NH Work Task 91-7.7

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
2234 SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

THREATENED AND ENDANGERED WILDLIFE MANAGEMENT IN NEW HAMPSHIRE'S COASTAL REGION

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FINAL REPORT

Submitted to the N.H. Office of State Planning

March 31, 1992
by the
Audubon Society of New Hampshire

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AUTHENTICATED U.S. GOVERNMENT INFORMATION GPO

Attachment #6

NH Work Task 91-7.7

WHAT YOU CAN DO TO HELP

- Contribute to our understanding of the distribution of terns within New Hampshire by reporting any sightings of Common, Arctic or Roseate Terns to the Audubon Society of New Hampshire or the NH Nongame and Endangered Wildlife Program, N.H. Fish & Game Department.

- Shooting or harassing threatened or endangered wildlife species is against the law. Report any illegal activities to the N.H. Fish & Game Department or your local conservation officer.

- Urge state and federal legislators to protect sensitive coastal areas from development, pollution and exploitation.

- Stay away from areas where terns are known or thought to be nesting and keep pets away from these place, to avoid disturbing the birds or leaving scent trails for predators.

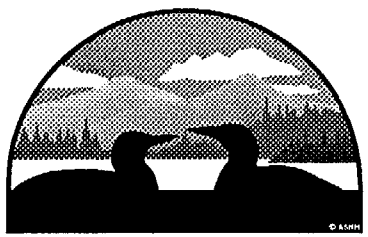
- Discourage gulls in beach areas by properly disposing of garbage and trash. Never dump wastes of any kind into the ocean.

- Learn more about the habits and needs of native wildlife so that you can help to educate others.

- Volunteer to assist with tern protection at a nesting area near your home.

- Support organizations working to protect endangered species and other nongame wildlife.

The Audubon Society of New Hampshire
is an independent nonprofit organization with programs in wildlife conservation, environmental affairs, land protection, and environmental education.

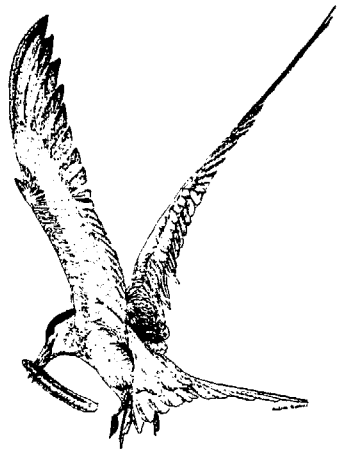


Further information about ASNH can be requested from:

Audubon Society of New Hampshire
PO Box 528-B
Concord, NH 03302-0516
603-224-9909

* This report was funded in part by a grant from the New Hampshire Coastal Program, as authorized by National Oceanic and Atmospheric Administration, (NOAA) Award Number NA 170Z0311-01.

TERNS

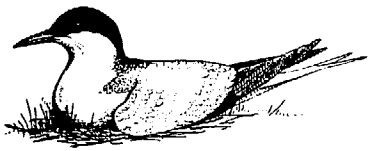


WHAT ARE TERNS?

Among the most elegant of seabirds, terns are smaller and more slender in build than the closely related gulls and are distinguished by long, narrow, pointed wings and deeply forked tails. They all have black caps during the breeding season, and long, tapering bills. The varying length of the tails and the colors of their bills can be used to tell the species apart.

Terns flit gracefully over the water, bills pointed downward, their long wings lifting them easily and swiftly 30-40 feet. When they spy food below, they plunge headfirst into the water, often disappearing completely under the surface. These birds sometimes gather in huge numbers over a school of fish, swirling in the air, screaming and diving again and again. Fisherman can often locate schools of fish by observing the tern's activities.

Attachment #5



LIFE HISTORY

Terns arrive in New England during the last half of May, and usually breed in colonies on barrier beaches, offshore islands and in the salt marshes. After a brief courtship, which may include ritualized flight displays and intricate caressing and preening of each other's feathers, mating ensues. Common and Arctic Terns build vulnerable nests on open shores, scooping out shallow scrapes in the sand, placing a few weeds on bare rock or nestling atop the salt marsh grasses. Roseate terns conceal their simple nests among tall grasses or vegetation or in rock crevices.

Between late May and late July, terns lay 2-3 oval eggs with various patterns of brown on a buff background; if one set of eggs is destroyed, terns may lay several times. The chicks hatch after about 21 days of incubation and within a few days seek shelter in the grasses or other concealing vegetation. Although the young are well developed when they hatch, they will stay near the nest, cared for by both adults and fed on small fish caught in the coastal shallows. Young terns are capable of short flights three to four weeks after hatching and tend to gather in small groups by the water's edge, waiting to be fed.

Terns can be aggressive when they are driving potential predators away from the nesting colony, especially during the height of their breeding season when they are defending their eggs and young. An individual who wanders too close to an active breeding colony is likely to be dive bombed and "white-washed" by crying birds. Keep in mind that you have wandered into the birds' nursery, and make a careful retreat.

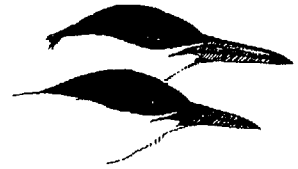
By late summer, large groups of terns begin to congregate on outer beaches and islands. Most depart for their southern wintering grounds in Central and South America in September. Some Arctic Terns make incredible oceanic journeys 25,000 miles, roundtrip between the Arctic and Antarctic via the coast of Africa and South America.

HISTORICAL REVIEW

The numbers of terns breeding along the New Hampshire coast, as along the entire Atlantic coast, has fluctuated greatly in the last century. Once among the most abundant nesting birds on the Atlantic and Gulf coasts, they have since been plagued by a variety of threats. Tremendous numbers of terns were killed in the late 1800's for the millinery trade. Although protective laws were eventually passed and terns increased temporarily in the early 1900's, their populations have declined drastically since the 1950's.

Gull populations have increased dramatically in recent years due to the increase in the open dumping of garbage and an enormous growth in the fishing industry. These larger, more aggressive birds compete with terns for nesting sites and prey directly on tern eggs and chicks. Terns are subsequently forced into more marginal areas for nesting and become more vulnerable to predators and human disturbance.

Terns have been greatly affected by coastal development and pollution. Shorefront development has reduced available habitat and caused greater disturbance by house pets, off-road vehicles and humans. Human habitation has disturbed the balance of predators as well, often exposing tern colonies to increased numbers of raccoons, skunks and rats.



CURRENT STATUS OF NEW HAMPSHIRE TERNS

New Hampshire currently supports only small numbers of the Common Tern. This tern population includes scattered pairs nesting on rocky islands in the coastal bays and colonies in the Hampton Harbor Estuary.

Field studies conducted annually since 1981 have documented serious instability in coastal colonies, where marginal nesting habitat and heavy predation have significantly hampered productivity.

NH Work Task 91-4.7

WHAT YOU CAN DO TO HELP

- Contribute to our understanding of the Osprey's distribution within New Hampshire by reporting any sightings to the Audubon Society of New Hampshire or the NH Nongame and Endangered Wildlife Program, N.H. Fish and Game Department.
- Shooting or harassing threatened or endangered wildlife species is against the law. Report any illegal activities to the N.H. Fish and Game Department or your local conservation officer.
- Learn more about the habits and needs of native wildlife so that you can help to educate others.
- Share your knowledge and concern about birds of prey to help dispel myths that lead others to harm them.
- Urge state and federal legislators to protect critical habitat for Ospreys and other wildlife.
- Support organizations working to protect endangered species and other non-game wildlife.

The Audubon Society of New Hampshire
is an independent nonprofit organization with active programs in land preservation, environmental education, legislative action, and non-game research and management.

Further information about ASNH can be requested from:

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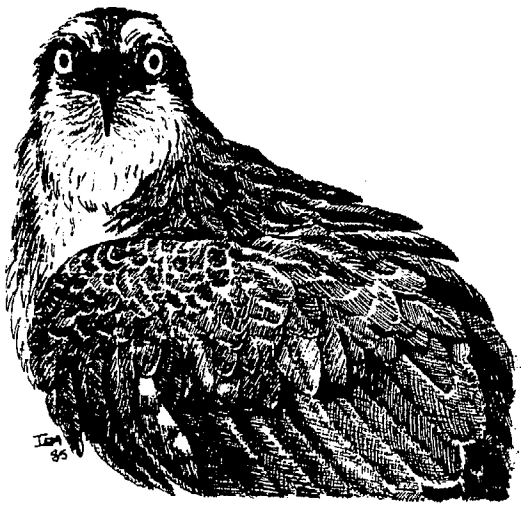
OSPREY



HOW CAN I IDENTIFY AN OSPREY?

The Osprey is a large, long-legged, fish-eating raptor. It is comparable in size with the all black Turkey Vulture and is larger than any other native hawk, standing almost two feet tall with a wingspan of up to six feet. Although often mistaken for the more massive Bald Eagle, it is considerably smaller. Seen in flight, the Osprey's prominent features are its white or slightly mottled underparts, dark brown back, the pronounced crook in its long wings highlighted by distinctive black wrist patches. Seen from closer proximity, the Osprey's bright yellow eye and broad, dark eyestripe help to distinguish it from other birds of prey.

Attachment #5

LIFE HISTORY

Ospreys arrive in New Hampshire during April, returning year after year to the same breeding grounds. An osprey nest is generally placed in the flattened top of a live or dead tree, but may also be placed atop man-made structures such as power transmission poles, waterfront pylons, channel markers and specially erected nesting platforms. The nest is up to five feet in diameter and is made with a large accumulation of various sized dead branches up to five feet long. Both sexes gather the nesting material, but the female does most of the nest arrangement. Nests are lined with sod, seaweed or marsh grass. Nests are often used in successive years and the annual increases in nesting materials, cause it to become very heavy and bulky.

Male and female Ospreys court each other with spectacular and vocal soaring, diving, and swooping. This display serves to favorably influence his mate and discourage potential rivals. The female lays from 2-4 blotched, oval eggs in two day intervals. Incubation by both the male and female continues for about 38 days. The chicks at hatch rely on the adults to feed them, but in 4-5 weeks they can eat , by themselves, the prey that both parents bring to the nest. Around 8 weeks, they are capable of flight and begin to follow the adults to their fishing grounds. After migrating south their first fall, young Ospreys spend the next year and a half on their winter grounds. They do not return to the breeding grounds until the spring of their second year.

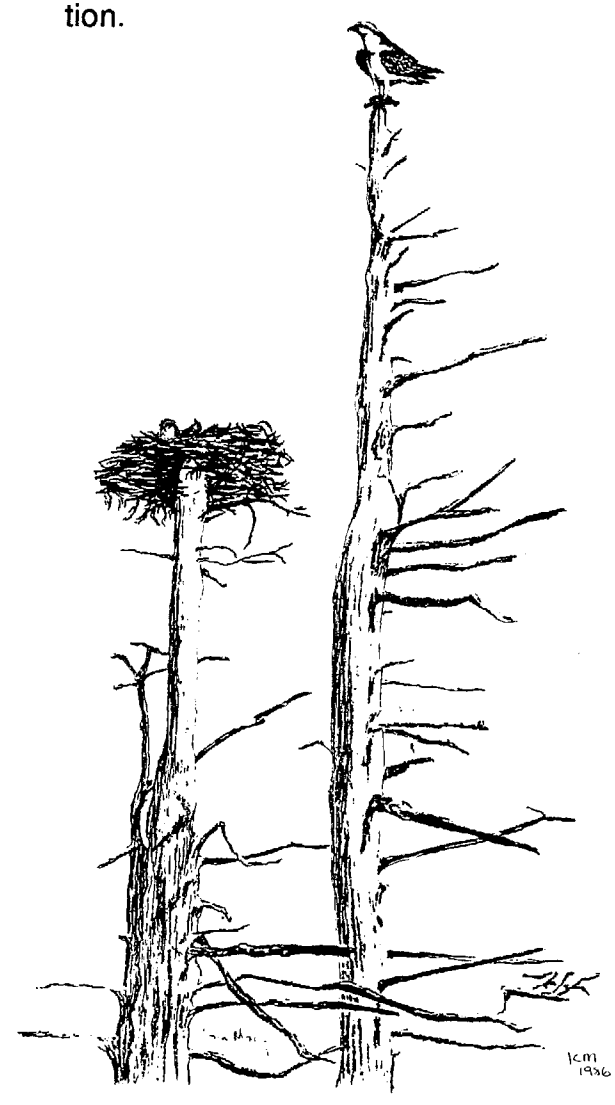
The osprey is a truly cosmopolitan bird. It is able to take advantage of water bodies suitable for its fishing way of life on every land mass on earth except New Zealand and Antarctica. Populations here in the northeast generally migrate to the warmer climates of Central and South America.

HISTORICAL REVIEW

In the two-decade period from 1950-70, the Osprey population was severely diminished, especially in the eastern United States. Ospreys initially declined because of pesticides such as DDT and other persistent chemicals in their food chain, which caused infertility and thinned egg shells. Since the banning of DDT in 1972, the Osprey has made a steady comeback although they may still be threatened by pesticide use in countries where Osprey winter as well as illegal shooting and the decline of fish populations in lakes affected by acid rain.

CURRENT STATUS OF NEW HAMPSHIRE'S OSPREYS

Since the early 1980's, Ospreys have maintained active nests in the Lake Umbagog region of northern New Hampshire. This population has experienced steady growth through the period, and now produces 15-22 young each year from an average of 17 nests. Since 1989, a pair of Osprey calls Great Bay their home. After an early nesting failure that year, they have successfully raised young in subsequent years. Each year brings more Osprey sightings and nesting attempts to the seacoast region. You can observe Osprey in southeastern New Hampshire from late March through mid-October. The Great Bay estuary system is a prime area. The marshes, harbors and beach areas along the seacoast can also be rewarding observation sites, especially during migration.



This report was prepared by:

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THREATENED AND ENDANGERED WILDLIFE MANAGEMENT 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 season at this time.

Active management and habitat protection of these four species will be critical to their future survival in New Hampshire. The information generated by this project can facilitate land use planning efforts to accomodate 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 1991 documented attempted nesting and the eventual abandonment of the Back Channel colony, poor reproductive success at the Hampton colony, improved reproduction at two small colonies on islands in Little Bay, and the abandonment of the Seabrook colony (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 and breeding status at existing colonies; surveys of potential nesting habitat; continuation of foraging studies; implementation of management techniques; and development of a visual presentation.

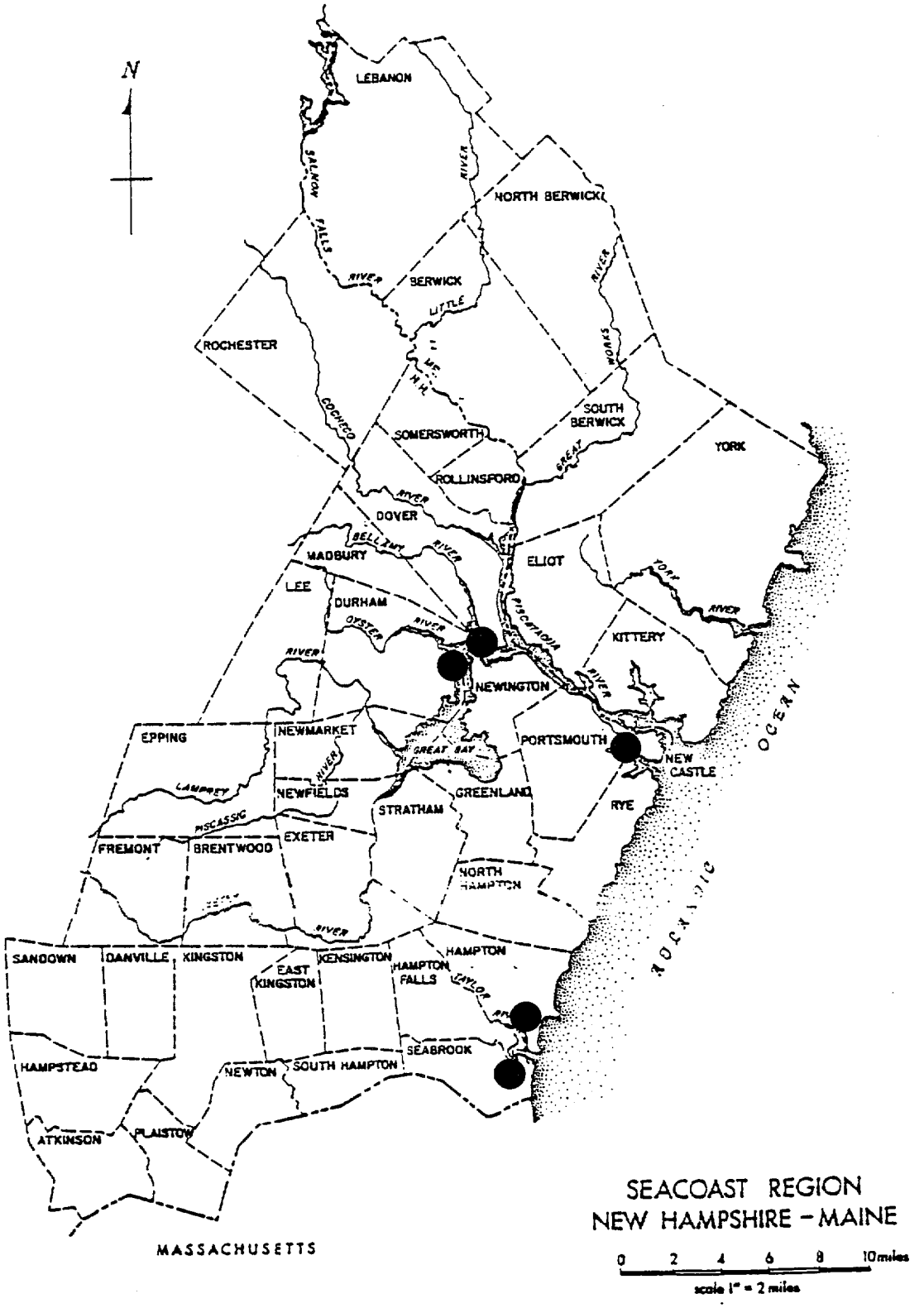

Figure 1. Location of Common Tern Colony Sites, 1989-92

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 2.5m. (8.0ft.) to 3.5m. (11.6 ft.) and low tides from -0.5m. (-1.5ft.) to 0.5m. (1.6 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 had previously nested in an area roughly 50 x 100 m. only 4-5 m. from the shoreline. 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. The 1992 field season did not document any attempted nesting at this site.

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.

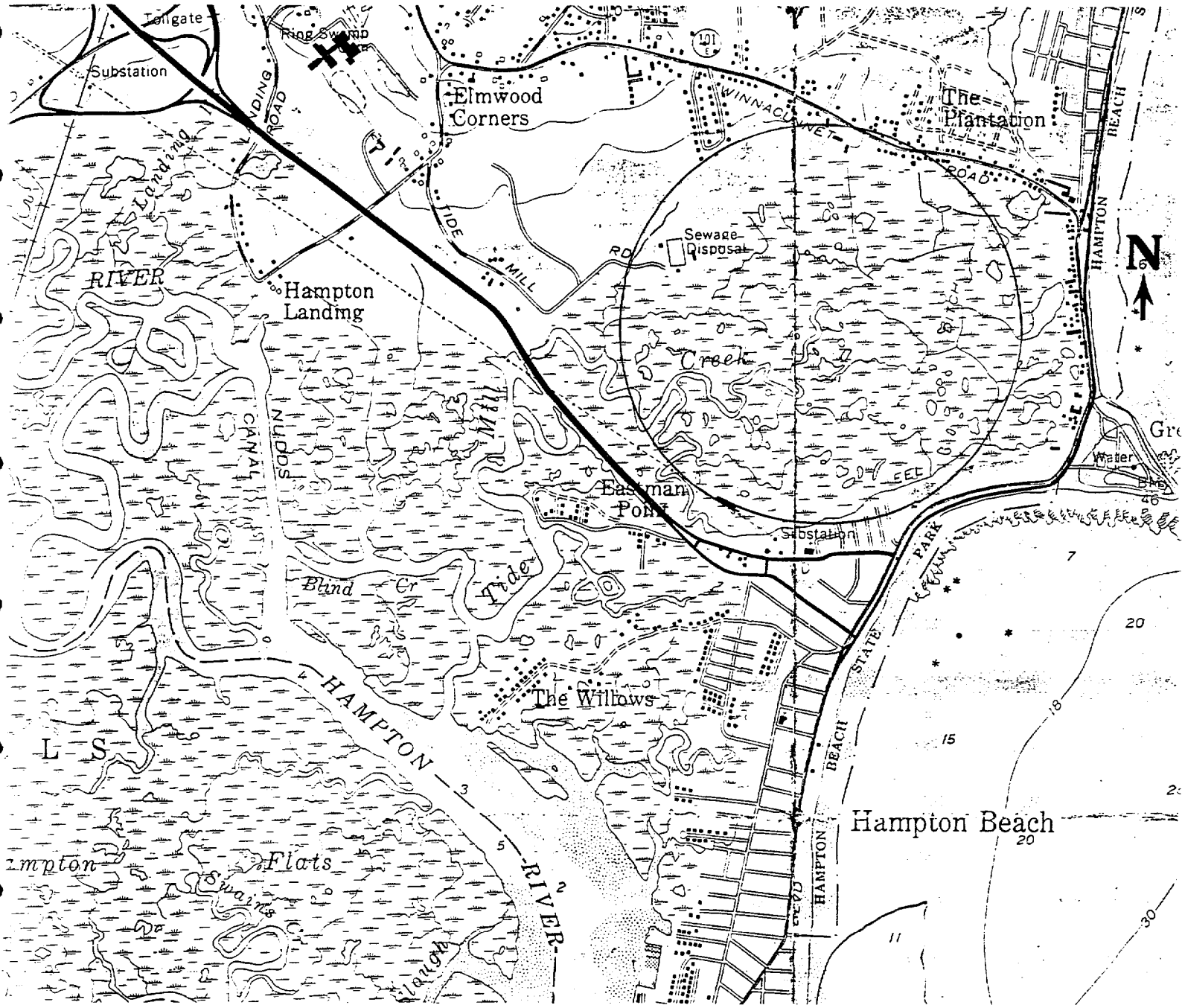

Figure 2. Location of Hampton Marsh Common Tern Colony, 1992

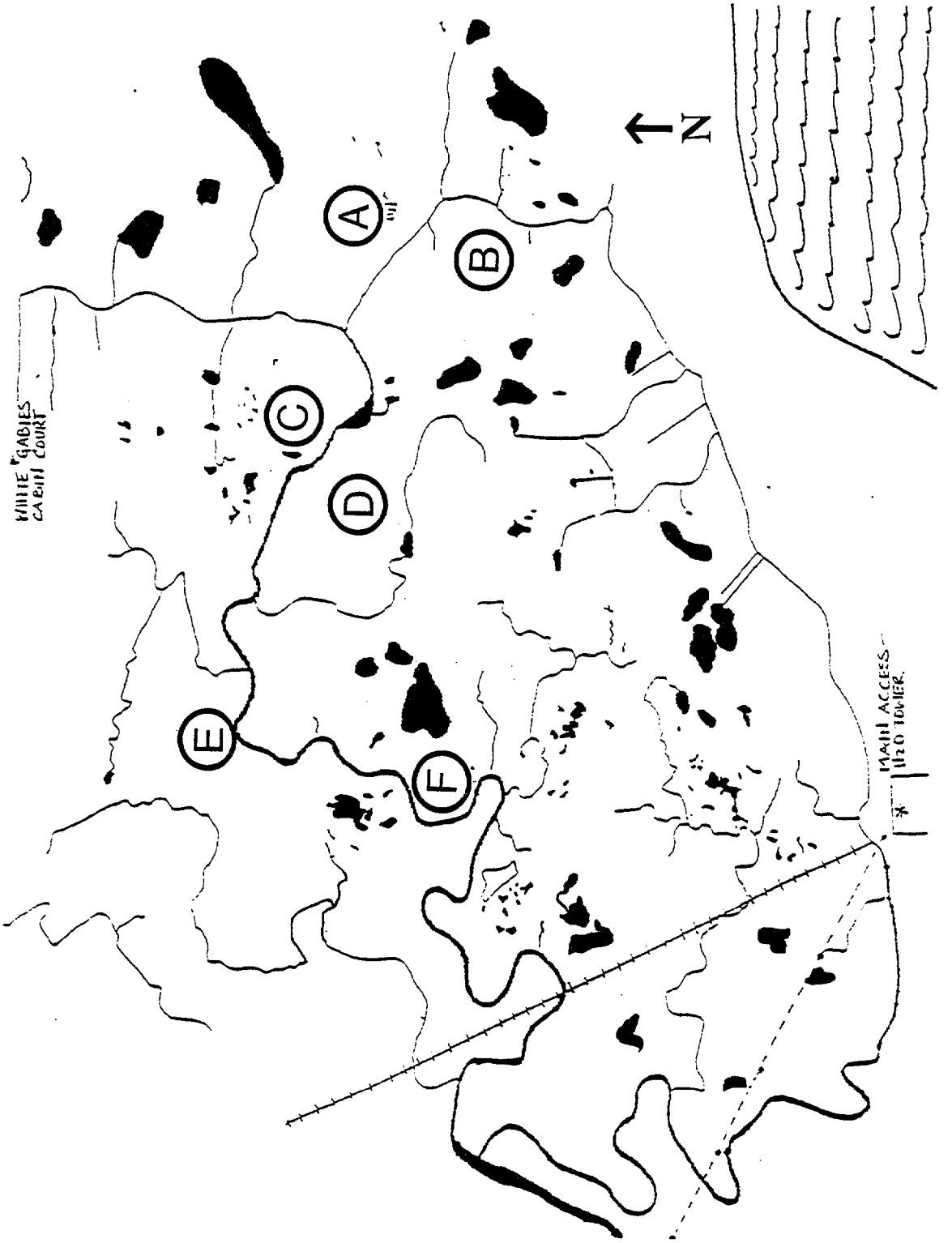

Figure 3. Nesting Locations of Hampton Marsh Tern Colony, 1992

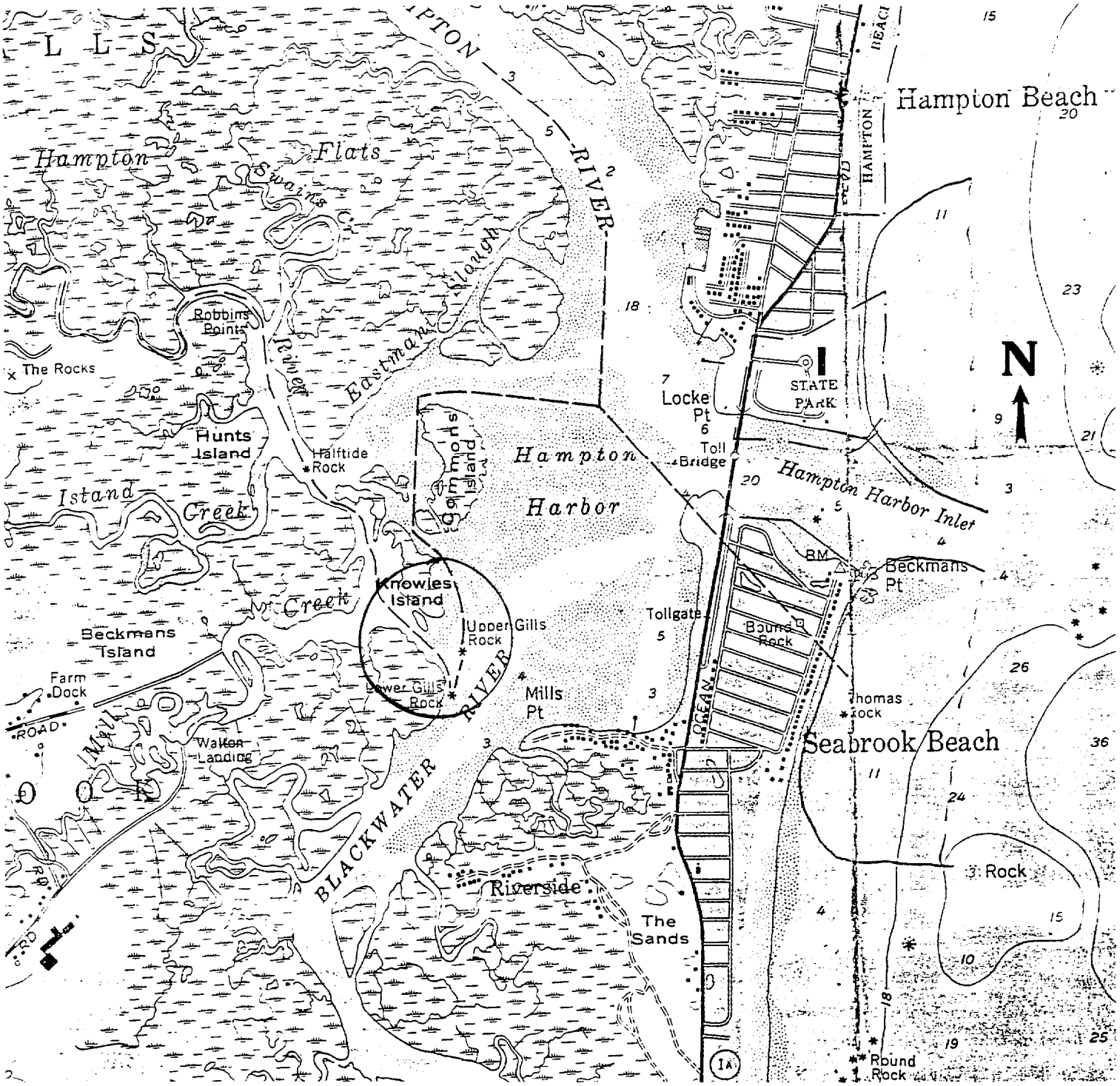

Figure 4. Location of Seabrook Common Tern Colony, 1991

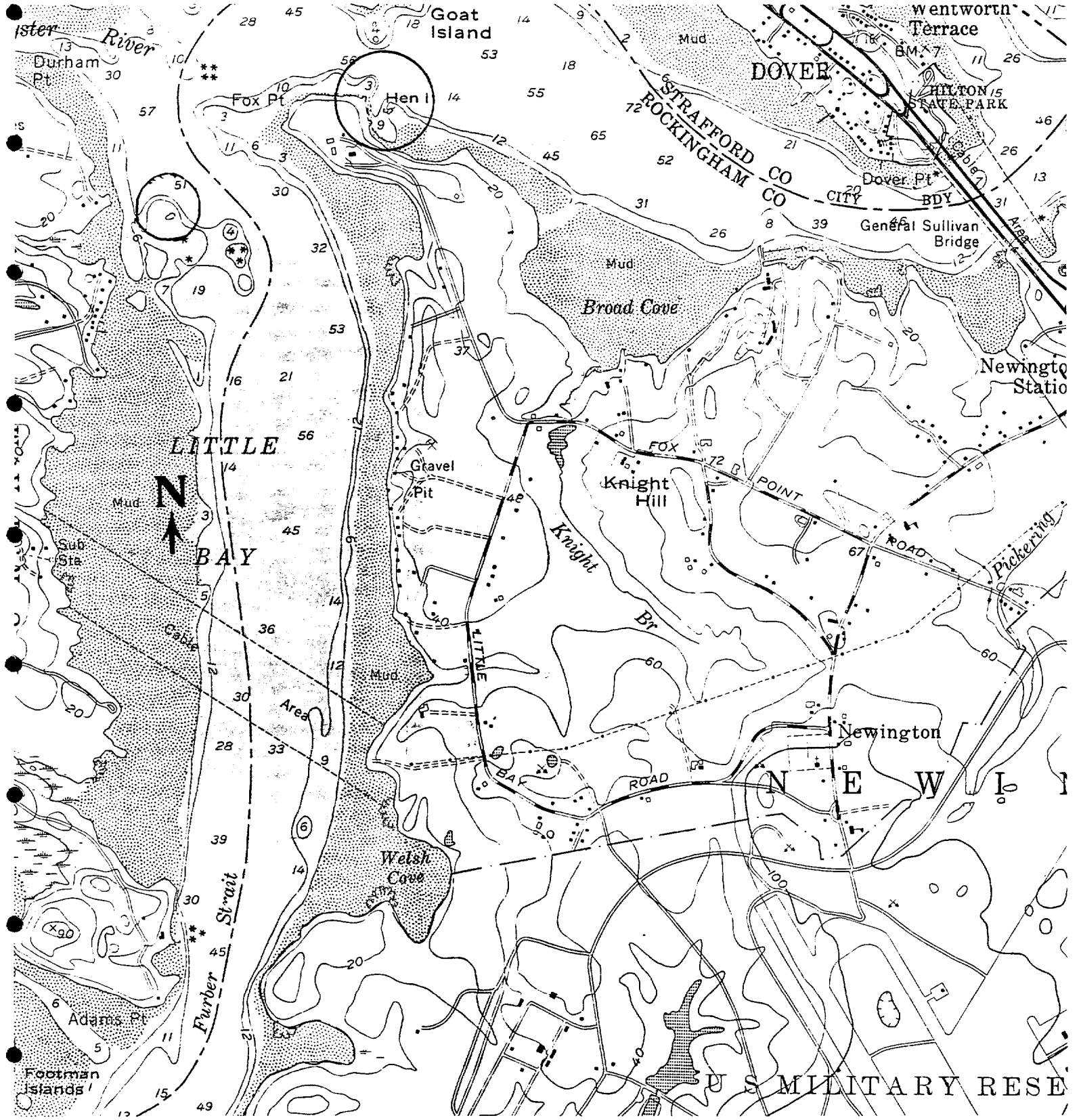

Figure 5. Location of Common Tern Colonies, Little Bay, 1992

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. Terns nested only on Island C in the 1992 breeding season.

METHODS

NESTING OBSERVATIONS

Project biologists monitored the Little Bay, Back Channel and Hampton estuary colonies a minimum of once per week from mid-May through early September. Data collected at each visit 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.

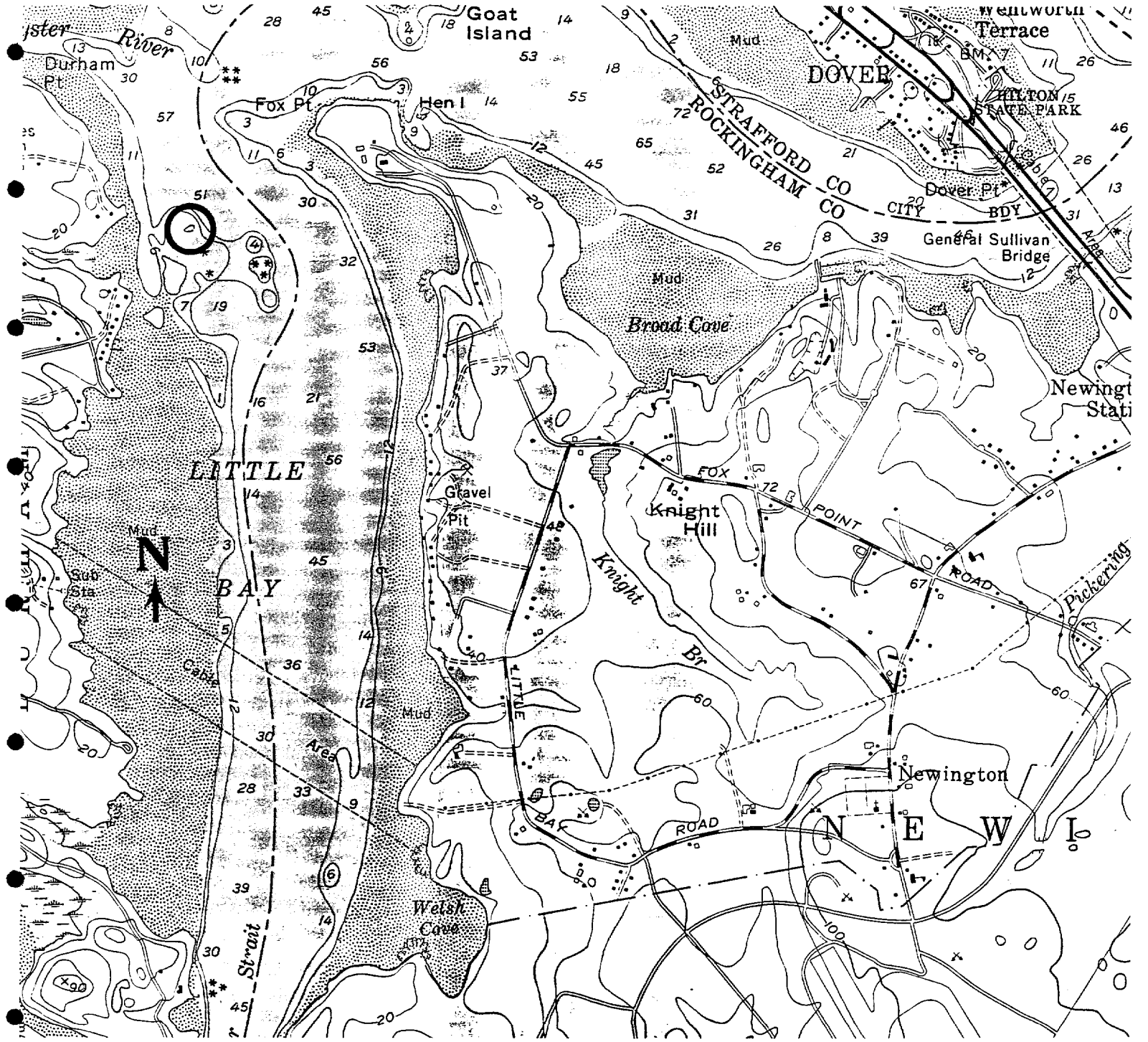

Figure 6: Location of Langley Island Common Tern Colony, 1992

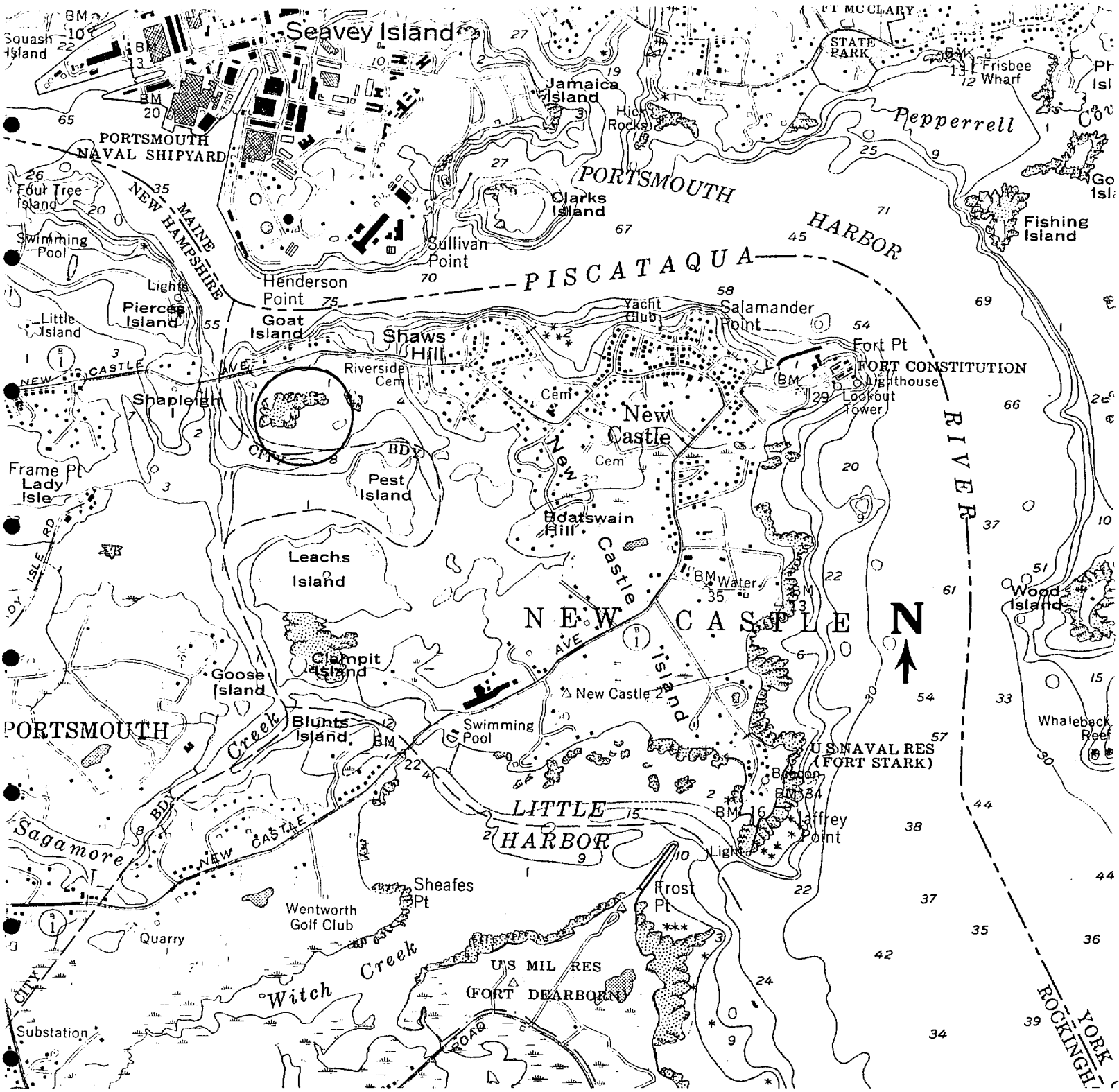

Figure 7. Location of Back Channel Common Tern Colony, 1992

Hampton Marsh

Project biologists visited the Hampton Marsh once or twice weekly from 18 May through 1 September. Surveys by foot and canoe were conducted to determine the number of birds present, to locate nests and to follow nesting progress.

The nests were recorded on a map, and each subgroup of nests were identified as to location.

Seabrook

The Seabrook colony was monitored from 18 May through mid-June, when it was determined that this site had been abandoned.

Hen Island

The Hen Island colony was monitored once or twice weekly from 18 May through 20 August. Periodic canoe visits to the island facilitated nest checking. 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 18 May through 1 September.

Back Channel

Back Channel islands were monitored once or twice weekly beginning 18 May and continuing through 31 August. Surveys by foot and canoe were conducted to determine the number of birds present, to locate nests and to follow nesting progress. 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 10 June, a survey of all historical and potential tern nesting sites was undertaken in Great and Little Bays. 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 included the Piscataqua River, Back Channel, Little Harbor, Portsmouth Harbor and out into the open ocean. The survey also covered the shoreline and potential foraging areas.

On 11 June, a survey of all historical and potential tern nesting sites in the Hampton Harbor Estuary was completed. 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.

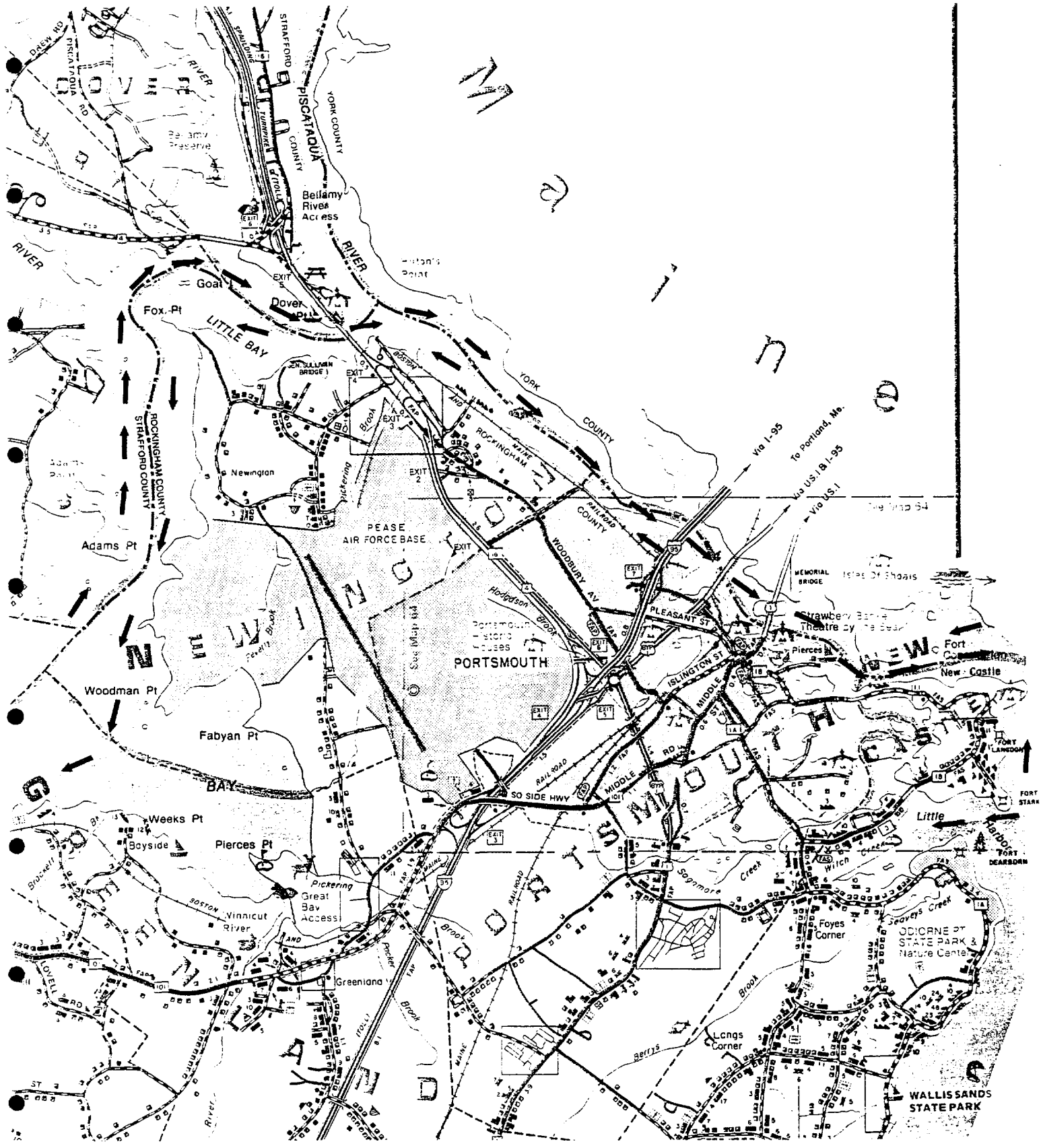

Figure 8. Survey Route for Historical and Potential Common Tern Breeding Sites, Great/Little Bay Out to Open Ocean, 1992

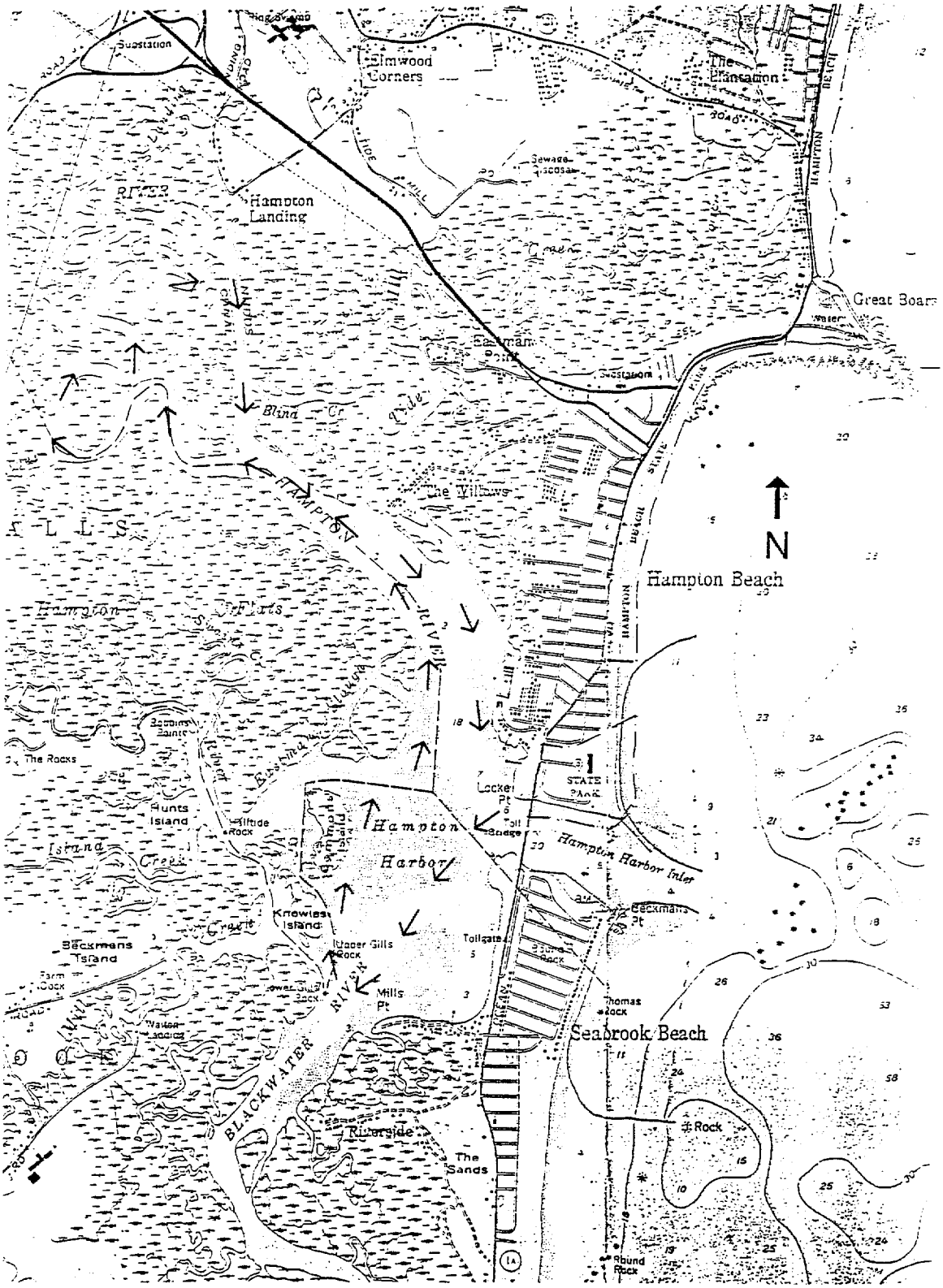

Figure 9. Survey Route for Historical and Potential Common Tern Breeding Sites, Hampton and Seabrook Marshes, 1992

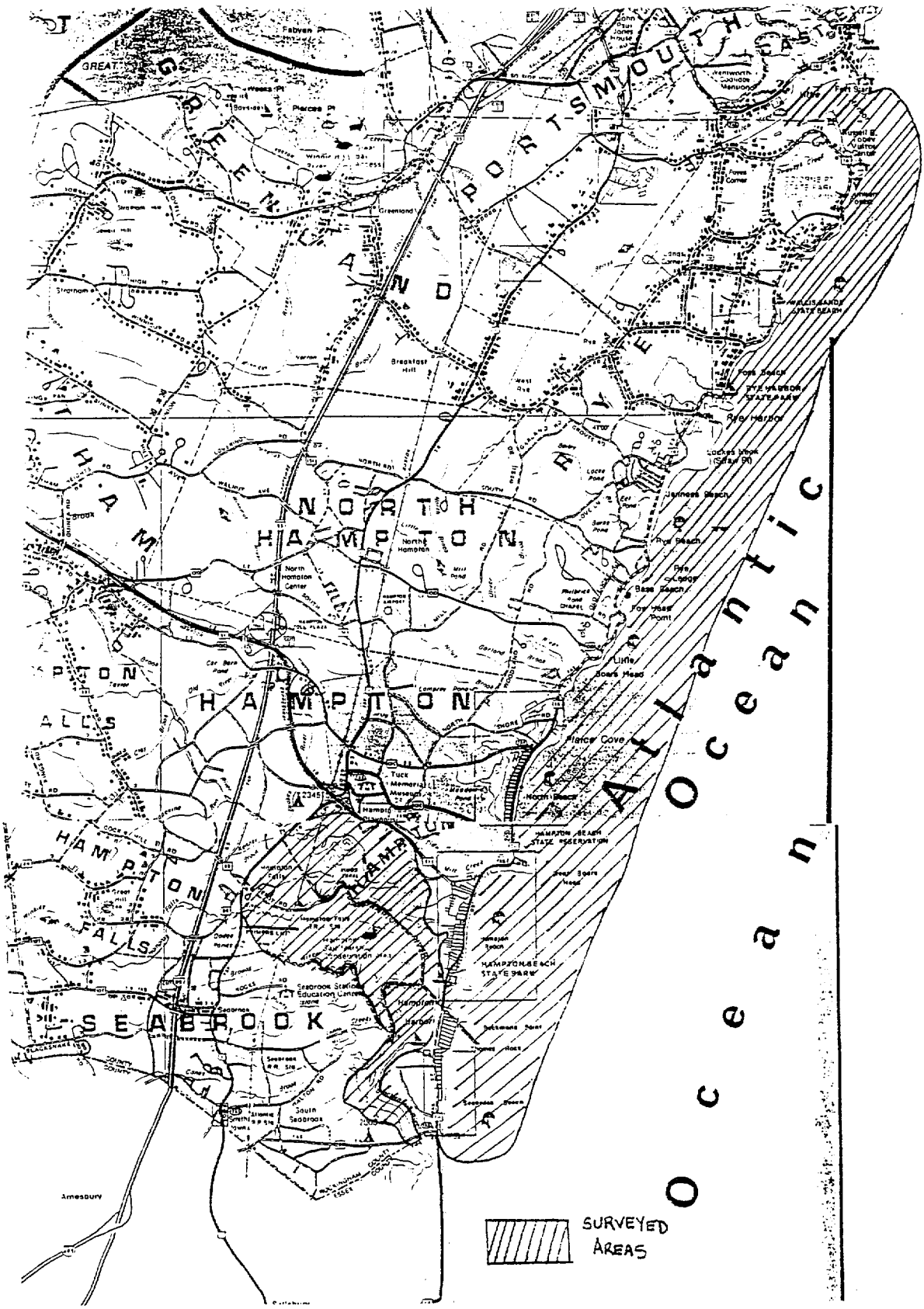

Figure !0. Common Tern Foraging Survey Coverage Odiorne to Seabrook, 1992

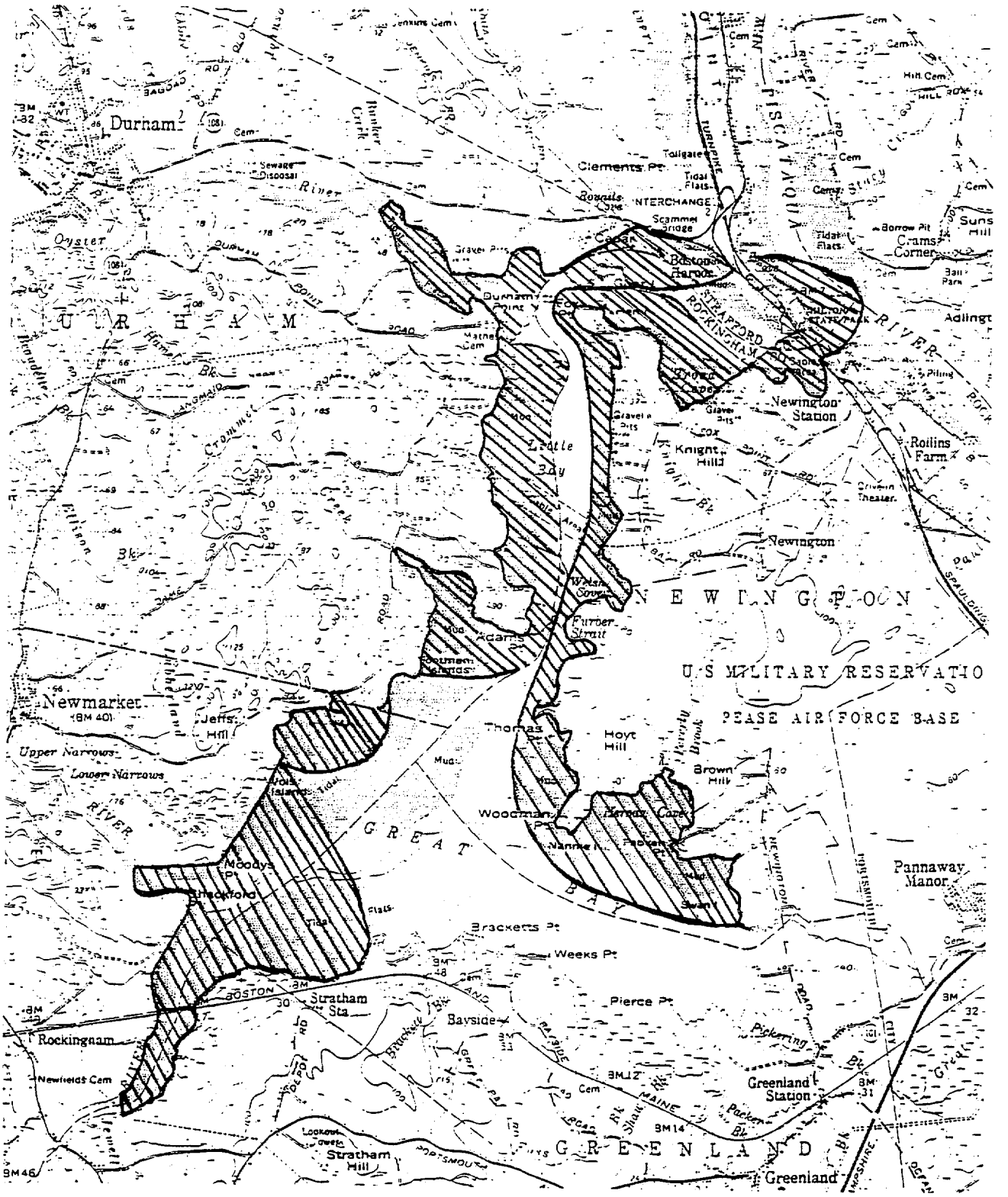

Figure 11. Common Tern Foraging Survey Coverage Great and Little Bays, 1992

TERN COLONY MANAGEMENT

Hampton Marsh

In an attempt to alleviate the problem of flooding, extra thatch was placed under 24 nests in which eggs had already been laid in areas D and E.. The thatch was comprised mainly of dried Spartina alterniflora that had washed up along the salt marsh, similar in composition to the substrate that the terns were nesting on. Each nest with its accompanying materials was lifted off the ground, the thatch was placed underneath to a depth of 10 cm., and the nest was set on top. Data collected for each nest included number of eggs and/or young and their condition, chicks hatched and fledgings; or record of failure. Additional data included the tide levels and the condition of nests without the "thatch treatment".

Jet skiis were observed in the tidal channels in both June and July. They traveled at a high rate of speed, throwing a large wake that swept up onto the salt marsh. The New Hampshire Fish and Game Department, the Port Authority and the Hampton Police Department were all informed of this problem. Signs should be placed at the entrance to this section of the marsh in 1993.

Hen and Langley Islands, Little Bay

Hen Island lost all nests to rats in the 1991 season. Trapping was carried out in the fall of 1991 in an attempt to eliminate the problem. On 23 April, 1992 rat traps were once again set out in anticipation of the arrival of terns. No rats were trapped from 23 April through 28 April, and it was assumed that no rats were present on the island.

This site is located in close proximity to the mainland and surrounded by boat moorings that serve residents of Newington. Contact with the selectmen in Newington has facilitated protection at this site, as town residents are well aware of the tern's vulnerability, and are careful about staying off the island during the breeding season.

Langley Island is also located close to the mainland. We have enlisted the help of the neighbor in closest proximity to this site, and he monitors the colony for both breeding success and disturbance.

Back Channel

"No Trespassing" signs were placed on all sides of Island C as soon as it was determined that the birds had begun to lay eggs at this site. This island is located in an area of high human and boat traffic, and the signs were an attempt to alleviate any human traffic on this nesting island. In addition, the Newcastle Police Department and nearby residents were informed of the tern activity at this location

Eight wooden shelters were placed at the nests for chicks to use as protection. Six of the shelters were 60cm.x 60cm.x 10cm., two shelters were 30cm.x 30cm.x 10cm. They had entrances on all sides, a solid roof, and open bottom. The shelters were placed approximately 1 m. from the nest just before the eggs hatched.

RESULTS

NESTING OBSERVATIONS

HAMPTON HARBOR ESTUARY:

Hampton

The highest count of adult terns at this site was 90, on 16 July. Surveys documented 80 nesting attempts. A nest count conducted by project personnel and volunteers during the week of 12 June documented 40 nests. In subsequent visits, 40 additional nests were documented and were thought to be both renests and late nestings. Fifty-eight nests (73%) contained three eggs, 16 nests (20%) contained two eggs and 6 (8%) contained one egg (Table 1).

First hatch occurred during the week of 21 June and hatching continued through approximately 15 August. A high tide of 3.5 m. (11.5 ft.) on 1 July coincided with a partial hatch of the first nesting. In the areas where extra thatch had been placed under 24 nests (D and E), 20 nests were still intact after the highest tides in early July. However, visits during the week of 8 July documented that all the remaining nests in area D (8 nests) had been wiped out. Evidence at the nests indicated that hatch had

Table 1. Number and percentage of Common Tern clutch sizes of New Hampshire nesting colonies, 1992

CLUTCH SIZE	HAMPTON	BACK CHANNEL	HEN	LANGLEY
4 EGGS				1(100%)
3 EGGS	58 (73%)	14 (67%)	4 (67%)	
2 EGGS	16 (20%)	5 (24%)	2 (33%)	
1 EGGS	6 (8%)	3 (14%)		

occurred, but no chicks could be located and the adults were not aggressive at this location. It was difficult to pinpoint reasons for failure, but a combination of high tides at hatch and predation were likely.

Renesting took place in areas A, C and F. All areas of renest were in sections of the marsh where dried thatch had collected in the high tides. These mats varied in size from 1m. x 1m. to greater than 12 m. x 12 m. The nests were placed from the center to the edge of these thatch mats. In addition, nests in the second round of nesting were built taller and more substantially than those in the initial round of nesting. Measurements of these renests showed the height to be as great as 15 cm. off the surface of the marsh.

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 12 airborne fledglings. The first chicks were observed in flight over area A on 20 July, and were survivors of the first round of nesting. The last chicks seen flying at the Hampton marsh were observed on 25 August. 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, a minimum of 20 nests were destroyed by tidal flooding. Project biologists observed 26 of the renesting attempts with eggs but not with chicks; presumably these nests failed. Predation was determined to bethe cause of failure in 11 nests. The egg or chick remains in these 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. 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 12 airborne chicks; productivity of the Hampton Marsh colony was .25 fledglings/nest (Table 3).

Table 2. Known causes of failure at New Hampshire Tern Colonies, 1992

CAUSES	EGGS	CHICKS	TOTAL NESTS
Failure to hatch	Hampton: 21 Hen Island: 1 Back Channel: 4		25
Predation	Hampton: 4 Back Channel: 7	Hampton: 7 Hen Island: 1 Back Chan.: 2	21+
Tidal flooding	Hampton: 20 Back Channel: 7	Hampton: 4+ Back Chan.: 1	32+

Table 3. Productivity of Common Tern Colonies at Hampton, Hen, Langley and Back Channel, 1992

	Nests	Airborne Chicks	Productivity Fledgl./Nest
Hampton	80	12	0.25 F/N
Hen	6	9	1.9 F/N
Langley	1	4	4.0 F/N
Backchannel	21	0	0.0 F/N

LITTLE BAY:

Hen Island

Terns were first observed foraging in Little Bay on 18 May. A survey on 10 June documented 5 nests being incubated on Hen Island (Table 1). Three nests were located on the eastern shore with two along the rocks on the west and southwest sides. A sixth nest was observed on 21 July and was thought to be a renest. On a nest check on 24 July feathers from a fledged chick were found on the west side of the island and was presumed to have been taken by a predator.

A maximum of 10 adult terns were observed at Hen Island. The first hatch at this site was observed on 25 June. This first hatch, coupled with the subsequent hatching of the remaining 4 nests, was evidence that all initial nesting was successful. The sixth nest was presumed to have failed when no chicks could be located at this site in August (Table 2). A total of 9 chicks were seen flying at Hen Island, although the predated chick had also reached fledging age (Table 3). Calculated from 9 airborne chicks; the productivity rate at Hen Island was 1.8 fledglings/nest (Table 3). The high success rate at Hen Island in 1992 was also documentation that the rats of the 1991 season had been eradicated.

Langley Rocks

On 10 June, a boat reconnaissance of this area revealed a pair of terns had established a nest at this site. Three eggs were observed in the nest. On 15 July, four chicks were observed on Langley Island and all chicks had fledged (Table 3). Terns were observed at this site through 1 September. 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 18 May. Possible nesting was observed within the grassy area on the east side of Island C on 25 May. A nest survey on 10 June documented 21 nests (Table 1). This was the first time since 1989 that terns had initiated nesting at this location during the initial nesting period. A total of 14 nests were congregated around one large rock in the center of island C, including one nest with 5 eggs. High activity continued on the island until 7 July when a nest count found only 7 nests remained active. Total abandonment of this site took place by 7 August.

Evidence of predation of eggs, chicks and adults was found on the island. The outer primaries of an adult tern was found near the 5-egg nest and may have been the result of predation by a Great-horned Owl (Bubo virginianus). Project biologists spent several evenings at the island in an attempt to determine if nocturnal abandonment And/or predation were a problem at this site, but no documentation could be made of this phenomenon. A minimum of 7 nests had been flooded during the high spring tides in early July. On 16 July, the remains of 3 additional nests were found. Red ants were evident at one nest, two dead chicks were found at the second, and an egg that had been penetrated was found at the third (Table 2).

A maximum of 40 adult terns were seen flying over the Back Channel Islands on 10 June. No chicks fledged from the Back Channel Islands in 1992 (Table 3).

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 10 June confirmed incubation by a pair of terns at Langley Rocks. Tern activity was also noted at Hen Island and the Back Channel Islands on this date. Terns were also engaged in

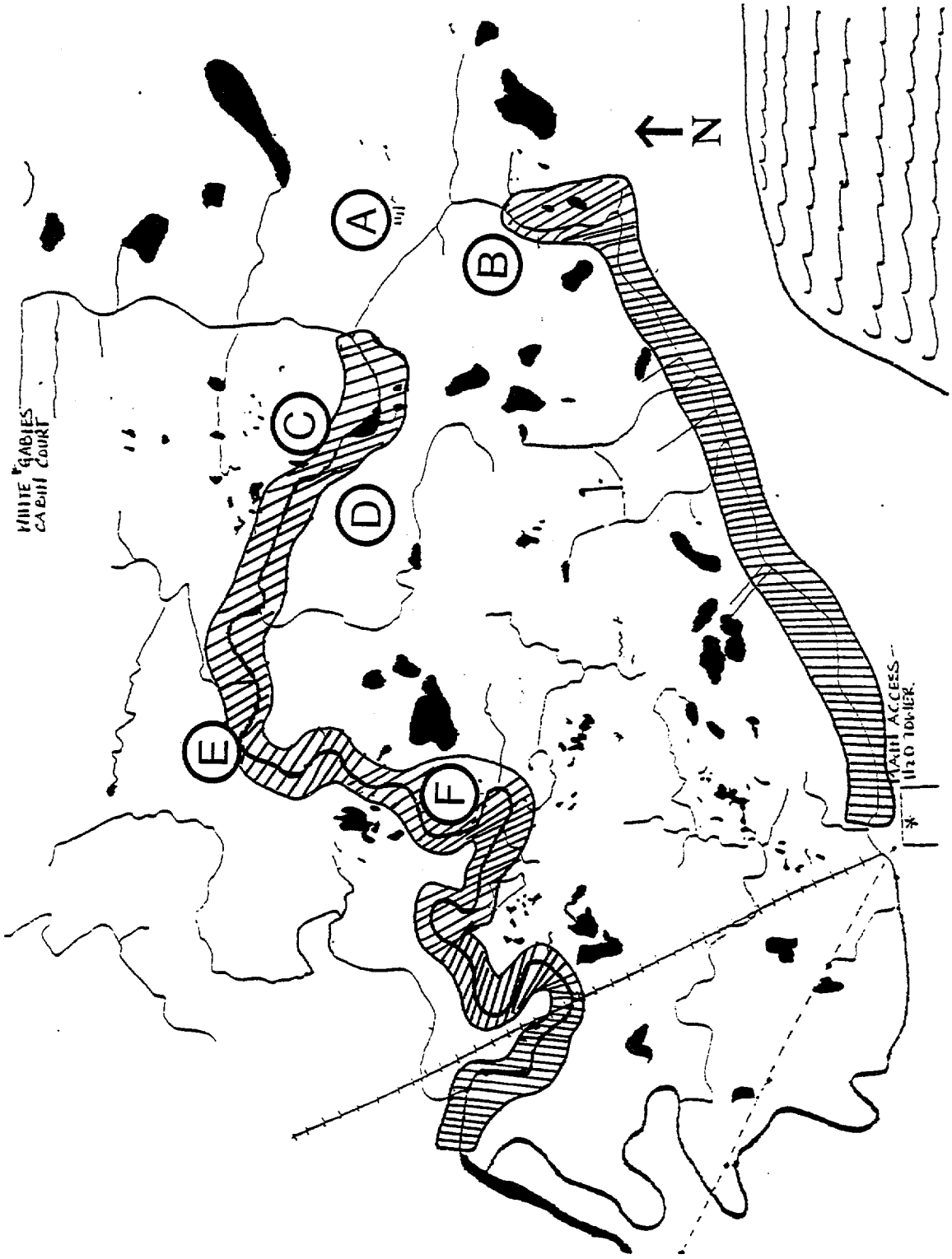

Figure 12. Common Tern Foraging Locations at Hampton Marsh, 1992

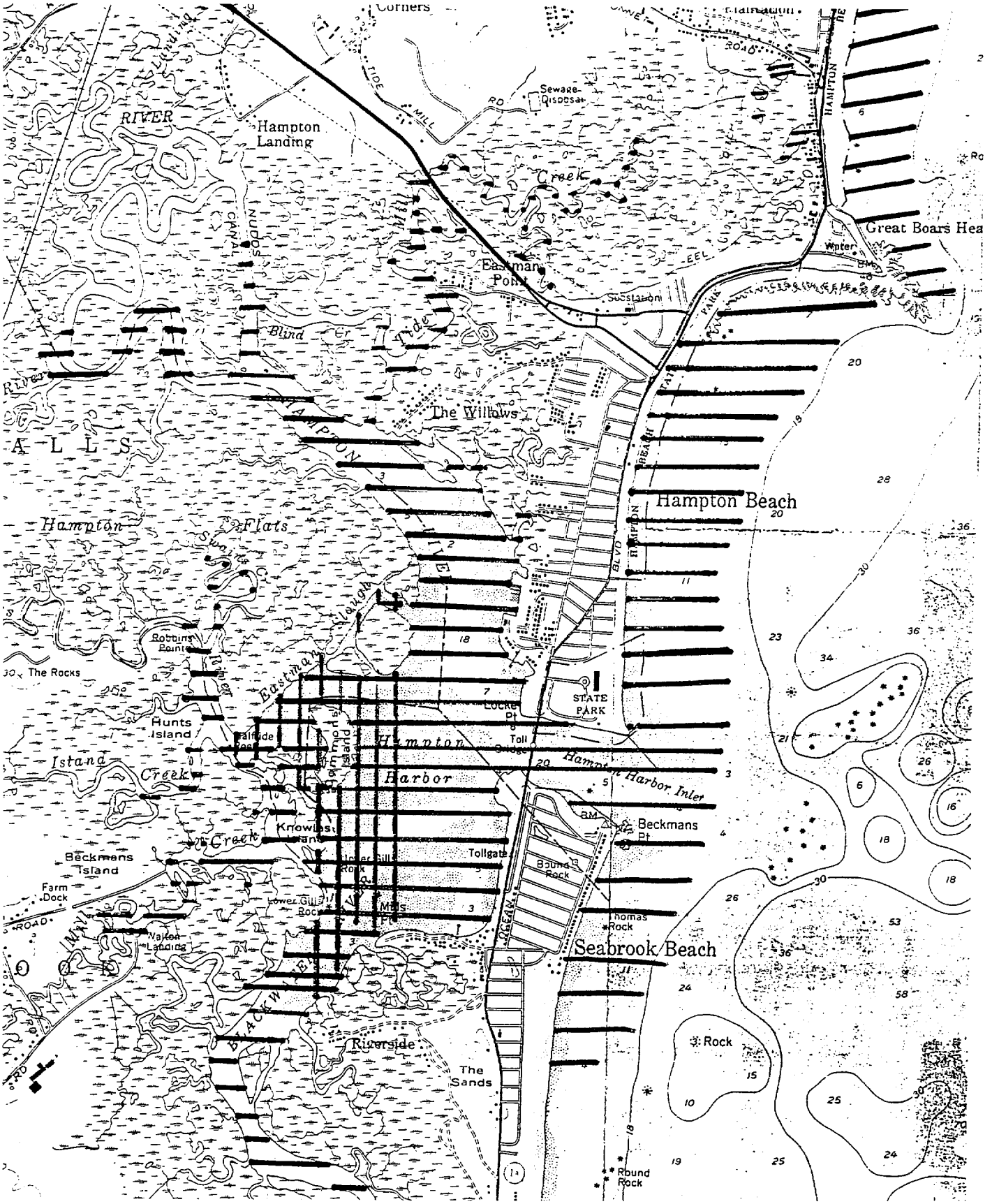

Figure 13. Common Tern Foraging Locations at Seabrook, 1992

active foraging at the mouth of the Piscataqua River, similar to the 1991 field season. A check of the shoreline in this area confirmed a small tern colony of 12+ pairs on Horn Island off Kittery Point, Maine. Terns had unsuccessfully nested at this location in 1991.

FORAGING STUDIES

Project personnel documented foraging activity that was consistent with the patterns observed during the 1990 and 1991 breeding seasons. As in 1990 and 1991, 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.
As in the two previous seasons, 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 Thomas Point on 6 August and off Moody Point during three observation periods during the breeding season. A single tern was also seen foraging just off the Stratham railroad bridge on 20 July.

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. In late July, terns were observed foraging over the South Mill Pond near downtown Portsmouth (Figure 15).

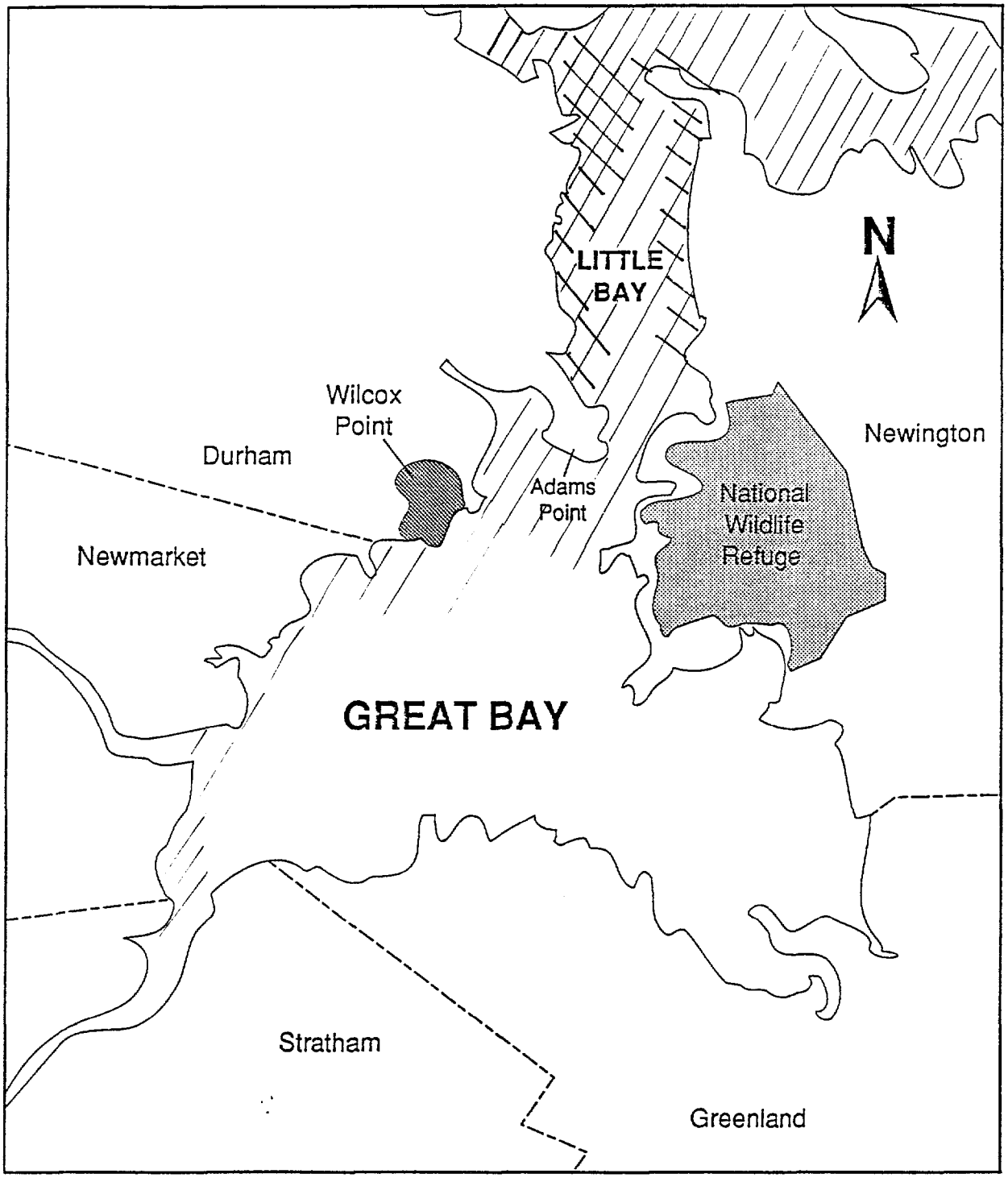

Figure 14. Common Tern Foraging Locations at Little Bay, 1992

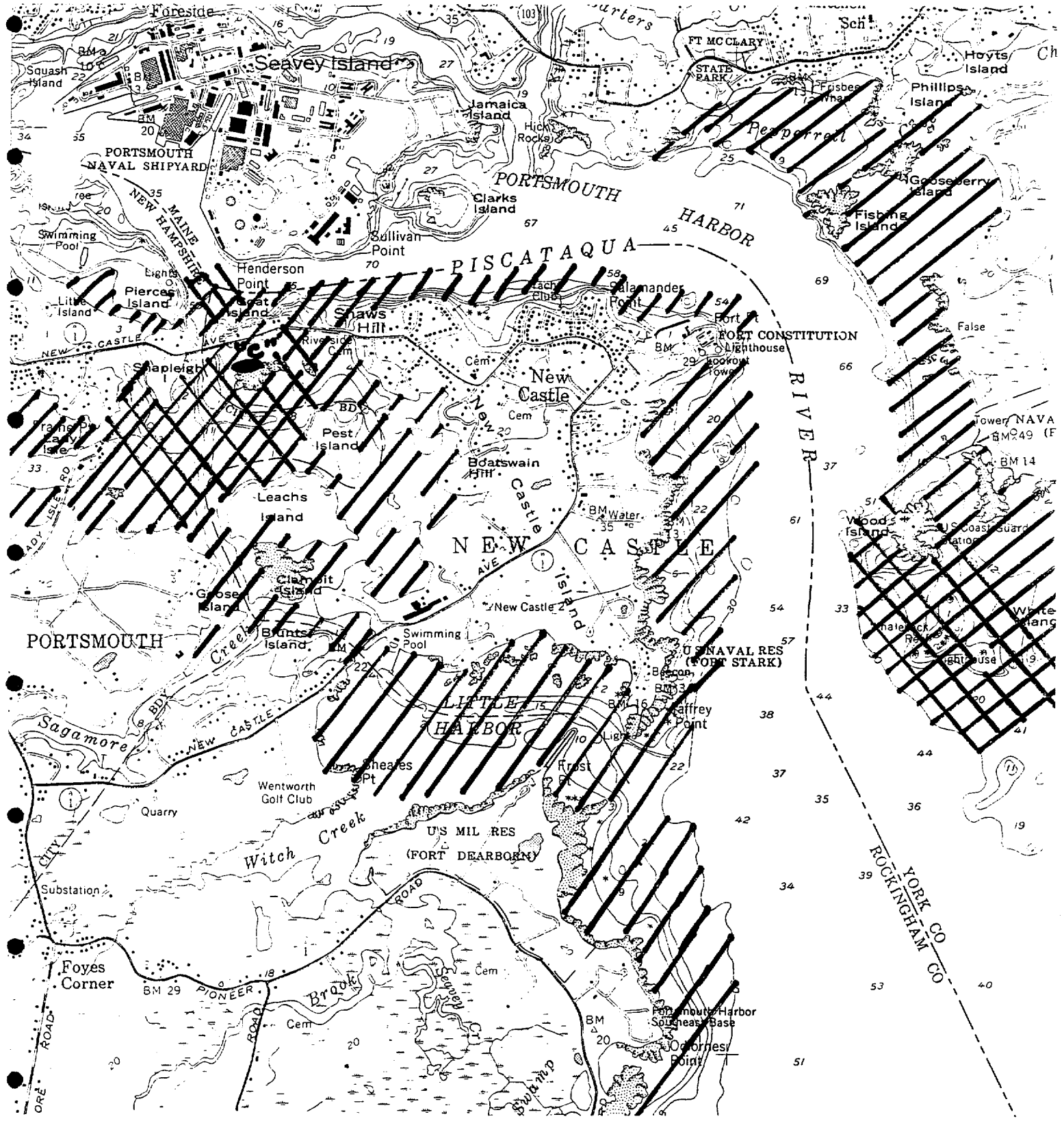

Figure 15. Common Tern Foraging Locations at Back Channel, 1992

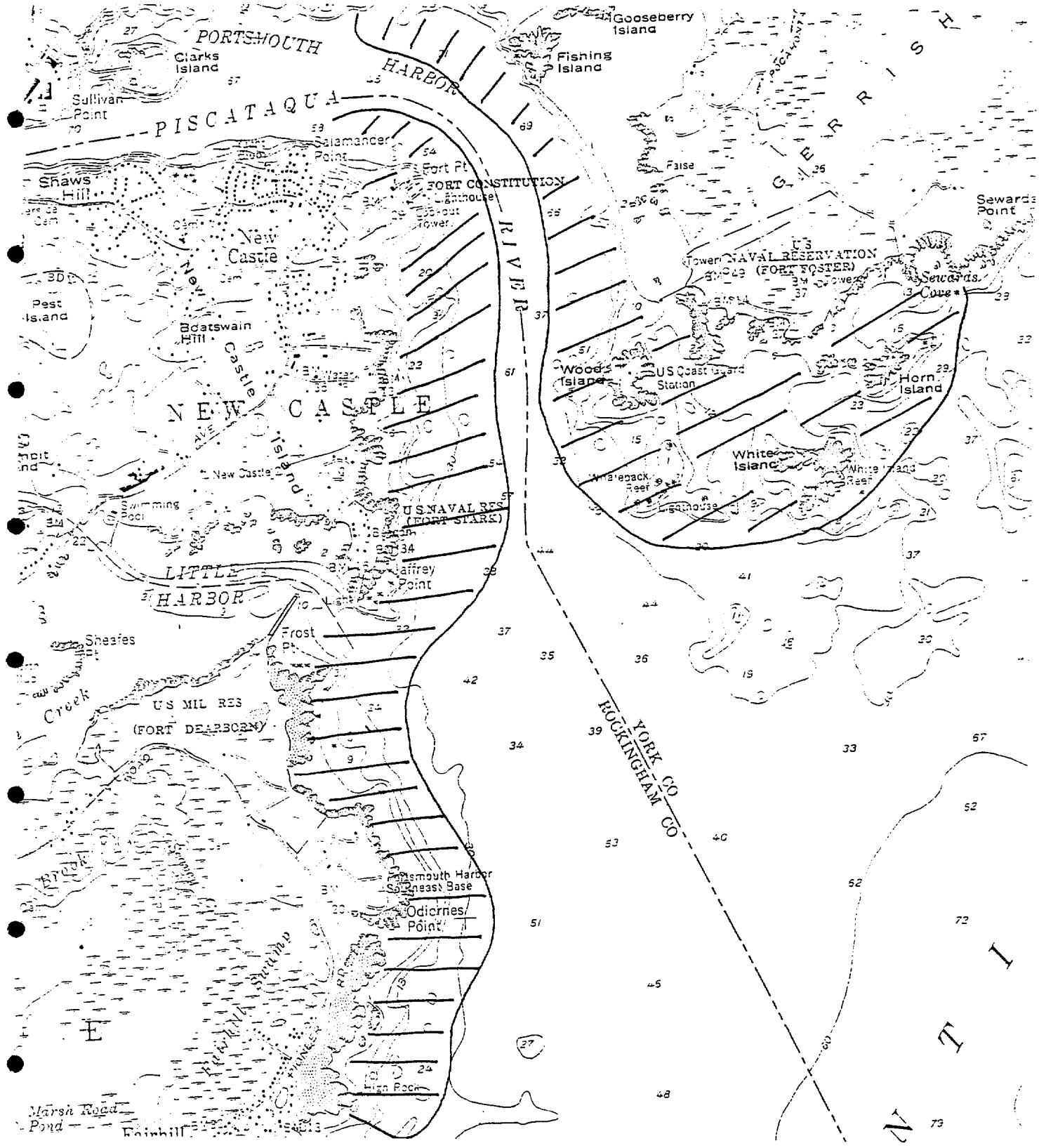

Figure 16. Common Tern Foraging Locations at Horn Island, 1992

The majority of the foraging activity off the Maine coast occurred in the area between Wood and White Islands, and Whaleback Rock. Populations from the Back Channel and Horn Island may intermix in the outer Portsmouth Harbor, Little Harbor and the coastal areas off New Castle and Kittery.

TERN COLONY MANAGEMENT

Hampton Marsh

Placement of additional thatch under 24 nests in the Hampton marshes yielded positive results. Immediately following a round of high spring tides in early July, 20 nests remained intact (83%). Of the remaining 16 known nests, a minimum of 10 had been destroyed by flooding (60%). However, a check of this same area 8 days later revealed that 8 additional nests had been destroyed. It was not clear if the cause was flooding or predation.

Jet skiis are a problem for the marsh nesting terns. Contact with the New Hampshire Fish and Game Department, the Port Authority, and the Hampton Police Department was made in the 1992 season. Project staff will pursue the elimination of the skiis in the tidal channels in 1993.

LITTLE BAY

Hen Island

It is difficult to assess the effectiveness of NO TRESPASSING signs unless the islands are under constant surveillance. It was evident that the nearby neighbors were vigilant in their efforts to keep people off the islands. On 7 July, project staff were confronted by the New Castle Police upon return from a nest check. A neighbor had seen people on the island, did not recognize them as staff, and had notified police.

The chick shelters were not effective on Hen Island, primarily because any chicks that hatched did not reach the age at which they could utilize the protection of the shelters.

LITTLE HARBOR

Hen Island

Trapping was successful in eliminating rats at this location. Trapping in the spring of 1992 helped to ensure that no rats were present at this site.

Contact with the Town of Newington and the local residents is the most effective technique for eliminating human disturbance at this site. The presence of terns is well known by those who utilize this site, and they are careful not to land on or venture too close to the island during the breeding season.

Langley Island

Local knowledge of nesting at this location is the best protection for this pair of terns.

DISCUSSION

Results of the nesting observations further confirm the low reproductive success and general difficulties experienced by terns nesting in mainland situations. A high rate of failure was documented in all colonies except Little Bay. The abandonment of the Seabrook site was probably the result of the poor reproductive success at this location during the 1990 and 1991 breeding seasons.

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 remains extremely low. 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).

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. Studies have shown that nests placed on floating mats of vegetation are more resilient to high tides (Burger and Gochfeld 1990). 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, dispersed and reconsolidated over larger regions of the marsh. Although the terns stayed in the general areas in which they had initiated nesting, the movement of thatch coincides with the dispersion of terns through these sections of the Hampton marsh by the end of the season.

The placement of extra thatch under nests in which eggs already had been laid led to an 83% survival rate of these nests through the period of high tides in early July. These results are in contrast to a 40% survival rate in the nests without "thatch treatment" and support the claim that adequate substrate in a marsh nesting situation can lead to higher productivity. The resulting fledging rate for chicks was not as positive at these same nests, and may indicate more intensive management is still needed. The flotation techniques utilized in 1991 were more effective in protecting hatched chicks. The placement of floats is, however, a very energy intensive management technique. Other options for improving nesting substrate should continue to be explored.

The success in eliminating rats from Hen Island in 1992 was evident in the productivity rate of 1.8 fledglings/nest after the failure of this colony to produce any chicks in 1991. Rat predation is a serious problem and aggressive control measures will need to continue in future years. Hen Island continues to be 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.

The successful fledging of 4 chicks at Langley Island also speaks to the suitability of Little Bay for tern nesting, especially as evidence of an adequate food supply in the vicinity of these colonies. Although clutches of 4 eggs are unusual, they have been documented in terns and other

members of the Larid family (Conover 1984). A pair of Great Black-backed Gulls also raised young at this site with no apparent negative interaction with the nesting terns.

Terns initiated nesting in May at the Back Channel Islands for the first time since 1989. In 1990 and 1991, small numbers of terns had moved into this location after presumed failure at another site. 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 a pair at this site in 1991 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. Unfortunately, the failure of terns to produce chicks at this site in 1992 was probably due to many of the same factors that caused the abandonment of this colony in 1989. The proximity of the Back Channel Islands to sources of predation make this a particularly difficult site to protect.

Continued nesting attempts on Horn Island off Kittery Point is of great interest. The decline in the numbers of terns nesting at the colony on Horn Island from 50+ pairs in 1991 to 12+ pairs in 1992 was coupled with the initiation of 21 nests at the Back Channel Islands. This makes the possibility of movement of the Back Channel population to the mouth of the Piscataqua River likely.

The formation of the colony at Horn Island, and the probable movement between Back Channel and Horn, is evidence that significant numbers of terns are searching for suitable nesting habitat in this immediate region. It also 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 both Horn and Back Channel 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 and 1991, 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 are initiated, 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.

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 posting at appropriate sites; post for jet skiis in the Hampton Marsh

- continue rat control at Hen Island

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

- continue to 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 3-hectare beaver pond in Durham within 3 km. 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. The 1991 breeding season also fledged three young, and this continued success indicates an adequate food supply and good parenting abilities. However, the hurricane loss of 90% of the nest cup in August 1991 allowed us to examine nest site tenacity in 1992.

The continued observations of additional adult ospreys in 1991 may indicate an undetected nest or the potential of a 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 their breeding grounds in their second year; and, if conditions are suitable to breed in their third summer (Henny & Van Velzen, 1972).

The goals of this project were to monitor the Durham osprey nest, survey potential nesting habitat in the coastal region for additional nests, survey for foraging activity, installation of predator guards at newly discovered nest sites, implementation of other nest protection strategies, and the development and distribution of public information.

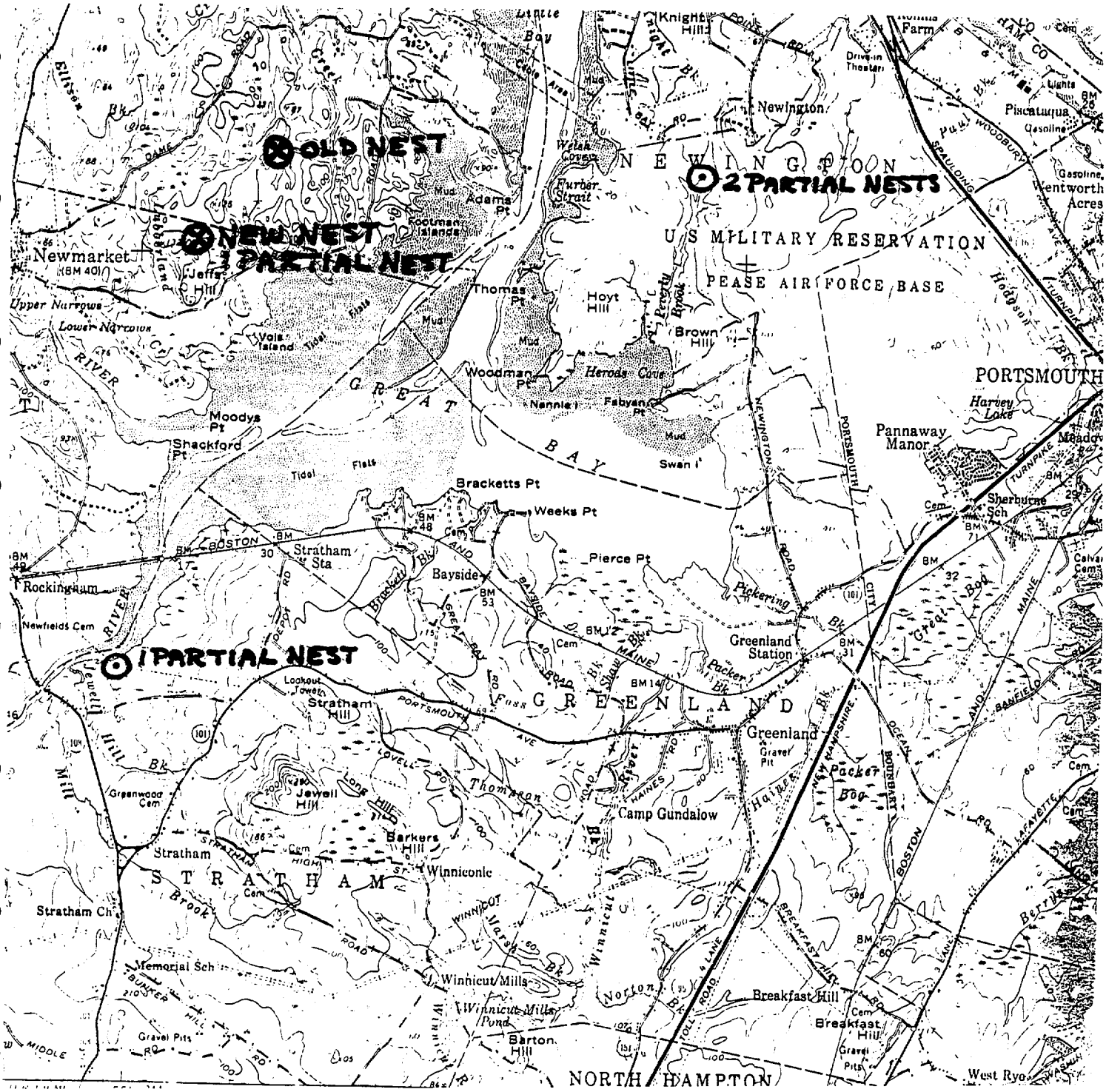

Figure 17. Osprey Study Area Location, 1992

STUDY AREA

WILLEY POND:

The pioneering osprey nest is situated in Durham, near the west shore of Great Bay, 1 km. southwest of the Bay Road bridge over Crommet Creek and 1 km. north-northwest of the intersection of Bay and Bay View Roads. The nest is in a flooded beaver pond of approximately 3 hectares which is one of a series of wetlands that characterize the area of Durham and Newmarket (Figure 17).

The nest is an enlarged, abandoned great blue heron nest approximately 13 meters above the surface of the pond. The nest tree is a dead black gum (Nyssa sylvatica) and is the most substantial tree in the pond. On 19 August 1991, 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.

PEARSON POND:

This nest site was located in another flooded beaver pond, approximately 1.3 km. southwest of Willey Pond, and 1.2 km. from the east side of Dame Road (Figure 17). The nest is in a flooded area approximately 10 hectares in size.

The nest tree is a slender eastern white pine (Pinus strobus) snag, 16-17 meters high. Its base is in the water and is surrounded by several other snags, several of which lean against the nest tree. An additional tree at this same location was also used for the transfer of prey.

SQUAMSCOTT RIVER:

This Stratham site lies along the marsh on the south shore of the Squamscott River, approximately 0.8 km. northeast of the Route 108 grid bridge adjacent to Chapman's landing, and 1.6 km. southwest of the railroad bridge across the mouth of the Squamscott River. It is surrounded by land protected by a conservation easement held by the Great Bay National Estuarine Research Reserve (Figure 17).

The nest is 24 meters off the ground, located on the crossbars of a power pole belonging to the Public Service Company of New Hampshire (#51 319 68).

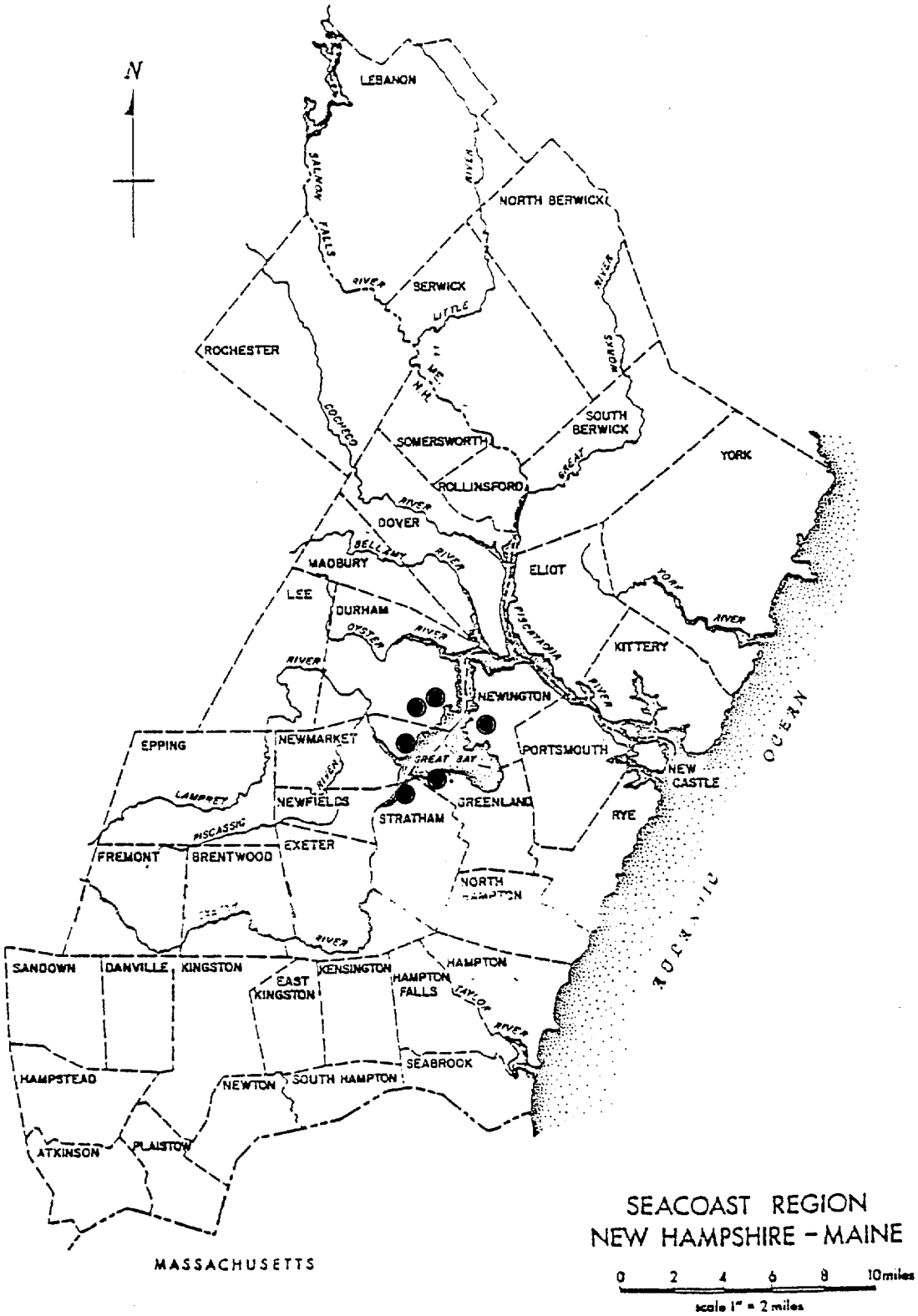

Figure 18. Coordinated Osprey Nesting and Foraging Survey, 1992

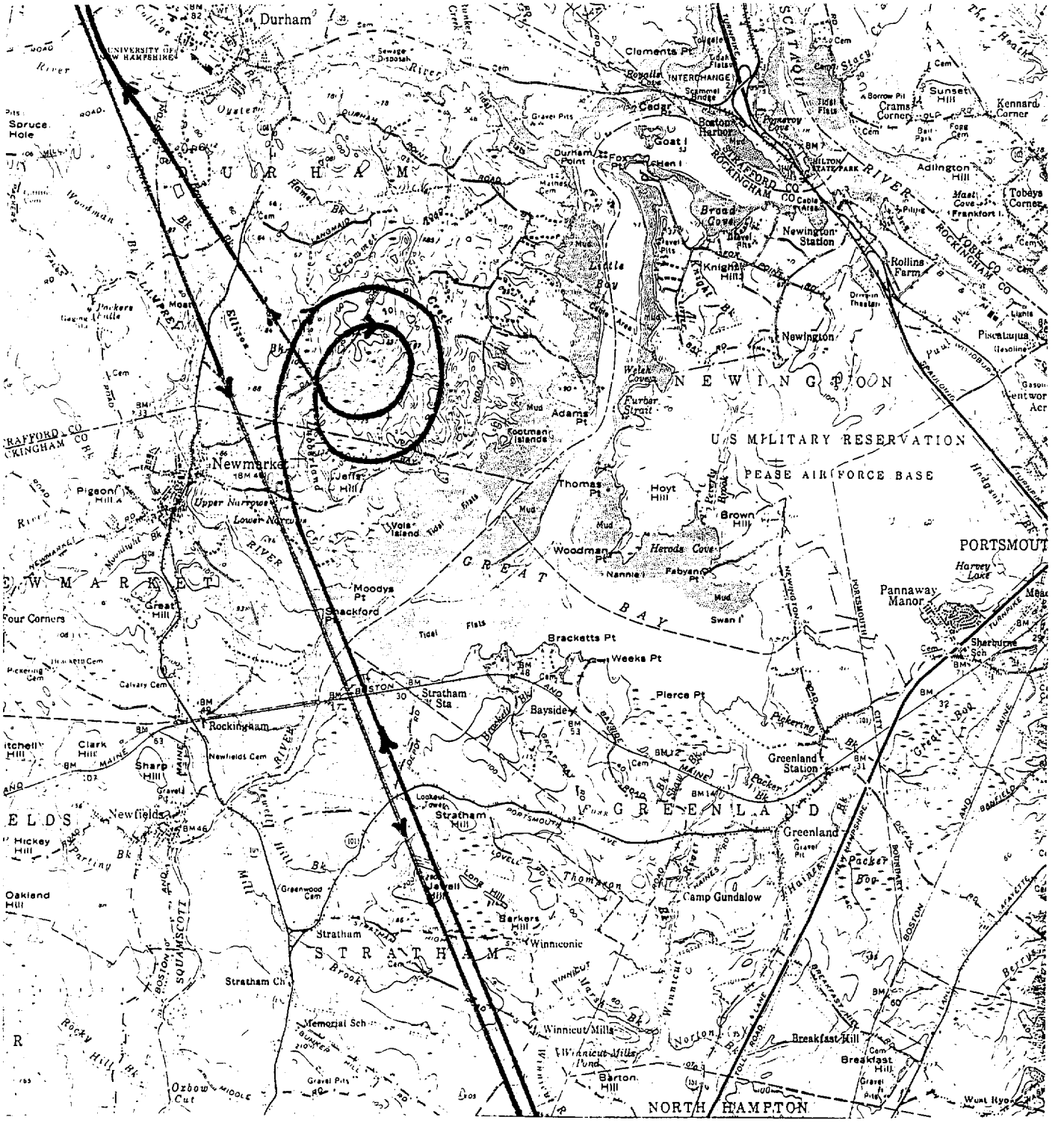

Figure 19. Route of Aerial Survey for Osprey Nests, 1992

GREAT BAY NATIONAL WILDLIFE REFUGE (transferred mid-August):
On 3 June, an osprey was observed taking marsh grass from the shoreline of Great Bay and flying north into the refuge area. On 12 June, a small bundle of sticks, attended by an osprey was found on top of one of the power poles just inside the gates of the abandoned weapons storage area. By 16 July, a second partial nest was erected on an additional power pole in close proximity to the original (Figure 17).

CROMMET CREEK:
In January of 1993 an additional nest site was discovered in the Crommet Creek area of Durham. This site is in a pond formed by Crommet Creek, 0.4 meters south of Longmarsh Road.

The nest is located in a deciduous snag, approximately 20 inches in diameter, and surrounded by relatively deep water. The nest is approximately 40 feet off the surface of the pond, and is estimated to be four feet in diameter.

METHODS
Project biologists monitored known nest sites throughout the breeding season to determine breeding status and success; conducted an aerial survey of potential nesting habitat, and surveyed potential foraging habitat for the presence of ospreys.

Project personnel monitored known nest sites once or twice weekly between 17 March and 7 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.

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 3 August. Fixed point surveys covered the nest site at Willey Pond, Pearson Pond, Chapman's Landing, the Stratham railroad bridge over the Squamscott River, Moody Point and the former weapons storage area on the Great Bay National Wildlife Refuge (Figure 19). Data recorded included date, time, weather, raptor presence, location and activity observed.

Table 4: Chronology of major breeding events, 1992.

EVENT	DATE
Male first at Willey nest	4/07
Start of courtship - Willey	4/07
Willey nest abandoned	4/24
Pearson Pond nest found	5/05
Pearson Pond abandoned	5/07
Nest found at Weapons Storage Area	6/12
Nest found on Squamscott River	7/20
Coordinated Survey	8/03
End of monitoring	9/07

Table 5. Osprey foraging activity, 1992

LOCATION	OBS. PERIODS	% OF OBS.
Moody Point	17	38%
Squamscott River	12	27%
Moat Island	6	13%
Great Bay NWR	3	7%
Fox Point	3	7%
Exeter River	1	2%
Wagon Hill	1	2%
Seabrook	1	2%
Odiorne	1	2%

Project personnel conducted an aerial survey of potential osprey nesting habitat in the coastal region 5 May. The survey route concentrated heavily on the Durham-Newmarket wetlands on the west side of Great Bay, but also included the drainages and reservoirs along the Lamprey, Oyster, Bellamy and Squamscott rivers. 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 20).

RESULTS

NEST OBSERVATIONS

WILLEY AND PEARSON PONDS:

The first sighting of an osprey at the Willey Pond nest site occurred on 7 April, with both adults present. Courtship activity was first observed on 7 April with copulations witnessed on 7, 12 and 18 April. The nest site was defended from a young red-tailed hawk (*Buteo jamaicensis*) on 7 April and from turkey vultures (*Cathartes aura*) on 14 April. However, no improvements were made to the existing nest, which had been heavily damaged during Hurricane Bob of August 1991.

The only fish brought to the nest site was consumed by the male. On 24 April, all signs of osprey occupancy at this site were gone, including the remnants of the original nest. The nest material may have been appropriated by a great blue heron that was actively building a nest in an adjacent site.

Numerous explorations on foot and the aerial survey of 5 May, located an incubating osprey on 9 May at a new nest in Pearson Pond. On 13 May, with the female incubating, the male brought a small fish to the nest which resulted in a food and incubation exchange. On 17 May, an additional incubation exchange was observed. On 22 May, no incubation was observed at this site, but the male performed a "sky-dance" while carrying a fish above the nest site. The female landed on the nest, a fish exchange took place, and the female headed south. The male remained perched at the side of the nest, then flew off and neither returned.

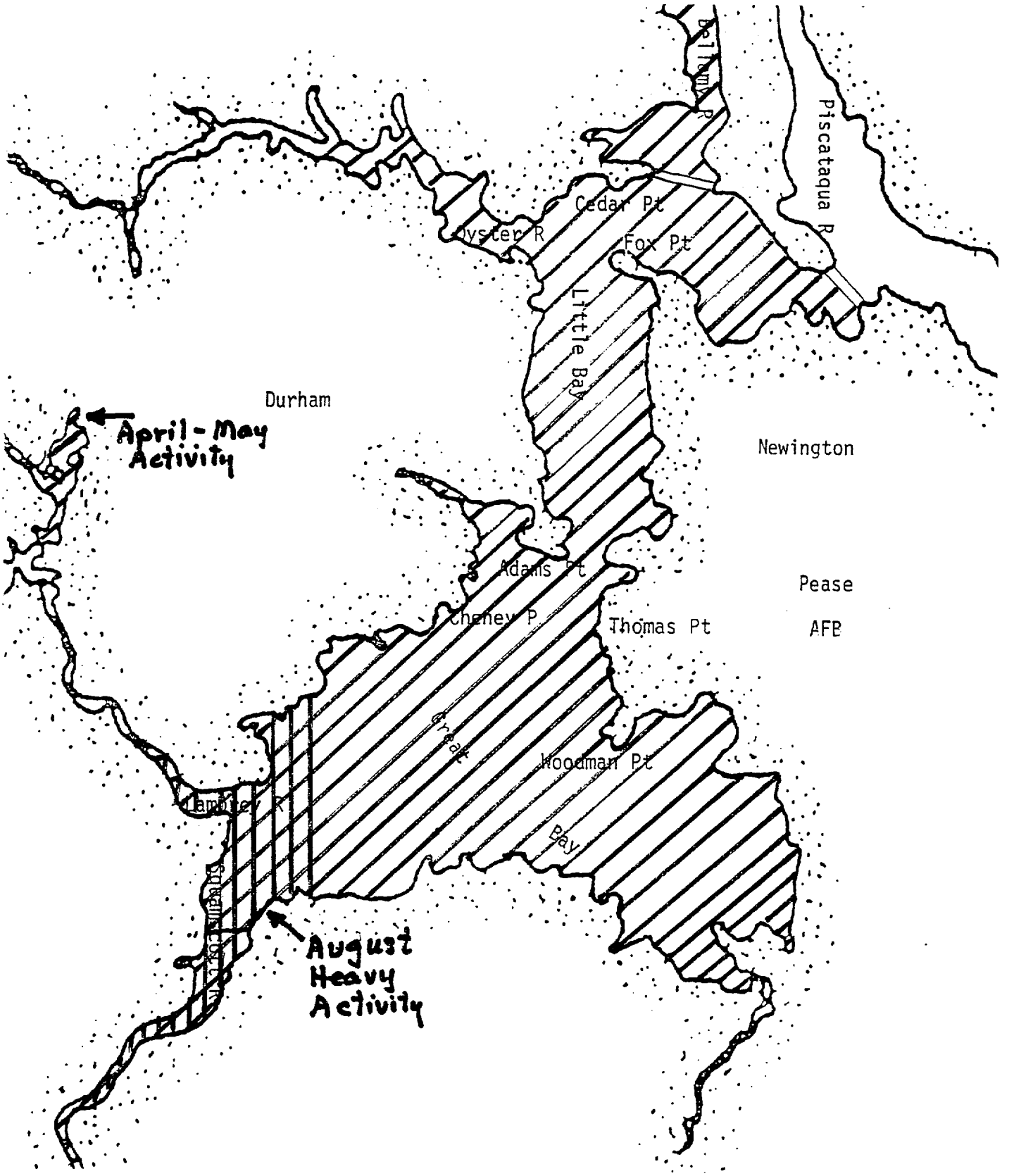

Figure 20. Osprey Foraging Locations, 1992

This was the last time that actual breeding activity was recorded for the season. On 3 and 10 August, one or more ospreys were seen flying around or perched at Willey Pond. On 19 and 24 August, a single osprey (appeared to be a male) spent several hours eating a fish while perched near the old nest at Willey Pond. The chronology of breeding observations is summarized in Table 4.

ADDITIONAL NEST OBSERVATIONS

GREAT BAY NATIONAL WILDLIFE REFUGE:
On 3 June, an osprey was observed taking marsh grass from the shoreline of Great Bay and flying north into the refuge area. On 12 June, a small bundle of sticks, attended by an osprey, was found on top of one of the power poles just inside the gates of the abandoned weapons storage area. By 16 July, a second partial nest was erected on an additional power pole in close proximity to the original. No additional building took place at this site.

During the 3 August coordinated survey, up to four individual osprey were seen at the weapons storage at one time. A brief copulation took place on one of the partially constructed nests.

SQUAMSCOTT RIVER:
On 20 July, another new nest was discovered along the south shore of the Squamscott River just south of the Stratham railroad bridge. It was built on the crossbars at the top of a power pole belonging to the Public Service Company of New Hampshire.

Activity at this nest for the next month included copulation, nest building, feeding, perching, loafing and fishing nearby. The occupants at this site were confirmed to be a second pair during the 3 August coordinated survey. A nearby resident reported that the nest was started in June by a pair of red-tailed hawks, and was taken over by osprey in mid-July.

This nest was inspected by PSNH employees to determine its safety in October of 1992. We accompanied PSNH staff on two field excursions to the osprey nest to come up with a strategy for improving the safety at this site. In January of 1993, PSNH employees lowered the powerlines underneath the nest by five feet and erected perches at the nest level. In

addition, if needed, they will cover the wires with a safety material that will help eliminate the danger of electrocution, as well as reduce the chance that the birds and/or nest material will cause shortout problems.

PEARSON POND:
On 27 July, a pair of osprey were perched in another nest just south of the original nest at Pearson Pond. A prey transfer was observed at this time.

COORDINATED SURVEY
Results of the coordinated eight hour survey on 3 August indicate that a minimum of five osprey were using the south and west sides of the bay area on that date. Multiple osprey sightings occurred at all sites except Pearson Pond where no osprey were observed. A count of five osprey would be consistent with earlier observations of a breeding attempt in the wetlands of Durham and Newmarket, a pre-breeding pair establishing a nest along the Squamscott River, and the solitary osprey found early in the season along the Lamprey River at Moat Island.

FORAGING OBSERVATIONS
Osprey were observed foraging during 45 of 63 separate observation periods. Moody Point, just north of the mouth of the Lamprey River on Great Bay, was the site of 38% of the foraging observations. The Squamscott River area accounted for 27% of the sightings, while the Great Bay National Wildlife Refuge and the Newington shoreline had 13% of the total sightings (Table 5).

This year, as in 1990 and 1991, early season foraging activity was observed in the vicinity of Moat Island on the Lamprey River adjacent to Route 108 in Durham. Foraging ceased in this location as the river became more heavily used by fishermen. Four birds were observed foraging at this site on 28 April.

Osprey foraging flights were seen over a good portion of Great Bay through the season (Figure 20). From late July through early September frequent foraging activity, involving one to three osprey, occurred near the mouthes of the Lamprey and Squamscott Rivers. Some activity continued along the Squamscott River as far upriver as the "Ox-bow", just north of the Route 101 bridge in Exeter.

AERIAL SURVEY

The aerial survey on 5 May allowed us to locate the Pearson Pond nest site. Numerous loops around the swamps in this vicinity finally revealed a large stick nest. A ground survey on 9 May confirmed that this nest was being incubated. No additional nests were discovered, but aerial observation confirms that many potential nesting sites exist throughout the Great Bay Estuarine System.

PREDATOR GUARD INSTALLATION

Predator guards were installed on all known potential nest sites in early March of 1993. Aluminum flashing, a minimum of 44 inches in height, was placed around the circumference of each nest tree at a height of between five and ten feet. Predator guards were placed at the following locations: Pearson Pond (two trees), Crommet Creek and the Squamscott River (two power poles).

DISCUSSION

The inability of the Durham osprey pair to successfully raise young in 1992 raises some questions. Although the pair returned to the original nest site, they never did any of the rebuilding that was necessary in light of the losses to Hurricane Bob. The pair found incubating at Pearson Pond were assumed to be the birds from the Willey Pond nest. The failure at Pearson Pond was possibly related to predators, as no predator guard could be placed on this nest tree once incubation had begun. It should be noted that we were informed by the U.S. Fish and Wildlife Special Agent that an osprey was shot and killed in Lee during the first part of April. Although this osprey was more than likely a migrant, it cannot be ruled out that one of the breeding pair was affected.

The construction of additional nests in the Great Bay Estuary and the observation of a minimum of five osprey in the bay on 3 August, gives strong support for the potential growth of this coastal osprey population in 1993. The success of the Durham breeding pair in 1990 and 1991 may well forecast the addition of other pairs in this region. Recruitment of

the young from this nest remains a possibility for 1993 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.

The similarity of the nests in the weapons storage area and along the Squamscott River could indicate they were built by the same pair of osprey. The nests at the Willey and Pearson Pond sites also appeared to be occupied by the same birds. The Willey and Pearson Pond osprey preferred a remote, wooded area while the Great Bay Refuge and Squamscott River sites have open, manmade structures.

This year's foraging observations helped to build on previous year's data , but we still need to strengthen our knowledge of foraging habitat use patterns. The data from 1990 through 1992 suggests that the mouth of the Lamprey River provides important foraging habitat for osprey in Great Bay. 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, the activity of the additional 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 nearby 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 survey potential nesting habitat, document any occupied breeding habitat, and implement nesting area protection techniques where necessary.

METHODS

Project staff and volunteers conducted field surveys for northern harrier activity from 17 May through 11 September. 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.

Project field staff and volunteers conducted fixed point northern harrier surveys from the following locations: The Blackwater River area in Seabrook, Farm Lane in Seabrook, Walton Road in Seabrook, Depot Road in Hampton, Landing Road in Hampton, the marshes west of Wallis Sands State Beach, and the marshes opposite Odiorne State Park. In addition, observations were conducted from the following locations in conjunction with monitoring of other coastal endangered species: The Great Bay Estuary, the Hampton Harbor saltmarshes, Pease International Tradeport, and the coastal marshes in Rye (Figure). Data recorded included date, time, weather and raptor presence, location and activity observed.

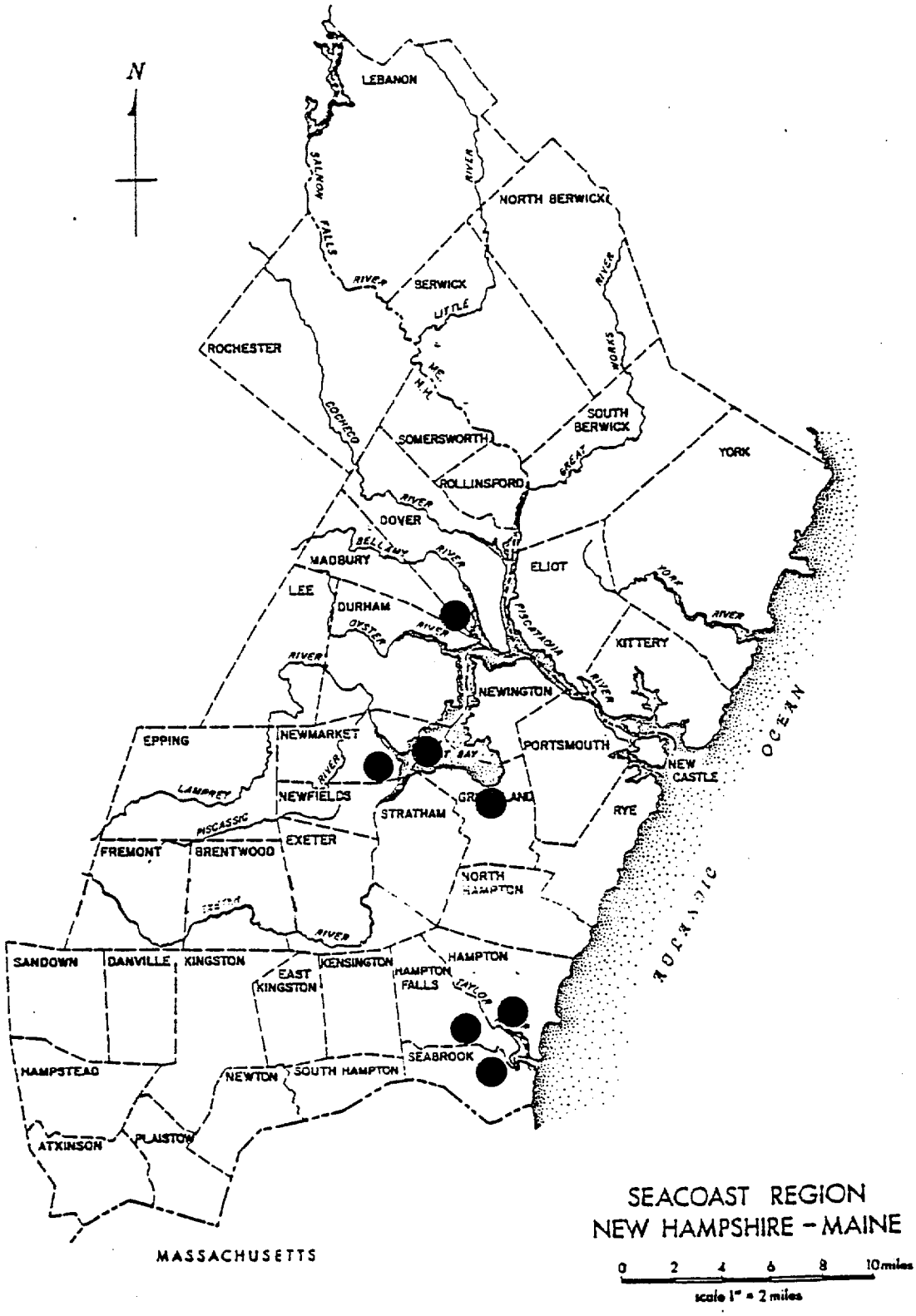

Figure 21. Northern Harrier Survey Locations, 1992

RESULTS

A female northern harrier was observed on 4 days in May from the airfield at the Pease International Tradeport, but breeding could not be confirmed. No other harrier sightings were made until 20 August when a female harrier was seen flying low over Awcomin Marsh in Rye Harbor State Park. A female harrier was observed on three separate days between 21 and 28 August from Walton Road in Seabrook. Field staff witnessed a female harrier in the same area on 1 September. The only other harrier sighting occurred on 4 September, when a female harrier was observed perched and preening on the branch of a downed snag in the saltmarsh northeast of Chapman's Landing off Route 108 in Stratham.

Northern harrier sightings during the 1992 field season document harrier use of coastal habitat. However, unlike 1990 and 1991, no adult northern harriers were observed in any of the salt marsh areas during the breeding season and no juvenile birds were seen at any time during the survey period. The presence of female harriers foraging over the Awcomin and Seabrook marshes near the beginning of the hawk migration period does not support nesting in the area.

DISCUSSION

The results are inconclusive as to whether harriers nested somewhere in the Hampton marsh area during the 1992 breeding season. Observations of female harriers at the Pease International Tradeport during May was evidence for the possibility of breeding activity at this location. However, no breeding could be confirmed and no juveniles were sighted.

Preliminary investigations indicate that suitable harrier nesting habitat does occur in the immediate vicinity of the Hampton/Seabrook marshes. Human activity levels and predation vulnerability at these sites 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 (NHF&G). 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 NHF&G 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).

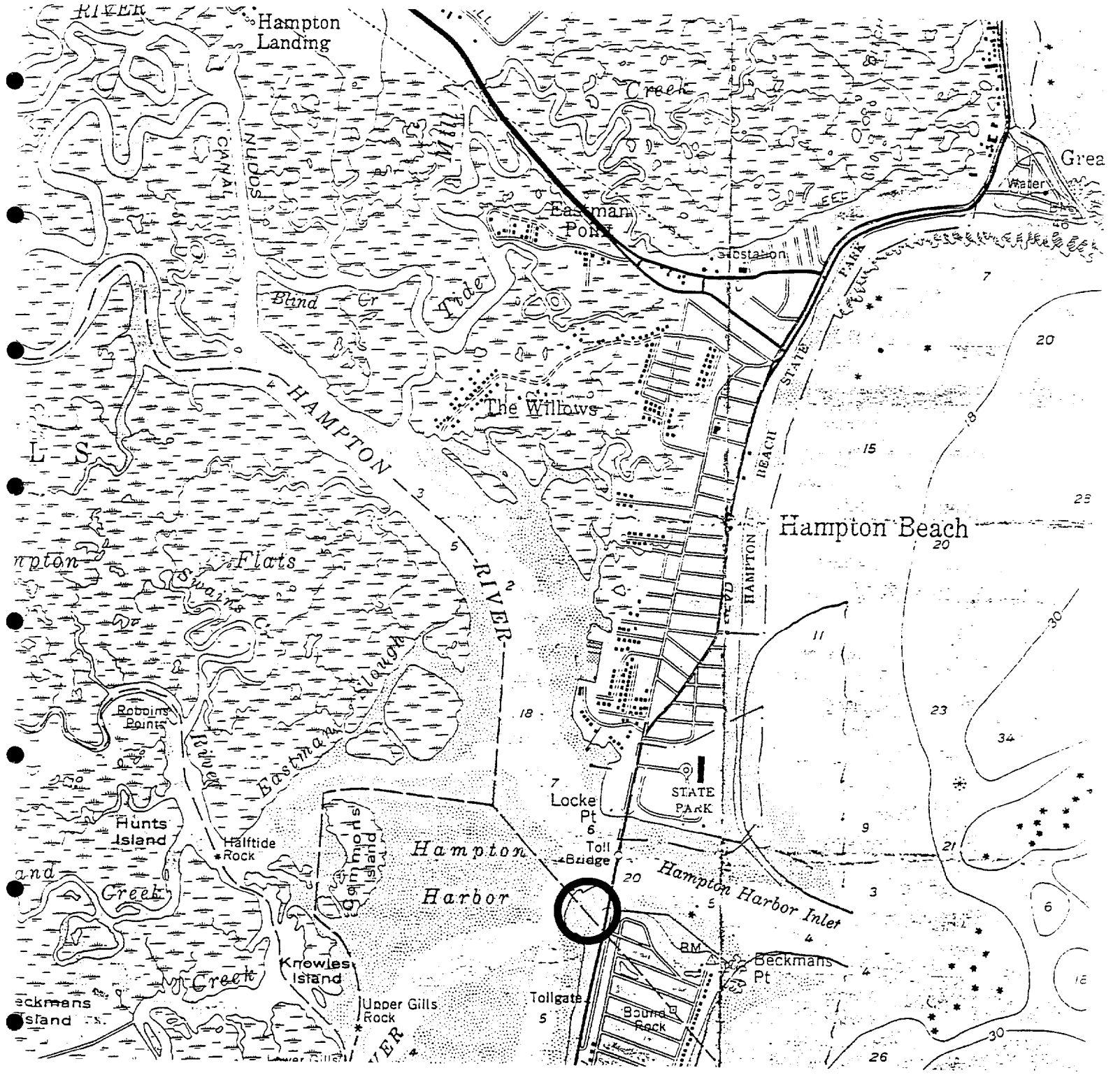

Figure 22. Location of Potential Piping Plover Habitat, 1989-92

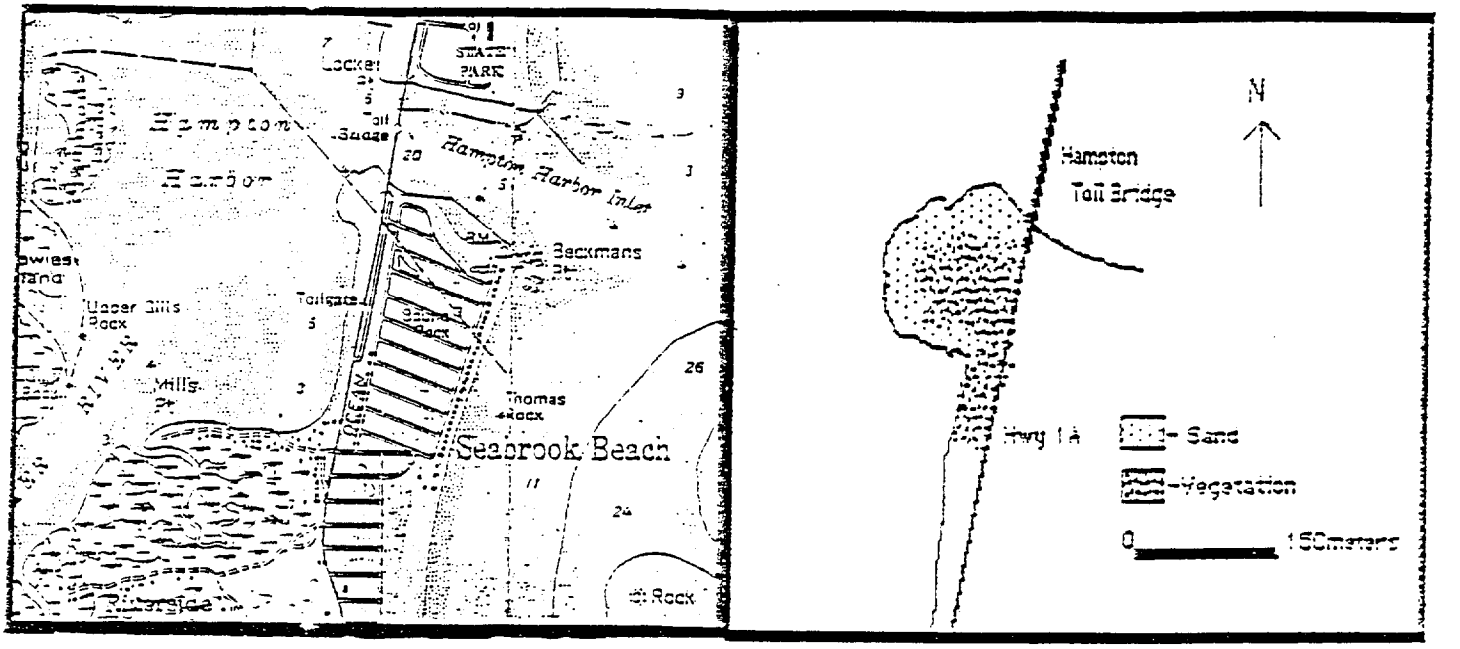

Figure 23. Potential Piping Plover Habitat, Hampton Harbor, 1989-92

Project personnel surveyed the area from 1 April through 15 July, and volunteers conducted additional surveys. Each visit included a walking survey of the beach and dunes recording the date, time, weather and species observed.

RESULTS

A single piping plover was observed on 16 May and 23 May. No other piping plovers were observed at this location and there was no evidence of breeding at this site. Thus, nest protection measures and a strong public relations effort were unnecessary this year.

DISCUSSION

The 1992 breeding season again 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. The final tally for Massachusetts showed 213 plover pairs, up 33 percent from the prior summer's count of 160 pairs. Of equally good news was the 1992 estimate for fledgling productivity at 2.02 per pair, which was the highest level since the species was listed as endangered and protection was increased in 1986 (Hecker, 1992). 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 1988,1989 and 1992 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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COMMON TERN SLIDE PRESENTATION

SLIDE#1: COMMON TERN
The Common Tern is an endangered species in New Hampshire. It is the only breeding tern that we have in N.H. at present.

SLIDE#2: FLYING TERN
Terns are closely related to gulls, but are very agile in flight with long pointed wings and forked tails.

SLIDE #3: LUNGING ISLAND
Historically, terns bred out at the Isles of Shoals. There were 1500-2000 pairs nesting on these islands through the 1940's.

SLIDE #4: MAP OF PRESENT TERN COLONIES
With changes in land uses of the outer islands, an increase in the number of gulls breeding on these same islands, terns were forced off the islands. They were pushed in towards the mainland and more marginal nesting sites.

SLIDE #5: NEWCASTLE ISLANDS
These new sites included small, rocky islands just off the mainland - such as these islands off Newcastle.

SLIDE#6: HAMPTON SALT MARSH
They also moved into the salt marshes along our coast. You can see the major development that rings this area, making the terns vulnerable to a variety of pressures.

SLIDE#7: SCOPE AT HAMPTON MARSH
Field studies conducted annually since 1981 have documented a recent population decline on the mainland where colonies have suffered from marginal nesting habitat and heavy predation. In addition, field studies have been able to document any changes in colony sites through this time period.

SLIDE#8: HAMPTON SALT MARSH
The present sites for tern colonies include the Hampton Salt Marsh, just north of Route 51, bordered by 1A on the east.

SLIDE#9: SEABROOK SALT MARSH
This colony site was occupied by terns in 1989 - 1991. It is located along the Blackwater River in Hampton Harbor, the backdrop being the Seabrook Nuclear Power Plant. Terns did not nest here in 1992.

SLIDE#10: FOX POINT
Small colonies exist on islands just off the mainland in Little Bay.

SLIDE#11: NEWCASTLE ISLANDS
Small colony exists on a series of small islands in the Piscataqua River.

SLIDE#12: CANOE ON MARSH
In order to monitor colonies, project staff will often canoe out. This allows for monitoring nests; documenting breeding success and failures; determining reasons for failure.

SLIDE#13: WALKING ON MARSH
Careful maneuvering through the tern nests, both on the marsh and the islands, can help o facilitate nest checks. It is critical to get in and out of the colonies in brief time periods, be especially cognizant of the weather, take great care in how you move through the colonies and limit the number of times you move through in a season.

SLIDE#14: NEST ON MARSH
Nests are placed directly on the substrate. In the salt marsh, terns place their nests directly on the thatch and areas of Juncus.

SLIDE#15: CLOSEUP OF NEST WITH 3 EGGS
A full clutch for Common Terns is 3 eggs. They will incubate these eggs for approximately 21 days.

SLIDE#16: CHICK HATCHING
When the chicks hatch out, they are cryptic in coloration, yet still very vulnerable to dangers in their colony. They will need to be fed by the adults for approximately 28 days before they are ready to fly.

SLIDE#17: CHICK AT FLEDGING
During the four weeks until they fledge, they will hide in the grasses in the marsh, or under the rocks and vegetation in the small island nesting colonies. The parents will feed them in these areas, typically in fairly close proximity to the actual nest cup.

SLIDE#18: GREAT HORNED OWL
During this time they are very vulnerable. Predators like the Great Horned Owl can decimate a colony, taking both chicks and adults.

SLIDE#19: MINK
Mammalian predators can also create serious problems for tern colonies. Mammals such as mink, raccoon, skunks can all decimate a colony as well.

SLIDE#20: RATS
Especially in areas where terns nest in close proximity to humans, rats can wipe out these ground nesting birds as well. In 1991, a small colony in Little Bay was wiped out by rats as they ate all the eggs that were laid. Project staff were successful in eradicating the rats through an extensive trapping program in both the fall of 1991 and the spring of 1992.

SLIDE#21: JET SKIIS
Jet skiis have been observed moving through the tidal channels during the tern nesting season. These machines throw a significant wake, which washes up onto the marsh and can flood vulnerable nests.

SLIDE#22: FLOODED MARSH
Natural flooding occurs in the marshes, as high spring tides may cover the entire marsh with water. When coupled with heavy rains, this can spell disaster for terns as their eggs may be washed out of the nests and terns die from exposure.

SLIDE#23: THATCH ON MARSH
The terns often choose to nest in the areas of the marsh where pockets of thatch have washed up with the tides and dried. These thatched areas create a substrate that often allows the terns to survive some of the more natural fluctuations in the water level.

SLIDE#24 BUILT UP TERN NEST
Terns that have lost a nest to flooding will often build a nest that is much more substantial and higher off the marsh grasses. This may also help them to persevere during flood periods. These higher nests are much more evident on a second round of nesting.

SLIDE#25: PLATFORM
Another method that project personnel have utilized to try to deal with flooding are artificial platforms. These platforms are plywood squares that are placed atop a foam core and anchored in the marsh by a line and spike. The problem has been that the terns do not often choose to nest on the platforms themselves.

SLIDE#26: PLATFORM UNDER THATCH
In an attempt to use the platforms to the terns' advantage, we experimented with lifting the already established nests, slipping the float underneath and placing the nest back on the float.

SLIDE#27: PLATFORM UNDER THATCH- AT FLOOD TIDE
Once the nest is placed back on the float, the float is barely detectable. The terns showed no hesitancy to return to their nests and the success rate on these platforms was upwards of 80%. Phenomenal in relation to those nests without the advantage of the platforms.

SLIDE#28: TERN IN FLIGHT OVER WATER
Another aspect of tern breeding behavior that project staff has looked at in the last couple of years has been their feeding and foraging behavior. Biologists monitored where terns were foraging as well as what they were feeding on. Data documents that terns forage in relatively close proximity to their breeding colonies.

SLIDE#29: VIEW OF HAMPTON HARBOR
Hampton Harbor is a key feeding area for the marsh nesting terns, as well as for migrants later in the season.

SLIDE#30: A view of the water column in Hampton Harbor at a peak feeding time during the breeding season helps to explain this. The area is loaded with sand lance, a preferred food for terns.

SLIDE#31: RESULTS OF FEEDING STUDY
Results of the feeding studies show that sand lance (Ammodytes americanus) was brought into the nests in greater than 50% of the feedings. The fish that was brought to nests most frequently after the sand lance was striped killifish (Fundulus heteroclitus).

SLIDE#32: ISLES OF SHOALS
The islands out at the Isles of Shoals still has suitable habitat for terns. There has been some preliminary work done to evaluate the suitability of White and Seavey Islands.

SLIDE#33: TERN DECOYS
In recent years, there has been a considerable amount of work done to recolonize terns to former colonies in both Maine and Massachusetts. The techniques used in these areas included placing tern decoys out in suitable habitat to visually attempt to attract terns.

SLIDE#34: TERN SPEAKER
In addition to placing decoys out in this habitat, speakers are also placed out to simulate the sound of a real tern colony. These speakers can be hooked up to a battery and timer, to turn on and off during the daylight hours.

SLIDE#35: SEAVEY ISLAND
Seavey Island still has some beautiful tern habitat. This is an island that is part of the White-Seavey complex that was recently returned to the state after the lighthouse was automated on White Island. The state has now instituted an island caretaker program at this site.

SLIDE #36: ADULT COMMON TERN
The hope is that we may soon be able to attempt these recolonization techniques. They have been extremely successfully in many locations where they have been instituted. With all the pressures on the mainland colonies in N.H., this may be one way to help insure that terns will continue to nest along New Hampshire's coast.

SLIDE#37: TERN CHICK
Continue to see tern productivity in this state.

OSPREY PHOTOGRAPHIC DOCUMENTATION

SLIDE#1: ADULT OSPREY
Osprey are a threatened species in New Hampshire. During most of this century, the only known osprey populations in N.H. occurred north of the White Mountains, primarily in the Androscoggin River Basin.

SLIDE#2: OSPREY IN FLIGHT
In the spring of 1989, osprey were observed engaged in breeding activity.

SLIDE#3: MARSHES IN DURHAM
They were observed in an abandoned heron rookery in a 7-8 acre beaver pond in Durham within a mile of Great Bay.

SLIDE#4: AERIAL OF WILLEY POND SITE
This osprey pair enlarged a great blue heron nest at this site.

SLIDE#5: PREDATOR GUARD EXPEDITION
Although they were not successful in their first attempt, a predator guard was placed at this site during the winter of 1990.

SLIDE#6: WILLEY POND NEST AT ITS PEAK SIZE
In 1990 and 1991, this pair of osprey successfully raised 3 chicks in each year. This marked the first time in the present century that breeding by ospreys was documented in the coastal region.

SLIDE#7: NEST AFTER HURRICANE
Unfortunately, in August of 1991, 90% of the nest cup was blown out of the tree by Hurricane Bob.

SLIDE#8: OSPREY AT NEST AFTER HURRICANE
Although a good portion of the osprey nest was gone, the adults and young of 1991 continued to use the remaining nest for feeding and loafing. The pair returned to this site in 1992, courtship ensued, but they never rebuilt the nest and soon abandoned this site.

SLIDE#9: PEARSON POND NEST
After an extensive but unsuccessful search by foot, an aerial survey revealed that the pair had moved to another beaver swamp approximately 1.5 km. from the Willey Pond site.

SLIDE#10: PEARSON POND NEST TREE
The nest tree at this location is a slender white pine snag, approx. 17 meters (55ft.) in height. Its base is surrounded by water and it is in close proximity to several other snags.

SLIDE#11: SQUAMSCOTT RIVER SITE
Foraging observations through the season revealed osprey activity at other locations in the bay. On 20 July, a pair of osprey were observed in courtship activity on a substantial nest placed on the crossbars of the PSNH powerlines that cross the Squamscott River above Route 108.

SLIDE#12: SQUAMSCOTT NEST
This pair of osprey were believed to have taken over at this site after a pair of red-tails had already started a nest. They did not appear to make any nesting attempt in 1992, but project staff are hopeful that they will return in 1993 and attempt to raise young.

SLIDE#13: SQUAMSCOTT NEST
PSNH employees spent a considerable amount of time this winter making this nest site safer for the birds. The powerlines were lowered away from the nest cup, and perches were constructed at the level of the nest. Both of these measures are an attempt to keep the birds from electrocuting themselves on the wires, and have been used successfully in other states.

SLIDE#14: BASS PONDS, GREAT BAY NATIONAL WILDLIFE REFUGE
Foraging expeditions also revealed considerable osprey activity in the freshwater ponds that border Great Bay at the National Wildlife Refuge. Considerable feeding was taking place at this location.

SLIDE #15: BASS PONDS, WITH WATER TOWER
Ospery were observed flying into the interior of the ponds and refuge through the early part of the season. You can see the distant water tower that is located in the former weapons storage area.

SLIDE#16: WEAPONS STORAGE AREA NEST
Investigations revealed that a partial nest was being constructed on the crossbars of the powerline that ran through the former weapons storage area. Although this nest was never completed, osprey were observed at this location through the season.

SLIDE#17: SUNSET OVER BAY
Foraging observations revealed that Great Bay was used extensively for foraging during the 1992 field season, especially at Moody Point and along the Squamscott River.

SLIDE#18: BAY SUNSET
Project staff are very hopeful that we will see an increased number of osprey breeding in the 1993 field season.