul	South	Additional 0.4 mi opened from Race Point South entrance.
26-Jul	North	0.1 mi of beach around outside of Race Point Light that was closed 15 April due to impassable beach configuration, opened.
28-Jul	South	Entire beach opened.
1-Aug	North	North self-contained area moved to traditional location.

The beach was opened 9 days earlier than last year.

APPENDIX D

Mean hatching and fledging dates of Piping Plovers on
beaches managed by the National Park Service,
Cape Cod National Seashore, 1995

Site	Time to Hatch (days)		Time to Fledge (days)	
	N ¹	Mean (Range)	N ¹	Mean (Range)
Wood End/Long Point	--	--	7	27.42 (26 - 28)
Race Point North	11	27.18 (26 - 28)	11	27.63 (27 - 30)
Race Point South	11	27.00 (25 - 30)	12	28.41 (27 - 32)
High Head	7	27.71 (26 - 29)	8	27.00 (26 - 28)
Ballston Beach	2	27.00 (26 - 28)	2	27.00 (27)
Great Island/Jeremy Point	--	--	7	28.71 (27 - 32)
Marconi Beach	--	--	8	29.62 (27 - 33)
Coast Guard Beach	--	--	4	29.50 (28 - 33)
Total	41	26.31 (22 - 33)	59	28.18 (26 - 33)

¹ Number of nests or broods upon which mean is based.

-- Indicates no data available or insufficient data available.

APPENDIX E

Nearest neighbor distances of Piping Plover nests on
beaches managed by the National Park Service,
Cape Cod National Seashore, 1995

Distance (m)	Site ¹								Total
	WE/LP	RPN	RPS	HH	BB	MAR	CGB	GI/JP	
0-50	1	0	4	2	0	4	3	5	19
51-100	2	3	3	2	0	3	4	3	20
101-150	1	7	1	0	0	0	4	0	13
151-200	3	5	2	2	0	0	2	0	14
201-250	5	0	0	0	0	0	1	1	7
251-300	0	1	0	0	0	0	1	0	2
301-350	0	0	1	1	0	1	0	2	5
351-400	0	0	1	1	0	0	0	0	2
401-450	2	0	3	0	0	0	0	0	5
451-500	0	0	0	0	0	0	0	0	0
501-550	3	0	0	0	0	0	0	0	3
551-600	0	0	1	0	0	0	0	0	1
601-650	0	1	0	0	0	0	0	0	1
651-700	0	0	1	0	0	0	0	0	1
701-750	0	0	0	1	0	1	0	0	2
751-800	0	0	0	0	0	0	0	0	0
801-850	0	0	1	0	0	0	0	0	1
851-900	0	0	1	0	0	0	0	0	1
901-950	0	0	0	0	0	0	0	0	0
951-1,000	1	0	1	0	0	2	0	1	5
> 1,000	1	0	2	0	3	4	0	1	11
Total	19	17	22	9	3	15	15	13	113

¹ WE/LP = Wood End/Long Point
RPN = Race Point Beach North
RPS = Race Point Beach South
HH = High Head
BB = Ballston Beach
MAR = Marconi Beach
CGB = Coast Guard Beach
GI/JP = Great Island/Jeremy Point

APPENDIX F

Brood residency dates for Piping Plovers on beaches
managed by the National Park Service, Cape Cod
National Seashore, 1990 - 1995

Site	Year	No. Pairs	No. Nests	First Hatch	Last Fledge	Range (days)
CGB	1990	5	6	2-Jun	28-Jul	56
	1991	7	10	5-Jun	18-Aug	74
	1992	8	12	7-Jun	29-Aug	83
	1993	8	10	28-May	18-Jul	51
	1994	9	18	5-Jun	30-Jul	55
	1995	9	15	8-Jun	26-Jul	48
MAR	1990	2	3	9-Jun	28-Jul	49
	1991	6	9	2-Jun	4-Aug	63
	1992	7	10	3-Jun	10-Aug	68
	1993	9	13	9-Jun	15-Aug	67
	1994	10	13	15-Jun	8-Aug	54
	1995	10	16	15-Jun	20-Aug	66
JPT	1990	1	1	--	--	--
	1991	3	3	25-Jun	17-Aug	56
	1992	4	4	2-Jun	19-Jul	47
	1993	6	7	1-Jun	5-Aug	65
	1994	7	9	27-May	8-Aug	73
	1995	11	13	2-Jun	24-Jul	52
BAL	1990	--	--	--	--	--
	1991	--	--	--	--	--
	1992	1	1	27-Jun	24-Jul	27
	1993	1	1	26-Jun	25-Jul	29
	1994	2	3	20-Jun	23-Jul	33
	1995	3	3	24-Jun	23-Jul	29
HHD	1990	1	1	10-Jul	4-Aug	24
	1991	3	5	24-Jun	31-Jul	37
	1992	3	4	10-Jun	6-Aug	57
	1993	8	8	4-Jun	31-Jul	57
	1994	10	13	28-May	25-Jul	58
	1995	8	9	5-Jun	25-Jul	50
RPS	1990	4	4	28-May	21-Jul	54
	1991	6	7	7-Jun	28-Jul	51
	1992	14	15	28-May	8-Aug	72
	1993	15	20	1-Jun	4-Aug	64
	1994	13	19	29-May	3-Aug	66
	1995	17	22	31-May	26-Jul	56
RPN	1990	1	1	--	--	--
	1991	2	2	6-Jun	13-Jul	37
	1992	4	4	10-Jun	16-Jul	36
	1993	6	8	27-May	14-Aug	79
	1994	10	13	31-May	7-Aug	68
	1995	16	17	2-Jun	19-Jul	47
LPT	1990	1	1	28-Jun	26-Jul	28
	1991	1	1	15-Jun	15-Jul	30
	1992	2	2	12-Jun	24-Jul	42
	1993	7	8	10-Jun	12-Aug	63
	1994	11	17	18-Jun	4-Aug	47
	1995	9	19	15-Jun	23-Jul	38