BREEDING STATUS, HABITAT USE, AND MANAGEMENT OF THREATENED AND ENDANGERED WILDLIFE IN NEW HAMPSHIRE'S COASTAL REGION

FINAL REPORT

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BREEDING STATUS, HABITAT USE, AND MANAGEMENT OF THREATENED AND ENDANGERED WILDLIFE IN NEW HAMPSHIRE'S COASTAL REGION

Background

The N.H. Fish and Game Department (NHF&G) recognizes as endangered or threatened six bird species whose documented or potential breeding ranges in New Hampshire occur exclusively or primarily in the coastal region. This project included field studies of the breeding season distribution, habitat use, status, and nesting success of Common Terns (state endangered), Ospreys (state threatened), Northern Harriers (state threatened), and Piping Plovers (state endangered, federally threatened). Bald Eagles (state and federally endangered) winter at Great Bay, but do not occur there during the breeding deason at this time.

Active management and habitat protection for these five species will be critical to their future survival in New Hampshire. The information generated by this project can facilitate land use planning efforts to accommodate both human and wildlife needs in the coastal region.

COMMON TERN

INTRODUCTION

Historically, Lunging Island at the Isles of Shoals supported New Hampshire's most significant documented tern colony, which peaked at 1500-2000 Common Tern pairs between 1928 and 1938, and also included 50-60 pairs of Roseate Terns (Sterna dougallii) and 25-30 pairs of Arctic Terns (Sterna paradisaea) (Jackson 1947). This colony's decline during the 1940's followed a decrease in human activity on the island and subsequent increases in Herring Gull (Larus argentatus) and Great Black-backed Gull (Larus marinus) numbers. Terns abandoned Lunging Island by 1955 (Taber 1955).

Since that time, the state's Common Tern population has included two mainland colonies and scattered pairs nesting on rocky islands in coastal bays or in salt marshes. Field studies conducted annually since 1981 have documented serious instability in coastal colonies, where marginal nesting habitat and heavy predation have significantly hampered productivity.

Field work in 1990 documented abandonment of the Back Channel colony, poor reproductive success at the Hampton colony, growth of a small colony on an island in Little Bay and the mid-season return of the Seabrook colony, which fledged few young (Figure 1). Despite management efforts on its behalf, the New Hampshire tern population continues to suffer from severe problems associated with marginal nesting habitat.

The goals of this project were to maintain the on-going data base on colony size, breeding status, and reasons for failure at existing colonies; continue to experiment with floatable nest platforms to mitigate tidal flooding; and identify important foraging areas.

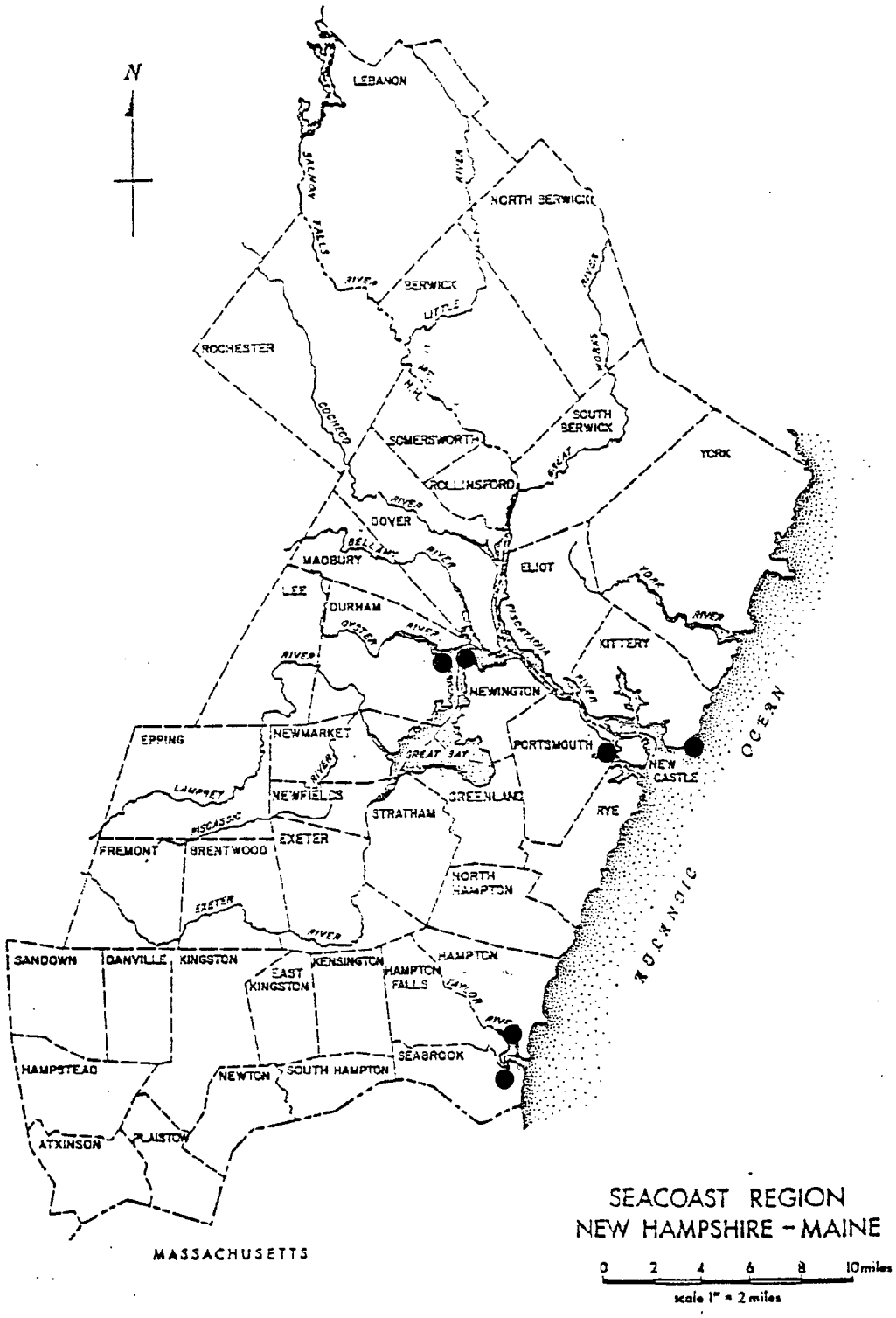

Figure 1. Location of Common Tern Colony Sites, 1989-91

STUDY AREAS

HAMPTON HARBOR ESTUARY:

Hampton

The Hampton colony nests on approximately 2 km. of salt marsh bounded by Winnicunet Road to the north, Rt. 1A to the east, and Rt. 51 to the southwest (Figure 2). Eel Ditch and Tide Mill Creek surround the primary nesting area (Figure 3). The dominant marsh vegetation includes saltwater cordgrass (*Spartina alterniflora*) along the channels and ponds, salt hay grass (*Spartina patens*) in the drier areas, and saltgrass (*Distichlis spicata*) where standing water occurs. High tides ranged from 2.4m. (7.8ft.) to 3.6m. (11.7 ft.) and low tides from -0.5m. (-1.5ft.) to 0.6m. (1.9 ft.).

Seabrook

This site is located on the west side of the Blackwater River between Lower Gill Rocks and Mill Creek (Figure 4). The colony nested in an area roughly 50 x 100 m. only 4-5 m. from the shoreline. A few additional nests were found within 100 m. west and north of the central colony. The majority of the nests were found in areas of *Juncus*, where the tern activity bent the rush into soft mats. A few nests were on mats of loose thatch that had been brought up with the tides.

LITTLE BAY:

Hen Island

Hen Island lies approximately 70m. east of Fox Point on Little Bay in Newington (Figure 5). The colony site is a town-owned island less than 0.8 ha. in area which supports small patches of sparse grasses, substantial shrub growth and several small trees. Town residents launch and moor private boats in the small cove east of Fox Point and south of Hen Island.

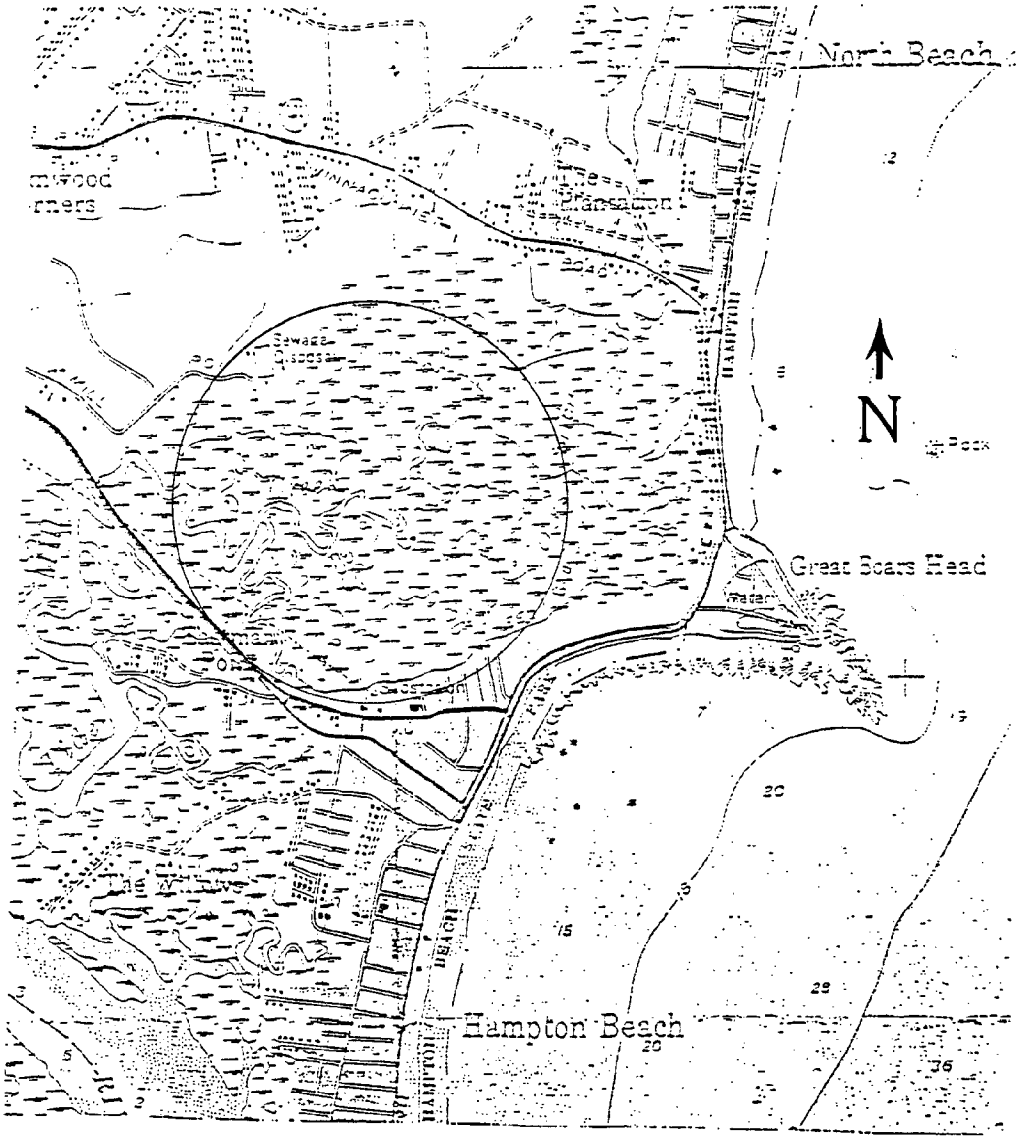

Figure 2. Location of Hampton Marsh Common Tern Colony, 1991

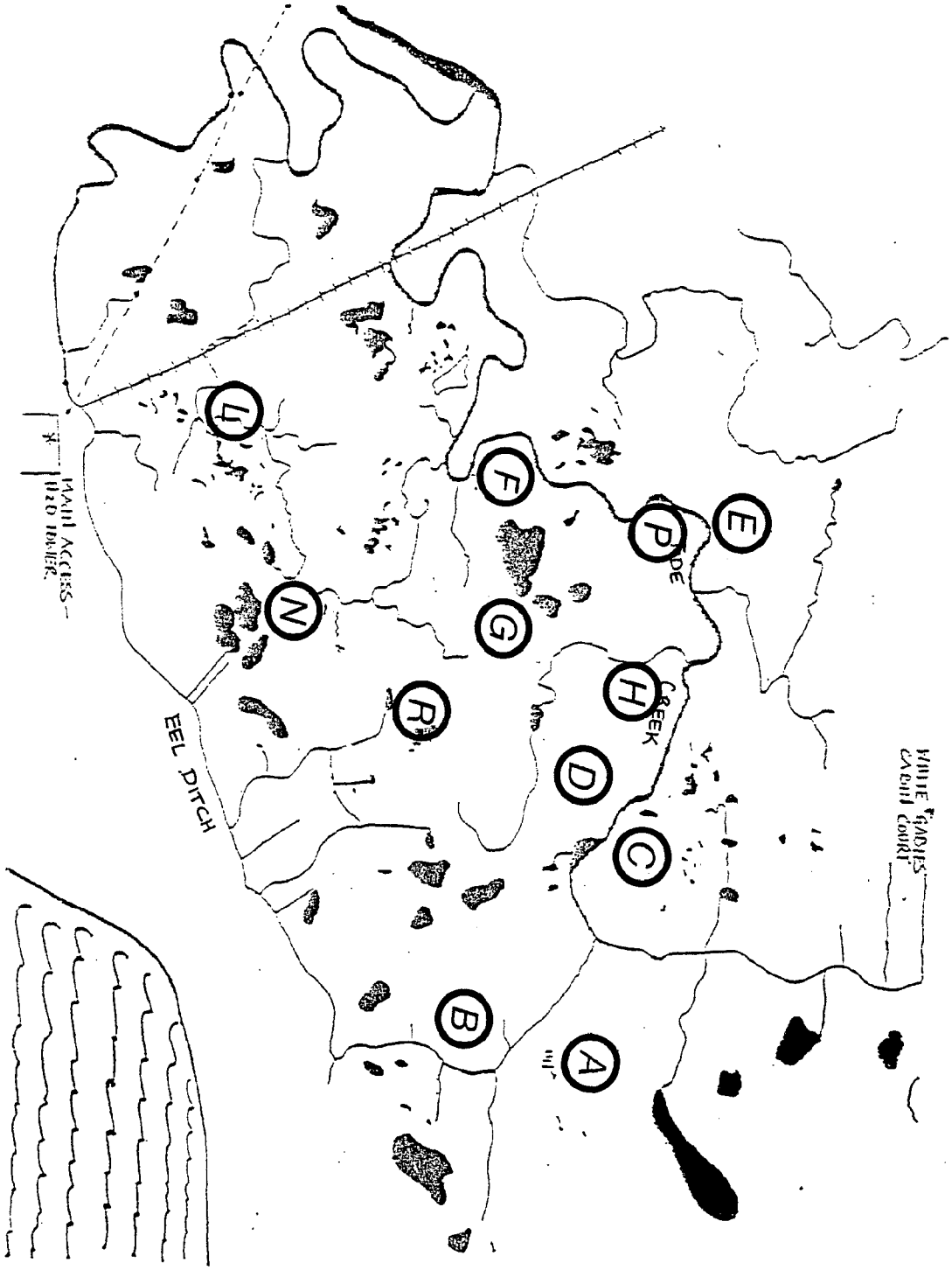

Figure 3. Nesting Locations of Hampton Marsh Tern Colony, 1991

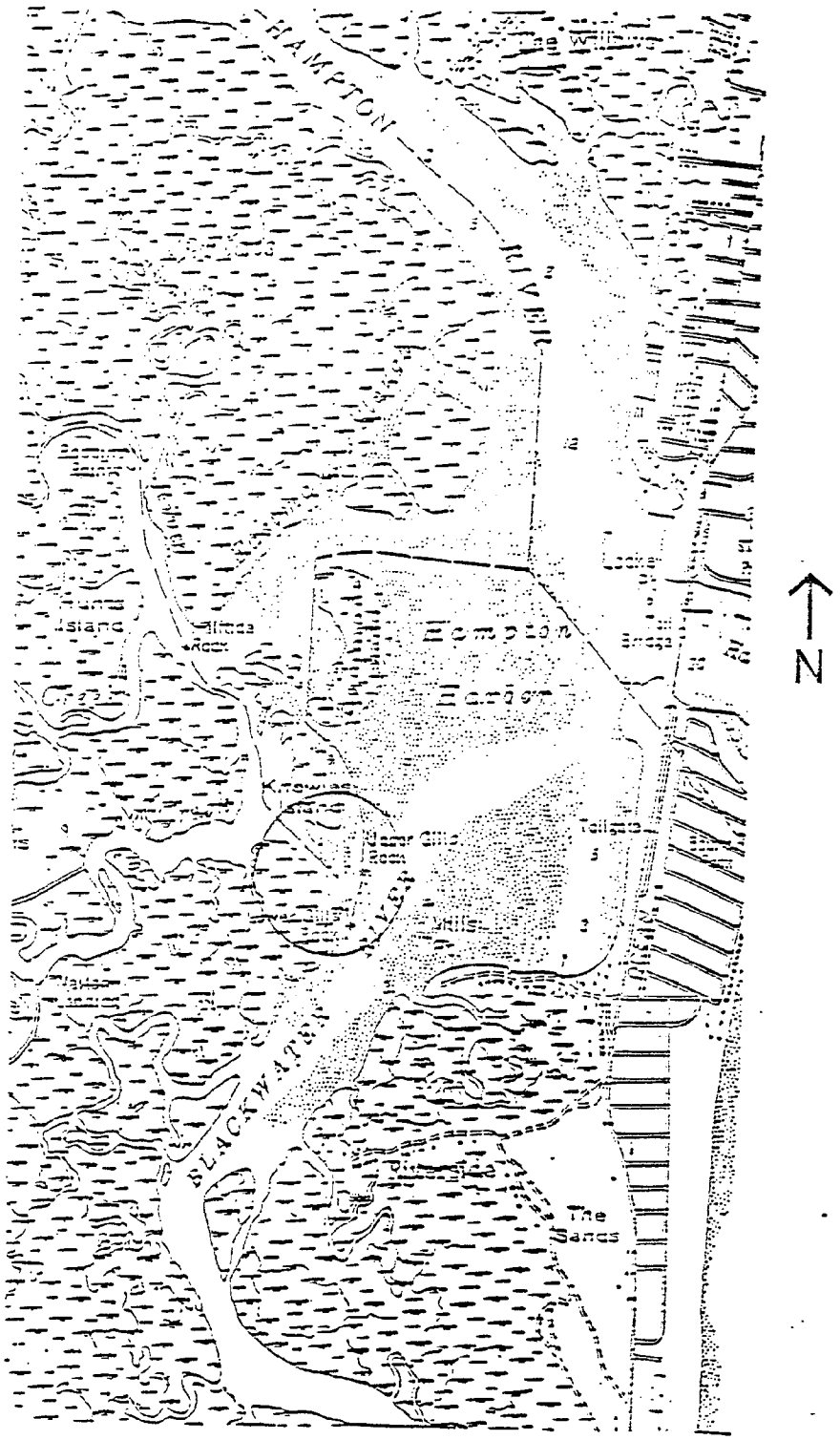

Figure 4. Location of Seabrook Common Tern Colony, 1991

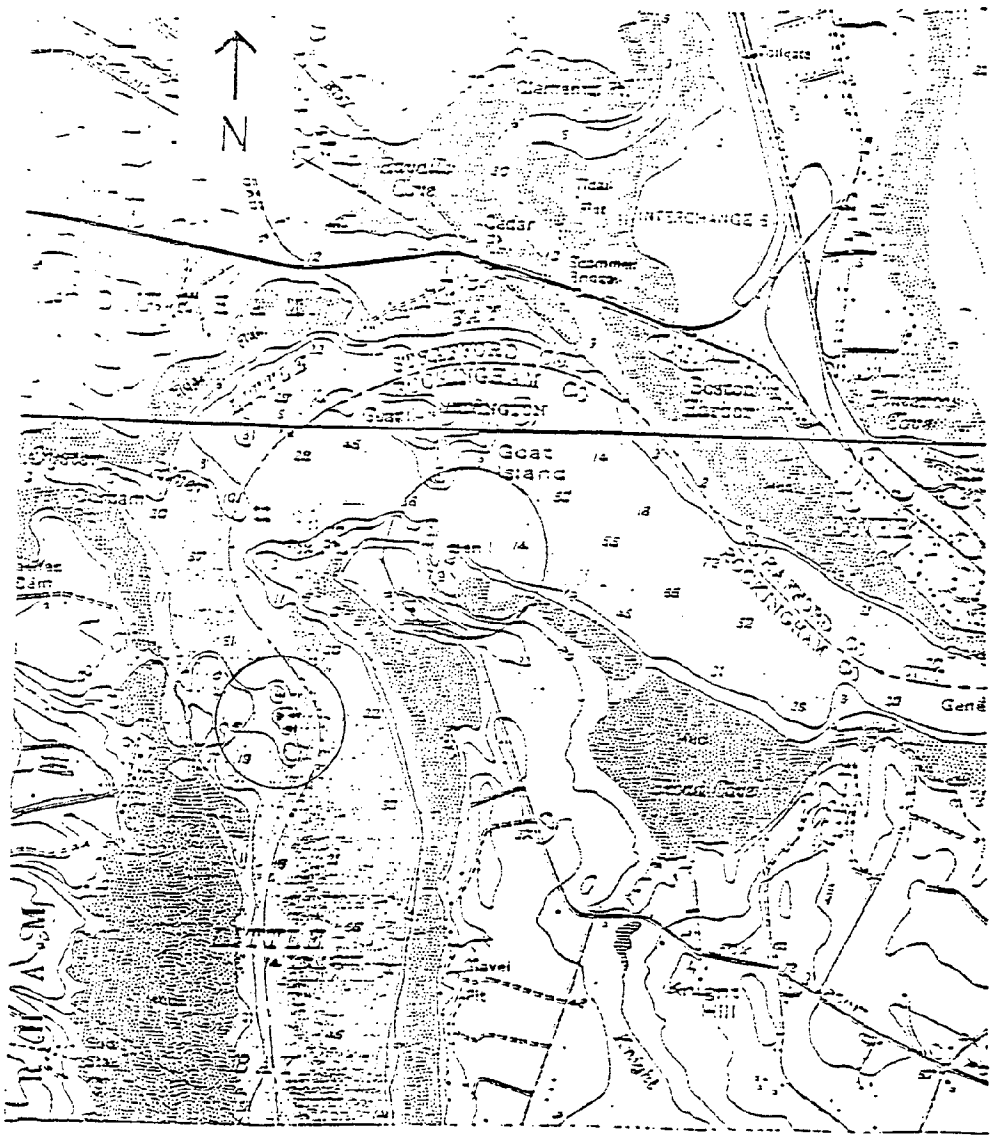

Figure 5. Location of Common Tern Colonies, Little Bay, 1991

Langley Rocks

This site is a 10m. x 15m. pile of rocks just east of Mathes Cove and south of the mouth of the Oyster River on the Durham shore of Little Bay. The terns coexisted here with a breeding pair of Great Black-backed Gulls and their chicks (Figure 6).

LITTLE HARBOR:

Back Channel

This colony includes a series of three privately owned unnamed islands just south of Goat Island in New Castle (Figure 7). Island A, less than 0.08 ha. in area, lies less than 100 meters from Goat Island and is characterized by rock ledge crowned with grass. Island B, measuring 0.08 ha., is more extensively vegetated and is ringed by rock ledge. Island C, 0.04 ha. in size, has more extensive grassy areas, rock outcropping and the remains of a small cottage.

METHODS

NESTING OBSERVATIONS

Project biologists monitored the Little Bay and Hampton estuary colonies a minimum of once per week from mid-May through early September. The Back Channel islands were checked periodically during 16 May through 28 June, when breeding activity was observed, and then monitored twice weekly through the end of the season. A site summary form was completed for each visit which included date, time, weather, number of terns and nests and other species observed. Data collected on active nests included time, status, presence of adult, number of eggs and/or young and their condition. Documentation of breeding chronology and reproductive success included dates and numbers of eggs laid, chicks hatched and fledgings; or date of failure.

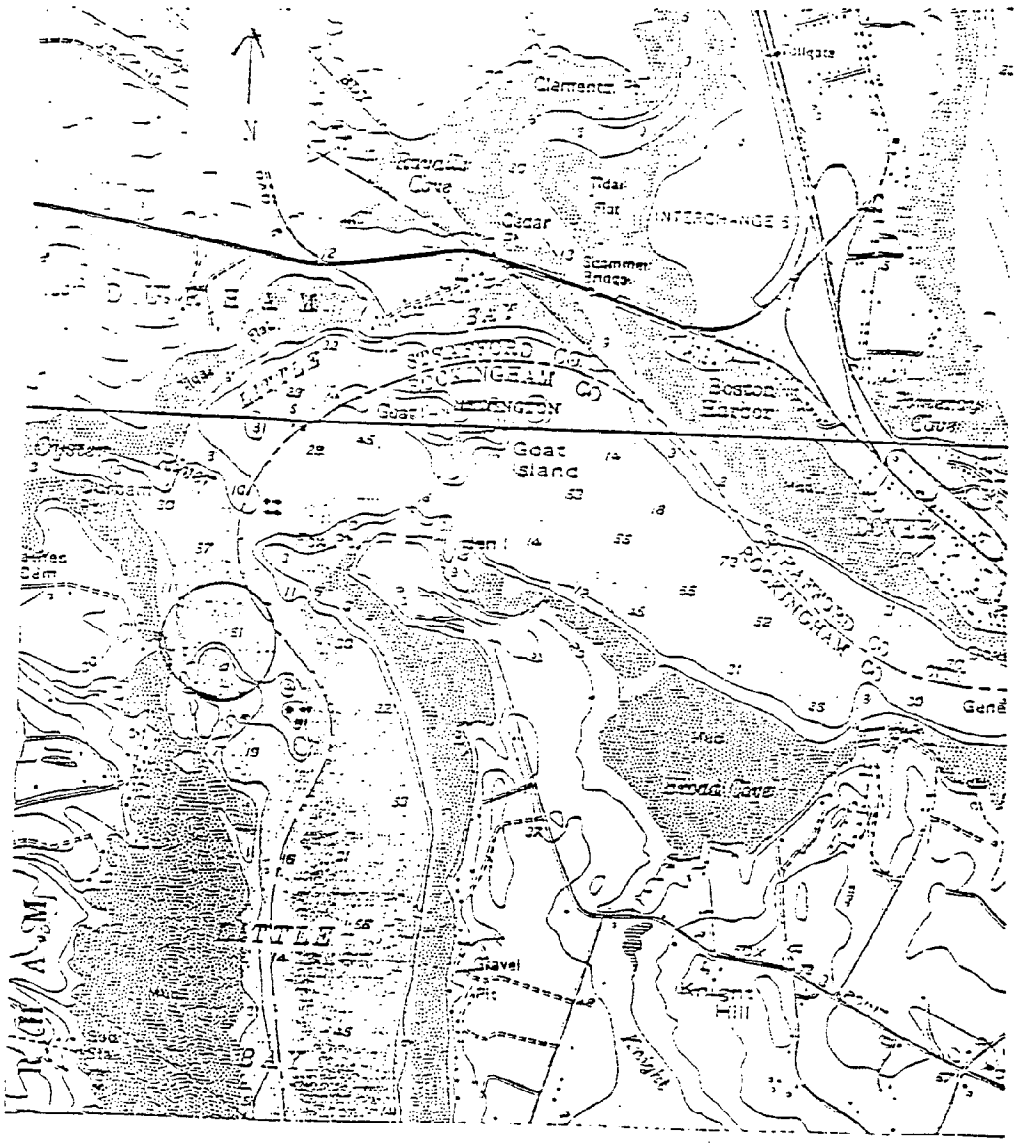

Figure 6: Location of Langley Island Common Tern Colony, 1991

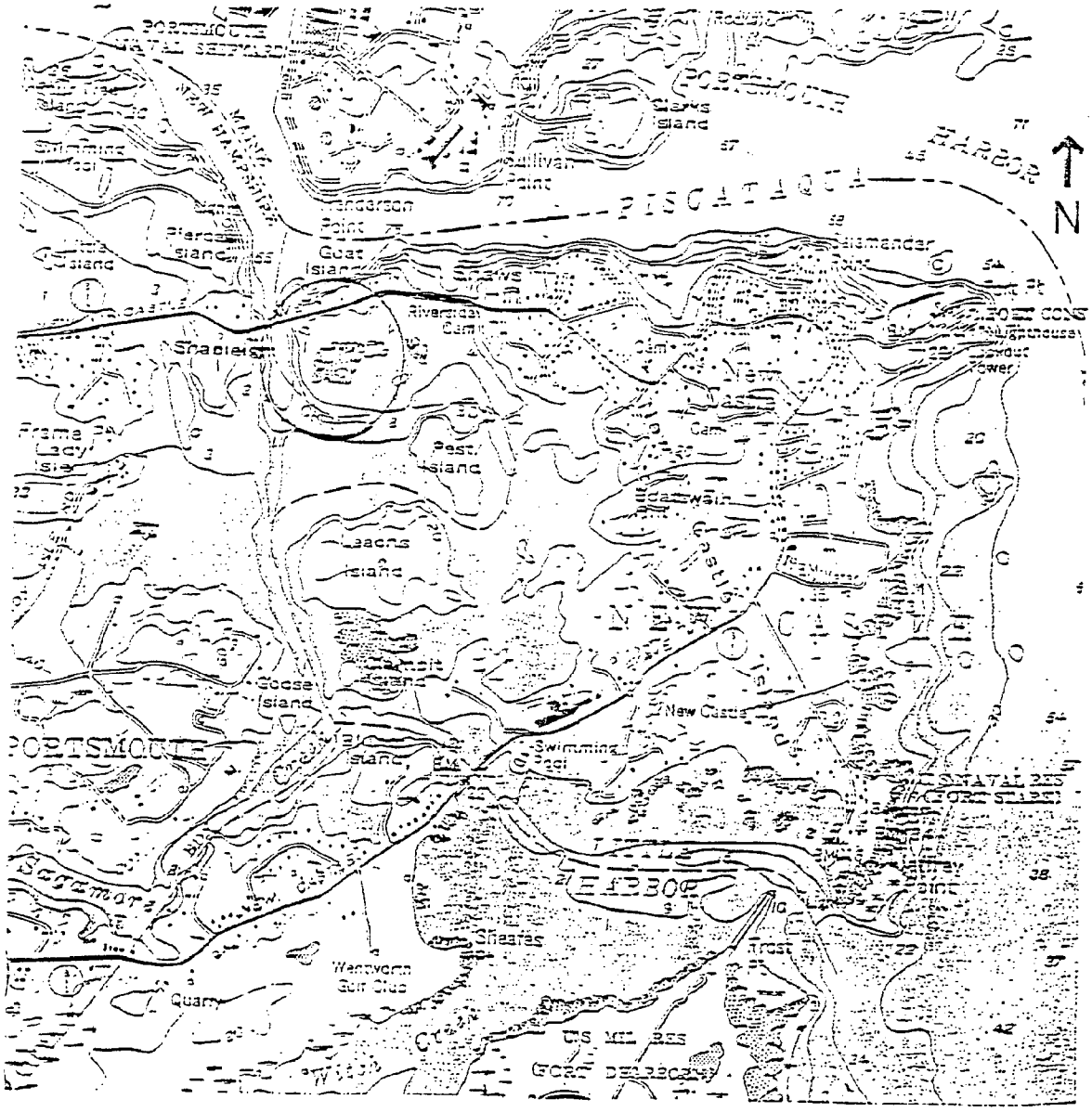

Figure 7. Location of Back Channel Common Tern Colony, 1991

Hampton Marsh

Project biologists visited the Hampton Marsh twice weekly from 16 May through 24 August and weekly from 24 August through 7 September.

Each nest found was marked by alpha numerics. The letter identified its location (section) in the marsh and the number signified when it was found relative to the other nests in that section (eg. C4 indicated the fourth nest found in area C).

Seabrook

The Seabrook colony was monitored a minimum of twice weekly from 16 May through 27 June, when it was determined that all nesting had been abandoned. Nests were located and mapped prior to abandonment; however, a final egg count had not been made prior to the dispersal of this colony.

Hen Island

The Hen Island colony was monitored twice weekly from 11 May through 15 July when it was determined that all nesting had been abandoned. The small size of the colony made nest marking unnecessary.

Langley Rocks

This pair of terns was monitored from shore and by boat on a periodic basis from 6 June through 14 August.

Back Channel

Back Channel islands were checked periodically beginning 16 May and then monitored twice weekly from nest initiation on 28 June through 2 September. Site summary and individual nest data were collected as at Hampton. The small size of the colony made nest marking unnecessary.

HISTORICAL AND POTENTIAL SITES

On 23 May, NHFG provided a boat and two biologists to assist in checking islands in Great and Little bays for tern nesting activity. The following sites were included: the unnamed island in the Oyster River, Langley Islands in Mathes Cove, Hen Island, Nannie Island and Swan Island. The survey also covered the shoreline and potential foraging areas.

On 19 June, NHFG again provided a boat and biologist to assist in a survey of Great and Little bays, the Piscataqua River, Back Channel, Little Harbor and Portsmouth Harbor out into the open ocean (Figure 8).

On 20 June, NHFG provided a boat and biologist to assist in a survey of Hampton Harbor for additional tern colonies. The survey route included all navigable tidal channels between Rtes. 286, 51 and 1 (Figure 9). The route continued through the channel under Rt. 51 and north into Tide Mill Creek and Eel Ditch.

Location, behavior and flight direction were noted for all terns observed. All tern activity was followed up by observations from accessible mainland and canoe launch sites.

FORAGING STUDIES

Biologists and volunteers conducted observations throughout the coastal area to identify important foraging areas and the frequency of their use. Observations occurred along the ocean shoreline from Odiorne Point to Seabrook beach; in Hampton Harbor and its associated marshes; in Great and Little bays, on the Piscataqua River, Portsmouth Harbor, Little Harbors and on the open ocean out to the Isles of Shoals (Figure 10).

Data collected during foraging observations included location, date, time, weather conditions, tide levels, foraging behavior and direction of travel.

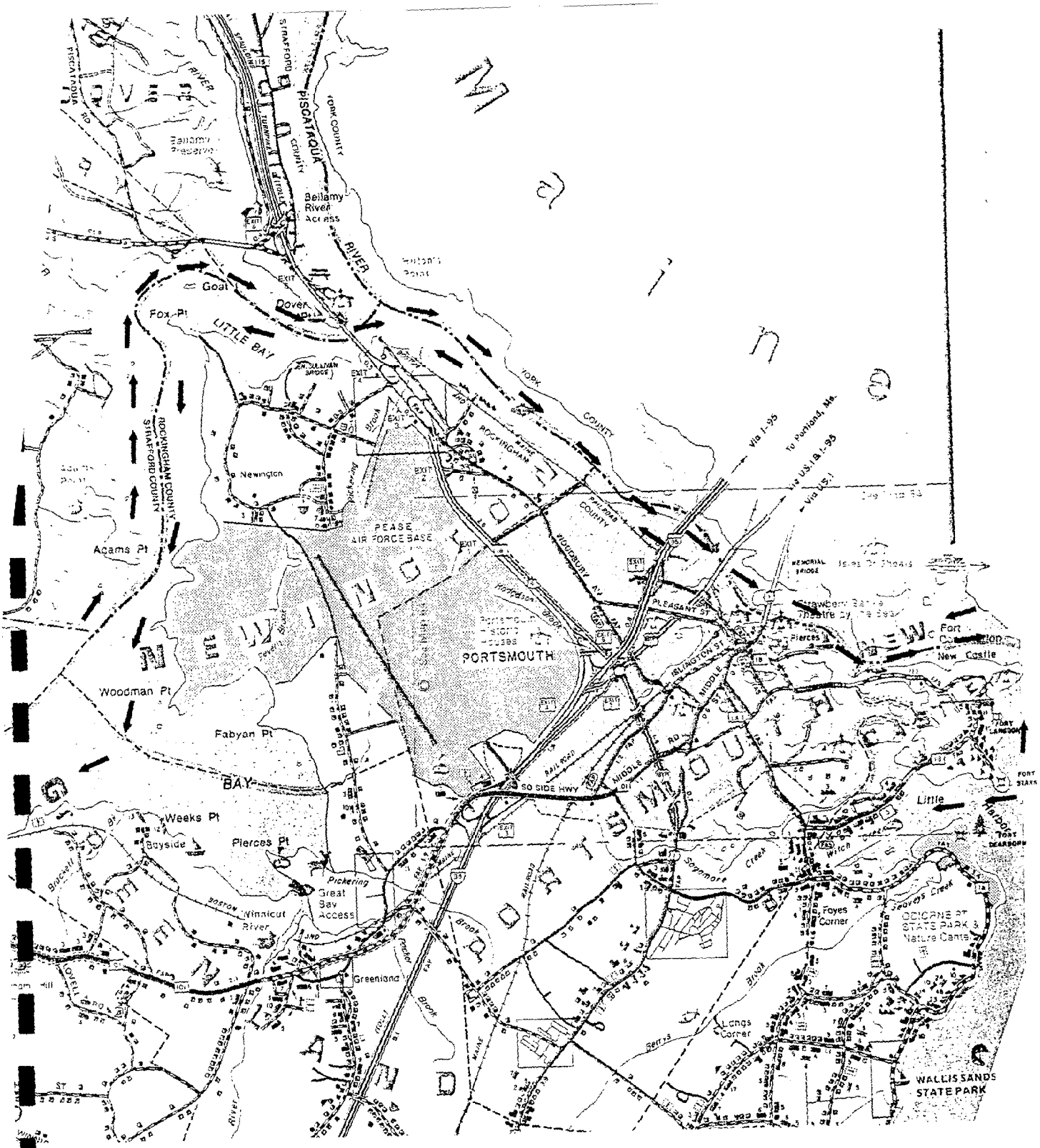

Figure 8. Survey Route for Historical and Potential Common Tern Breeding Sites, Great/Little Bay Out to Open Ocean, 1991

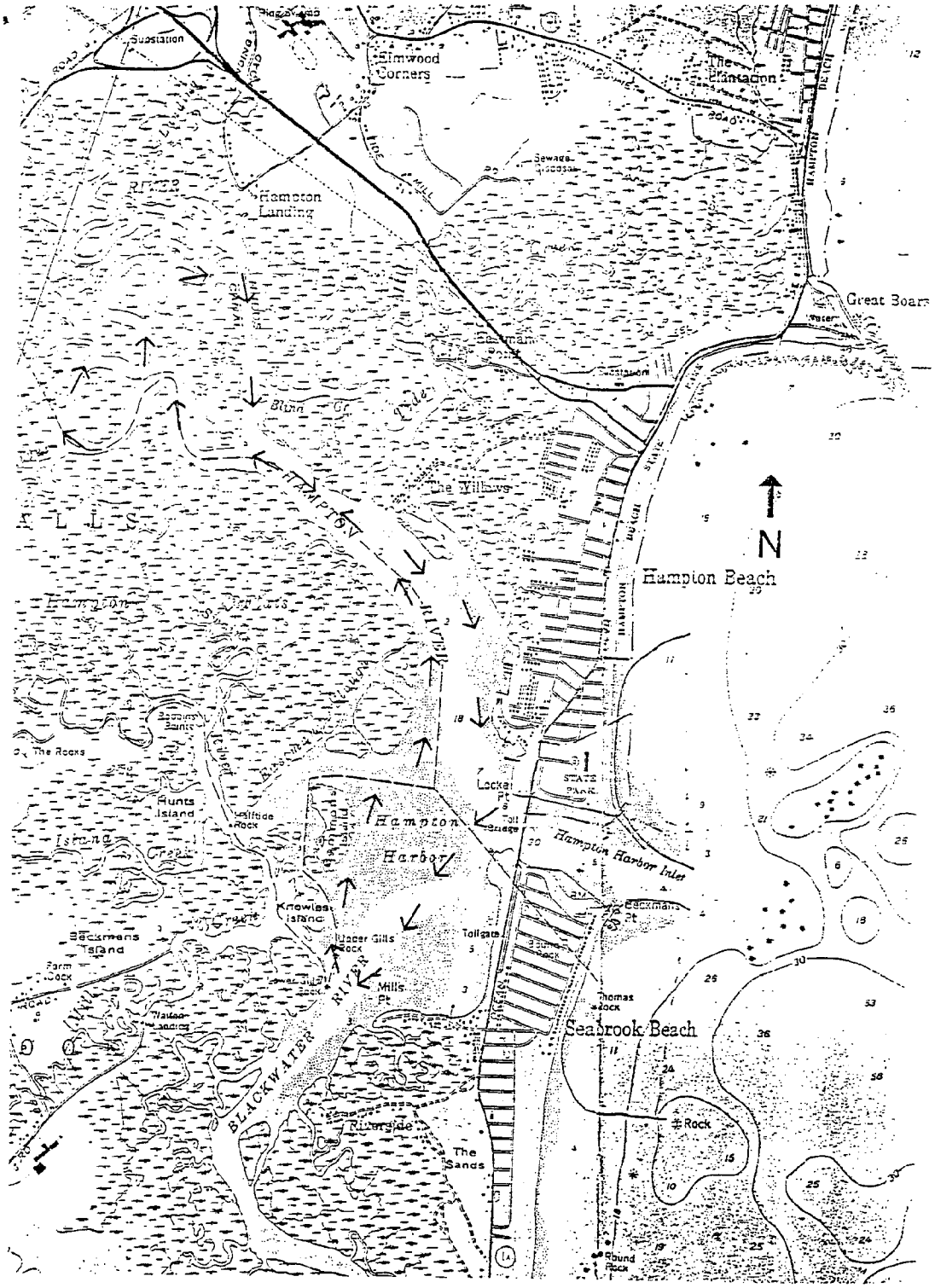

Figure 9. Survey Route for Historical and Potential Common Tern Breeding Sites, Hampton and Seabrook Marshes, 1991

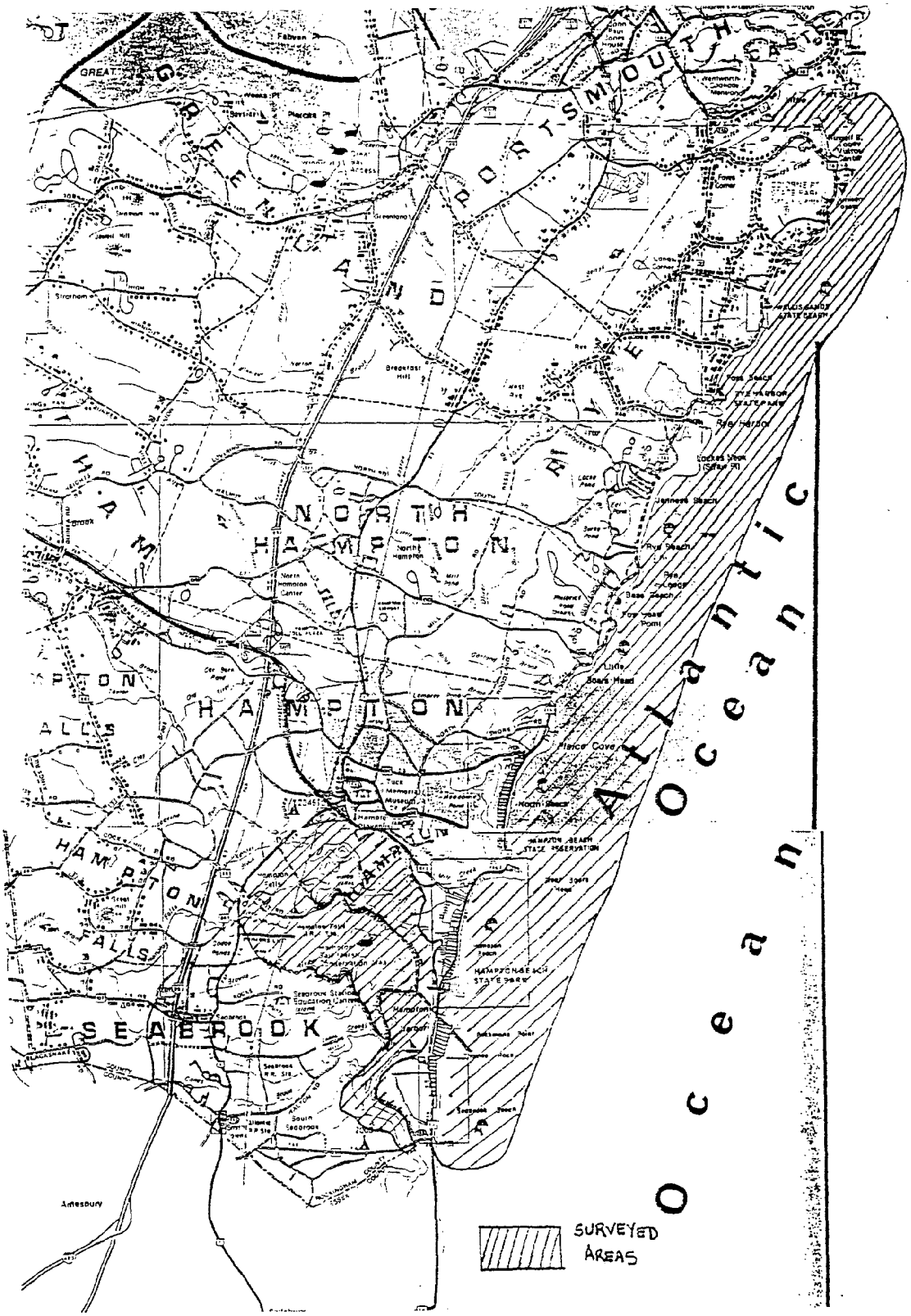

Figure !0. Common Tern Foraging Survey Coverage Odiorne to Seabrook, 1991

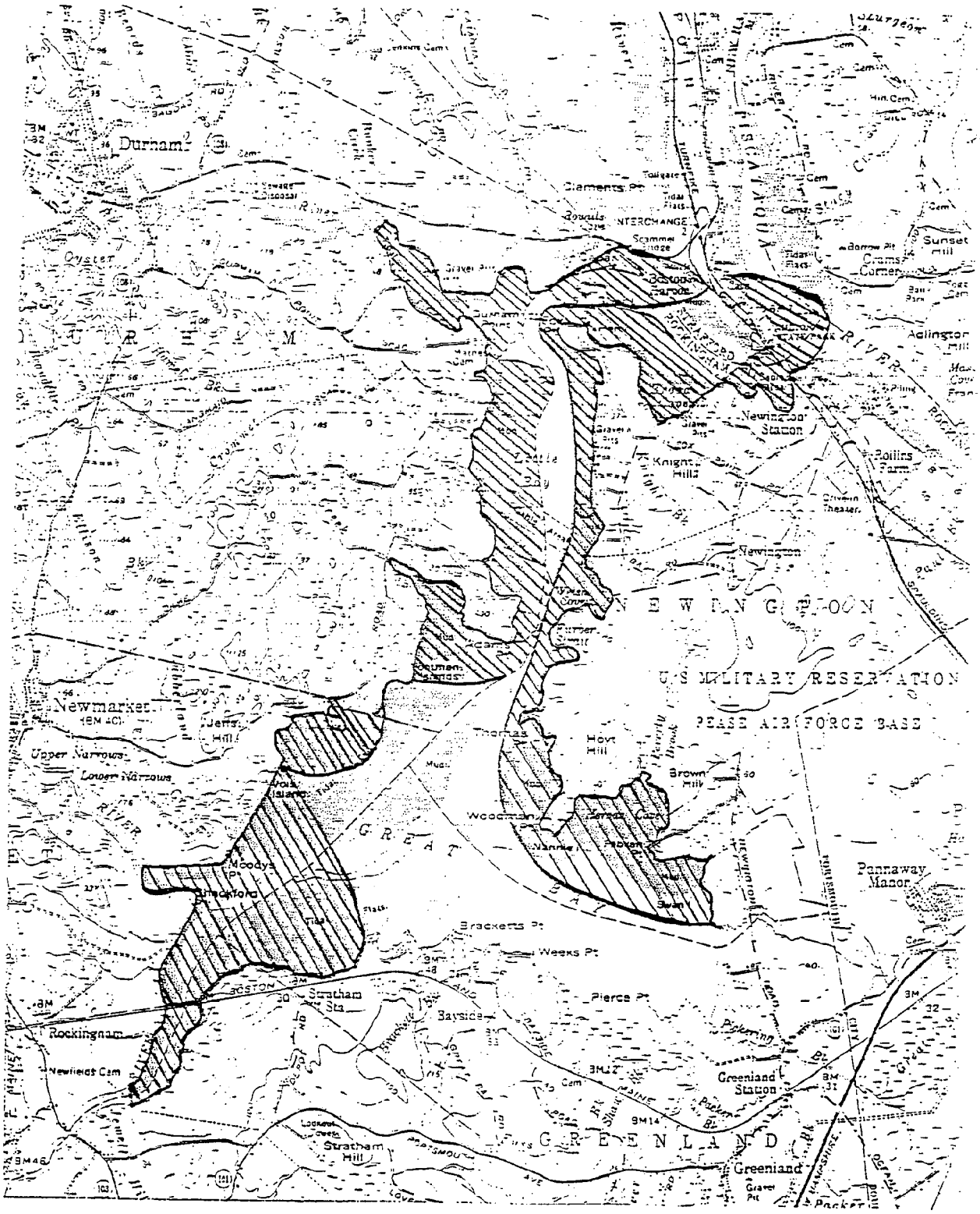

Figure 11. Common Tern Foraging Survey Coverage Great and Little Bays, 1991

FEEDING STUDIES

Project biologists conducted feeding studies at both the Hen Island and Hampton colonies to determine identity and frequency of prey fed to chicks. Data collected during feeding observations included nest location; times of tern arrival and departure; identification of provider and receiver; number, size and species of prey items delivered; direction from which deliveries came; weather conditions and tide levels.

A 1.4 m. x 1.4 m. burlap-covered wooden blind was placed in the Seabrook colony on 24 May as the terns began nest initiation. After the failure of this colony, the blind was moved to the Hampton marsh and relocated 20 m. from an active nesting area. Observations were conducted at nine nests during the weeks of 9 August and 15 August. Observation periods lasted 4 hours. Hurricane "Bob" destroyed the blind on 18-19 August.

FLOTATION MANAGEMENT

Seven nest floats were placed in the Seabrook marshes prior to nest initiation. Each float was constructed from a 0.6 m. x 0.6 m. plywood base, edged with a 2.5 cm. border and attached to a 5 cm. piece of foam core. Floats were anchored into the marsh by 1.5 cm. steel spikes connected to 1.8 m. cords, and were covered with loose thatch. All nest floats were placed in areas of the marsh that appeared vulnerable to flooding.

On 10 July, after it was determined that the Seabrook colony had abandoned and in anticipation of a second round of very high tides, the nest floats were moved to the Hampton marsh. The platforms were placed under seven nests in which eggs already had been laid. Each nest with its accompanying materials was lifted off the ground, a float was slipped underneath and the nest was set on top. Each float was marked with both a number and the alpha numerics of the nest it supported. Data collected for each float included number of eggs and/or young and their condition, chicks hatched and fledgings; or date of failure. Additional data included tide levels and the condition of "non-floating" nests in the immediate vicinity at time of observation.

RESULTS

NESTING OBSERVATIONS

HAMPTON HARBOR ESTUARY:

Hampton

The highest count of adult terns at this site was 93, on 16 August. Surveys documented 99 nesting attempts. A nest count conducted by project personnel and volunteers during the week of 11 June documented 32 nests. In subsequent visits, 67 additional nests were documented. Fifty one nests (52%) contained three eggs, 29 nests (29%) contained twoeggs and 19 (18%) contained one egg (Table 1).

First hatch occurred during the week of 24 June and hatching continued through 16 August. A high tide of 3.6 m. (11.7 ft.) on 13 June was coupled with severe thunderstorms and heavy rain. One nest (three eggs) survived the resulting flooding. The 67 additional nests all were assumed to be renesting attempts. Observations suggest that the Seabrook terns moved into the Hampton marshes after abandoning their nests subsequent to the tidal flooding on 13 June.

Once tern chicks are 2-3 days old they can hide adeptly in the grasses surrounding the nests. However, chicks which reached fledging age were readily observed as they practiced flight patterns and actively begged from adults. Project biologists observed 10 airborne fledglings. An additional chick was observed near fledging on 4 September. Although the Gulf of Maine Tern Working Group defines a fledged tern chick as one that reaches the age of 14 days (Gulf of Maine Tern Working Group, pers. comm.), this statistic was very difficult to obtain in the Hampton marsh colony, as the nests were widely scattered and the chicks very difficult to locate even with nest markers.

Nest failures often were difficult to document. During the first round of nesting, 31 of 32 nests were destroyed by tidal flooding and heavy rain. Project biologists observed 47 of the renesting attempts with eggs but not with chicks; presumably these nests failed. Predation was determined to be the cause of failure in 6 nests. The egg or chick remains in these

Table 1. Number and percentage of Common Tern clutch sizes of New Hampshire nesting colonies, 1991

CLUTCH SIZE	HAMPTON	BACK CHANNEL	LANGLEY IS.
3 EGGS	51 (52%)	3 (60%)	
2 EGGS	29 (29%)	2 (40%)	1 (100%)
1 EGG	19 (18%)		

nests pointed to either gull or Black-crowned Night-heron predation (Nycticorax nycticorax). Both black-crowned night-heron and gulls were frequently observed in the Hampton marsh colony. A Northern Harrier (Circus cyaneus) was observed at Hampton on 11 June. Many of the other nest failures were probably due to tidal flooding, weather conditions or abandonment (common for late nesting attempts) (Table 2). Calculated from 10 airborne chicks and the one additional near-airborne chick; productivity of the Hampton Marsh colony was .20 fledglings/nest (Table 3).

Seabrook

The highest count of adult terns at this site was 50 on 3 June. Surveys documented 25 nesting attempts by 7 June. The high tides and flooding rains of 13 June destroyed all of the 25 nests (Table 2). Two pairs renested but were again flooded during the high tides of 11 July. Two to five terns were observed in the Seabrook colony throughout the breeding season, but no chicks were produced (Table 3).

LITTLE BAY:

Hen Island

Terns were first observed foraging in Little Bay on 11 May. A survey on 22 May documented 4 nests being incubated on Hen Island. Three nests were located on the eastern shore with the fourth along the rocks on the southwest side. By 29 May, all four of these initial nests had been abandoned and a new nest was established in the middle of the island. Observations on 31 May revealed that courtship feeding was occurring at other sites on Hen Island, and an additional nest census on 6 June found 3 active nests with a total of four eggs. Terns appeared to be relaying, although there was no direct evidence of nest predation. Terns made additional nesting attempts on this island from 10 June through 15 July.

The cause of nest failure was, at first, difficult to determine. A few shell fragments were found on the island and several of these appeared to have been destroyed by black-crowned night heron. However, there was no sign of the large numbers of eggs that had been lost, and conditions ruled out any flooding or washover problems. On 10 July, four small Norway

Table 2. Known causes of failure at New Hampshire Tern Colonies, 1991

CAUSES	EGGS	CHICKS	TOTAL NESTS
Failure to hatch	Hampton: 21 Back Channel: 4		25
Predation	Hampton: 4 Hen Island: 7+	Hampton: 2	13+
Tidal flooding w/ heavy rain	Hampton: 46 Seabrook: 27	Hampton: 5	78

Table 3. Productivity of Common Tern Colonies at Hampton, Seabrook, Hen, Langley and Back Channel, 1991

	Nests	Airborne Chicks	Productivity Fledgl./Nest
Hampton	99	11	0.2 F/N
Seabrook	27		0.0 F/N
Hen	7+		0.0 F/N
Langley	1	1	1.0 F/N
Backchannel	5	2	0.4 F/N

rats (Rattus norvegicus) were found under an abandoned sign that was lying amidst the vegetation in the center of the island. On 12 July, four rat traps were baited and set under the sign; from 14 July through August a total of eight Norway rats ranging in size from 24.5 - 36.0 cm. were caught and removed.

A maximum of 16 terns were observed at Hen Island. No eggs reached the hatch stage and all were assumed to have been lost to predation, primarily caused by the presence of rats (Table 2). By 16 July, the terns had begun to abandon this site and no terns were observed at this location after 23 July (Table 3).

Langley Rocks

On 23 May, a boat reconnaissance of this area revealed no tern activity. Terns were first observed in Mathes Cove on 6 June. On 19 June, a visit to the island confirmed that a pair of terns were incubating a single egg; an additional cracked egg was found nearby.

On 10 July, a single chick was observed on Langley Island and this chick fledged by 1 August (Table 3). A great black-backed gull nest on the island fledged two chicks.

LITTLE HARBOR:

Back Channel:

Terns were first observed at the Back Channel islands during a check on 16 June. A pair of terns were engaged in courtship feeding at the Back Channel islands on 20 June. Incubation by a single pair was noted on 28 June and a survey of this nest site found three eggs. A visit to the island on 24 July revealed that the eggs had hatched, but one chick was found dead of apparent exposure. The two remaining chicks fledged by 15 August and were still in the area on 2 September.

A survey on 16 July found three nests on the rocky ledges on the south side of Island B. Two of the nests had three eggs and one had two eggs (Table 1). An additional nest of two eggs was found on Island B on

24 July. Observations from 9 August noted decreased activity around Island B and by 16 August the terns had abandoned this island. Remains of three of the 10 eggs known on Island B were found; all three eggs appeared to have suffered from black-crowned night-heron predation. There was no evidence of the remaining seven eggs or any sign of chicks (Table 2).

A maximum of 22 adult terns were seen flying over the Back Channel Islands on 15 August and again on 30 August. A total of two chicks fledged from the five known nests for a productivity of 0.4 chicks/nest at Back Channel.

HISTORICAL AND POTENTIAL SITES

Surveys of potential breeding habitat documented tern activity at a number of locations.

The survey of Great and Little bays on 19 June confirmed incubation by a pair of terns at Langley Rocks. Tern activity was also noted at the Back Channel Islands on this date and followup on 20 June found a pair engaged in courtship activities. An additional discovery during the 19 June boat survey was active foraging by 20+ terns at the mouth of the Piscataqua River. A subsequent check of the shoreline in this area located a tern colony of 50+ pairs on Horn Island off Kittery Point, Maine.

FORAGING STUDIES

Project personnel documented foraging activity that was consistent with the patterns observed during the 1990 breeding season. As in 1990, nesting terns were foraging in close proximity to the breeding colonies.

Terns from the Hampton colony foraged along the tidal channels that flow through the colony area (Figure 12). Foraging along Tide Mill Creek and Eel Ditch was most evident at high tide and as chicks began to fledge and the birds gathered in "loafing" areas along the channel. In addition to foraging in the channels, many birds were observed flying to and from Hampton Harbor. Return trips brought prey items back into the colony.

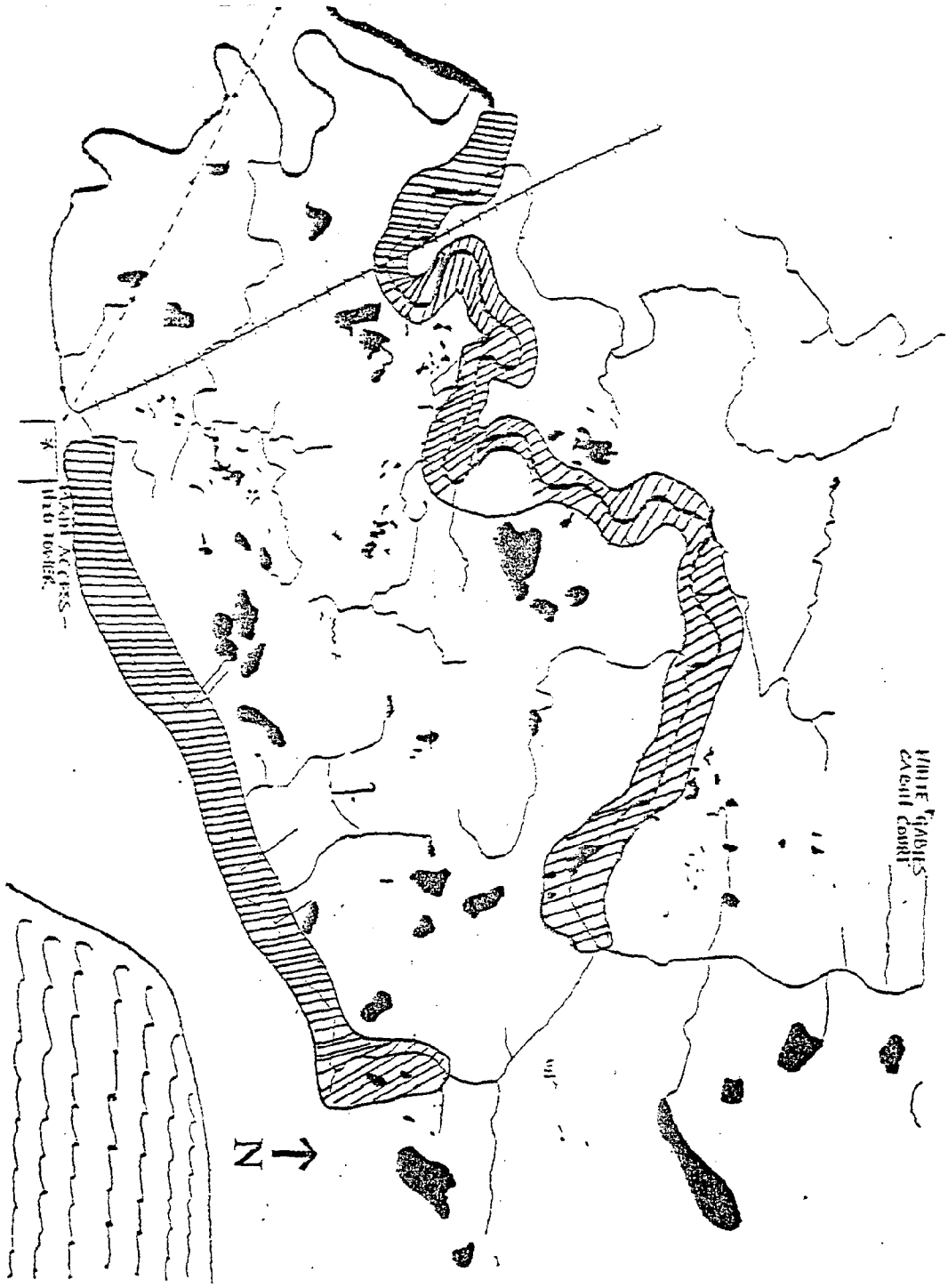

Figure 12. Common Tern Foraging Locations at Hampton Marsh, 1991

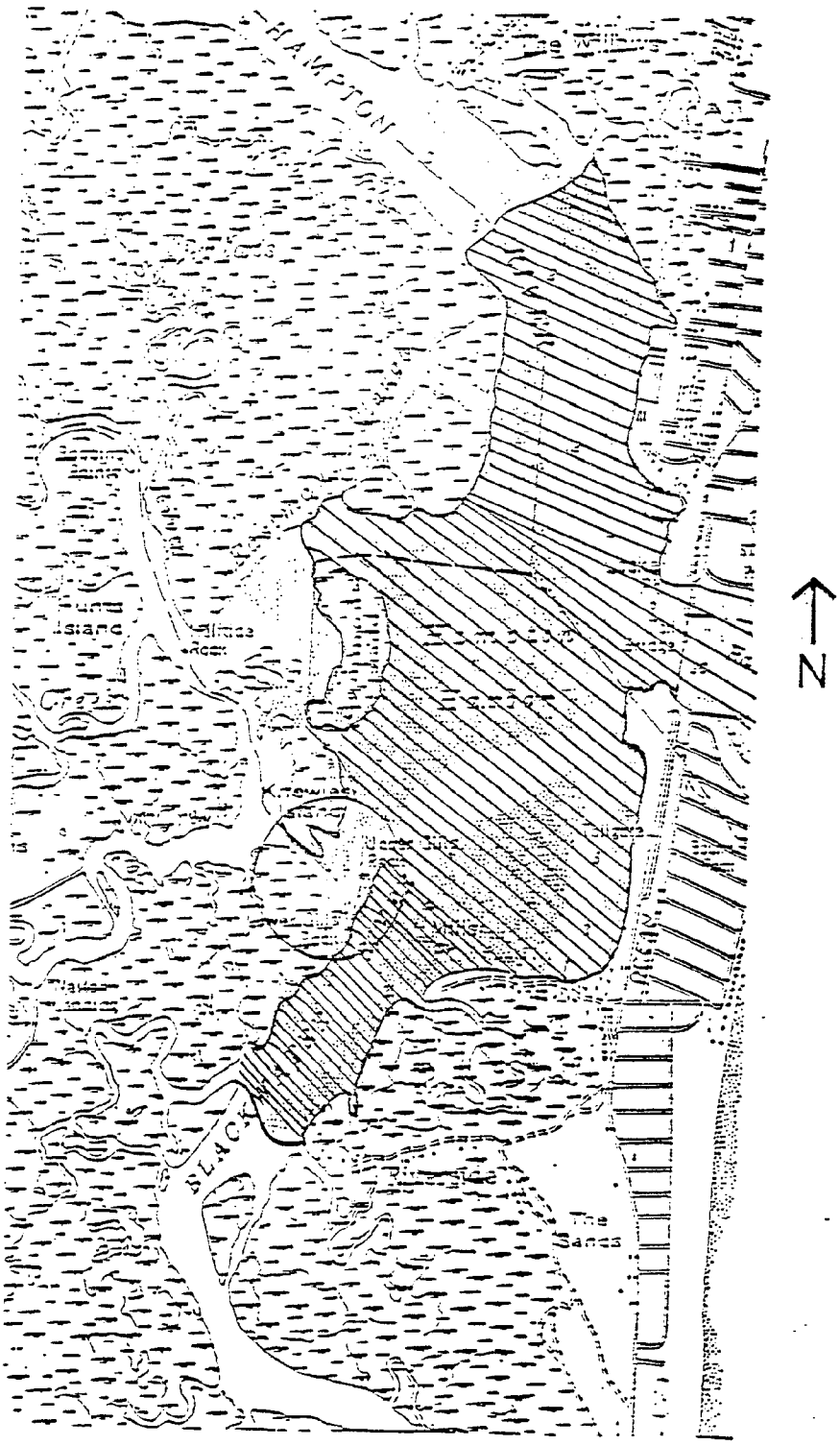

Figure 13. Common Tern Foraging Locations at Seabrook, 1991

The Seabrook colony birds foraged along the Blackwater River and in Hampton Harbor, both in immediate proximity to the colony (Figure 13). As in 1990, visual observations revealed an abundance of prey. The most active foraging took place in the final two hours of a rising tide.

The Hen Island and Langley Rocks terns also foraged in close proximity to the breeding areas. The most active foraging took place in Broad Cove, an area of protected waters less than 0.5 km. from the Hen Island colony (Figure 14). Foraging was also observed along the shores of Little Bay, the mouth of the Oyster River, Royall's Cove, and the waters immediately around Hen and Goat Islands. In addition, terns were seen foraging off Adam's Point and the Footman Islands on 27 July, and off Moody Point on four separate occasions.

The Back Channel terns foraged in the waters immediately adjacent to the breeding islands. The waters off Leach's, Pest, Shapleigh, Goat and Pierces Islands as well as off Lady Isle were also used for foraging. On three evenings in August, terns were observed foraging over the South Mill Pond near downtown Portsmouth (Figure 15).

Terns were observed foraging at the mouth of the Piscataqua River and Little Harbor on 100% of the survey periods (Figure 16). Successful catches were followed back to the Horn Island colony, less than 1 mile northeast of this location. With over 100 individual terns at this colony, the foraging demand was greatest at this site.

FEEDING SURVEYS

Feeding studies were made more difficult this year by the high rate of nest failure and subsequent transience of breeding terns along the coast. However, the data gathered were consistent with data collected in 1990.

Hampton

The placement of the blind at the Hampton marsh facilitated feeding observations at this site, and appeared to pose minimal disturbance to the

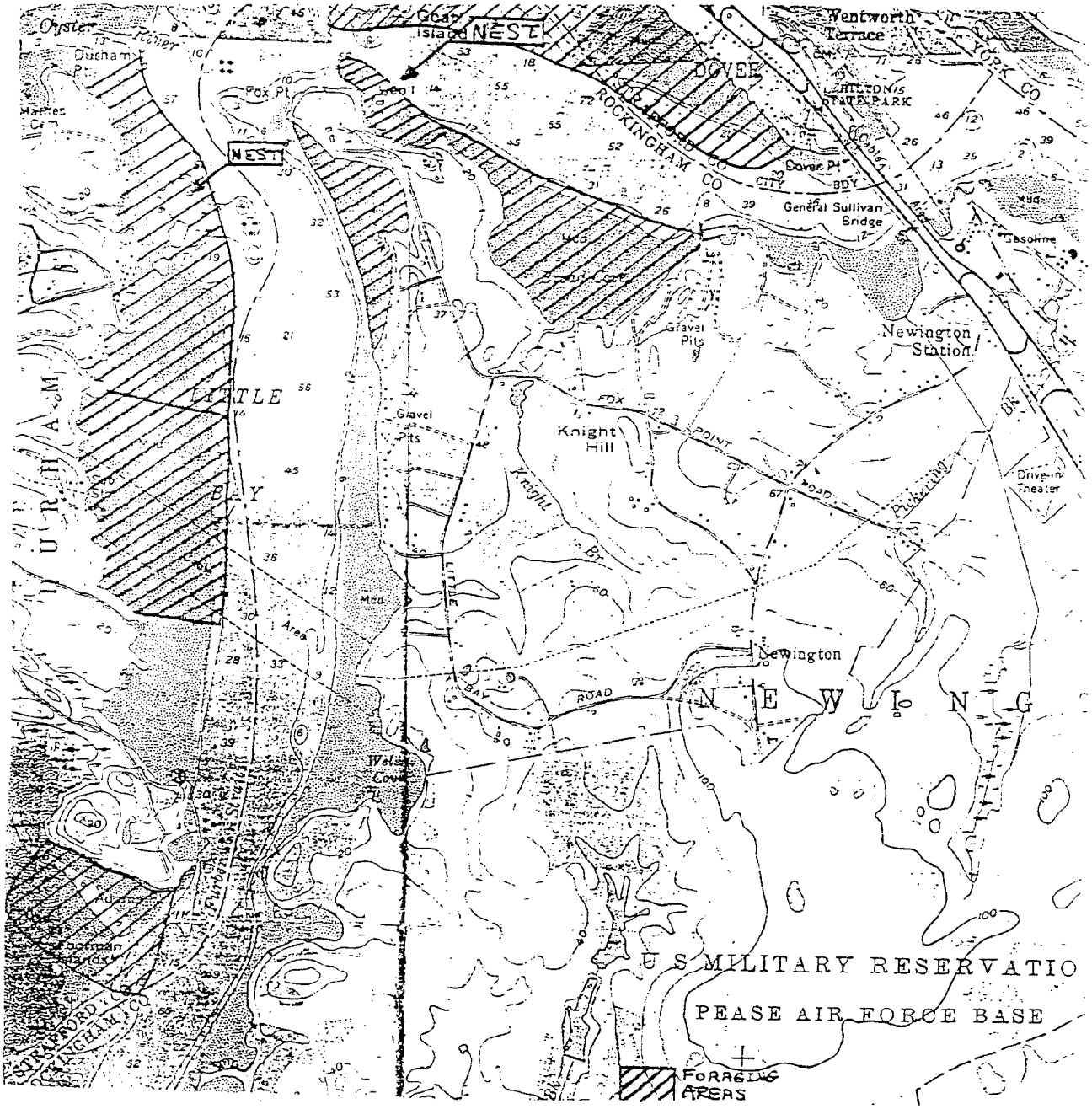

Figure 14. Common Tern Foraging Locations at Little Bay, 1991

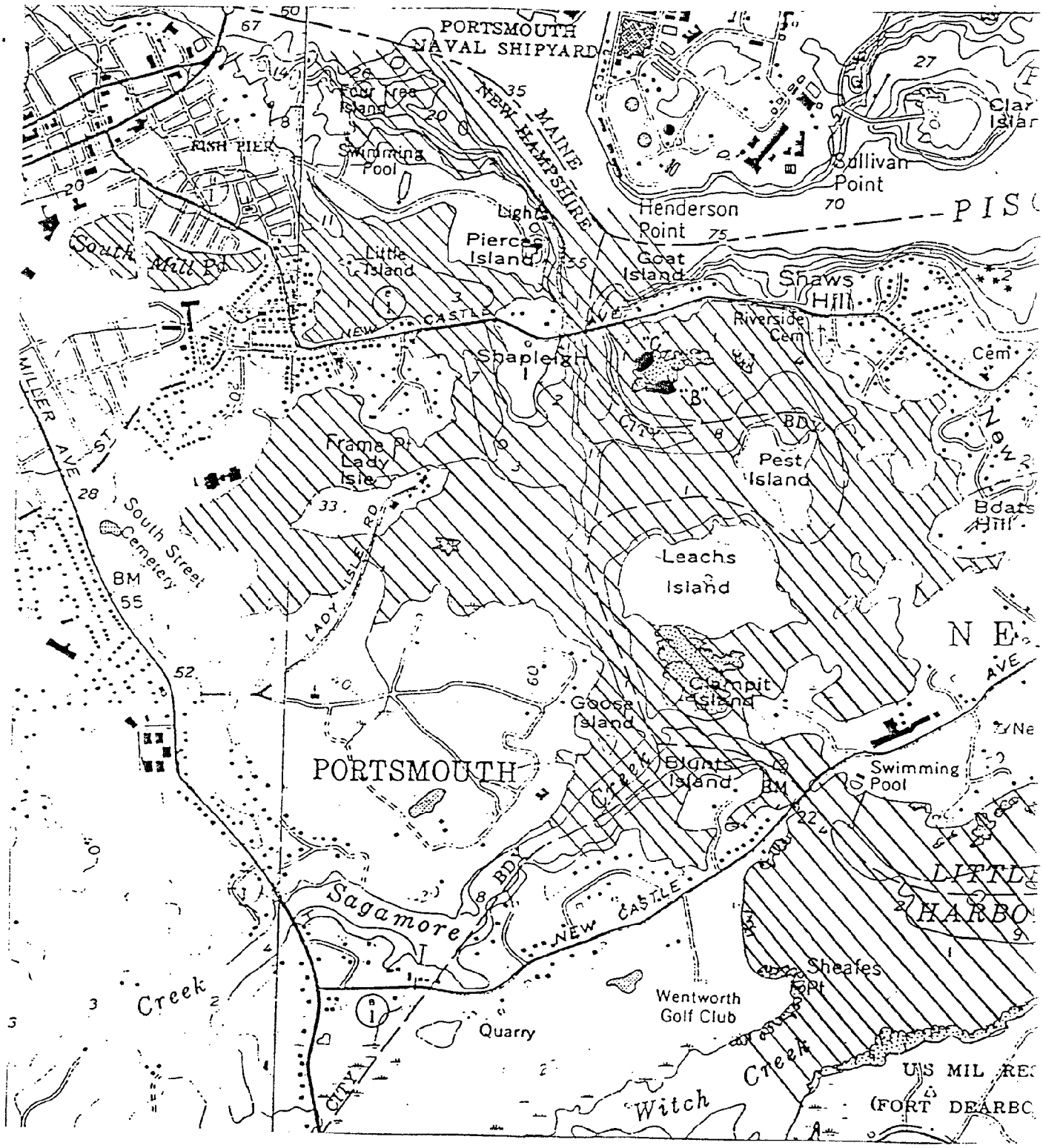

Figure 15. Common Tern Foraging Locations at Back Channel, 1991

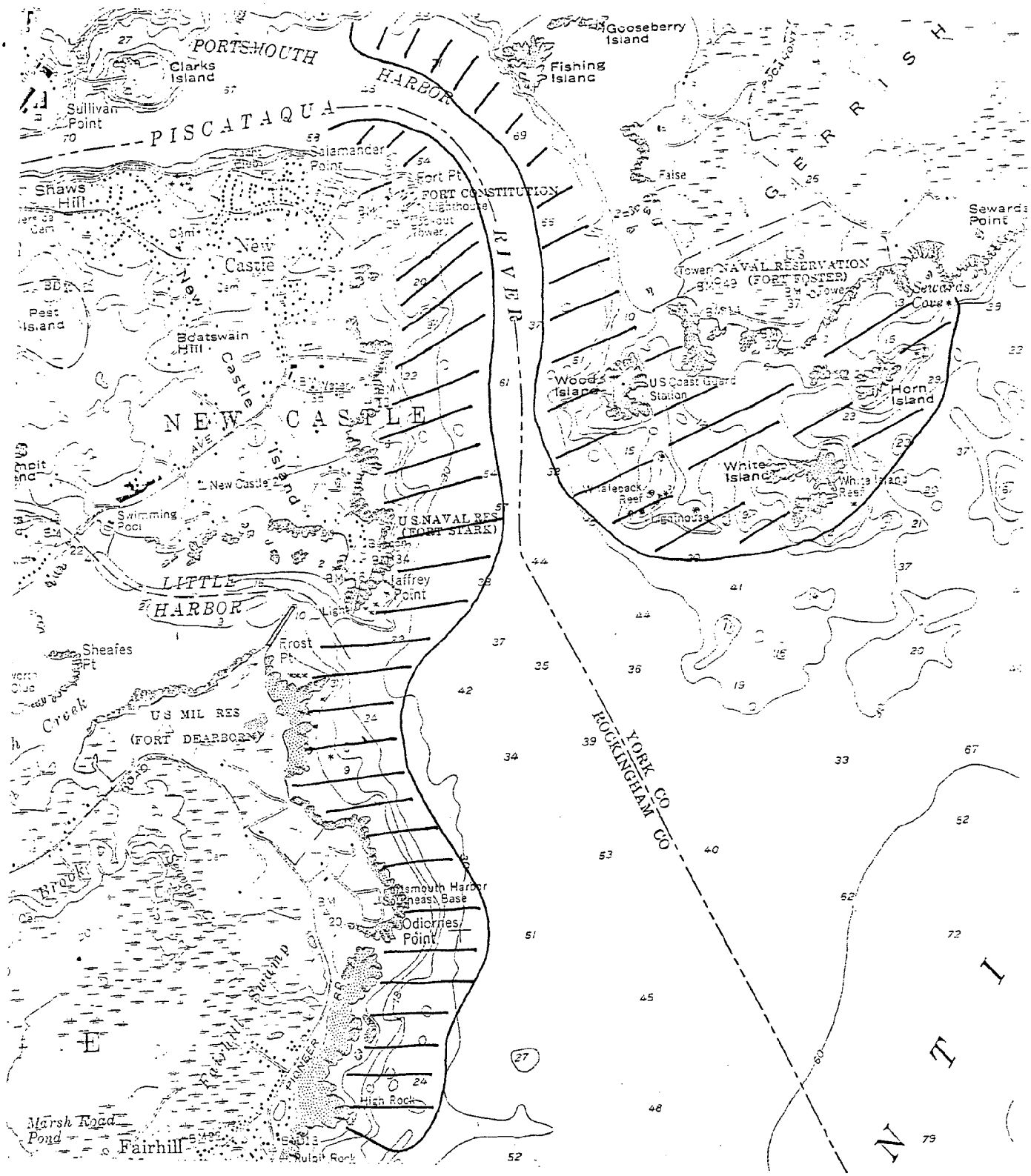

Figure 16. Common Tern Foraging Locations at Horn Island, 1991

terns. The terns appeared to habituate quickly, landing back at their nests within minutes of blind placement. Terns frequently used the blind for a perch, with or without human occupants present. The blind enabled observation of the activities around five nests.

Feeding frequency, expressed as the number of prey items delivered per chick, per hour was 0.9 during the week of 9 August and 1.0 in the week of 15 August. Destruction of the blind during Hurricane Bob on 19 August precluded further feeding observations.

The principal prey species at the Hampton colony was sand lance (Ammodytes americanus), which was fed during 71.4% of the observed feedings. The second most abundant food source was striped killifish (Fundulus heteroclitus) brought in during 26.2% of the observed feedings. Atlantic herring was observed being brought to a nest site on one occasion (Table 4). All prey items came from the direction of Hampton Harbor.

Hen and Back Channel Islands

The principal prey species at Hen and Back Channel Islands was Atlantic herring (Clupea harengus). Observations noted that schools of Atlantic herring were abundant in the waters surrounding both islands, especially in August when bluefish (Pomatomus saltatrix) chased schools into the shallow waters on the incoming tide. Feeding frequency at the Back Channel nest was 2.5 during the week of 31 July and 1.7 in the week of 9 August.

Feeding studies discovered that adult terns at Back Channel Islands and Langley Rocks were attempting to feed chicks that belonged to another pair. After the round of failures at Back Channel in mid-August, 3-5 adults with prey were routinely observed circling above the surviving chicks. This same phenomenon was noted at Langley Rocks. On numerous occasions 4-5 adults terns, each with prey, perched in a loose circle around a chick. The parents were seen to chase these "helpers" from the immediate vicinity of the nest.

FLOTATION MANAGEMENT

Terns exhibited minimal interest in the floats placed at the Seabrook colony during nest initiation. A pair of terns was observed in courtship atop a float on 12 June as high tides began to encroach on nesting habitat.

Placement of the floats under nests in which eggs already had been laid yielded very positive results. Immediately following a second round of high tides on 11 July, flooding of nests was apparent in the areas without flotation but the floats kept their nests high and dry. Six of the seven floats hatched chicks giving a hatch rate of 86%, and it is possible that the seventh float also yielded chicks but they were never found. The hatch rate for all known nesting attempts was 15%. Floats were placed under 7% of all observed nests. The chicks hatched from these floats represent 32% of all known hatches in the Hampton marsh.

DISCUSSION

Results of the nesting observations further confirm the low reproductive success and general difficulties experienced by terns nesting in mainland situations. The high rate of failure in all colonies contributed to considerable movement by breeding terns. In contrast to 1990 when 3 breeding sites were occupied, terns attempted to breed at 6 locations in 1991.

The Hampton marsh colony size and productivity has remained relatively consistent over the last few years. Although a few chicks achieved fledging in this location, the colony's productivity is only slightly above zero. Flooding and predation continue to account for the highest percentage of failed nests. This is consistent with the findings of most researchers who believe flooding to be the main disadvantage to marsh nesting (Burger and Lesser 1978, 1979; Burger 1982; Buckley and Buckley 1982; Erwin and Smith 1985). The complete failure (with the exception of one nest in Hampton) at both the Hampton and Seabrook colonies on 13 June set the stage for movement of the Seabrook terns into the Hampton colony. This influx of breeding birds into Hampton contributed to the doubling of nesting attempts from 52 in 1990 to 99 this season.

As in past years, observations documented a widening dispersal of nests as the season progressed. In the past this was thought to be due, at least in part, to continued low productivity combined with the pressures of predation. The high loss to flooding this season allowed for an examination of dispersal in the context of nesting substrate.

The majority of nests at Seabrook were situated in areas of Juncus where the tern activity bent the rush into soft mats. These nests were extremely vulnerable to flooding. In contrast, nests placed on floating mats of vegetation are more resilient to high tides. Safina et.al (1989) found that the number of pairs of nesting birds was related to the area of vegetation mats present. Nest surveys at Hampton in early June found terns scattered through 6 sections of the marsh, primarily along areas of loose thatch. As the season progressed, flooding caused considerable nest failure and the consolidated tracts of thatch were broken up and dispersed over larger regions of the marsh. This breakup of thatch coincides with the dispersion of terns into 16 sections of the Hampton marsh by the end of the season.

The placement of floats in the Seabrook marsh at nest initiation resulted in little interest by prospecting terns. However, the complete failure of this colony early in their breeding cycle may have been a major factor in this outcome. The placement of these same floats under nests in which eggs already had been laid led to the extremely high 86% hatch rate in Hampton. This supports the claim that adequate substrate in a marsh nesting situation can lead to higher productivity. This is, however, a very energy intensive management technique. Other options for improving nesting substrate should be explored.

The failure of the Hen Island colony was disappointing after the success there in 1990. Rat predation is a serious problem at this site and aggressive control measures will be needed to allow future productivity. The timing of nest initiation at Langley Rocks and the Back Channel Islands reflects movement of the abandoning Hen Island terns to these satellite locations. With adequate rat control, Hen Island still remains suitable for nesting terns with the availability of nest sites well above the high tide line, the protective attitudes of people using the Fox Point mooring area, and the apparently adequate food supply found in nearby waters.

Chicks were raised at the Back Channel Islands for the first time since 1985. Egg predation had been the direct cause of zero productivity at this site during 1985-1989 and the terns had abandoned the site in 1990. The success of the pair on Island C may have been due to a number of factors including their late start and the added protection of the other adults at this site as the chicks reached fledging age.

The appearance of 50+ pairs of terns on Horn Island off Kittery Point was of great interest for a number of reasons. First, the formation of this colony is evidence that significant numbers of terns are searching for suitable nesting habitat in this immediate region. Second, it supports the potential for preliminary efforts to relocate terns to more viable breeding habitat such as the Isles Of Shoals (Gulf of Maine Tern Working Group, 1990). Horn Island is in direct line of sight and within 4 miles of the Isles of Shoals. All nests failed on Horn due to lack of cover and predation by both gulls and black-crowned night-herons. Complete failure at this site will likely cause continued movement of this population.

The foraging observations underscore the importance of maintaining water quality in the vicinity of tern colonies. As in 1990, terns were documented foraging in close proximity to colony sites; providing an important indicator of local environmental quality. As development pressures continue to grow in this region and plans to expand the port of Portsmouth get underway, it will be critical to monitor the water quality along our immediate coast. Contamination of the water in the Great Bay watershed, the Piscataqua River or along the Hampton Harbor estuary could be devastating to this endangered population of terns. Further studies of common tern foraging habits on the New Hampshire coast will contribute to an important baseline against which changes can be assessed.

The feeding studies were consistent with the findings in 1990. Nest failures at all sites made feeding observations difficult this season. Observations at Hampton did confirm that Ammodytes and Fundulus continue to be the terns' primary food sources at that colony. Observations at Back Channel Island were also consistent with last year's Hen Island data and show Clupea as the principal prey species there. Feeding data should be collected in future years to more accurately assess both the availability and variability of preferred prey species.

MONITORING AND MANAGEMENT RECOMMENDATIONS

- continue to monitor all colonies during mid-May through August to assess their status, document productivity, and determine reasons for failure

- conduct complete survey of known colonies and potential habitat during the target period established by the Gulf of Maine Tern Working Group to correlate data with Maine and Massachusetts

- maintain contact with regional efforts, through working groups or committees, to facilitate information exchange regarding concerns and strategies

- contact landowners of nesting areas to advise of nesting activity and request permission to land on property; encourage posting where already established and request permission to continue and/or initiate poting at appropriate sites.

- pursue reintroduction project at the Isles of Shoals, including finalizing logistics for gull control and subsequent tern relocation

- explore options for improving the nesting substrate in the Hampton marshes

- begin a more thorough natural resource inventory of the Hampton estuary

- continue feeding and foraging studies to determine the consistency of observed patterns

OSPREYS

INTRODUCTION

During most of this century, the only known nesting osprey populations in New Hampshire occurred north of the White Mountains, primarily in the Androscoggin River drainage.

In the spring of 1989, an osprey pair enlarged a great blue heron nest in an abandoned rookery in a 7-8 acre beaver pond in Durham within 2 miles of Great Bay. As is often the case with first year pairs, the nest was unsuccessful. The pair remained in the vicinity throughout the breeding season, and a third adult also was present in the area. Biologists installed a predator guard on the nest tree during the winter to prevent mammalian predation of future eggs and young.

During the 1990 season the pair returned to the same nest tree and fledged three young. This marked the first time in the present century that a successful breeding by ospreys was documented in New Hampshire's coastal region. Observations of additional adult Ospreys in 1990 indicated the possibility of an undetected nest or a newly formed pair.

The goals of this project were to survey potential nesting habitat in the coastal region for additional nests, to determine breeding success and management needs of nesting pairs and to identify foraging areas.

STUDY AREA

The pioneering osprey nest is situated in Durham, near the west shore of Great Bay, 0.7 miles southwest of the Bay Road bridge over Crommet Creek and 0.7 miles north-northwest of the intersection of Bay and Bay View roads. The nest is in a flooded beaver pond of approximately 10 acres which is one of a series of wetlands that characterize the area (Figure 17).

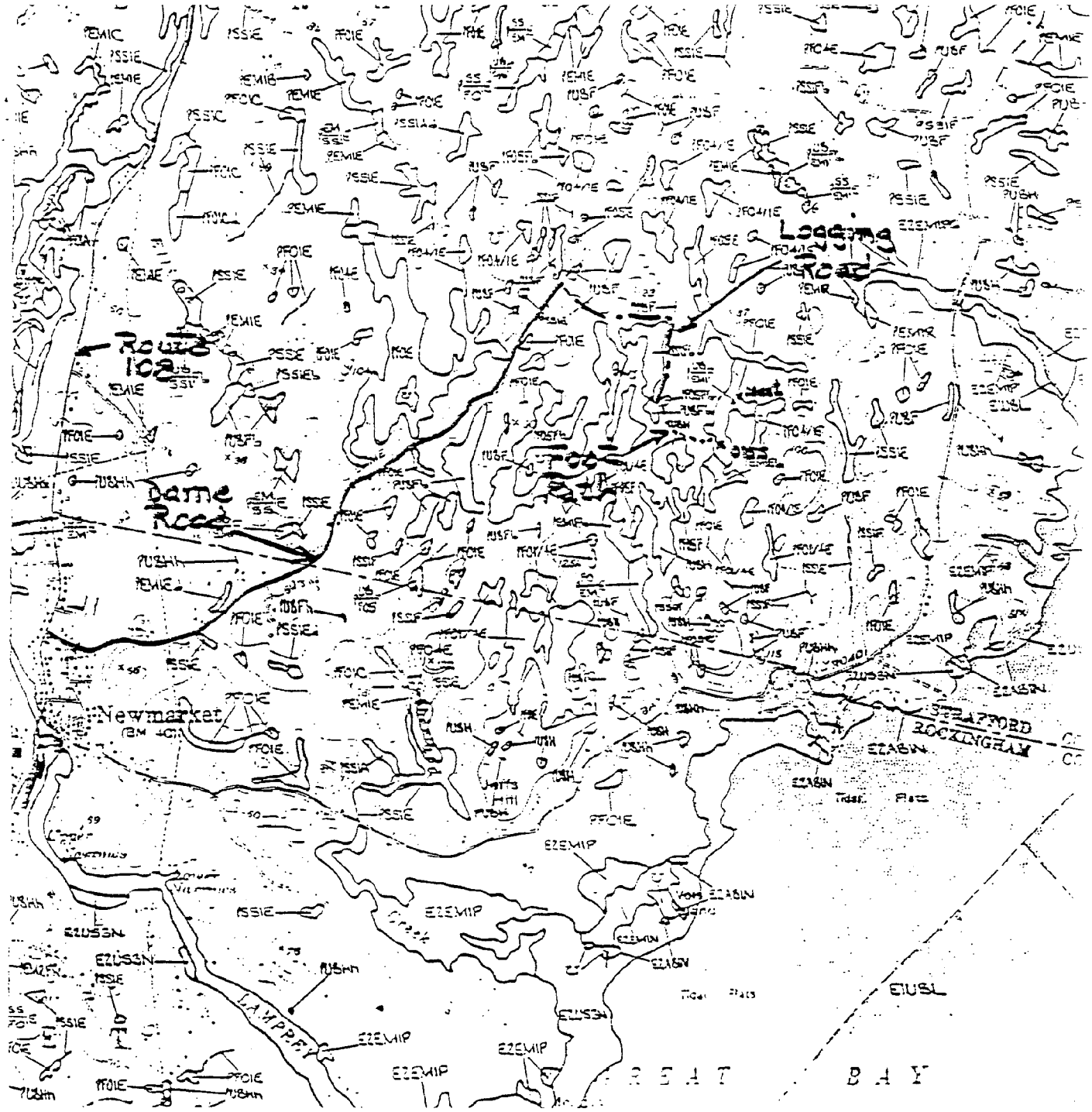

Figure 17. Osprey Study Area Location, 1991

METHODS

Project personnel observed the Durham nest site twice weekly between 29 March and 2 September. Field data forms for nest activity and feeding habits included date, time, weather and identity of birds present. Documented observations included osprey presence, courtship displays and behavior, prey deliveries and transfers, and any additional osprey activity in the area. After the chicks hatched, data included: number of chicks, development, dates of fledging and the initiation of hunting by young.

Biologists surveyed potential foraging habitat by observing from selected fixed point locations in one to four-hour time periods. In addition, a coordinated osprey foraging survey took place on 27 July. Several survey techniques were employed. Fixed point surveys covered the Durham nest site, Adam's Point north and south, Moody Point, Depot Road, Colony Cove, the Bellamy River and Fox Point. A pair of observers took a canoe up the eastern side of the bay along the Pease Air Force Base shoreline and used Nanny Island as an additional fixed point location. A driving route circled the perimeter of Great and Little bays (Figure 18). Data recorded included date, time, weather, raptor presence, location and activity observed.

Project personnel conducted an aerial survey of potential osprey nesting habitat in the coastal region was conducted on 22 June. The survey route included wetland areas along Interstate 95 in Portsmouth, Greenland, Hampton and Seabrook; drainages and reservoirs along the Lamprey, Oyster, Bellamy and Squamscott rivers; and a sweep around the Bellamy Reservoir in Dover. Reduced altitude and space restrictions due to the closure of Pease Air Force Base allowed good access to the wetlands around Great Bay. This area continues to have excellent potential for new nest sites (Figure 19).

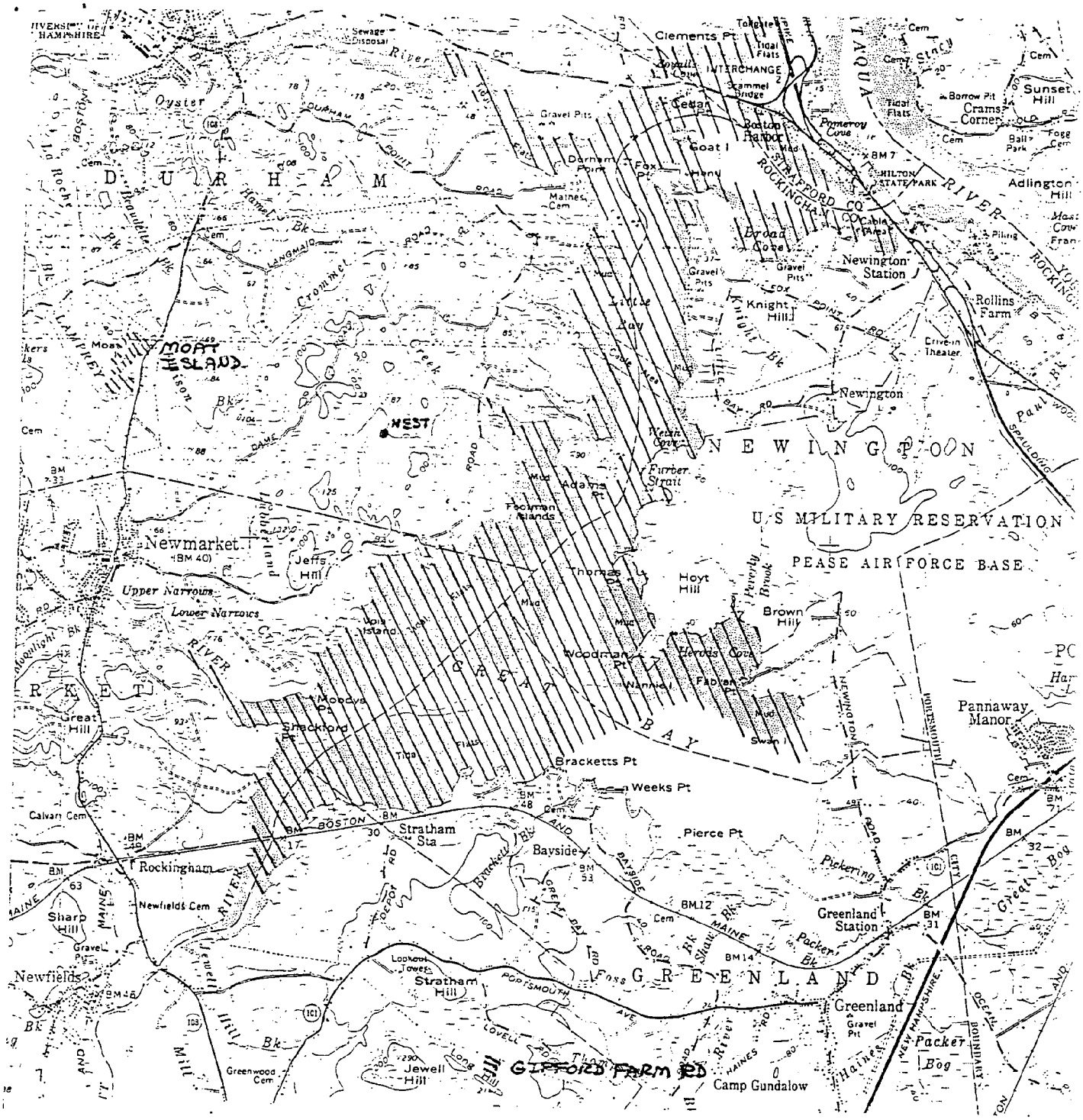

Figure 18. Coordinated Osprey Foraging Survey, 1991

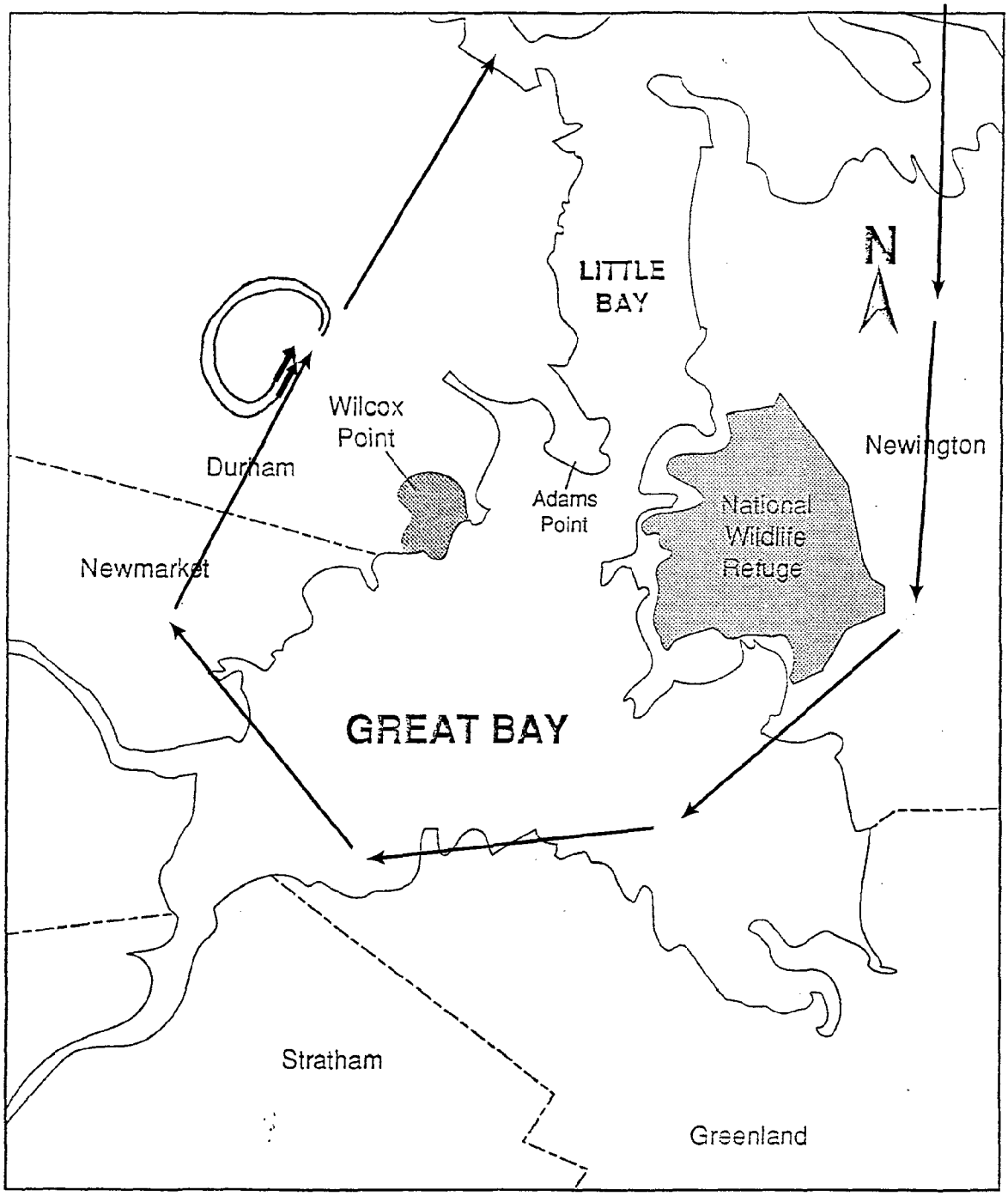

Figure 19. Route of Aerial Survey for Osprey Nests, 1991

RESULTS

NEST OBSERVATIONS

The first sighting of an osprey at the nest site occurred on 29 March, and both adults were present by 3 April. Courtship activity was first observed on 3 April and incubation began on 22 April. Hatch was documented on 30 May; a chick was visible in the nest on 7 June and all three young could be seen by 11 June. The first two chicks fledged by 21 July, 52 days after hatch. By 27 July all three chicks were flying (Table 4).

Additional ospreys visited the nest area on 13 of 48 observation periods (27%) between 15 April and 28 August. The presence of an additional osprey elicited protective behavior in both the male and female of the breeding pair, who flew to the nest and vocalized loudly. The male subsequently followed the visiting osprey out of the area and performed a territorial flight display over the pond. The presence of other raptors in the area, which were especially numerous in the spring, generally brought little reponse. One exception to this lack of response was the presence of two Turkey Vultures (Cathartes aura) in the vicinity of the nest tree on 30 May. This date marked the hatch of the first chick, and the adult ospreys engaged in distress vocalizations during the vultures' presence.

On 19 August, the winds of Hurricane Bob blew off the top 90% of the nest, but left the tree and the base of the nest intact. Both adults and their young continued to use the remaining portion of the nest for both perching and feeding through the early part of September.

FORAGING OBSERVATIONS

Osprey were observed foraging during 25 of 40 separate observation periods. Moody Point, just north of the mouth of the Lamprey River on Great Bay, was the site of 61% of the foraging observations. The Newington shoreline accounted for 17% of the sightings (Table 5).

Table 4: Nest chronology in 1991 as compared to 1990

EVENT	1991 DATE	1990 DATE	1991 DAYS	1990 DAYS
Male first at nest	3/29	4/03		
Courtship begins	4/03	4/10		
Onset of incubation	4/22	5/02		
Chicks hatch	5/30	6/10	38	39
Female foraging	7/04	7/25		
Chicks fledge	7/21	8/05	52	56
End of monitoring	9/02	8/26		

Table 5. Osprey foraging activity, 1991

DATE	LOCATION	FLIGHT
4/10	Moody Point	over bay
4/11	Stratham	stocked fire pond
4/16	Moat Island	perched & ate fish
4/17	Moody Point	over bay
4/19	Moody Point	mouth of Lamprey R.
	Moat Island	flew north
5/07	Moat Island	perched with fish
5/14	south end	drifted west
5/29	Oyster R. mouth	flew south
6/08	Moody Point	over pond
6/14	Fox Point	flew north
6/16	Moody Point	flew up Lamprey R.
7/01	Lubberland Creek	
7/06	Moody Point	
	14:51	flew north toward nest
	16:01	
	16:17	
	17:11	flew north toward nest
	17:15	ate at Lamprey R. snag

7/07	Moody Point	
	17:05	flew up Squamscott R.
	17:32	flew up Lamprey R.
	17:40	flew up Lamprey R.
	18:03	flew north toward nest
7/26	Newington	flew SW across bay
7/29	Moody Point	two osprey over bay
7/30	Moody Point	
	07:50	at mouth of Lamprey R.
	16:20	flew north toward nest
8/06	Moody Point	
	18:46	
	19:08	flew NE
8/07	Moody Point	
	17:46	
	17:47	ate on mud mound
8/14	Moody Point	two osprey over bay
8/16	Moody Point	
	14:04	flew SW, migrating?
	14:04	territorial flight
	16:25	flew north toward nest
	16:29	flew north toward nest
8/21	Moody Point	
	18:10	flew north toward nest
9/02	Back Channel	
	12:30	adult, migrating?
	12:45	immature, soared E

The coordinated osprey foraging survey on 27 July located two adults. One adult was observed as it flew across Adam's Pt. and headed east over the Newington shoreline. The second bird was seen along the Newmarket shore between Wilcox Pt. and Vol's Island. Observations at the nest site confirmed that both adults were out of this area during the time of the sightings at Great Bay (Figure 20).

All observed prey delivered to the nest appeared to be fish 6-14 inches long.

AERIAL SURVEY

The aerial survey did not reveal any new nest sites.

DISCUSSION

The breeding season progressed normally at the Durham nest site. The successful fledging of three young in both 1990 and 1991 indicates an adequate food supply and good parenting abilities. The hurricane loss of 90% of the nest cup will enable us to examine nest site tenacity in 1992. Ospreys are known to be faithful to their chosen nest sites.

The continued observations of additional adult ospreys may indicate an undetected nest or the potential of an additional nonbreeding pair. The success of the Durham breeding pair may well forecast the addition of other pairs in this region. Recruitment of the young from this nest is a possibility in 1992 as osprey are known to migrate back to the breeding grounds in their second year; and, if conditions are suitable to breed in their third summer.

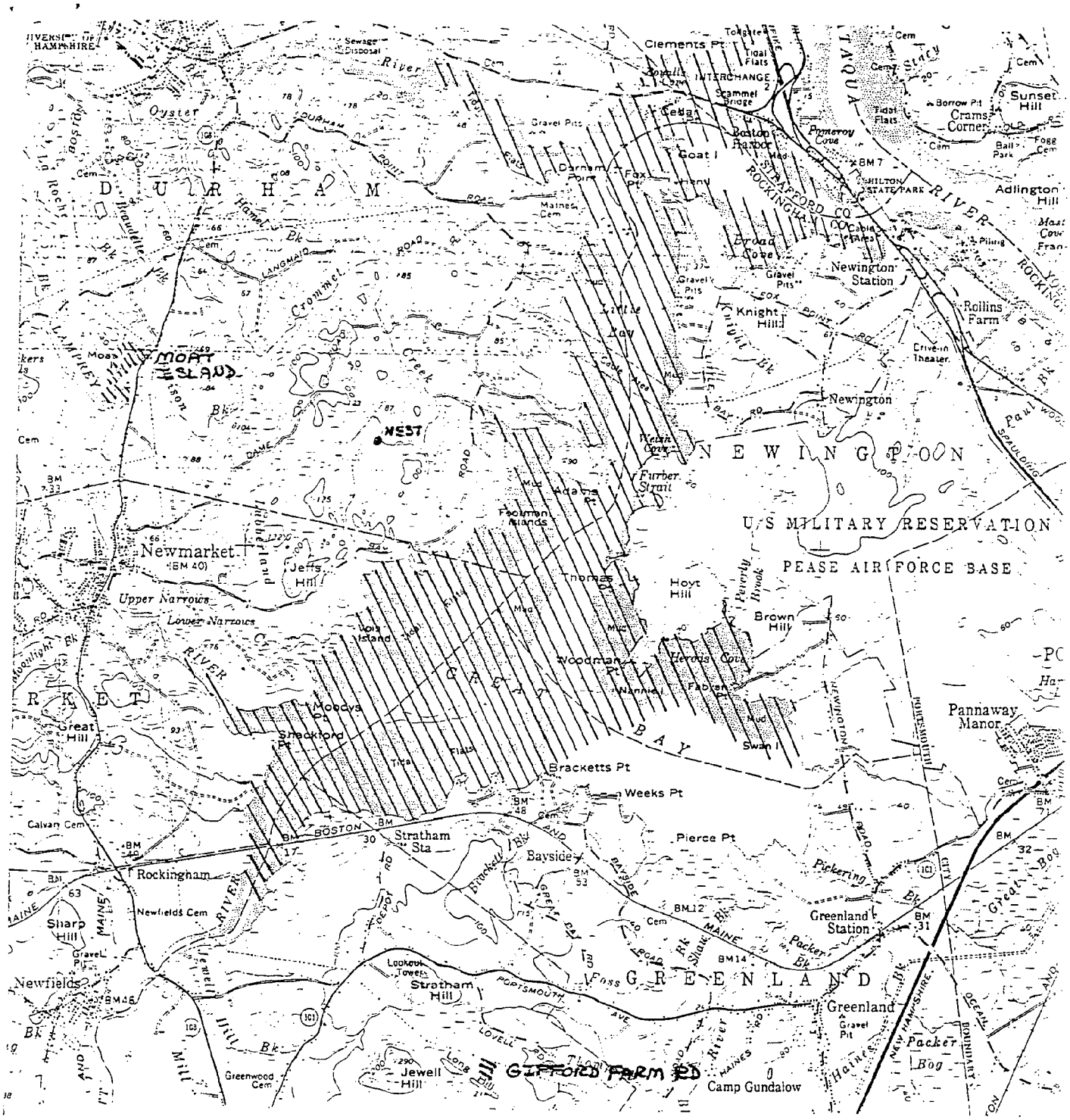

Figure 20. Osprey Foraging Locations, 1991

This year's foraging observations helped to build on preliminary data from 1990, but we still need to strengthen our knowledge of foraging habitat use patterns. The data from both 1990 and 1991 suggest that the mouth of the Lamprey River provides important foraging habitat for this breeding pair. Further coordinated simultaneous observations over several days are needed to identify consistent patterns. Coordination of osprey foraging observations with New Hampshire Fish and Game's fishing surveys may be possible.

Detection of osprey nests in remote sections of the coastal region is a continued challenge. The aerial survey, especially in light of reduced flight restrictions, remains the most effective means of searching a large area for new nests. The development and distribution of public information on osprey in this region could help locate activity.

Continued productivity of the currently known breeding pair and possible further recruitment from an unknown source population will likely produce new nests in the coming years. Identification and protection of nest sites, preferred perch trees and foraging habitat is critical to the successful expansion of this fledgling osprey population.

Monitoring and management recommendations

- Conduct annual aerial surveys of the Great Bay estuary system and other coastal area wetlands to detect new nests

- Monitor annually all known coastal osprey nests to document breeding success of this new population

- Install predator guards on all newly discovered nests during the first winter after discovery

- Negotiate for protection of nest sites and adjacent perch trees

- Conduct coordinated surveys of potential foraging areas

- Negotiate for protection of important perch trees in area of foraging activity

- Develop and distribute public information on coastal ospreys

NORTHERN HARRIER

INTRODUCTION

Documented nest sites of northern harriers (Circus cyaneus) in New Hampshire have occurred primarily north of the White Mountains during the past decade. Earlier in the century, harriers were uncommon summer residents in the vicinity of Durham (Dearborn, 1903). Reported sightings since 1963 suggest possible nesting in the vicinity of Great Bay and Hampton Harbor.

The goals of this project were to confirm any breeding activity in the coastal region, document any occupied breeding habitat and to conduct a survey of the marsh/upland interface in the Hampton Harbor estuary to identify potential nesting areas.

METHODS

Project staff and volunteers conducted a field survey for northern harrier activity on 8 August, when young of the year should be in the late nestling stage or recently fledged. The survey effort focused on areas which provide suitable nesting habitat most likely to be occupied and/or from which harrier activity has been reported in recent years.

Several survey techniques were employed. Fixed point surveys covered the Hampton Harbor saltmarshes from Depot Road in Hampton Falls and Walton Road in Seabrook, the area to the west of Rt. 1A from Odiorne Pt. in Rye, and the Greenland - Newmarket section of Great Bay from Moody Point in Newmarket; a walking route north along the railroad tracks from Depot Road expanded the coverage of the Hampton estuary; a canoe route covered the marshes along Tide Mill Creek and Eel Ditch in Hampton and a driving route covered fields along the southern and eastern shores of Great Bay in Greenland, Stratham and Newmarket (Figure 21). Data recorded included date, time, weather and raptor presence, location and activity observed.

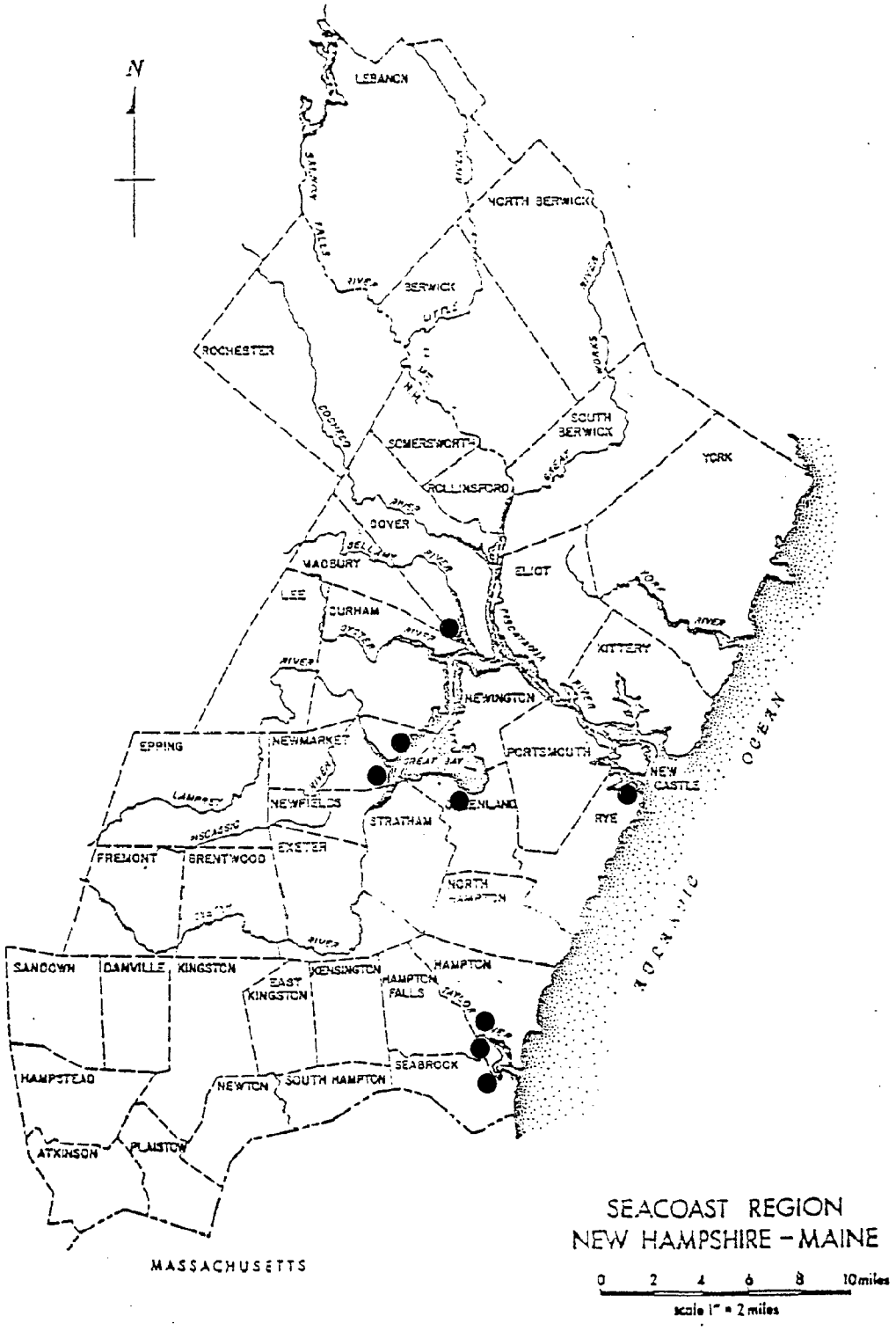

Figure 21. Northern Harrier Survey Locations, 1991

Project personnel also inspected 24" x 24" black and white aerial photographs of the Hampton Harbor estuary, taken in 1981 and available at the U.S. Agricultural Stabilization and Conservation Service office in Epping, to locate potential northern harrier nesting habitat. Biologists conducted field inspections of the undeveloped saltmarsh edge from Walton Landing to Rt. 286; from Depot Road to Farm Brook in Seabrook; from Depot Ave. to Browns River in Hampton Falls and of several islands in the saltmarsh to search for areas of potential nesting habitat too small to detect from aerial photos.

RESULTS

During the coordinated harrier survey on 8 August, biologists observed a female harrier soaring above the salt marshes at Odiorne Point. Independent observers documented female harriers over the tern colony at Seabrook on 3 and 7 June. A female harrier also was observed at the Hampton tern colony on 11 June. Male and female harriers were seen off Moody Point on Great Bay in April and were most likely migrants. Observations provided no clues to potential nest locations.

The aerial photograph inspection identified 10 areas of potential harrier nesting habitat. These include two areas in the vicinity of Meadow Pond, two patches of old field habitat north of the Drakes River, a pipeline corridor extending northeasterly from the sewage treatment plant in Hampton, 4 patches of shrubby vegetation along a powerline in the vicinity of Hampton Landing in Hampton, and a large shrubby upland area just north of the Massachusetts line and just west of the edge of the marsh. The field inspection yielded small patches of potential nesting habitat along the edge of the marsh which are unlikely to be large enough to attract a harrier, and a powerline corridor through an island northeast of Beckman's Island in Seabrook.

DISCUSSION

The results are inconclusive as to whether harriers nested somewhere in the Hampton marsh area during the 1991 breeding season. Observations of female harriers along the marshes in the early part of June points to the possibility that breeding activity did occur. Unlike 1990, however, no juveniles were sighted.

Preliminary investigations indicate that suitable harrier nesting habitat does occur in the immediate vicinity of the Hampton/Seabrook marshes. Areas identified from the aerial photographs need to be field checked for current suitability, since the photographs were taken 10 years ago. Human activity levels and predation vulnerability at these sites also needs to be assessed. The powerline corridor on the island in Seabrook may provide the most attractive nesting habitat, given its immediate access to extensive foraging habitat and isolation from human activity.

The nature of the salt marsh precludes significant human recreation use, thus minimizing human disturbance within the marsh itself. The marsh/upland interface, however, is highly vulnerable to disturbance and development. Encroachment of development and increased predation pressure from dogs and cats along the marsh edge provide increasing threats to harriers and other ground nesting birds. Remaining natural habitat along this interface needs protection. Protection of the upland buffers wherever opportunities exist around the edge of the marsh will be critical to the future of harrier breeding success in the Hampton and Rye marshes.

Both foraging and nesting habitat are less extensive and more fragmented in the vicinity of Great Bay. However, potential breeding areas do still exist and deserve continued monitoring.

MONITORING AND MANAGEMENT RECOMMENDATIONS

- conduct surveys in early May to detect courtship and pre-nesting activity

- conduct a coordinated survey during the first two weeks of August to detect immature harriers

- conduct an aerial photograph inspection and field survey of the Rye saltmarshes to identify potential nesting areas.

- field check sites identified in aerial photograph inspection of Rye and Hampton marshes to assess current habitat suitability

- conduct breeding season observations to determine use of the Hampton saltmarsh island by nesting harriers. If harrier use is detected, contact utility to discuss corridor maintenance practices and recommend habitat management strategies to avoid adverse impacts to nesting harriers

- negotiate protection of any documented nesting areas

PIPING PLOVER

INTRODUCTION

The piping plover is a federally listed threatened species along the Atlantic Coast and is listed as endangered by the N.H. Fish & Game Department (NHFG). Shoreline development and heavy recreational use of sandy beaches have contributed to the decline of this species from Maine to North Carolina.

The piping plover nested historically on sandy beaches along the New Hampshire coast. The only remaining available habitat consists of a sand spit on the southeast shore of Hampton Harbor, adjacent to Route 1A just south of the Hampton Harbor bridge. Plovers nested consistently at this site from 1951 or before through the early 1970's. A pair was present in the spring of 1984, and observed behavior indicated a nesting attempt which presumably failed during an extremely high tide. An annual monitoring effort has been underway since 1987. Observers documented a single bird present on 16 and 20 May 1988, but found no signs of a nesting attempt. A single bird was foraging at the site on 23 July 1989, but was presumably an early migrant from further north.

The focus of this project was to monitor the existing breeding habitat for piping plover activity and implement management techniques to promote nesting.

STUDY AREA AND METHODS

The remaining breeding habitat is state-owned and managed by NHFG as the Hampton Harbor Wildlife Management Area (Figure 22). A guard rail installed in 1987 prevents vehicular entry, but the area is easily accessible on foot and is often used for swimming, sunbathing, windsurfer access and shoreline fishing during the summer months. The site includes sandy beach, an overwash area, and a small area of dunes which support beach grass (*Ammophila breviligulata*), dusty miller (*Artemisia stelleriana*), and other dune vegetation (Figure 23).

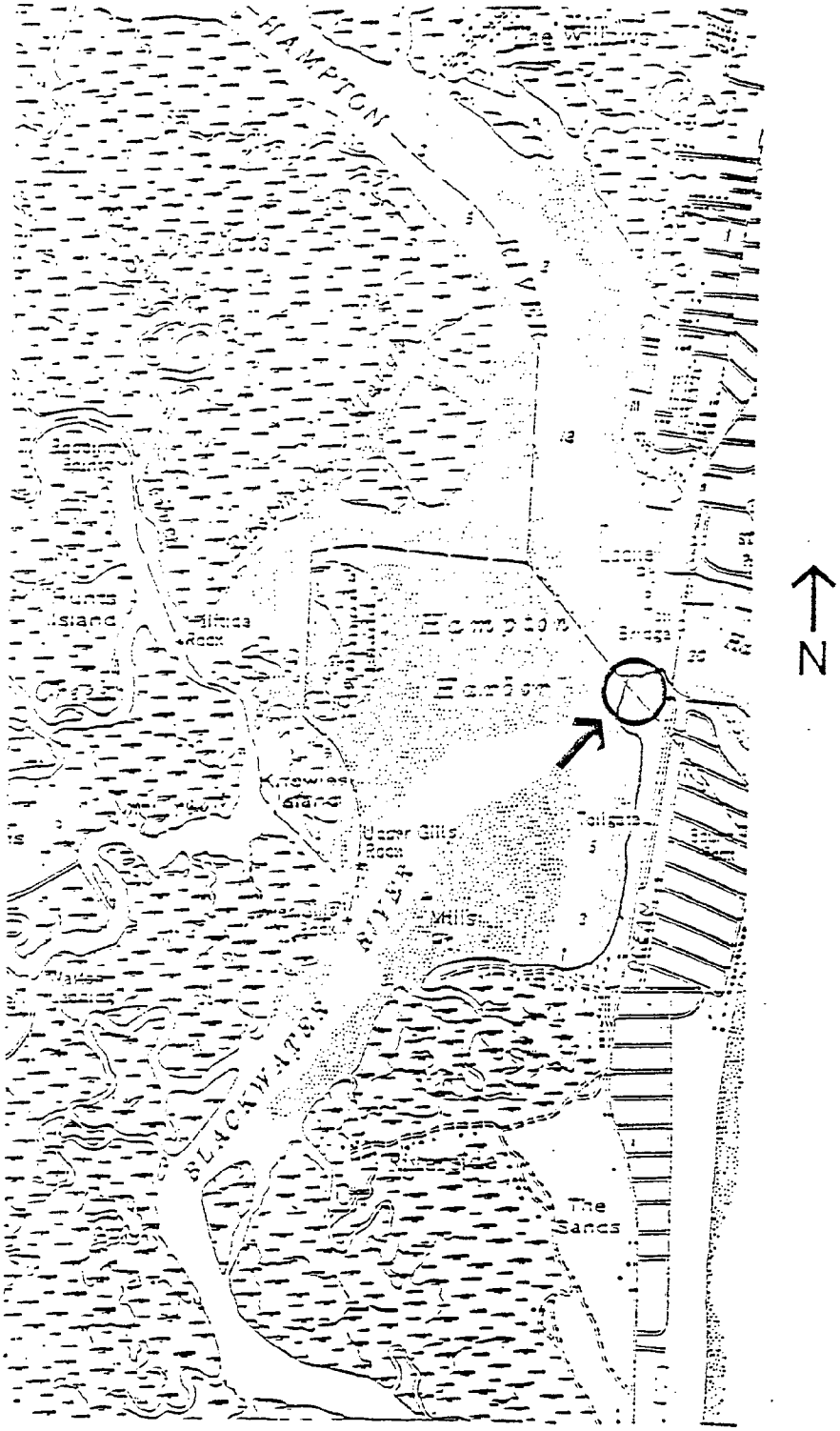

Figure 22. Location of Potential Piping Plover Habitat, 1989-91

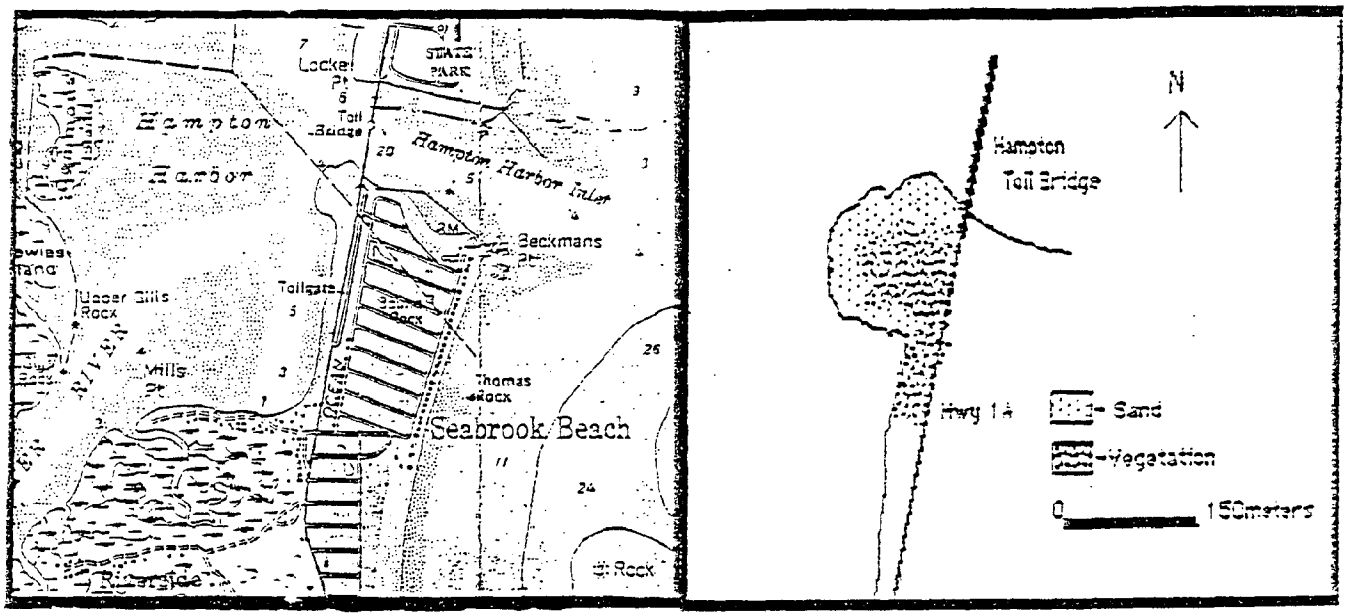

Figure 23. Potential Piping Plover Habitat, Hampton Harbor, 1989-91

Project personnel surveyed the area on 10 days between 3 April and 15 June, and volunteers conducted additional surveys. Each visit included a walking survey of the beach and dunes and the completion of a site summary form including date, time, weather and species observed.

RESULTS

No piping plovers were observed during any site visits. No additional sightings were reported from other sources.

DISCUSSION

The 1991 breeding season brought continued improvement in piping plover productivity at sites along the Atlantic coast. The closure of the Parker River Wildlife Refuge piping plover habitat during the breeding season, along with other intensive management efforts, succeeded in increasing productivity in neighboring Massachusetts. Piping plovers experienced increased nesting success in Maine as well. As the regional population continues to grow with the support of intensive protection and management efforts, colonizing pairs can be expected to reoccupy former breeding habitat that remains suitable for nesting.

Although New Hampshire's breeding habitat experiences moderate recreational use in the warmer months, human activity is low in March and April and should not present a deterrent to prospecting plovers when they first return to set up territories. Visits by migrants in 1988 and 1989 indicate that the area may still be attractive to plovers. In addition, successful nesting of killdeer at this site in 1991 may speak to the suitability of the habitat.

The Hampton Harbor Wildlife Management Area continues to provide viable piping plover nesting habitat and has high potential for eventual reoccupation. Although intensive management will be necessary to support successful nesting here, as at most breeding sites, proven techniques are available to promote nesting success.

Monitoring and management recommendations

- Continue to monitor the site annually during April and May
- When the site becomes occupied
    - close area to public access until chicks fledge
    - protect nest site(s) with predator exclosure(s)
    - conduct public relations campaign, including local presentations and media coverage
    - provide site warden for at least the first several nesting seasons
- Investigate the feasibility of creating additional nesting habitat with dredge spoils from periodic dredging projects in Hampton Harbor

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