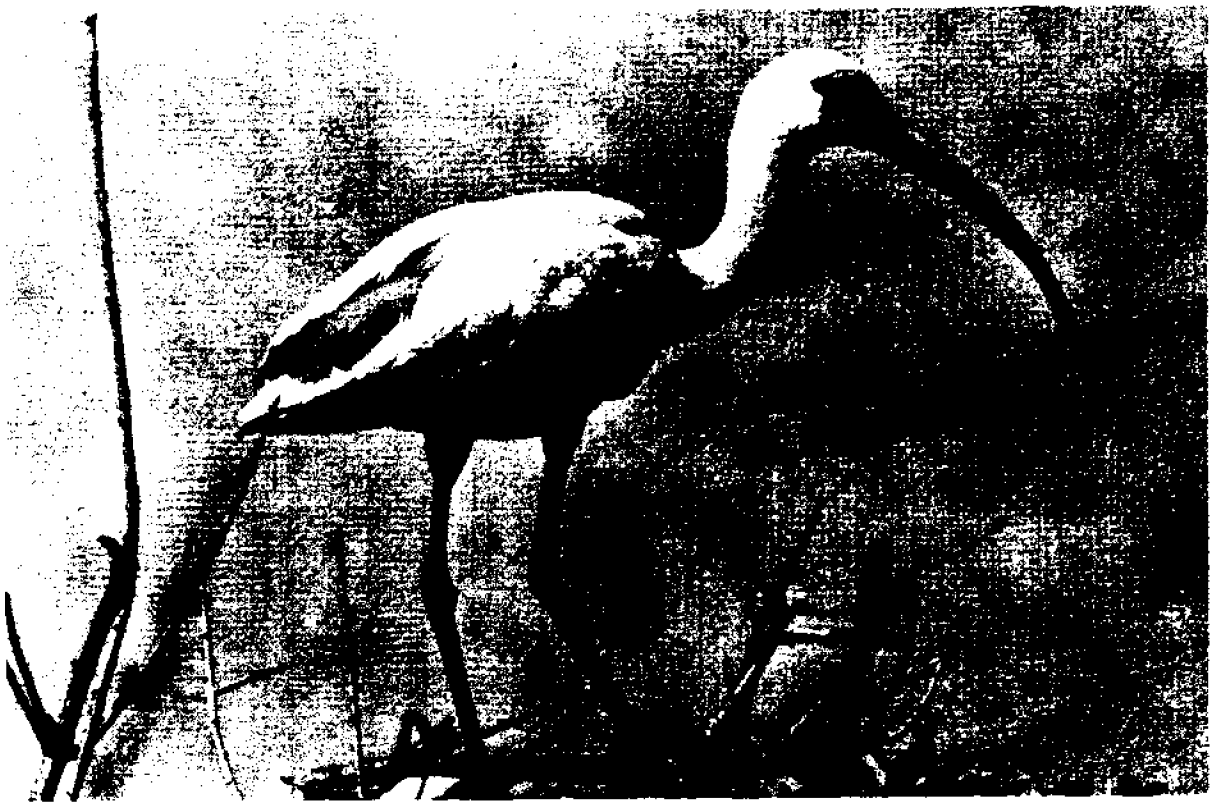
Atlas of colonial waterbirds of North Carolina estuaries

By James F. Parnell and Robert F. Soots, Jr.



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ATLAS

of

COLONIAL WATERBIRDS OF NORTH CAROLINA ESTUARIES

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Dr. Donald McCrimmon of the Laboratory of Ornithology, Cornell University and Dr. John Weske of the U. S. Fish and Wildlife Service read portions of the manuscript.

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INTRODUCTION

We began a project in 1970 designed to study community succession on dredged material islands in North Carolina. During that project, which lasted through 1974, we studied many dredged material islands containing bird colonies and became convinced that these man-made islands were exceedingly valuable bird habitats in the North Carolina coastal zone (Soots and Parnell 1975). We also discovered that many man-made changes were occurring or were planned that appeared likely to affect coastal bird populations. In addition, we found that there were no estimates of the numbers of birds nesting in the coastal area. It was therefore not possible to evaluate the effects of man's activities or proposed activities on coastal bird populations.

Upon completion of the study of community succession on dredged material islands, the North Carolina Sea Grant Program funded a study to determine the breeding population levels of the colonially nesting waterbirds in North Carolina estuaries. Colonial nesters were emphasized because they aggregate at nesting time and are therefore more vulnerable to man's disturbances than solitary nesters.

During that first season (1975) appropriate techniques were developed for censusing the 20 to 22 species suspected to be breeding in the state. In 1976 we began work on the first full set of censuses. Teams of professional biologists and student assistants visited every known colony site in the North Carolina estuaries and along more than 475 kilometers of beaches. The summer of 1976 was very wet, and reproductive cycles of many species were seriously disrupted by frequent heavy rains. While population estimates were made, we were not confident of the estimates made in 1976. We thus repeated the censuses during the 1977 breeding season. There was less rain during the summer of 1977, and breeding conditions were good for most colonial nesters. The 1977 census results appeared to be representative of current breeding populations, and these data are presented in this report.

The United States Fish and Wildlife Service in 1975 initiated a series of censuses of nesting populations of wading birds along the Atlantic Coast (Custer and Osborn 1977) which provided assistance in the formative stages of this project. In 1976 their survey included the ground nesting sea birds and again funded a portion of our data gathering effort. Late in 1976 the United States Army Corps of Engineers funded Dr. Parnell to study the effects of the diking of dredged material islands on coastal bird life in North Carolina (Parnell et al. 1978). During 1977 this project interacted closely with the Sea Grant supported study and allowed us to further expand our data gathering capabilities.

This atlas is the culmination of three years of direct study of colonial waterbird populations and the indirect result of eight years of

work on birds in the coastal zone of North Carolina and elsewhere. It was designed for the use of all who utilize the coastal zone. It is hoped that the atlas will provide information to the agencies working in the estuaries and on the barrier islands which will make them aware of the presence and nesting requirements of colonial nesting waterbirds during the early stages of planning processes.

If the value of this reference is to be maintained, it must be updated regularly. Bird colonies move in response to vegetational changes, erosion, and other factors. Thus, the usefulness of this atlas will diminish with time. Surveys conducted at five-year intervals should maintain the applicability of the information in this volume.

THE SETTING

North Carolina's estuaries and barrier islands extend about 500 kilometers from Virginia to South Carolina. The northern barrier islands are separated from the mainland by shallow open sounds up to 40 kilometers in width, while from Cape Lookout southward the sounds are generally less than two kilometers in width. The sounds are bordered on the east by narrow sandy barrier islands which are intermittently broken by inlets or river mouths (Fig. 1). Salt marshes generally fringe the shallow protected areas contiguous to the western shore of the barrier islands. Saltmeadow cordgrass and black needlerush are the dominant plants in the marshes north of Morehead City, while the southern marshes are dominated by smooth cordgrass. These differences in vegetation relate very much to differences in tidal amplitude. The large northern sounds such as Pamlico show little daily tidal range, while south of Morehead City water levels fluctuate from 1.0 to 2.0 meters daily.

The western side of sounds north of Morehead City generally border on a low mainland vegetated by saltmeadow cordgrass and black needlerush marshes and by shrub bog communities called pocosins. From about Morehead City south the mainland drops more abruptly from upland forests into the marshes.

The small natural islands scattered through the estuary appear to be of variable origin. Most are low in elevation and were formed by shoaling. They vary from small lumps of only a few square meters to islands of several hectares in extent. Most are in exposed locations, and erosion and frequent flooding maintain bare substrates or low halophytic plant communities. Grasses, shrubs or even forests sometimes develop in protected sites.

The Atlantic Intracoastal Waterway, dug through the North Carolina estuaries in the 1930s, resulted in the creation of many man-made islands composed of dredged materials. These islands occur in an almost unbroken chain from Morehead City south to the South Carolina state line. Dredging has also been an important factor in maintaining channels through inlets and to the major ports at Morehead City and Wilmington. This action has created characteristic grouping of islands on the sound side of most inlets and along the Cape Fear River from its mouth to the Wilmington harbor 40 kilometers upstream.

The climate along the North Carolina coast is moderated by the Atlantic Ocean. The mean monthly temperature is about 17°C with a mean annual low of 12.2°C, and a mean annual high of 21.7°C (averaged between Cape Hatteras and Wilmington United States Weather Bureau stations from Environmental Data Service 1976 a & b). Rainfall averages 140 cm annually. While rainfall is scattered throughout the year, amounts tend to be heaviest between June and September.

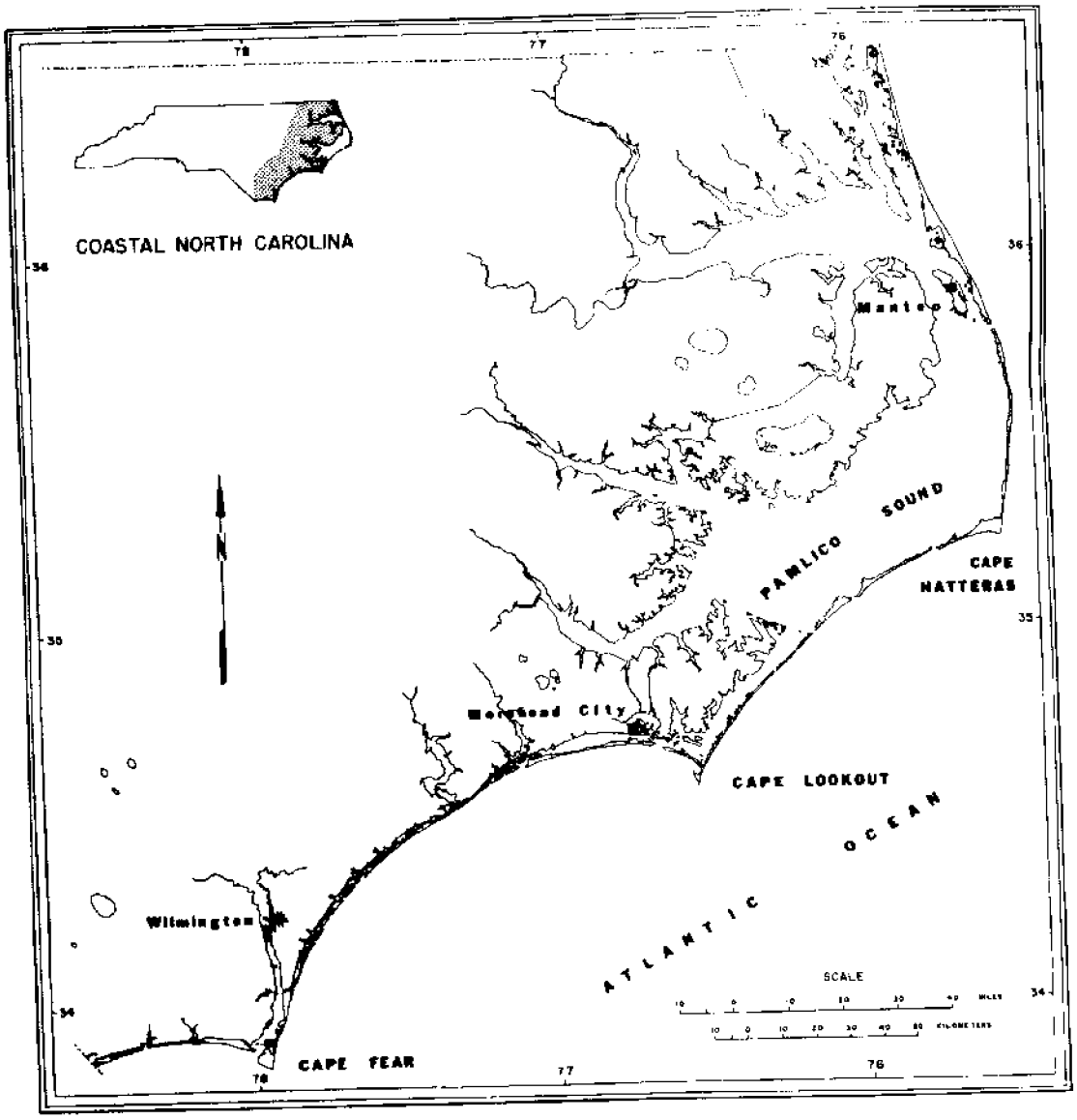

Fig. 1. Coastal North Carolina---the study area.

Major weather factors influencing bird populations are spring storms, locally called "northeasters," severe thunderstorms and hurricanes. During northeasters winds may exceed 20 knots for several hours or days resulting in severe beach erosion and flooding in the sounds as unusually high water levels are reached. Hurricanes have a strong influence on the structure and vegetation of coastal islands, but are infrequent and generally are of less direct influence on bird colonies than are northeasters which may occur during the late spring or early summer when birds are nesting.

HISTORY OF COLONIAL WATERBIRDS IN NORTH CAROLINA

Colonial waterbirds have undoubtedly nested along the North Carolina coast for thousands of years. The earliest reference to this group of birds appears to be an observation of a flock of white cranes by Captain Barlowe at Roanoke Island in 1954 (Pearson et al. 1919). These were undoubtedly egrets.

Plume hunters first entered the North Carolina nesting colonies in 1882. They continued collecting egrets and terns at least until 1903 when the first Audubon warden was appointed and began work in Pamlico Sound (Pearson et al. 1919). Least Terns were especially sought by the plume hunters, as their wings were of an appropriate size for use on women's hats. Pearson et al. (1919) reported that 10,000 skins of this tern were collected from Cobb's Island, Virginia, in a single season. Other terns were also utilized as were the plumes of several species of herons and egrets. The breeding plumes of the Great Egret, called "aigrettes," were especially sought. By 1900 most species of herons and egrets were very rare in North Carolina, apparently as the result of the activities of plume hunters (Pearson et al. 1919).

In 1905 the National Association of Audubon Societies was formed and a national effort was begun to protect the nation's spectacular bird life (Graham 1978). The protection of colonial waterbirds and their nesting sites was an important consideration. After several years of intense work, during which the Audubon Society hired game wardens to patrol nesting colonies in North Carolina (Pearson et al. 1919), colonial bird populations began to show a slow rise. By 1919 when T. Gilbert Pearson, the first president of the North Carolina Audubon Society, and C. S. and H. H. Brimley of the North Carolina Museum of Natural History wrote the first edition of Birds of North Carolina, populations of these waterbirds were beginning to increase. That volume provided the first public accounts of population levels for many of North Carolina's colonial birds. In 1942 Birds of North Carolina was updated as a second edition. It contained additional information on the slow recovery of numbers of colonially nesting waterbirds (Pearson et al. 1942).

A poorly documented, but important, event in the lives of these colonially nesting waterbirds was the construction of the Atlantic Intracoastal Waterway through North Carolina during the 1920s and 1930s (Hall 1975). This activity, plus the dredging of channels associated with coastal inlets and rivers, resulted in the creation of over 400 man-made islands in the North Carolina estuaries (Soots and Parnell 1975a). These islands provided much suitable nesting habitat for colonial waterbirds at a time when increased beach utilization and development of the barrier islands was eliminating much of the natural nesting habitat available to the colonial nesters. While clear documentation of the degree of use of dredged material islands by birds has not been available until recently (Soots and Parnell 1975a; Parnell and Soots 1978), it is very likely that

these islands have been exceedingly important in the recovery of populations of colonial waterbirds in North Carolina.

A number of workers have added to the knowledge of colonial waterbirds in North Carolina in recent years. Mr Harry Davis of the North Carolina Museum of Natural History banded pelicans, gulls, and terns on the coast for many years, and Dr. T. L. Quay and his students at North Carolina State University at Raleigh worked closely with coastal herons and egrets, and especially with the bird life of the Cape Hatteras and Beaufort regions. Dr. John Funderburg, while a graduate student at North Carolina State University, provided the first detailed census of colonial waterbirds of southeastern North Carolina (Funderburg and Quay 1959).

In recent years there has been an increased awareness of the problems of wildlife and especially the loss of wildlife habitat by human encroachment. This concern led to the passage in 1973 of the Endangered and Threatened Species Act by the United States Congress. This Act provided a strengthening of federal law for the protection of species that are in critical danger of becoming extinct. This in turn generated interest at the state level to determine the status of all birds so that they could receive additional protection if necessary. In 1975 the North Carolina Museum of Natural History, the North Carolina Department of Natural and Economic Resources, the North Carolina Wildlife Resources Commission, and the North Carolina Academy of Science sponsored a conference on Endangered and Threatened Plants and Animals in North Carolina. In preparation for this conference, a committee was appointed to study the status of all species of birds occurring in North Carolina and to make recommendations relative to their need for assistance. This committee recommended that most species of colonial waterbirds be considered "of special concern." This means that, while population levels are not known to be sharply declining in the state, close continuing observations are warranted. A special consideration was the fact that these birds often nest in dense aggregations. Species whose populations were adequate, but which nest in only a few dense breeding colonies, are much more subject to catastrophes than species of similar population levels which nest at many widely scattered locations. It is our opinion that most of the colonial waterbirds nesting in North Carolina have maintained relatively stable populations over the past few years. All, however, depend on relatively few breeding sites which are under man's control. Much of their recent success has been fortuitous and not based on any positive attempt by man to assist the birds. Care will be necessary in future years if populations are to be maintained at present levels or perhaps even increased.

BIOLOGY OF COLONIAL WATERBIRDS

The term "colonial waterbird" refers to those birds that are closely associated with aquatic habitats and which tend to nest in aggregations of from a few pairs to many thousands of pairs. Colonial waterbirds found in North Carolina include pelicans, cormorants, herons, egrets, ibises, gulls, terns, and skimmers. All, except the cormorants, characteristically nest primarily on islands within the estuaries or on the barrier beaches. They have been subdivided into colonial seabirds (pelicans, gulls, terns, and skimmers) and colonial wading birds (herons, egrets, and ibises).

Colonial Seabirds

Most of the colonial seabirds which nest in North Carolina are migratory. Most individuals of these species spend the winter in more southerly regions and return in the spring. Some species such as the Sandwich Tern begin courtship activities during migration and upon arrival are paired and ready to begin nesting. Most species begin courtship after they reach the breeding grounds and are not ready to begin nesting for several weeks after their arrival.

Several days prior to nesting, courting birds will generally gather at the nesting sites. Here further courtship may occur as the birds coordinate internal cycles in preparation for the beginning of the nesting process.

The gulls, terns, and skimmers that nest in North Carolina are ground nesters. Most nest on bare or nearly bare sandy or shell covered sites (Fig. 2). A few prefer sites vegetated by grasses and forbs (Fig. 3). They build very simple nests, often just a shallow saucer-like depression in the sand. In some cases a few bits of shell or sticks are added. The Brown Pelican, which may nest on the ground or in low shrubs, builds a bulky nest of sticks and debris.

Colonial seabird colony sizes and distances between nests vary. Royal Terns place their nests very close together (averaging more than 6 nests per meter^2), while Least Tern nests were often widely scattered (averaging 213 square meters per nest)(Jernigan *et al*. 1978). Royal Terns also usually nest in very large assemblages. The colony in the Cape Fear River contained more than 5000 nests in 1977. Least Terns, Gull-billed Terns, Common Terns, and Black Skimmers generally nest in colonies of a few pairs to several hundred pairs.

There are several interesting patterns of species association. Preferred sites often attract several species. Some regularly nest in mixed groupings. For example, Gull-billed Terns, Common Terns, and Black Skimmers often nest in loosely mixed aggregations. They prefer similar habitats and are not disturbed by other species nesting nearby. In fact, Black Skimmers, which are not very aggressive, may seek the

Fig. 2. Typical bare nesting site preferred by colonial nesters such as the Royal, Sandwich, and perhaps Least Terns.

Fig. 3. Sparsely vegetated site preferred by ground nesting species such as Common Terns or Gull-billed Terns.

association of the much more aggressive Common Terns (Erwin 1977). On the other hand, Least Terns almost never nest in close association with other species. They may nest on the same island with others, but will generally separate their colony sites from other species and are very aggressive toward intruders.

An interesting nesting association exists between Sandwich and Royal Terns. Sandwich Terns always locate their nests within Royal Tern colonies. In other parts of the world, they associate with other species in a manner similar to their association with Royal Terns in North America (Camp et al. 1974, Langham 1974).

Most of these colonial seabirds lay one to four eggs. Royal and Sandwich Terns generally lay one egg, sometimes two, while most others lay from one to four eggs with clutches of two or three being most common. Incubation periods range from 19 days in the Least Tern to 28 days in the Brown Pelican (Palmer 1962). The young of all species, except the Brown Pelican, are relatively well developed at hatching (semi-precocial or precocial). Gull and tern chicks generally remain in the nest for only a few days and then may move about over the colony site. Royal and Sandwich Tern chicks form large groups called creches which roam over the colony site and surrounding terrain, specially bare shorelines. Brown Pelicans are hatched blind and naked (altricial) and require three to four weeks of development before they leave the nest (Palmer 1962).

The usual food for young seabirds is small fish or crustaceans. The Gull-billed Tern is an exception, feeding heavily on terrestrial arthropods. Terns transport food items in their beaks and pass them directly to the young. Gulls generally swallow the food which is later regurgitated for the young. Brown Pelican young often thrust their beak deep into the crop of the parents to obtain food.

Young terns and gulls grow rapidly. Young Least Terns are ready for their first flight in about 21 days (Hardy 1957), while the much larger Herring Gull juveniles may require seven to eight weeks to attain flight (Haycock and Threlfall 1975). Brown Pelican chicks develop more slowly and do not reach flight until nine weeks have passed (Palmer 1962).

After young birds attain flight they continue to return to colony sites to be fed, to rest, and to roost. This use may continue for several weeks until the young gain independence of the adults and drift away from colony sites.

Young birds often wander widely in late summer and early fall, and this is the season when they are often observed far from normal habitats and ranges.

As autumn cold fronts arrive, migrant species move toward wintering grounds. Use of colony sites as resting and roosting areas may continue

Table 1. Summary of Period of Colony Occupation With an Indication of the Peak of Incubation for Colonial Waterbirds Nesting in North Carolina.

Species	Period of Colony Occupation	Peak of Incubation		Incubation Period[2] (days)
		Southeastern N. C.	Northeastern N. C.	
Brown Pelican	March to Sept.	NA[1]	NA[1]	28
Great Egret	March to Aug.	15-30 Apr.	1-15 May	23-24
Snowy Egret	April to Sept.	1-15 May	7-21 May	21-24
Louisiana Heron	April to Sept.	1-15 May	1-15 May	23-25
Little Blue Heron	April to Sept.	15-30 Apr.	7-21 May	22-25
Green Heron	April to Aug.	15-30 Apr.	1-15 May	19-21
Black-crowned Night Heron	March to Aug.	15-30 Apr.	1-15 May	24-26
Cattle Egret	April to Oct.	1-15 May[1]	15-30 May[1]	22-23
Glossy Ibis	April to Sept.	1-15 May	7-21 May	21
White Ibis	March to Aug.	15-30 Apr.	NA[3]	21-23
Herring Gull	May to Sept.	NA[3]	1-15 June	26
Great Black-backed Gull	May to Sept.	NA[3]	1-15 June	26-28
Laughing Gull	April to Aug.	20-31 May	7-21 June	20
Gull-billed Tern	May to Aug.	20-31 May	1-15 June	22-23
Forster's Tern	May to Aug.	NA[2]	1-15 June	23
Common Tern	May to Sept.	21 May-7 June	1-15 June	21
Least Tern	April to Sept.	21 May-15 June	1-15 June	19
Royal Tern	April to Aug.	7-21 May	15-25 May	30-31
Sandwich Tern	April to Aug.	7-21 May	15-25 May	20-23
Caspian Tern	May to Aug.	NA[3]	15-25 May	20
Black Skimmer	May to Oct.	1-15 June[1]	1-15 June[1]	23-25

[1]Nesting period prolonged, initiation of incubation erratic, several censuses required.
[2]Species does not nest in this sector.
[3]Incubation periods referenced in species accounts.

during this season. Numbers may remain high as local populations are supplemented by migrants from farther north.

Least Terns move south early. They are seldom seen in North Carolina waters after late summer. On the other hand, it may be late December by the time Laughing Gulls depart the state.

Some species continue to be present throughout the winter. We do not know whether these are the same birds that nested here or whether local nesters go further south to be replaced by others from more northerly areas. Some Brown Pelicans, Royal Terns, Caspian Terns, and Forster's Terns remain in North Carolina throughout the winter. Herring and Great Black-backed Gulls become more abundant during the winter.

Colonial Wading Birds

Ten species of colonially nesting wading birds breed along the North Carolina coast.

Most of the herons, egrets, and ibises are rather early breeders, and by late March or early April they begin to assemble at colony sites. Some individuals may have actually roosted at the colony sites through the winter. Often Great Egrets and Black-crowned Night Herons will be the first species to begin nesting, but other species will generally be close behind.

Most courtship takes place at the colony sites. Courting birds will often be present at a site for several days or even weeks prior to the beginning of nest building.

Nesting habitat requirements for herons, egrets, and ibises are quite different from those of gulls and terns. Most waders nest in dense thickets of shrubs and low trees (Fig. 4). In North Carolina wax myrtle, silverling, marsh elder, bayberry, and red cedar are most commonly utilized. Colonies will occasionally become established, however, in dense stands of giant cordgrass or phragmites or in dense mixtures of salt-meadow cordgrass and sea ox-eye daisy. Nests will range in elevation from the ground to 20 meters high in trees.

Nests of herons and egrets are generally flimsy stick platforms. Nests of the ibises are similar but more elaborate. Often nest contents can be determined by peering up through the bottom of the nest.

Waders generally lay from one to five eggs per clutch with three or four eggs being usual (Palmer 1962). All herons and egrets lay pale blue eggs and several are difficult to identify to species. The Glossy Ibis lays a bright blue egg, and the White Ibis lays a whitish-tan egg heavily speckled with darker reddish-brown markings.

Fig. 4. Three dimensional aspect of heron and egret nest placement in a shrub thicket.

Since most wading bird nesting colonies (often called heronries) are three dimensional, nest placement is more complex than with the ground nesters. In most colonies, nests will be placed from near ground level to the top of the available vegetation.

Nests of several species are often closely intermingled without apparent order. Studies do indicate that some species have preferences for slightly different nest sites (Burger 1978, McCrimmon 1978), but this is often not readily apparent.

The earliest Great Egrets and Black-crowned Night Herons may begin laying eggs in late March in southeastern North Carolina. Most of the other herons and ibises will soon follow and nesting may be well underway by late April. The Cattle Egret may, however, delay the bulk of its nesting until early summer. In the northern heronries the schedule may be as much as a month later than in the more southern colonies.

In typical years at most sites nests will continue to be started well into June. If Cattle Egrets are present nests may continue to be started into August. Some of these late starts appear to be renesting

attempts by birds that have had their initial nests destroyed. Others apparently are simply late nesters. The proportions are unknown but late nesting numbers are much greater during years when early nest failures are obvious, as when spring storms occur.

All of the wading birds are semi-altricial (the young are born blind, with some down feathers, and are helpless), and incubation periods are between 17 and 24 days (Palmer 1962). The young grow rapidly and in a few days will leave the nest if disturbed and attempt to climb about in the supporting vegetation. This is a critical period in the life of waders, because when young birds fall to the ground they are seldom able to return to the nest. Such young birds are generally not fed by the parents and will soon die. As young waders approach flight age, they often leave the nests and move into the tops of the vegetation. At between three and six weeks of age they generally attain flight capabilities (Palmer 1962). They then begin to make short flights out from the colonies but return to be fed, to rest, and to roost.

Adult waders may forage several miles from the colony site gathering food. When they return they regurgitate the food for the young. Most herons, egrets, and ibises feed on a variety of small fishes, crustaceans, and worms. The Cattle Egret is, however, primarily insectivorous, feeding on such foods as grasshoppers gleaned from nearby pastures and fields.

Young wading birds, like young gulls and terns, often wander widely in late summer and early fall. As the weather turns colder most move southward for the winter. Reduced members of all species, except the Green Heron, remain in the coastal marshes of North Carolina throughout the winter, and some may continue to roost at the breeding sites.

MANAGEMENT OF COLONIAL WATERBIRDS

The concept of managing populations of animals goes back at least to Mosaic Law. In more recent years the concept of maintaining or increasing populations of game species has been widely accepted and practiced. Such management has almost always involved the idea of providing excess animals for "taking" by hunters or fishermen or to attempt to rescue species in danger of extinction.

The idea of managing "non-game" species has only recently become widespread. Initially this management consisted only of the protection of species through laws which restricted the killing of individuals. Thus, most migratory birds are protected by international treaty whether or not they are "game" species. The protection of nesting places has been closely associated with this concept. This has been a major goal of the sanctuary program of the National Audubon Society since 1904 (Anderson 1978). Very recently, efforts to manipulate environments to provide more or better habitat for non-game species in need of management have begun.

Historically then, management of non-game species generally first involved a determination that there was a danger of the number of individuals declining or that, in fact, numbers were known to be declining. This has been followed by the protection of critical habitat elements, the manipulation of habitat, and, if all of these failed, the breeding of captive stock.

The first step in determining whether or not management was needed for colonial waterbirds was to inventory populations and to correlate findings with the basic biology of the species. In our study of the breeding populations of colonial waterbirds in North Carolina a variety of census techniques were used.

Census Techniques

The first aspect of the censusing of nesting colonial waterbirds is to locate all colony sites. This was accomplished by aerial survey. A Cessna 170 aircraft was used, and, at altitudes of 200 to 500 feet, all colonies could be located, except those of the Least Tern. The small size of Least Terns required very low level passes over apparently suitable habitat, and at times ground checks were necessary to verify the presence of colonies. Generally, a pilot and two observers were utilized in the aerial surveys, and coastal NOAA charts were used to plot sites. Flights were made over all North Carolina beaches and estuarine islands. The location and species composition of each colony was recorded. This survey generally required about 16 hours of flight time.

Numbers of most species could not be determined from the air, and ground visits to each site were necessary. Royal and Sandwich Terns could be censused through the use of aerial photography. These birds generally nest in large, compact colonies on bare or nearly bare sites and are easily visible from above. These colonies were photographed from alti-

tudes of 400 to 500 feet with 35 mm cameras using black-and-white film. The resulting photographs when enlarged to 11 x 14 inches allowed individual incubating birds to be counted. When compared to total ground counts this generally has been accurate within five percent. We also established that Royal and Sandwich Tern colonies in North Carolina averaged about 6.5 nests per square meter, so if the colony area can be determined (either from photographs or from ground measurements), colony size can be easily estimated. These techniques do not allow separation of Royal and Sandwich Terns, thus a combined total is obtained. Ground counts are necessary to determine the number of nests of each species.

There is also some promise for estimating numbers of Black Skimmers and Forster's Terns by aerial means, but these techniques have not proven completely satisfactory to date.

Ground visits were necessary to achieve accurate counts for all species other than Royal and Sandwich Terns. Access to colony sites was by boat or, in some cases, by four-wheel drive vehicles or on foot. All sites were visited at least once and most were visited two or three times. The timing of initial censuses was at the peak of the first surge of incubation. This varied with the species and with the north-south distribution of colonies in the state. Subsequent counts were made at intervals slightly longer than the incubation periods of the species involved (Table 1). All nests containing eggs on subsequent visits will thus represent nests started since the last visit. Censuses can then be repeated until no nests with eggs are found. On these secondary visits only nests with eggs were counted. These were added to previous totals. This technique obviously did not separate new nesting efforts from renesting attempts and resulted in some lack of precision. During dry years renesting is minimal and estimates should be relatively accurate. During wet years many nests are destroyed and renesting may be heavy. In such years census data obtained as described above will be less reliable. A second possible technique is to count only once at the peak of the incubation period and to use the resulting values as indices. Both systems require some subjective evaluation on the part of the observer and require a knowledge of the biology of the species being counted.

Most colonies of gulls, terns and skimmers contained no more than 100 to 200 nests and were on bare or sparsely vegetated sites. Total counts were thus possible. In such cases observers walked slowly through the colony site and counted all nests. If necessary, repeated crossings were made with each observer counting a strip three to five meters wide marked by dragging a foot across the sandy substrate. At such times it is also feasible to record nest contents and thus obtain additional data. With two or three observers, colonies of up to 300 to 400 nests could be censused in 15 to 30 minutes. This technique was regularly used in colonies of Black Skimmers, Common Terns, Gull-billed Terns and Least Terns.

In colonies containing several hundred nests or in colonies where dense vegetation concealed the nests, total counts were achieved by counting

nests within narrow strips marked by hanging surveyors flagging along strip perimeters. The flagging was removed after censuses were completed.

Sample counts were necessary in ground nesting colonies of over 1,000 nests or in colonies covering as much as two or three hectares. This was necessitated by time constraints for working in nesting colonies.

No colony should be disturbed during the middle of a hot summer day or on a cool rainy day, and disturbances at any time should be kept to a minimum. Any technique used should be designed to keep disturbances at specific nests no more than 10 to 15 minutes and should be done under weather conditions that will not endanger eggs or chicks.

Two methods of sampling large colonies of ground nesting birds were utilized and found satisfactory. Both required that the area occupied by the colony be determined first. This was done either by actual field mapping or by the use of aerial photographs. Vertical aerial photographs of colony sites were enlarged and carried into the field. Generally a scale could be established by field measurement between topographic features visible on the photograph and measurable at the site. Loss of accuracy due to distortion at the edge of photographs was considered insufficient to cause significant error. The area occupied by the colony could then be determined with the use of a planimeter. Sample areas were then counted in the same manner as in smaller colonies. Generally regularly spaced strips were counted to assure that all portions of the colony were represented in the sample.

A second sampling technique was adapted from a method developed for estimating the density of trees. It is known as the point-quarter method (Cottam and Curtis 1956). This method involved the determination of the average area occupied by each nest and a projection of this value over the entire area occupied by the colony. Using this technique the colony was mapped and a series of bissecting lines established. The distance between lines depends on colony size, but was usually 10 to 20 meters. Forty points were then randomly selected along these lines. Each point was considered as the center of an imaginary quadrat divided into four sectors. The distance from the central point to the nearest nest in each quadrat was measured and recorded. The square of the average for all measurements provided an estimate of the average area occupied by a nest. This value was then divided into the total area occupied by the colony to produce an estimate of the number of nests present. This technique worked well in large Laughing Gull colonies where dense low vegetation made total counts too time consuming. About two hours were required to complete such an estimate, but this did not involve disturbance of the whole colony for the entire period. A basic assumption of the technique is that the nests are randomly distributed. It was most successful when vegetation was relatively uniform. The technique underestimates the number of nests when their distribution is clumped.

Censusing the mixed species wading bird colonies posed several problems

not encountered with the ground nesting seabirds. Wading birds generally nested in thickets and thus had a three-dimensional nest distribution. In some cases nests were too high to be investigated, due to the flimsy nature of the vegetation, and such nest by nest investigation was also quite time consuming. In addition, it was difficult under field conditions to make positive identifications among Louisiana Heron, Little Blue Heron, and Snowy Egrets eggs (all are pale blue and about the same size and shape), or between small downy Snowy Egret, Cattle Egret, and Little Blue Heron chicks (all are white and of similar form). A technique was devised which involved total nest counts but with the addition of "unknown nest with eggs" and "unknown nest with small downy chicks" categories. Total nest counts were made by traversing the colony with a group of observers. Each observer reported nests within his sample strip by species and nest contents to a recorder. Surveyor's flagging was used to mark the area counted during each pass through a colony.

At the completion of the count, nest totals were available for all species whose nests were identifiable. In addition, totals of "unknown nests with eggs" and "unknown nests with young" were available. Upon completing the census, sample counts were made of adult waders over the colony. It was then assumed that unknown nests were in proportion to adults counted. If 50 percent of the adults counted in the samples were Little Blue Herons, 50 percent of the unknown nests were considered to be Little Bule Heron nests. It was established by sample counts that the ratio of herons present to nests was nearly one to one during incubation, so apportionment of unknown nests with eggs was probably very accurate. Apportionment of nests with small downy young may have been less accurate if ratios of adults to nests varied between species. This technique does, however, provide a reasonably efficient method which was easily repeatable from site to site and from season to season. Further refinement of the technique is needed.

There are several additional factors that must be taken into account in censusing colonial waterbirds in North Carolina. First, it is important to make the initial census at the peak of incubation (Table 1). At this time adults are not easily disturbed and damage is minimized. The most critical times for censusing ground nesting birds are when the young are just hatching or after chicks are large enough to leave the nests. Hatchlings cannot regulate their body temperature efficiently during the first days after hatching and are susceptible to heat stress. Chicks that leave nests and wander into adjacent territories are also likely to be injured by attacks from nearby adults. The most dangerous time for censusing wading bird colonies is when chicks are between one and three weeks of age. At this age they will often attempt to climb out of the nest when disturbed. Such chicks are often not yet agile enough to climb about successfully and fall to the ground. These birds usually die.

It is therefore very important to census ground nesting colonies initially at the peak of incubation. Wading bird colonies can be censused at this time or when the young are very small if weather conditions permit.

Counts subsequent to the initial census were often difficult due to the variety of age classes present. In such cases the observer must use careful judgment as to whether a complete census is possible without undue disturbance or whether less accurate estimates are in order. The well-being of the young birds should always be the first concern.

Management Methods

When censuses indicate that populations are low or declining, it may be determined that management is necessary. Censuses correlated with a knowledge of the biology of the species in question may also indicate a dependence by certain species on an environmental factor already known to be strongly regulated by man. In such cases this awareness may allow continued management by design rather than by accident and may prevent declines in numbers. This is clearly the case with the dependence of many species of nesting waterbirds on dredged material islands in North Carolina. In 1977, 79 percent of all colonial waterbirds nested on man-made or man modified sites (Table 2). Management has been occurring for years incidental to dredging operations in the estuaries. Should this management cease, populations levels of most species of colonial waterbirds would be expected to decline.

All of the colonially nesting waterbirds are protected as migratory birds by Migratory Bird Treaties. Thus the killing of these birds is illegal, and the first step in their management has been taken. A few nesting sites are in public ownership and receive management in the form of protection. For example, all colonies of beach nesting terns within the Cape Hatteras National Seashore were posted in 1978. A few privately owned sites also are carefully protected by interested owners. The U.S. Corps of Engineers usually has disposal easements and does not own the islands on which dredged materials are deposited. Ownership of most island sites in North Carolina is uncertain, however, and no protection is provided to the nesting colonial birds. Public or private agency ownership may be needed for some additional sites. Protection at many sites can occur without public ownership if agencies which control or utilize the sites or agencies which have authority to protect migratory birds will accept the necessary responsibility.

An important kind of management is the prevention of disturbance at active colony sites. Most colony sites are occupied by courting or nesting birds from early spring through late summer. See Table 1 and the species accounts for the time frame for each species. During this period there should be no major human activities at active nesting sites. The deposition of dredged materials and regular vehicular traffic especially should be avoided. Some colony visitation may be necessary during the reproductive period. In such cases visits should be of short duration under weather conditions which will not cause stress to eggs or young. See Soots and Landen (1978) for further details.

The actual management of habitat is still largely in the research stage. However, any technique that creates or maintains appropriate substrate

Table 2. Numbers of nests of colonial waterbirds in 1977 by species and site type.

	Mainland Sites	Barrier Beach Sites	Natural Estuarine Island Sites	Man-made/ Modified Sites	Totals
Brown Pelican	0	0	0	101	101
Great Blue Heron	0	0	0	1	1
Great Egret	0	0	61	438	499
Snowy Egret	0	0	46	1027	1073
Louisiana Heron	0	0	112	1523	1635
Little Blue Heron	0	0	92	713	805
Green Heron	0	0	13	77	90
Black-Crowned Night Heron	0	0	12	235	247
Yellow-Crowned Night Heron	0	0	0	2	2
Cattle Egret	0	0	230	1371	1601
Glossy Ibis	0	0	34	386	420
White Ibis	0	0	0	1951	1951
Herring Gull	0	0	15	475	490
Great Black-Backed Gull	0	0	0	10	10
Laughing Gull	0	0	4288	8228	12516
Gull-Billed Tern	0	96	1	524	621
Forster's Tern	0	146	935	324	1405
Common Tern	0	1008	618	3270	4896
Least Tern	99(79)[1]	896	22	1349	2366
Royal Tern	0	0	1392	15316	16708
Caspian Tern	0	0	0	10	10
Black Skimmer	0	664	29	1232	1925
Sandwich Tern	0	0	94	1847	1941
Totals	99	2810	7994	40410	51313
Percent	01	05	16	79	100

[1]Two mainland colonies (79 nests) were on dredged materials.

and vegetation on sites which receive protection from interference by humans and mammalian predators will likely be used by colonial birds. Sites which are near inlets or in or near river mouths are especially likely to be occupied. Table 3 provides a listing of habitats and periods of use (Soots and Parnell 1975) for each species of colonial waterbird nesting in the North Carolina estuaries.

The primary tool available at present for the maintenance of habitat is the deposition of dredged materials. When dredged materials are deposited bare sites generally result. Such sites will then revegetate passing through a series of predictable stages of succession each of which may provide nesting habitat for different species of nesting birds. The details of this pattern will vary especially depending on the presence or absence of dikes (Figs. 5 and 6). See Soots and Parnell (1975) and Parnell et al. (1978) for detailed discussions of this process.

It is important that a series of sites suitable for all species be scattered along the entire coast of North Carolina. For example, bare sites, sites sparsely vegetated by herbs, sites moderately vegetated with herbs, and thicketed sites should be maintained in the vicinity of all inlets and river mouths where studies indicate that concentrations of colonial birds usually occur. See the Species Accounts for specific recommendations.

Soots and Landen (1978) provide an extensive discussion of management of dredged material sites for birds. This should be carefully studied by anyone anticipating active management of dredged materials for nesting birds. Buckley and Buckley (1976) provide recommendations for management with special reference to colonies on public lands.

Little research has been done to date on the maintenance or creation of habitat for colonial waterbirds by means other than the management of dredged materials. Most management recommendations have been based on an interpretation of incidental management or on expectations based on a knowledge of the biology of the species. It has been demonstrated that chemicals may be effective in the control of vegetation on dredged material island sites (Worsham et al. 1974), and the physical removal of vegetation has been successful in a few instances such as Gull Island in Long Island Sound, New York (Harwood 1976), and in the Laguna Madre in Texas (Chaney et al. 1978). The testing of such management techniques is the major goal of a current research project, and by the early 1980s we expect to be able to recommend specific habitat manipulation techniques for the maintenance of the most important habitats of colonial waterbirds in North Carolina.

Table 3. Nesting habitats, earliest year of invasion, and estimate of the useful life of nesting sites for colonial seabirds without further modification.

Earliest year of Invasion	Species	Typical Nesting Habitat	Estimated Period of use (years)
1	Black Skimmer	Bare sand to moderate cover of herbs	7
2	Least Tern	Bare sand and shell to 10% cover of low herbs	4
2	Royal Tern	Bare sand to sparse cover of herbs	4
2	Sandwich Tern	same as above	4
2	Gull-billed Tern	Bare sand (with drift material or shell) to moderate herbs	6
2	Common Tern	Bare sand or shell to moderate cover of herbs	6
3	Forster's Tern	Drift material surrounded by moderate to dense marsh grasses	?[1]
5	Herring Gull	Sparse to dense herbs clumped	5
5	Laughing Gull	Moderate to dense herbs	10
10	Herons and Egrets[2]	Dense herbs with scattered shrubs to maritime forests	30+
10	Glossy Ibis	as above	30+
20	White Ibis	Shrub thickets to maritime forests	30+

[1]Once established such marshes may persist indefinitely. The presence of drift materials varies from year to year.

[2]Includes Cattle Egret, Great Egret, Green Heron, Little-blue Heron, Snowy Egret, and both Night Herons.

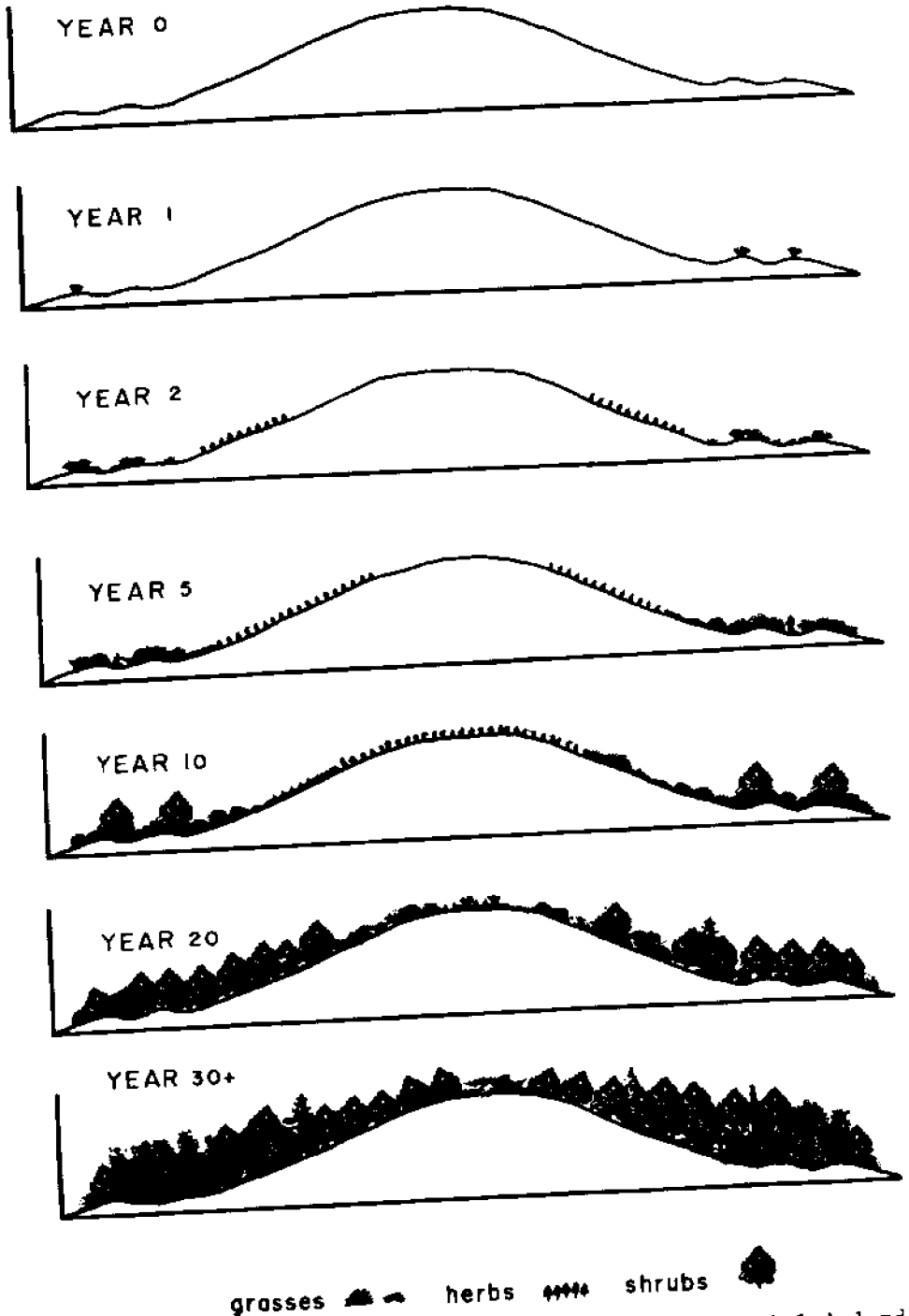

Figure 5. Plant succession on undiked dredged material islands (Soots and Parnell 1975)

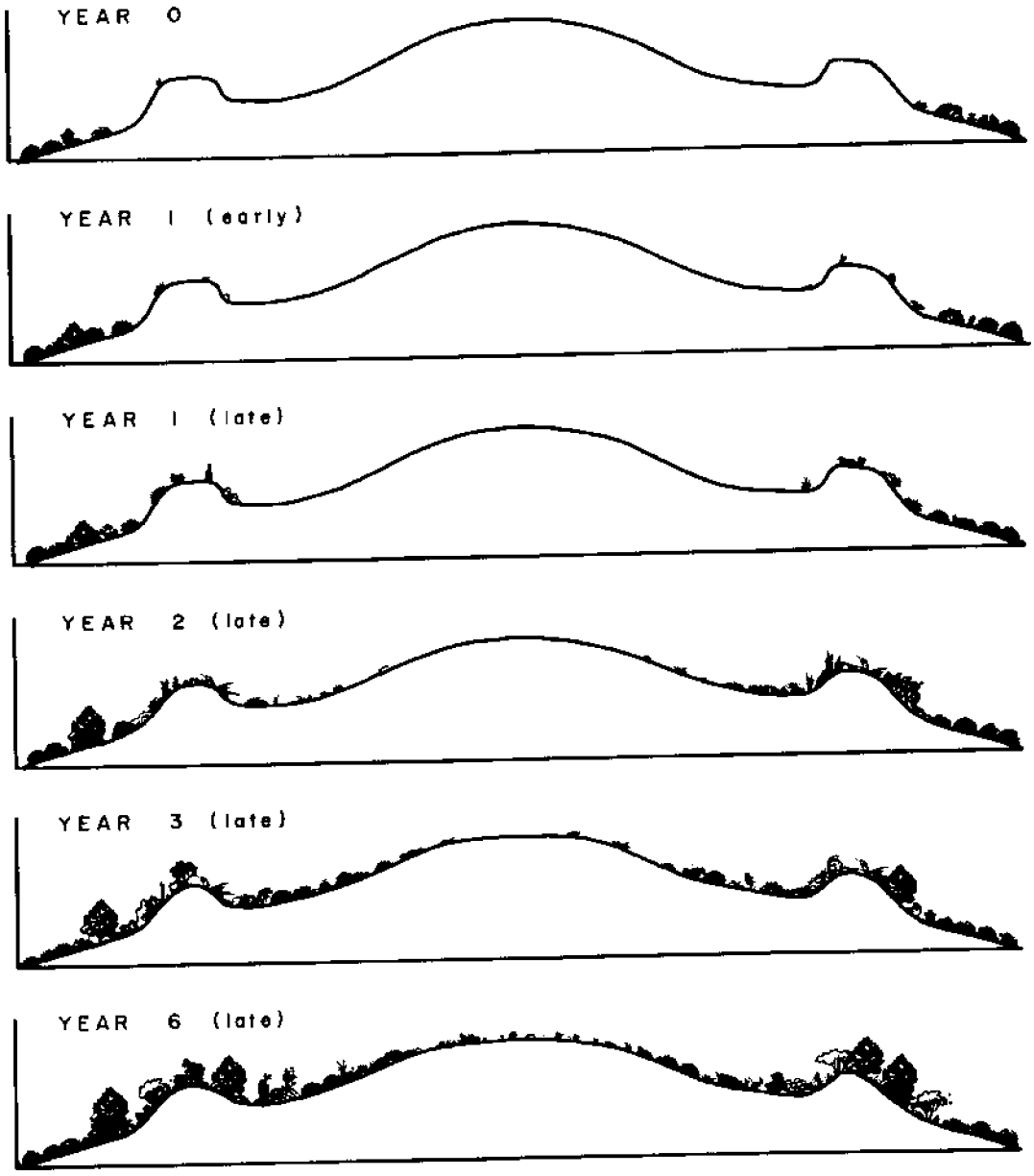

Figure 6. Plant succession on diked dredged material islands (Parnell et al. 1978)

SELECTED REFERENCES

There are a number of references that will be helpful to a reader wishing to become familiar with the biology and management of colonial waterbirds.

Volume One of the Handbook of North American Birds by Ralph Palmer (1962) provides detailed accounts of the life histories of wading birds. It summarizes almost all of the information published prior to its appearance. For lengthly anecdotal accounts which contain much usable information, refer to Life Histories of Marsh Birds by A. C. Bent (1926), and to Life Histories of North American Gulls and Terns by A. C. Bent (1921). Both the 1919 and 1942 (revised in 1959) editions of Birds of North Carolina (Pearson et al. 1919, Pearson et al. 1942, and Pearson et al. 1942 revised by Wray and Davis 1959), provide accounts of colonial waterbirds in North Carolina that give the reader insight into populations and distributions in North Carolina at earlier times. Wading Birds (1978) edited by Sprunt, Ogden, and Winckler provides an excellent review of current research on wading birds.

For reference to the current status of North Carolina birds refer to Endangered and Threatened Plants and Animals of North Carolina by Cooper et al. (1977).

Further information on the management of colonial waterbirds in North Carolina can be found in Proceedings of a Conference on Management of Dredge Islands in North Carolina Estuaries (Parnell and Soots, Eds., 1975), in Development and Management of Avian Habitat on Dredged Material Islands by Soots and Landen (1978), in The Use of Dredge Islands by Wading Birds (Parnell and Soots 1978), and in Plant Succession and Bird Utilization on Dredged Material Islands in North Carolina Estuaries by Parnell et al. (1978).

For the latest information on nomenclature refer to The Checklist of North American Birds, Fifth Edition (AOU 1957) and its 1973 and 1976 supplements.

SPECIES ACCOUNTS

This section contains information on identification, range, taxonomy and status, 1977 North Carolina breeding populations, and management of each species of colonial waterbird nesting in the North Carolina estuaries.

Photographs and short statements provide assistance with the identification of each species. For further help refer to field guides such as A Guide to the Birds (Peterson 1947) or Birds of North America (Robbins et al. 1966).

The worldwide and North American ranges of each species are outlined to give the reader an indication of how the North Carolina population fits into the total range of the species. North America is defined as North America north of Mexico to be consistant with the Checklist of North American Birds (AOU 1957). Information on taxonomy and status are provided for similar reasons.

The population data for 1977 provide a summarization of present breeding numbers and indicate the level of use of natural and man-altered nesting habitats by each species. Nesting habitats are grouped as barrier beaches, natural estuarine islands, and man-made/modified sites. Beaches include sites on the open barrier beach or on sand flats behind the barrier dunes. Such sites may be natural or may have been modified by dune building, off-road-vehicle travel, or other human activity. Site conditions were not clearly separable into natural and modified conditions and no effort was made to do so. Natural estuarine islands referred to sites not constructed or modified by dredged material deposition or modified by other major human impacts such as building construction. Most man-made/modified sites were those created or modified by dredging. A few sites were modified by the construction of buildings, the deposition of ballast rocks, or other factors.

The section on population trends provides a historical perspective against which one can view the current population data and status of each species.

The breeding biology of each species is outlined with emphasis on those facts of importance to individuals or agencies working with coastal ecosystems. The expected dates of colony occupancy, habitat preferences, and other pertinent features of the breeding biology of each species is provided. Critical aspects of the breeding cycle are discussed when known.

Management recommendations are made for each species or related groups of species where such specific recommendations are presently possible.

BROWN PELICAN (Pelecanus occidentalis)

Fig. 7. Incubating Brown Pelicans.

Identification

Adult Brown Pelicans are easily identified, having white heads and dark bodies. The only other North American pelican, the White Pelican, has a white body with dark wing tips. Immature Brown Pelicans have dark heads and bodies.

Range

Worldwide: Breeds along the coasts of North America, Central America and northern South America (AOU 1957).

North America: Breeds along the coast of California, along the Atlantic coast from North Carolina to Florida, and across the Gulf coast from Florida to Texas (AOU 1957).

North Carolina: Breeds in southeastern Pamlico Sound and on the Cape Fear River. Brown Pelicans occur along the entire coast at all seasons.

1977 Colony Sites: 11-06, 11-07. 1978 Colony Sites: 11-04, 39-35.

Taxonomy and Status

Two subspecies of Brown Pelicans occur regularly in North America. The subspecies nesting on the Pacific coast is Pelecanus occidentalis californicus. The subspecies nesting on the Atlantic and Gulf coasts is P. o. carolinensis. Both are on the Federal List of Endangered Species.

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	2	100	101	100
Man-made/Modified Sites	0	0	0	0
Totals	2	100	101	100

Population Trends

This species has undergone recent declines in numbers throughout much of North America. It was first recorded nesting in North Carolina in 1929 when 14 nests were counted on Royal Shoal in Pamlico Sound (Pearson et al. 1942) near the 1977 colony sites. The known history of this colony is given below (adapted from Parnell and Soots 1976).

The History Of The Brown Pelican Nesting Colony Near Ocracoke, North Carolina.

Year	Date	Nests With Eggs	Juv.	Adults	Site	Source
1929	?	14?	?	?	Royal Shoal	Pearson, et al. (1942)
1947	6 Aug.	14	33	55	Shell Island	Wolff (1947)
1948	19 July	0	0	225	Castle Rock	Shaftesbury (1949)
1948	6 Aug.	0	0	200	Ocracoke vicinity	Shaftesbury (1949)
1957	7 Aug.	35	87	162	Shell Island	Wolff (1958)
1958	?	100+	?	500	Shell Island	Quay (1959)
1959	?	?	116	?	Shell Island	Davis (1960)
1960	29 June	6	85	?	Shell Island	Davis (1960)
1961	8 July	2	51	?	Shell Island	Davis (1961)
1965	4 July	?	77	70	Shell Island	Grey (1965)
1970	7 July	?	31	68	North Rock	Steiner (1970)

Year	Date	Nests With Eggs	Juv.	Adults	Site	Source
1972	23 June	30	17	130	North Rock	Parnell & Soots (1976)
1973	30 May	30	22	115	North Rock	Parnell & Soots (1976)
1974	11 June	41	53	69	North Rock	Parnell & Soots (1976)
1975	2 June	47	0	84	North Rock	Parnell & Soots (1976)
1975	5 Aug.	0	39	175	North Rock	Parnell & Soots (1976)

The colony has likely been present every year since at least 1929, but has apparently moved several times as island suitability has changed. It is very difficult to project population trends from the available data, but at least there is no clear downward trend.

In 1978, a new colony was established on the Cape Fear River near Southport, North Carolina. This was the first recorded instance of Brown Pelicans nesting in North Carolina at a site other than in Pamlico Sound.

Breeding Biology

Breeding Phenology: By late March nests have been built and eggs laid in North Carolina. We also found, however, that nests with eggs were still present as late as early June. The incubation period for the Brown Pelican is about 4 weeks and the young birds first fly at about 9 weeks (Palmer 1962). Colony sites are thus occupied from March through August.

Critical Features: Sites 11-04 and 39-35 were low in elevation. Island erosion was occurring and losses due to flooding during periods of storm tides appeared likely. Herring Gulls were also nesting near the Ocracoke colony. Whether or not they prey on pelican eggs is unknown. The increase of sport fishing boats in Ocracoke Inlet and nearby waters of Pamlico Sound represents a threat of increased disturbance.

Nesting Habitat

Substrate: Brown Pelican nests were placed on the ground on substrate of shell and sand, or in low marsh elder thickets as much as one-half meter above the ground.

Vegetation: The Ocracoke colony was on a site dominated by marsh elder, saltmeadow cordgrass, and salt grass. The Cape Fear River site was dominated by a variety of low grasses and forbs, primarily salt grass and marsh elder.

Fig. 8. Brown Pelican nestlings.

Management

The Ocracoke Brown Pelican colony appeared to be healthy in 1978. Protection from disturbance may prove helpful. The construction of an elevated island site nearby would provide protection from overwash if the pelicans could be induced to move their colony. Some protection from storm erosion might be feasible. The Cape Fear River colony was on a severly eroding dredged material island. No management, other than site protection should be attempted until this colony is well established.

Fig. 9. Brown Pelican nesting site on North Rock Island (Site 11-07).

GREAT BLUE HERON (Ardea herodias)

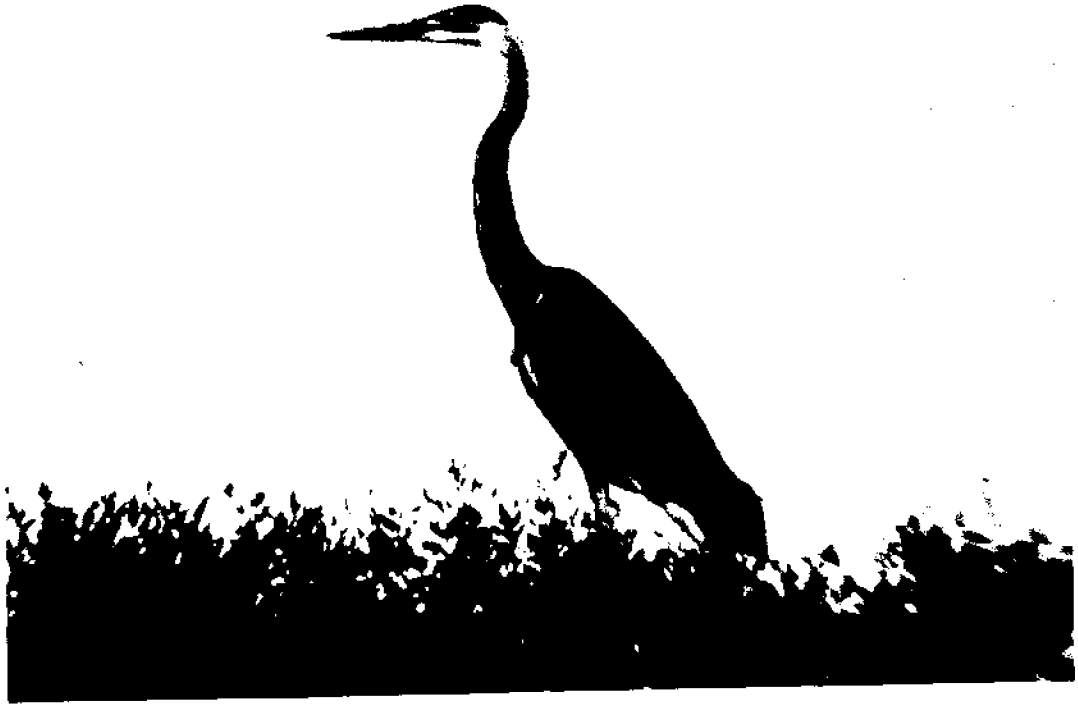

Fig. 10. Immature Great Blue Heron

Identification

This heron is identified by its large size and slaty gray coloration. Adults are about 4 feet (1.2m) tall (Peterson 1947).

Range

Worldwide: Breeds throughout much of North America, in the West Indies, Mexico, and the Galapagos Islands (AOU 1957).

North America: Breeds across much of southern Canada and the United States. Winters throughout most of the United States (AOU 1957).

North Carolina: The Great Blue Heron is a relatively common to sparse permanent resident of the coastal plain and a transient or summer visitor elsewhere. It nests primarily in colonies in the coastal plain swamps. Individual pairs have been found at 2 estuarine colonies.

1977 Colony Sites: 22-41.

Taxonomy and Status

Several subspecies of the Great Blue Heron (Ardea herodias) have been described from North America. The subspecies nesting in North Carolina is Ardea herodias herodias. In North Carolina the Great Blue Heron is considered "of special concern" (Parnell et al. 1977).

North Carolina Breeding Population

A single nest was found in an estuarine colony in 1977. The coastal plain nesting population was estimated at 988 nests in 1976 (Soots and Parnell 1979).

Population Trends

Colonies of Great Blue Herons have been known to nest in the coastal swamps since 1898. In 1939, 2 colonies were known. One in Brunswick County contained about 40 pairs, and the other in Bertie County contained 58 nests (Pearson et al. 1942). In 1976, 22 inland sites were located containing a total of 988 nests (Soots and Parnell 1979). No trends are apparent.

Breeding Biology

Breeding Phenology: Great Blue Herons are among the earliest of nesting herons and may begin building their nests in March (Palmer 1962). The incubation period is about 28 days, and the young apparently require about 60 days to reach flight (Palmer 1962).

Critical Features: Unknown

Nesting Habitat: Most colonies were located in the tops of swamp forests (Soots and Parnell 1979). The nests seen in estuarine colonies were placed with those of the Great Egret in the tops of wax myrtle or live oak.

GREAT EGRET (Casmerodius albus)

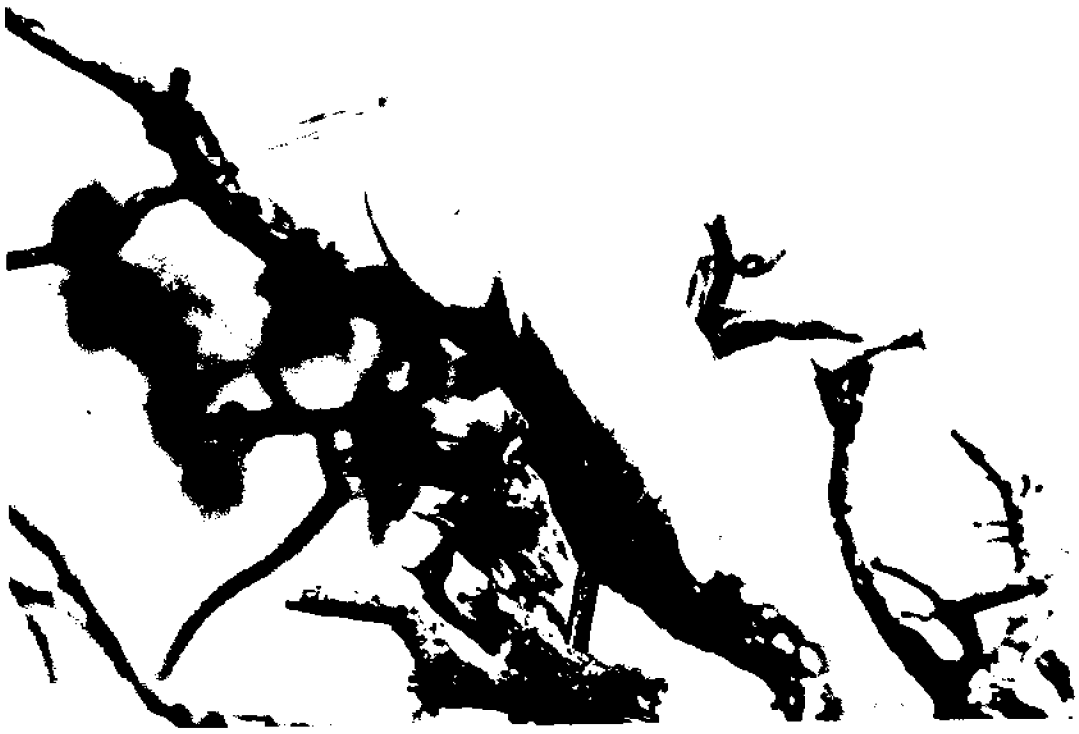

Fig. 11. Adult Great Egret at nesting site.

Identification

This is the largest of the White Egrets found in North Carolina. It is readily identified by its white plumage, yellow bill, and black legs and feet.

Range

Worldwide: Breeds in Europe, Asia, Australia, Africa, South America, Central America, and North America (AOU 1957).

North America: The Great Egret breeds along the Pacific coast north to Oregon, in the Mississippi Valley, along the Atlantic coast from Main to Florida, and along the entire Gulf coast. It winters across the southern United States and as far north as southern Oregon along the Pacific coast, and from New Jersey southward along the Atlantic coast (Palmer 1962, Custer and Osborn 1977).

North Carolina: Breeds in most estuarine colonies from Currituck Sound to the Cape Fear River. Also nests inland in coastal swamps (Soots and Parnell 1978). Winters regularly in reduced numbers throughout the estuaries and coastal plain.

1977 Colony Sites: 01-01, 03-05, 06-12, 07-02, 07-05, 10-02, 11-04, 11-07, 14-02, 16-01, 17-01, 21-03, 21-04, 22-41, 27-07, 39-46, 39-51.

Taxonomy and Status

A single subspecies, Casmerodius albus egretta, occurs in North America. It is listed as "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	4	23	61	12
Man-made/modified sites	13	77	438	88
Totals	17	100	499	100

Population Trends

This species was eagerly sought by the plume hunters of the late 1800's. Pearson et al. (1919) states that formerly it was an abundant species in the southern states but gives no authority. A single colony containing about 20 pairs located at Orton Plantation in Brunswick County, and carefully protected by the owner, was the only known breeding site in North Carolina in the early 1900's. The species was considered rare, and Pearson et al. (1919) expressed doubt that it would remain a part of the North Carolina avifauna. By the time the second edition of Birds of North Carolina was published in 1942 (Pearson et al. 1942) the Orton colony had grown to 50 pairs, and breeding colonies had also been recorded in Carteret County. By 1955 when Funderburg and Quay (1959) studied the maritime birds of southeastern North Carolina this species had become a common summer resident.

Our research indicated that this species has become widespread throughout the estuaries. It was generally an important species in most coastal

heronries and also nested at several inland sites (Soots and Parnell 1978).

Breeding Biology

Breeding Phenology: Some Great Egrets spend the winter in North Carolina and may roost at or near colony sites throughout the winter. By early March they have begun courting at Battery Island, and by late March eggs are present in many nests. By mid-April nesting is well underway throughout the estuary. Egg laying will continue into May, but most individuals of this species begin nesting early and do not extend the nesting period into late summer as do many of the other waders. Incubation requires 23 to 24 days, and the young birds reach flight at about 6 weeks (Palmer 1962). Great Egrets have thus usually fledged their young by early July. Some birds may continue to roost at colony sites through the fall and winter.

Fig. 12. Juvenile Great Egrets in nest.

Critical Features: Great Egrets are affected most by inclement weather during the nesting season and by habitat loss. Human disturbance may also be a factor.

Nesting Habitat: Great Egret nests have been found on the ground, in stands of giant reed, in shrub thickets, in tall trees, and on man-made platforms.

Most colonies in North Carolina are located on dredged material islands in the upper canopy of well established shrub thickets dominated by wax myrtle, bayberry, silverling or red cedar.

Fig. 13. Great Egrets nesting in canopy of shrub forest at Battery Island, North (Site 39-51).

Management

Critical Factors: The availability of well developed shrub thickets on isolated islands near inlets appears to be the major habitat requirement

for most wading birds. Such sites should be free from mammalian predators and from human disturbance.

Availability of Suitable Habitat: Most estuarine heronries are located on dredged material islands. The preferred shurb thickets require 10 to 20 years to develop (Soots and Parnell 1975). Frequent dredging in some locations has prevented the development of suitable habitat. In other cases the threat of future deposition on existing active or potential sites is a major factor.

Management Methods: The prevention of the deposition of dredged materials on or the diking of active sites is of critical importance. The prevention of disposal or diking on selected potential sites could also be an important factor. The planting or encouragement of shrub vegetation on certain sites may also be beneficial.

Wading bird colony sites may persist almost indefinately if appropriate vegetation is maintained and if sites are protected from disturbance. This means that site protection by private or public agency ownership or control is feasible. An important management possibility in North Carolina is the management of wading bird colony sites by the National Audubon Society or by State or Federal agencies.

SNOWY EGRET (Egretta thula)

Fig. 14. Snowy Egret in breeding plumage.

Identification

This small white egret is easily identified by its black bill with a yellow base and black legs with contrasting yellow feet.

Range

Worldwide: Breeds in North America and Central and South America (AOU 1957).

North America: Breeds primarily along the Atlantic coast from Maine south to Florida (Custer and Osborn 1977) and across the Gulf coast (Palmer 1962). Nests inland from California to Colorado and south to New Mexico and Texas (AOU 1957). Winters primarily along the Atlantic coast from New Jersey to Florida and across the Gulf coast to Mexico (Palmer 1962).

North Carolina: Nests in most coastal colonies from Currituck Sound to the Cape Fear River. Winters in southeastern North Carolina in reduced numbers.

1977 Colony Sites: 01-01, 03-05, 06-10, 06-12, 06-19, 07-02, 07-05, 10-02, 11-04, 11-07, 14-02, 16-01, 17-01, 21-03, 21-04, 22-41, 39-46, 39-51.

Taxonomy and Status

Two subspecies have been described from North America. Egretta tnula thula is the Atlantic and Gulf coast race while E. t. brewsteri is the western form (AOU 1957). E. t. thula is listed as "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	5	28	46	4
Man-made/Modified Sites	13	72	1027	96
Totals	18	100	1073	100

Population Trends

Like the Great Egret, the Snowy Egret was slaughtered by plume hunters in the late 1800's. In 1898, Pearson found no evidence of Snowy Egrets in North Carolina (Pearson et al. 1942). In 1904 the only known breeding colony in North Carolina consisted of 8 pairs nesting at Orton Plantation in Brunswick County (Pearson et al. 1942). By 1939 several nesting colonies of wading birds were known to be active in the North Carolina estuaries. Snowy Egrets were apparently present in all of these. This included 20 Snowy Egrets at Battery Island (Pearson et al. 1942). By 1955 the number at Battery Island had grown to 70 nests (Funderburg and Quay 1959) and by 1977 numbers had increased to over 400 nests. The Snowy Egret is presently widespread in the coastal colonies. It was the fourth most abundant wading bird censused.

Breeding Biology

Breeding Phenology: While a few Snowy Egrets overwinter in North Carolina, most move into North Carolina in the early spring. By late March they gather at Battery Island and are incubating by mid-April. Snowy Egrets were found incubating as late as mid-June. The incubation period ranges from 21 to 24 days (Jenni 1969), and the young leave the nest at 20 to 25 days of age (Palmer 1962). In 1977 Snowy Egrets occupied breeding sites until late July and early August. During the wet rainy

summer of 1976, birds were still laying eggs at Battery Island in mid-July. Such renesting attempts could easily result in nesting activities extending into September.

Critical Features: Snowy Egret breeding success is closely tied to the weather in May and June. Prolonged cool rainy periods result in the death of many young and will extend the breeding season due to extensive renesting attempts. The pressure of mammalian predators may also be catastrophic.

Fig. 15. Pale blue Snowy Egret eggs in typical platform nest.

Nesting Habitat: Snowy Egrets nest primarily in thickets of wax myrtle, bayberry, silverling, and marsh elder. They generally place their nests within the cover of the interior of the shrubs from ground level to shrub tops. In the Monkey Island colony they nested as high as 15 to 30 meters in red cedars and hackberrys.

Management

See Great Egret account.

LOUISIANA HERON (Hydranassa tricolor)

Fig. 16. Adult Louisiana Heron.

Identification

This medium sized heron is identified by its generally dark back, head, and neck and clear white belly.

Range

Worldwide: Breeds across the southern United States into Central America and Northern South America (AOU 1957).

North America: Present at all seasons along the Atlantic coast from Maryland to Florida and across the Gulf coast (Palmer 1962). Breeds as far north as New York on the Atlantic coast (Custer and Osborn 1977).

North Carolina: Present all year throughout the estuaries. Nests in most colonies from Currituck Sound to the Cape Fear River.

1977 Colony Sites: 01-01, 03-05, 06-10, 06-12, 06-19, 07-02, 07-05, 10-02, 11-04, 11-07, 14-02, 16-01, 17-01, 21-03, 21-04, 22-41, 39-46, 39-51.

Taxonomy and Status

A single subspecies, Hydranassa tricolor ruficollis, is recognized from North America. In North Carolina it is considered "of special concern" (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	5	28	112	7
Man-made/modified sites	13	72	1523	93
Totals	18	100	1635	100

Population Trends

This heron was first reported in North Carolina in 1898. In that year 4 breeding sites were discovered. These were in Carteret and Brunswick Counties, and a total of "a thousand or more pairs" were estimated (Pearson et al. 1942). Apparently they had not suffered at the hands of the plume hunters as did the Great and Snowy Egrets. Funderburg and Quay (1959) listed the Louisiana Heron as a common summer resident in southeastern North Carolina in 1955. They recorded 159 nests at Battery Island. It continues to be a common breeding species throughout the North Carolina estuaries. It was present in all of the estuarine breeding colonies in 1976 and 1977 and was the second most abundant species.

Breeding Biology

Breeding Phenology: Louisiana Herons begin moving to colony sites in early spring. Courting birds were present at Battery Island by the end of March in 1977. By mid-May some eggs had already hatched, indicating that egg laying had begun by late April. The incubation period is about 23 to 25 days (Jenni 1969). The age at which the young leave the nest is unknown, but it is probably about 3 weeks. Louisiana Herons may have extended breeding seasons, and in 1977 (a dry year) birds were still incubating at Battery Island during the third week of July. Colony sites may thus be active into late August or early September.

Fig. 17. Eggs and newly hatched young of the Louisiana Heron.

Critical Features: See Snowy Egret Account.

Nesting Habitat: See Snowy Egret Account.

Management

See Great Egret Account

LITTLE BLUE HERON (*Florida caerulea*)

Fig. 18. Adult Little Blue Heron.

Identification

The adult Little Blue Heron is the only uniformly dark medium-sized heron seen in North Carolina. Immatures are white with pale greenish-yellow legs and bill. During the moult to adult plumage they may appear "pied" having patches of dark and light feathers.

Range

Worldwide: Breeds in eastern North America, Central America, and northern South America (AOU 1957).

North America: Breeds along the Atlantic coast from Massachusetts southward to Florida (Custer and Osborn 1977), across the entire Gulf coast, and up the Mississippi Valley to Missouri (AOU 1957). Winters across the Gulf coast and northward along the Atlantic coast to Virginia (AOU 1957).

North Carolina: Breeds in most of the estuarine colonies from Currituck Sound to the Cape Fear River. It overwinters in small numbers primarily in southeastern North Carolina.

1977 Colony Sites: 01-01, 03-05, 06-10, 07-02, 07-05, 10-02, 11-04, 11-07, 14-02, 16-01, 17-01, 21-03, 21-04, 22-41, 27-06, 39-46, 39-51.

Taxonomy and Status

A single subspecies Florida caerulea caerulea occurs in North America. It is considered "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	3	18	92	11
Man-made/modified sites	14	82	713	89
Totals	17	100	805	100

Population Trends

In the 1919 edition of Birds of North Carolina (Pearson et al. 1919) stated that the Little Blue Heron was "one of the most abundant herons in the state." In the late 1800's and early 1900's this species nested at inland sites at Lake Mattamuskeet in Hyde County, Great Lake in Craven County, and near Red Springs in Robeson County (Pearson et al. 1942). In 1937, George Lay visited a newly discovered heronry in Bertie County. He estimated that 10,000 Little Blue Herons of all ages were present (Lay 1937). A careful survey of this colony in 1938 produced an estimate of 540 nests (Craighill and Grey 1938). In the 1930's Little Blue Herons were also reported nesting at several coastal sites from Buxton to Southport (Pearson et al. 1942).

In the early 1900's, all known colony sites were in the coastal swamps. By the 1930's, however, the species was shifting its center of abundance to the coast, and colony sites were reported at both inland and coastal locations.

A hint of the reason for this shift came in a report by Robert Wolff that in 1953 a heronry near Plymouth, estimated to contain over 1,000 nests in 1952, was destroyed by a timbering operation during the egg laying period (Wolff 1954). By the 1960's reports of inland Little Blue Heron colonies ceased. In coastal aerial surveys in 1975 and 1976 we found no Little Blue Herons nesting in the inland swamps. The species is now, however, a regular and common component of most of the estuarine multi-specied colonies. It is usually present in small to moderate numbers but was the second most abundant species in the colony at Emerald Isle.

Breeding Biology

Breeding Phenology: Little Blue Herons begin nesting by early April. The incubation period ranges from 22 to 25 days (Jenni 1969) and young birds are about one month old at first flight (Palmer 1962). Renesting due to adverse weather may be extensive. Reproductive activity may thus continue at colony sites well into July in normal years, and as late as September during wet rainy summers.

Critical Features: Little Blue Herons are subject to considerable mortality of embryos and young during extended periods of cool wet weather. They are also subject to losses due to mammalian predators and to human disturbance of colonies. Cattle Egrets may cause nesting mortality by stealing nesting material and by competing with the Little Blue Heron for nest sites (Werschkul 1977, Chaney et al. 1978).

Nesting Habitat

Little Blue Herons nest most often in thickets of wax myrtle or silverling, at elevations of 2 to 3 meters. They will also, however, occasionally place nests 10 to 15 meters up in live oak or hackberry trees, or at ground level in dense stands of saltmeadow cordgrass or sea ox-eye. Nests are usually in dense vegetation well hidden from view.

Management

See Great Egret Account.

GREEN HERON (*Butorides striatus*)

Fig. 19. Immature Green Heron.

Identification

The Northern Green Heron is, except for the Least Bittern, the smallest heron occurring in North America. Feather color of the upper parts of the adult is a dark grayish green. The under parts are brownish gray. The wings are greenish in color and the feet and legs are yellow. The top of the head is greenish black while the rest of the head and most of the neck is chestnut (Peterson 1947).

Range

Worldwide: Breeds in North America, Central America, the West Indies, and northern South America (AOU 1957).

North America: Breeds throughout the eastern two-thirds of the United States northward to southern Canada and in the western coastal states. Winters chiefly from southern United States southward (AOU 1957).

North Carolina: Breeds throughout the central and eastern parts of the state. A few remain through the winter, mostly along the coast (Pearson et. al. 1959).

1977 Colony Sites: 01-01, 22-41, 27-03, 27-04, 27-06, 27-07, 39-46

Taxonomy and Status

There are 3 subspecies recognized in North America. Butorides striatus virescens breeds throughout the eastern two-thirds of the United States extending into southern Canada and northern Mexico. B. s. anthonyi breeds in the far western states. B. s. frazari is resident locally in the southern half of Baja California. The Green Heron is not listed in the Endangered and Threatened Plants and Animals of North Carolina (Parnell et al. 1977).

1977 Breeding Population[1]

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	1	14	13	14
Man-made/modified sites	6	86	77	86
Totals	7	100	90	100

[1]The Green Heron is not as strongly colonial as other herons. Isolated nests could have been easily missed during estuarine surveys. The species also nests at inland sites. There is no available information on the abundance of nesting birds inland.

Population Trends

Due to its elusive habits and solitary nesting behavior, very little is known about populations of Green Herons in North Carolina or elsewhere. The population in North Carolina estuaries appears to have remained stable during the past 7 years.

Breeding Biology

Breeding Phenology: Egg laying begins in North Carolina in late April The incubation period ranges from 19 to 21 days (Meyerriecks 1960). Young attain flight in 21 to 23 days (Meyerriecks 1960). By mid-July most young have fledged. Unusually cold, wet weather during the early part of the breeding season may extend the egg laying period into early July.

Critical Features: The Green Heron is less colonial than the other species covered in this atlas, however, it shows a preference for nesting around the perimeter of colonies of the other more colonial species or in isolated shrubs or trees adjacent to such colonies.

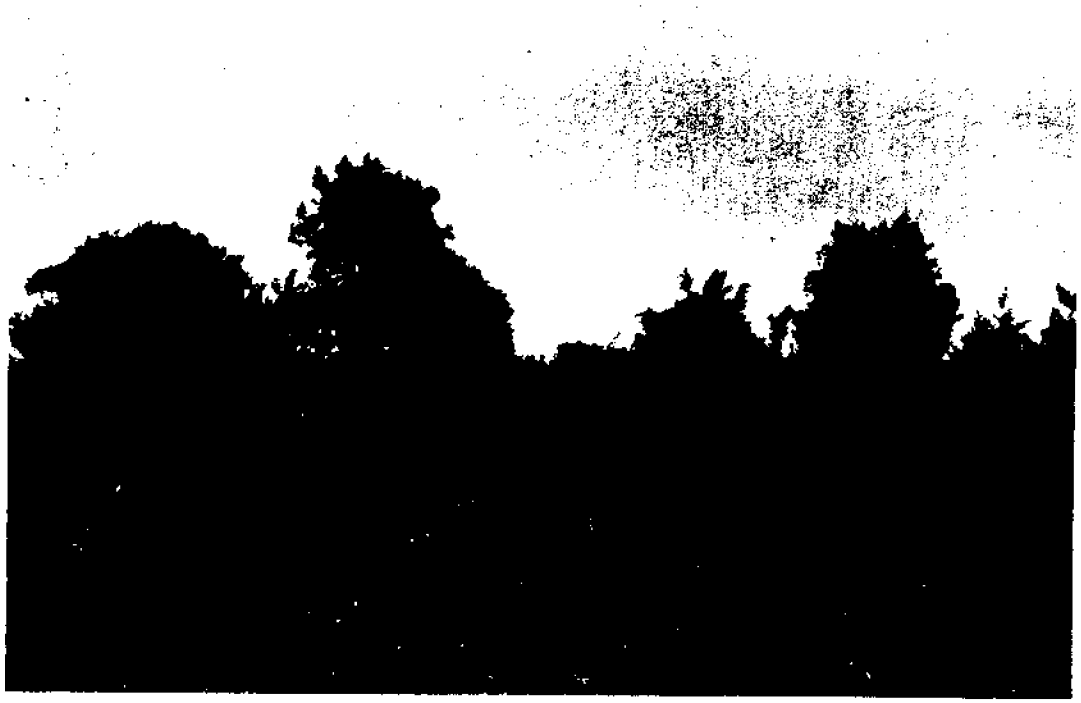

Fig. 20 Typical estuarine nesting habitat of the Green Heron.

Nesting Habitat

In the estuaries, Green Herons showed a preference for nesting on islands in the mid-seral stages of plant succession. These were usually located closer to the mainland than islands on which other species of herons nested. The Green Heron showed a strong preference for nesting in red cedar when this plant was present (C. Byrd 1978). Wax myrtle, marsh elder, yaupon, and hackberry were also selected as nesting sites. C. Byrd (1978) found that height among 77 nests found in the estuaries ranged from 0.2 to 4.8 meters and averaged 1.4 meters.

Management

This species nests singly or in small aggregations around the edges of the mixed-species colonies. Management for the mixed species assembledges will benefit this species to some extent. It does not, however, lend itself to management to the degree of the other more highly colonial species.

BLACK-CROWNED NIGHT HERON (Nycticorax nycticorax)

Fig. 21. Adult Black-crowned Night Heron.

Identification

A stocky medium-sized heron with a very dark back and a white face and venter. Sexes are similar. Immatures are brown streaked.

Range

Worldwide: Europe, Asia, Indonesia, Africa, South America, and North

America (AOU 1957).

North America: Breeds from southern Canada southward through most of the non-arid portions of the United States (Palmer 1962). Winters in the southern states, and into Central and South America.

North Carolina: Breeds in most of the coastal colonies from Roanoke Sound to the Cape Fear River. Winters throughout the coastal zone of North Carolina.

1977 Colony Sites: 03-05, 06-12, 07-05, 10-02, 11-07, 14-02, 16-01, 17-01, 21-03, 21-04, 22-41, 39-46, 39-51.

Taxonomy and Status

A single subspecies Nycticorax nycticorax hoactli occurs in North America. This race appears on the 1977 "Blue List" (Arbib 1977) and is "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	2	15	12	5
Man-made/modified sites	11	85	235	95
Totals	13	100	247	100

Population Trends

In the early 1900's the Black-crowned Night Heron was considered to be a regular summer resident along the North Carolina coast (Pearson et al. 1919). It appears that this species was not actively sought by the plume hunters. It was recorded nesting at several sites from Dare to Brunswick County at that time. There are, however, almost no indications in the early literature of numbers of birds. This is likely due to their nocturnal feeding habits and their habit of nesting in small isolated colonies, as well as nesting in association with other herons and egrets in the larger mixed species colonies. The only comparison possible is between the present study and Funderburg and Quay's work in southeastern North Carolina in 1956. They found only 5 nests at Battery Island, while in 1977 we located 75 nests at this site. It is likely that this species did not reach the very low population level in the late 1800's that was common for most waders. It also appears, however, that this species may be sharing the general increase in numbers seen for most waders in recent years.

Breeding Biology

Breeding Phenology: Black-crowned Night Herons are usually among the earliest nesting species in the coastal colonies. Courting and egg laying was observed as early as late March at Battery Island in 1977. In the Roanoke Sound colony large feathered young were present by 2 June 1977. Given an incubation period of 24 to 26 days and a requirement of 6 weeks until fledging (Palmer 1962), these nests must have been started by late March or early April. Nesting is often prolonged, however, either by late starters or second nesting attempts. In some colonies eggs were still being incubated in early June of 1977, indicating that the nesting cycle would continue at least into mid-July and perhaps into early August.

Critical Features: This species will nest both in the multispecied colonies and in small isolated pure colonies. They may thus be less affected by catastrophes befalling the large colonies. They are, however, adversely affected by prolonged wet weather. They also prey on the young of other wading birds in the multispecied colonies and may have a detrimental impact especially when associated with other environmental problems such as bad weather.

Nesting Habitat: Black-crowned Night Herons nested in a wide range of conditions. They were most commonly found nesting in the dense interiors of the coastal shrub thickets. Nests were most often placed in wax myrtle, silverling, or red cedar. They were also commonly found nesting in small isolated low clumps of silverling and marsh elder, and at times placed their nests at ground level in dense stands of saltmeadow cord grass, black needlerush, or sea ox-eye.

Management

See Great Egret Account.

YELLOW-CROWNED NIGHT HERON (Nyctanassa violacea)

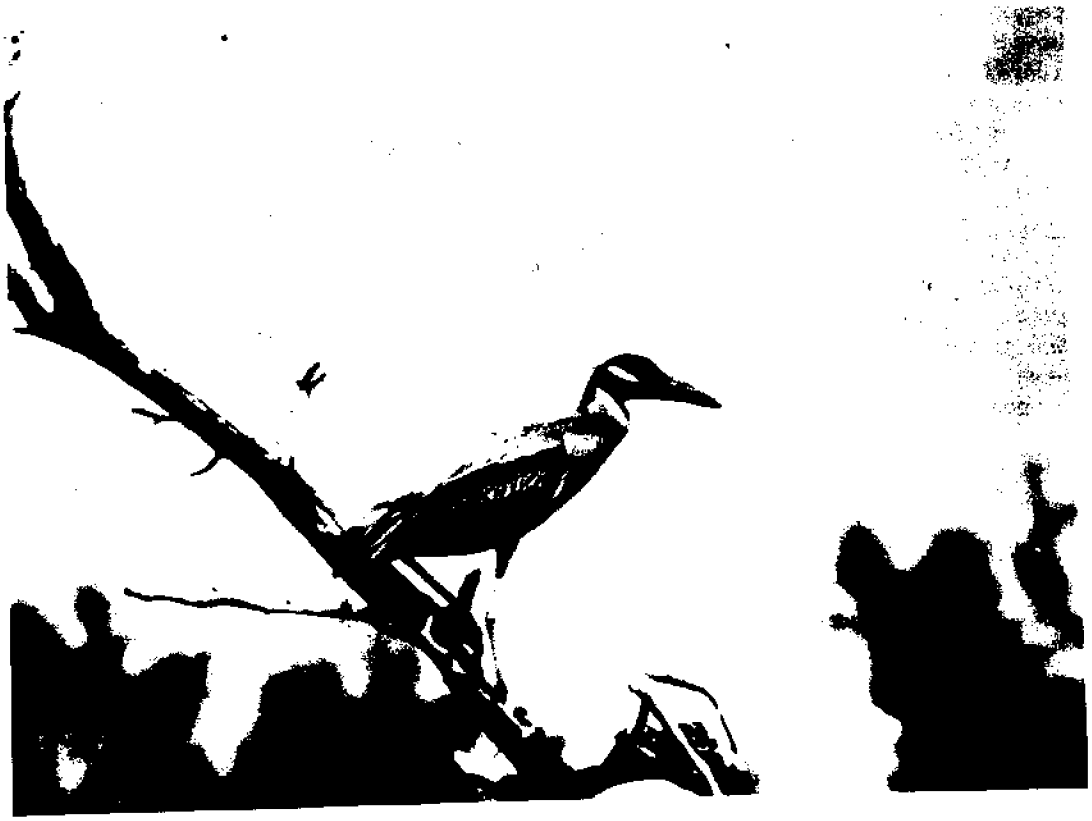

Fig. 22. Adult Yellow-crowned Night Heron.

Identification

The adult is medium-sized and stocky with a dark gray body (above and below). It has a white crown and white facial spot on an otherwise black head. The plumage of immatures is very similar to that of the immature Black-crowned Night Heron, but is more finely speckled on the back (Peterson 1947).

Range

Worldwide: Breeds in North America, Central America, and south to Peru

and Brazil in South America (AOU 1957).

North America: Breeds along the Atlantic coast from Massachusetts south to Florida, across the entire Gulf coast, and up the Mississippi Valley to Illinois and Ohio (Palmer 1962). Winters along the Atlantic coast from South Carolina to Florida and across the Gulf coast (Palmer 1962).

North Carolina: The range in North Carolin is poorly known. The only nesting sites discovered during this study were near Beaufort (1976) and at Pea Island (1977). This species regularly winters in small numbers in southeastern North Carolina.

1977 Colony Sites: 07-02.

Taxonomy and Status

A single subspecies Nyctanassa violacea violacea occurs in the United States. It is listed as "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	0	0	0	0
Man-made/altered sites	1	100	2	100
Totals	1	100	2	100

Population Trends

The Yellow-crowned Night Heron is the least known of the herons nesting in North Carolina. Although it was suspected that this species nested in the state at the time the first edition of Birds of North Carolina was written, no nest had been found (Pearson et al. 1919). The first nesting record came from near Rocky Mount in 1939 (Pearson et al. 1942). Nesting records since that time have indicated that the species nests sporadically as single pairs or very small colonies, primarily in the swamps of the coastal plain (Pearson et al. 1942, revised Wray and Davis 1959). We have found small numbers of Yellow-crowned Night Herons at only 2 estuarine sites. It is likely that small isolated colonies have been overlooked. It appears that this species has been and continues to be the least abundant of the herons of North Carolina. Indications are that its numbers have not changed dramatically in North Carolina since the early 1900's.

Breeding Biology

Too little data are available to provide more than a brief summary. At the 2 sites where we found Yellow-crowned Night Herons nesting, their phenology appeared similar to that of the Black-crowned Night Heron. Palmer (1962) does not give the incubation period or fledging period for the Yellow-crowned Night Heron, thus indicating a general lack of basic information about the biology of the species.

The nests in the 2 coastal colonies were in dense thickets dominated by wax myrtle. Nest placement was similar to that of Black-crowned Night Herons.

Management

See Green Heron Account.

CATTLE EGRET (Bubulcus ibis)

Fig. 23. Cattle Egret in breeding plumage.

Identification

A medium-sized white egret with yellow bill and legs. During the nesting season there is a yellow-buff cast to the crown and back.

Range

Worldwide: Breeds in southern Europe, southern Asia, Australia, Africa,

northern South America, Central America, and eastern North America (AOU 1957).

North America: Breeds along the Atlantic coast from New York to Florida and across the Gulf coast to Texas (AOU 1957, Custer and Osborn 1977, Ogden 1978). Winters in Florida and southward (Palmer 1962).

Nortn Carolina: Nests in colonies from Currituck Sound to the Cape Fear River. Does not winter in North Carolina.

1977 Colony Sites: 01-01, 03-05, 07-05, 14-02, 16-01, 21-04, 22-41, 39-46, 39-51.

Taxonomy and Status

A single subspecies, Bubulcus ibis ibis, occurs in North America. The North American population is expanding.

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	1	11	230	14
Man-made/modified sites	8	89	1371	86
Totals	9	100	1601	100

Population Trends

The Cattle Egret was first recorded in the United States in Florida in the early 1940's (Palmer 1962). Since that time the species has spread rapidly north (Ogden 1978). It was first recorded nesting in North Carolina in 1956 when 2 pairs were found in the colony at Battery Island (Quay and Adams 1956). By 1959, there were approximately 14 pairs nesting at Battery Island, 8 adults in the colony at Beaufort, and several adults at the Pea Island colony site (Quay and Funderburg 1959).

Since that time there has been a steady increase in numbers of Cattle Egrets nesting in North Carolina. By 1977 it had become the third most abundant nesting wading bird. The North Carolina nesting population appears to be continuing to grow.

Breeding Biology

Breeding Phenology: By mid-April the earliest birds have arrived at colony sites and have begun nesting. This species spreads its nesting

over a very long period, and in 1977 many birds were still incubating eggs in mid-July. The incubation period is 22 to 23 days (Jenni 1969), and the young birds require 6 to 7 weeks to fledge (Palmer 1962). Cattle Egrets may thus occupy nesting sites well into September.

Critical Features: Cattle Egrets appear susceptible to cold rainy weather, but the long breeding period may result in a smaller percentage of the seasonal effort being lost due to inclement weather than for a species which has a more synchronous nesting cycle. Loss of suitable habitat and human disturbance appear to be the most critical factors in the continued well-being of this species.

Nesting Habitat: Cattle Egrets usually nest in dense shrubs or low trees. Nests range in height from about 2 meters up to 15 meters. We have not seen Cattle Egret nests on the ground or in dense grasses. They most commonly nest in wax myrtle, yaupon, silverling or red cedar.

Management

See Great Egret Account

GLOSSY IBIS (Plegadis falcinellus)

Fig. 24. Immature Glossy Ibis.

Identification

Identified as an ibis by its long decurved bill and wader appearance. It is slightly smaller than the White Ibis and is a dark bird. It appears black in poor light and a rich iridescent bronze color in sunlight.

Range

Worldwide: Widespread throughout Europe, Asia, Indonesia, Australia, Africa (AOU 1957), and eastern North America (Hailman 1959, M. Byrd 1978).

North America: Breeds along the Atlantic coast from Maine to Florida (Custer and Osborn 1977) and across the Gulf coast to Texas (AOU 1957).

Winters casually north along the Gulf coast and in south Florida (AOU 1957). It wanders north in spring and summer to southern Ontario, Quebec, and Nova Scotia, and through states east of the Mississippi River (M. Byrd 1978).

North Carolina: Nests in most estuarine colonies from Roanoke Sound to the Cape Fear River. Seldom seen in winter in North Carolina.

1977 Colony Sites: 03-05, 06-10, 07-05, 10-02, 11-04, 11-07, 14-02, 16-01, 17-01, 21-03, 39-46, 39-51.

Taxonomy and Status

A single subspecies Plegadis falcinellus falcinellus occurs in North America. In North Carolina the Glossy Ibis is considered "of special concern" (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	2	17	34	8
Man-made/Altered Sites	10	83	386	92
Totals	12	100	420	100

Population Trends

The 1919 edition of Birds of North Carolina (Pearson et al. 1919 indicated that the Glossy Ibis had not been recorded in North Carolina. The first record for the state was from Bodie Island in 1926 (Pearson et al. 1942). In 1956 at least 12 pairs nested at Battery Island (Quay and Adams 1956), and 6 pairs were present in a colony near Morehead City (Davis 1957). Following 1956 the species began to spread rapidly northward and now nests into Maine (Custer and Osborn 1977). In North Carolina there is some indication that the breeding population of this species is beginning a decline.

Breeding Biology

Breeding Phenology: Glossy Ibises do not begin nesting with the earliest group of herons but appear to enter the colonies after they have been occupied by other species. Nesting generally begins in mid-April. The incubation period is 21 days, and they attain flight at about 6 weeks after hatching (Palmer 1962). Renesting may continue well into the summer if early clutches fail. Colony sites may thus be occupied through August, especially during wet summers.

Fig. 25. Glossy Ibis nest with eggs.

Critical Features: This species appears very susceptible to cool wet weather. Under these conditions in 1976, many dead and dying young were observed, and production of young was very low. This species regularly nests on or near the ground and may be more subject to mammalian predation than other species.

Fig. 26. Typical mixed-species breeding colony located in a low shrub thicket.

Nesting Habitat: Glossy Ibis nests are usually scattered throughout mixed species heronries. They appear to prefer dense vegetation (Burger and Miller 1977), but will nest from ground level to the upper portions of the shrubs or low trees of most colony sites. They have been found nesting in saltmeadow cordgrass, sea ox-eye, giant reed, wax myrtle, bayberry, and other vegetation.

Management

See the Great Egret account

WHITE IBIS (*Eudocimus albus*)

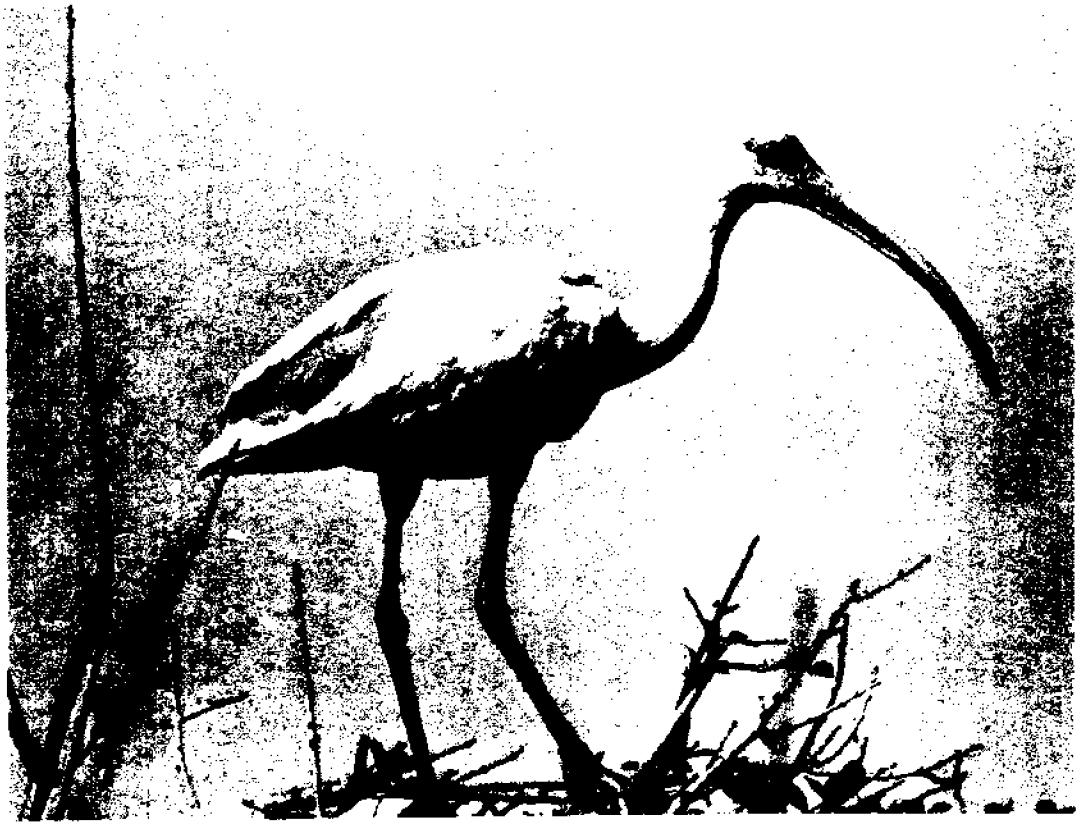

Fig. 27. Adult White Ibis.

Identification

Ibises are long-legged wading birds with decurved bills. The adult White Ibis is easily identified by its white plumage, black wing tips, and red bill and feet. Immature birds are dark but show conspicuous white rumps when flying away from the observer (Peterson 1947).

Range

Worldwide: Breeds in the southeastern United States, along both coasts of Central America, in the West Indies, and into northern South America.

(AOU 1957).

North America: Breeds along the Atlantic coast from Virginia (Frohring and Beck 1978) to Florida and across the Gulf coast to Texas (Palmer 1962). Winters along the Gulf and Atlantic coasts north to North Carolina.

North Carolina: Breeds only at sites near Southport and near Beaufort. Winters commonly in southeastern North Carolina.

1977 Colony Sites: 21-03, 39-46, 39-51.

Taxonomy and Status

A single subspecies occurs in North America. It is listed as "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	0	0	0	0
Man-made/modified sites	3	100	1951	100
Totals	3	100	1951	100

Population Trends

The first record of the White Ibis in North Carolina was an observation of 3 immature birds on 26 July 1889 (Pearson et al.1919). Irregular observations continued until 1950 when an estimated 1,200 birds were found nesting at Lennons Marsh (Stephens 1950). Beginning in the early 1960's White Ibises appeared in the Battery Island colony. The first nest was located in 1963 (Adams 1963). Since that time there appears to have been a steady increase in the numbers of White Ibis at Battery Island. In 1970, 300 nests were counted and 1,000 adults estimated to be present. In 1976, 3,124 nests were counted. The lower number of nests (1,948) found in 1977 is unexplained. In 1972 White Ibises were found nesting in small numbers in the heronry in the Newport River near Beaufort. By 1976, numbers there had increased to 51 nests. It thus appears that White Ibises are steadily increasing in numbers in North Carolina, and it is expected that the species will spread into other colonies.

Fig. 28. Nest of White Ibis containing the heavily speckled eggs characteristic of this species.

Breeding Biology

Breeding Phenology: White Ibises are relatively early nesters at Battery Island. In 1977, about 2,000 adults were courting by late March. By mid-April egg laying was well underway. The incubation period is 21 to 23 days and young birds attain flight in about 5 weeks (Palmer 1962). By mid-July most young birds have begun to fly. Flying juveniles, however, continue to utilize colony sites for several weeks. Battery Island is thus occupied by White Ibises from late March until early August.

Critical Features: The White Ibis appears to be less affected by inclement weather than are other species of wading birds. In 1976, when most species suffered heavy losses during prolonged periods of cool, rainy weather, White Ibises appeared unaffected and fledged large numbers of young.

Nesting Habitat

White Ibises nest in dense aggregations in shrubs or trees. They nest from near ground level up to 8 to 10 meters in elevation. Nests are usually placed near the centers of the shrub or tree. In North Carolina they appear to prefer live oak, yaupon, red cedar, or the toothache tree.

Fig. 29. Nesting habitat of the White Ibis at Battery Island, south (39-46).

Site Management

See the Great Egret Account.

HERRING GULL (Larus argentatus)

Fig. 30. Adult Herring Gull.

Identification

The adult Herring Gull is a large gull with a gray back, gray upper wings and black wing tips. The remainder of the body is white. The bill is yellow with a red spot on the lower mandible during the breeding season. Adult coloration is not achieved until the third year (Bent 1921). Immature birds are dark brown. See a field guide for further details (Peterson 1947, Robbins et al. 1966).

Range

Worldwide: Breeds across northern North America, Europe, and Asia (AOU 1957).

North America: Breeds from Alaska across Canada and the northern United States to the Atlantic coast. The breeding population extends down the Atlantic coast to North Carolina (AOU 1957, Parnell and Soots 1975).

North Carolina: Herring Gulls nest from Roanoke Sound south into Core Sound. A single nest was recorded on the Cape Fear River in southeastern North Carolina in 1971, and 2 nests were found in 1972 (Parnell and Soots 1975). Populations show a dramatic increase in autumn, and the species is a common winter resident along the entire North Carolina coast.

1977 Colony Sites: 03-05, 03-06, 03-07, 03-09, 05-06, 06-08, 06-10, 06-12, 10-02, 11-04, 11-05, 11-06, 11-07, 14-01, 14-02, 14-03, 15-11, 16-01, 16-02.

Taxonomy and Status

A single subspecies, Larus argentatus smithsonianus, breeds in North America. Its populations are generally increasing, and it is sometimes considered a pest.

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	1(6)[1]	14	15	3
Man-made/Altered Sites	7(10)[1]	86	475	97
Totals	7(16)[1]	100	490	100

[1]Sites with fewer than 4 nests

Population Trends

Herring Gull populations appear to be increasing all along the Atlantic coast (Kadlec and Drury 1968). They were first found nesting in North Carolina in 1962 when 2 nests were located on Gull Island in Pamlico Sound (Hailman 1963). In 1972 we discovered 81 nests at 2 Pamlico Sound sites. During 1973, 98 nests were found at 6 sites (Parnell and Soots 1975). By the summer of 1977 the population had grown to 489 nests at 22 sites. Most nesting was still confined to Pamlico Sound. The breeding population has thus grown steadily, and this population expansion is likely to continue

Breeding Biology

Breeding Phenology: It is not known whether or not the North Carolina nesting Herring Gulls spend the winter in the vicinity of colony sites

or migrate further southward. Nesting begins in early May in North Carolina. The incubation period is about 26 days (Bent 1921), and by early June the first young have begun to appear. Hatching continues well into June with a few nests with eggs still present in early July. Seven to eight weeks are required before the young are able to fly (Haycock and Threlfall 1975), and thus colony sites may be occupied into late August.

Fig. 31. Typical deeply cupped nest of the Herring Gull.

Critical Features: While this species appeared not to be affected by weather, there was an unexplained loss of nests in 1977 followed by a strong renesting effort. Preferred nesting cover on natural islands was often found at very low elevations, and nests were subject to overwash. This species is a predator on other nesting ground birds and is generally considered undesirable.

Nesting Habitat

Substrate: Most Herring Gull colonies were placed on substrates of fine sand and drift material in 1977. This appeared to be related to vegetation more than an actual preference for a particle size.

Fig. 32. Typical nesting habitat of the Herring Gull in North Carolina.

Topography: Most of the larger Herring Gull colonies were on the slopes and domes of well elevated dredged material islands. Individual nests or small groups of nests were often placed on drift ridges adjacent to salt marshes.

Vegetation: Herring Gulls appeared to prefer nesting sites offering relatively dense cover at the nest but also with good visibility from the nest. Thus, nests were often placed nest to clumps of dense grasses either in a habitat with a relatively sparse overall cover or in dense cover adjacent to openings. Dominant plant species associated with colony sites were saltmeadow cordgrass, seaside goldenrod, American beachgrass, and panic grasses.

Management

This species is generally considered an undesirable component of the nesting avifauna. Management might be designed to discourage rather

than encourage the species. The reduction of suitable habitat and/or direct intervention during the nesting cycle may be desirable. Further work is needed to determine whether or not this species is having a deleterious effect on nesting populations of other waterbirds.

GREAT BLACK-BACKED GULL (Larus marinus)

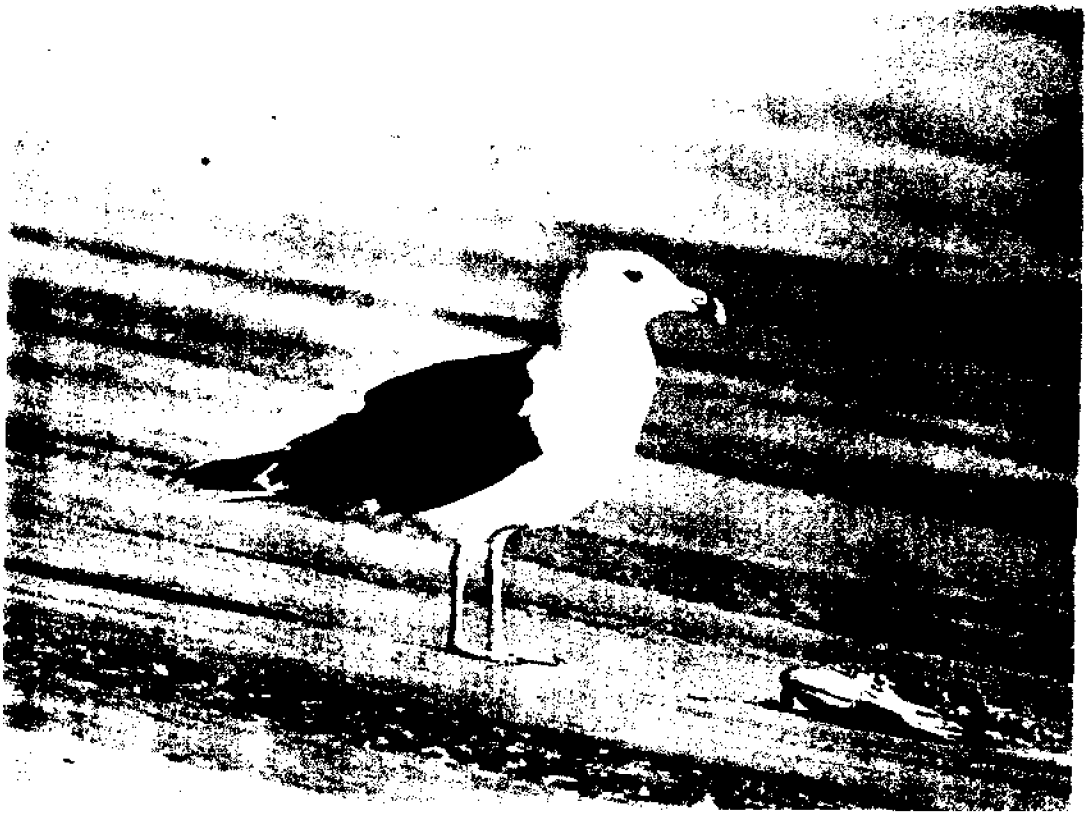

Fig. 33. Great Black-backed Gull.

Identification

The name is appropriate. This is the only large black-backed gull to be expected along the Atlantic coast. It is even larger than the Herring Gull, which it closely resembles except for its dark back and upper wings.

Range

Worldwide: Breeds in northeast North America, Europe, and northeast Russia (AOU 1957).

North America: Breeds in eastern Canada, the northeastern United States, and south to North Carolina (AOU 1957, Parnell and Soots 1975). Winters along the Atlantic coast to northeast Florida and in the Great Lakes (AOU 1957).

North Carolina: Breeds only in Roanoke Sound and Pamlico Sound in the vicinity of Oregon Inlet.

Colony Sites: In 1977 nests were found at the following sites: 03-05, 03-06, 03-07, 03-09, 06-07.

Taxonomy and Status

There are no geographic races of this species (AOU 1957). It appears to be expanding its range southward along the Atlantic coast.

1977 Breeding Population

In 1977, 10 nests were located at 5 sites. No site contained the 4 nests necessary to be considered a colony.

Population Trends

The first breeding record for North Carolina was in 1972 when an adult was observed feeding a large juvenille on a dredged material island in Roanoke Sound (Parnell and Soots 1975). Since that time, numbers have gradually increased.

Breeding Biology

Breeding Phenology: The breeding biology of this species appears to be very similar to that of the Herring Gull. Great Black-backed Gulls were usually found nesting within Herring Gull colonies, and the discussion of Herring Gull breeding biology would appear to apply generally to this species. Further study of the biology of this species at the southern edge of its range is needed.

LAUGHING GULL (Larus atricilla)

Fig. 34. Laughing Gull in breeding plumage.

Identification

The Laughing Gull is the only black-headed gull that occurs along the North Carolina coast in summer. It is a medium sized gull with a black head, dark gray mantle, and white underparts.

Range

Worldwide: Breeds along the western Atlantic coast from Nova Scotia south to northern Venezuela, and along the eastern Pacific coast from California into Mexico (AOU 1957).

North America: Breeds along the Atlantic coast from Nova Scotia to Florida and across the Gulf coast to Texas. It also breeds in southern California (AOU 1957). Winters primarily along the Gulf coast of the United States and into South America (AOU 1957).

North Carolina: The Laughing Gull nests at scattered sites from Roanoke Sound to the Cape Fear River. It is seen along the entire coast in spring, summer, and fall. Numbers decline by early December and the species is generally absent in winter.

1977 Colony Sites: 03-05, 03-06, 03-07, 03-09, 06-02, 06-10, 06-12, 06-20, 07-03, 09-03, 09-04, 10-02, 10-04, 10-06, 11-04, 14-01, 14-02, 15-11, 16-01, 16-02, 17-01, 39-28.

Taxonomy and Status

Larus atricilla is a monotypic species----no subspecies are recognized (AOU 1957). It is considered "of special concern" in North Carolina (Parnell et al. 1977) due to its heavy dependence on a few coastal, primarily man-made, sites for nesting.

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	7(2)[1]	35	4288	34
Man-made/Man Altered Sites	13	65	8228	66
Totals	20(2)[1]	100	12516	100

[1]Sites with fewer than 4 nests

Population Trends

Pearson et al. (1942) commented that the Laughing Gull was not known to breed in North Carolina at the turn of the nineteenth century. By 1908, however, they indicated that about 50 young birds were raised on Royal Shoal in Pamlico Sound. By 1939, breeding colonies were present at several sites in Cedar Island Bay and in Pamlico Sound. It was estimated that perhaps 15,000 Laughing Gulls nested in the state in 1939 (Pearson et al. 1942). If this estimate was correct, then populations at present may be nearly stable. We do know, however, that the species has extended colonies southward from Pamlico Sound and now nests to the Cape Fear River.

Breeding Biology

Breeding Phenology: Laughing Gulls return to North Carolina waters by late March. By early April courtship has begun, and by mid-May egg laying is well underway. The incubation period is about 20 days (Bent 1921). By early June, young are hatching. Young Laughing Gulls require 4 to 6 weeks to attain flight, and flightless young are often still in the colony sites as late as late July.

Fig. 35. Laughing Gull nest.

Critical Features: The dense grassy flats (primarily saltmeadow cordgrass) preferred by Laughing Gulls often develop at low elevations along the perimeters of dredged material islands or on low natural islands. Colony sites are thus prone to flooding during periods of unusually high tides. Laughing Gulls generally nest in relatively large colonies and may abandon a site that becomes inhabited by mammalian predators such as Norway Rats.

Nesting Habitat

Substrate: Most Laughing Gulls colonies in North Carolina are placed on sites with fine sand and silt substrates. This appears to relate to the vegetation that develops on such sites rather than to a direct preference for fine textured substrate materials.

Topography: Laughing Gulls generally nest on low flats, in swales between more elelvated features, or on the lower slopes of dredged material islands.

Fig. 36. Typical nesting habitat of the Laughing Gull.

Vegetation: Laughing Gulls prefer a relatively dense cover of grasses and forbs less than 1 meter in height. The dominant species was usually salt-meadow cordgrass. Seaside goldenrod, panic grasses, and American beach-grass were often intermixed and ground cover was usually over 50 percent. Open space for communal courtship activities appears to be important (Noble and Ward 1943).

Management

Critical Factors: The Laughing Gull is one of the more successful breeding colonial waterbirds in North Carolina. Its numbers are relatively high and reproductive success appears to be good. The most critical factor in its continued existence appears to be the maintenance of sufficient amounts of suitable habitat.

Availability of Suitable Habitat: Suitable habitat is plentiful at present. Since most currently used sites are on dredged material islands, the maintenance of this habitat depends on the rate and schedule of dredged material

deposition. Suitable habitat for Laughing Gulls requires at least 4 to 8 years to develop on dredged material islands (Soots and Parnell 1975, Parnell et al. 1978). Frequent dredging may thus prevent the development of suitable habitat. Sites may be utilized for 5 to perhaps 15 years if not disturbed, or until the sites are invaded by silverling, wax myrtle, or bayberry.

Management Methods: The maintenance of isolated islands with the proper vegetative cover throughout the estuary should assure that this species will flourish. It may be necessary to remove encroaching brush, curtail dredged material deposition, or to initiate predator control to protect specific colony sites.

GULL-BILLED TERN (Gelochelidon nilotica)

Fig. 37. Gull-billed Terns at nest on Ocracoke flats (Site 11-01).

Identification

This medium-sized tern is recognized by its stubby black bill, its pale coloration, and a slightly forked tail.

Range

Worldwide: Distributed along the east coast of North, Central, and South America, the west coast of North and Central America, across Europe and Asia, and into Africa and Australia (AOU 1957).

North America: Breeds from New York State (Buckley and Buckley 1975) to Florida and across the Gulf coast to Texas. Also breeds in California from the Salton Sea southward. Winters along the Gulf coast and into Central and South America (AOU 1957).

North Carolina: Nests from Roanoke Sound southward to the Cape Fear River. Does not winter in North Carolina.

1977 Colony Sites: 05-06, 06-02, 06-08, 06-09, 06-11, 06-23, 09-03, 09-04, 11-01, 12-01, 14-01, 14-04, 14-05, 14-11, 14-14, 17-03, 20-03, 20-06, 39-26, 39-37, 43-09.

Taxonomy and Status

Gelochelidon nilotica aranea breeds along the Atlantic and Gulf coasts of North America, while G. n. vanrossemi breeds in Califronia. G. n. aranea is considered "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	3(1)[1]	18	96	15.5
Natural Estuarine Islands	(1)[1]	0	1	0.2
Man-made/Altered Sites	14(2)[1]	82	524	84.3
Totals	17(4)[1]	100	621	100.0

[1]Sites with fewer than 4 nests

Population Trends

Pearson et al. (1919) noted that in 1909 "A pair of these exceedingly rare birds" nested in Dare County. They were again reported breeding at Ocracoke in 1933 (Pearson et al. 1942). Since that time numbers have increased and nesting has spread along the North Carolina coast. This is still, however, one of the less common breeding terns in North Carolina. Population trends of this species should be watched closely.

Breeding Biology

Breeding Phenology: Gull-billed Terns return to North Carolina by mid-April to early May. Courtship begins soon after arrival or may already be in progress prior to arrival. By mid-May egg laying is usually underway and it may extend through mid-July. The incubation period is about 22 to 23 days and first flight is at about 4 to 5 weeks (Reilly 1968). Young may still be present in some colonies until early August.

Critical Features: This species nests on beaches, natural estuarine islands, and dredged material islands. On the beaches Gull-billed Terns are often disturbed by people and vehicles. On both natural beaches and islands, nests are often at low elevations and are subject to flooding. They will renest if nests are destroyed.

Fig. 38. Gull-billed Tern nest with eggs.

Nesting Habitat

Substrate: Gull-billed Terns prefer substrates of sand, shell, or a mixture of the two. They also occasionally nest on drift materials. They generally show a preference for the presence of coarse material (shells, debris, etc.) in the colony sites.

Topography: Beach colonies generally nest on flats adjacent to inlets or at areas of recent overwash. Dredged material island colonies generally are placed on elevated slopes or domes. Individual nests are usually placed on slightly elevated lumps or ridges.

Vegetation: Gull-billed Terns generally prefer colony sites sparsely vegetated with grasses or forbs. In our study, cover averaged approximately 14 percent, while vegetation height averaged only about 12 centimeters. The most common plants in colony sites were sea rocket, salt-meadow cordgrass, and seaside goldenrod.

Fig. 39. Typical nesting habitat of the Gull-billed Tern, Common Tern, and Black Skimmer.

Management

Critical Factors: The tendency to nest on beaches in areas subject to human disturbance and overwash appears to be the most critical problem. On dredged material islands the presence of bare or sparsely vegetated sandy areas is critical.

Availability of Suitable Habitat: Habitat appears to be adequate at present. However, much beach habitat is unusable at present due to off-road-vehicle travel.

Management Methods: See section on the Common Tern and Black Skimmer.

FORSTER'S TERN (Sterna forsteri)

Fig. 40. Forster's Terns on nests.

Identification

Forster's Terns are easily confused with Common Terns as they are of similar size, shape, and coloration. They are most readily separated by the presence of silver primaries (the outer wing feathers) when seen from above as compared to dark gray Common Tern primaries. The base of the bill of the Forster's Tern is orange rather than red during the breeding season. Bills of both species have black tips. The calls are very different and once learned are a very useful aid to identification.

Range

Worldwide: Breeds at scattered inland and coastal sites across Canada

and the United States (AOU 1957). Winters in southern United States and Mexico.

United States: Breeds from eastern Washington to south central California, across the north central states, along the Atlantic coast from Maryland to North Carolina, and along the Gulf coast in Louisiana and Texas (AOU 1957, Fussell 1974). Winters from California south into Mexico, and from Virginia to Florida and along the Gulf coast (AOU 1957).

North Carolina: Breeds in Pamlico and Core Sounds. Winters along the entire coast.

1977 Colony Sites: 06-10, 06-12, 06-16, 06-19, 06-20, 06-22, 07-03, 09-02, 09-03, 10-03, 10-04, 10-06, 10-07, 10-09, 10-10, 11-01, 11-04, 11-05, 11-06, 11-07, 12-02, 12-16, 12-17, 12-18, 12-19, 12-23, 13-01, 14-10, 14-12, 16-02, 16-03.

Taxonomy and Status

No geographic races of Sterna forsteri are recognized. It is not considered as Endangered or Threatened in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	2	7	146[2]	10
Natural Estuarine Islands	19(3)[1]	68	935	67
Man-made/modified Sites	7	25	324	23
Totals	28(3)[1]	100	1405	100

[1]Sites with fewer than 4 nests

[2]Sites in edge of marsh on sound-side of barrier beach

Population Trends

Forster's Tern was considered a migrant and winter resident along the North Carolina coast until 1972 when several nesting colonies were discovered in Pamlico Sound. Apparently the species has been nesting for some time, but had not been reported. Since that time nesting sites have also been located in Core Sound. It is not clear as to whether the nesting population is increasing, decreasing, or stable.

The species was known as a rare winter resident in the state in the early 1900's (Pearson et al. 1919), apparently having suffered losses during the late 1800's. Numbers began to increase slowly during the early 1900's and the species is currently a relatively common winter resident along the entire coast.

Breeding Biology

Breeding Phenology: Forster's Terns are already in the region when spring arrives. By mid-May they have begun nesting. The incubation period is 23 days (Bent 1921), and by early June the first young should have hatched. Age at first flight is unknown, but it is likely about 4 weeks. Young birds may thus reach flight by early to mid-July. Renesting efforts are common, however, and young are often flightless into late July or early August.

Fig. 41. Forster's Tern nest on drift material.

Critical Features: Forster's Terns are primarily marsh nesters placing their nests on drift rows or mats of dead plant materials washed up into smooth cordgrass marshes. Most nests are only a few centimeters above high tide. Storm or spring tides regularly destroy whole colonies, and renesting appears to be a regular feature of their biology. On several occasions large numbers of broken eggs or dead chicks have been found at colony sites. The cause of this mortality is unknown.

Nesting Habitat

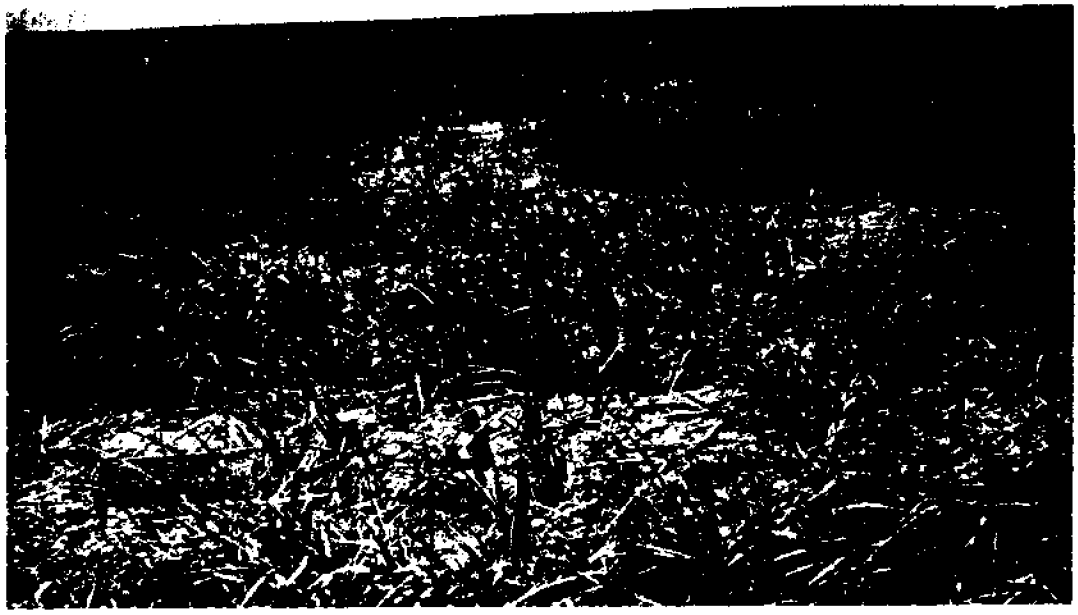

Fig. 42. Typical Forster's Tern nesting habitat in smooth cordgrass around perimeter of Beacon Island (Site 11-04).

Substrate: In 1977, 75 percent of the Forster's Tern nests found were placed on drift rows of mats of dead smooth cordgrass or eelgrass. Occasionally nests were found on other substrates such as bare sand.

Topography: Nests were almost always in linear rows along drift lines.

Vegetation: Colonies were most often located in smooth cordgrass marshes, although they were occasionally in patches of saltmeadow cordgrass or sea oxeye daisy.

Management

Critical Factors: The most critical factors in the breeding cycle of this species appear to be (1) flooding, and (2) an unknown factor resulting in the death of many embryos and downy young.

Availability of Suitable Habitat: There appears to be adequate suitable haibtat, although the birds move often as the necessary drift rows of vegetation do not persist from year to year.

Management Methods Available: Few management techniques are available in terms of habitat manipulation. This species usually nests on isolated natural marsh islands and likely are little affected by man's activities. The posting of colony sites may prevent some disturbance by fishermen.

COMMON TERN (Sterna hirundo)

Fig. 43. Adult Common Tern.

Identification

A medium sized tern characterized by an orange-red bill and feet, a pale gray mantle, white underparts and a deeply forked tail.

Range

Worldwide: Breeds at scattered localities across Canada, the eastern United States, Europe, and Asia (AOU 1957).

North America: Breeds across much of Canada. In the United States it nests across the north central prairie region, the Great Lakes region, along the Atlantic coast from Maine to North Carolina, and at several

sites on the Texas coast. Common Terns winter north to Florida and the Gulf coast (AOU 1957).

North Carolina: The Common Tern nests from Roanoke Sound south to Monks Island near the Shallotte River. It is not present in North Carolina during the winter months.

1977 Colony Sites: 05-06, 06-02, 06-08, 06-09, 06-10, 06-11, 06-12, 06-14, 06-15, 06-16, 06-18, 06-20, 06-21, 06-22, 06-23, 09-03, 09-04, 11-01, 11-05, 11-07, 12-01, 14-01, 14-03, 14-04, 14-05, 14-08, 14-10, 14-11, 14-14, 17-03, 17-07, 17-08, 18-08, 18-11, 18-12, 18-13, 18-20, 18-25, 20-02, 20-03, 20-06, 22-08, 22-45, 23-14, 26-07, 31-01, 32-02, 33-22, 35-02, 39-26, 39-27, 43-09.

Taxonomy and Status

A single subspecies, Sterna hirundo hirundo, occurs in North America. In North Carolina it is "of special concern" (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	6(2)[1]	14	1008	20
Natural Estuarine Islands	14(2)[1]	32	618	13
Man-made/modified Sites	24(3)[1]	54	3270	67
Totals	44(7)[1]	100	4896	100

[1]Sites with fewer than 4 nests

Population Trends

Pearson et al. (1919) indicated that, while Common Tern numbers had been decimated by the plume trade, it was the second most abundant nesting tern in the North Carolina estuaries in 1919. It was reported to nest commonly in Pamlico Sound and in Beaufort Harbor. Estimates of a "few thousand" nesting birds present in the early 1940's (Pearson et al. 1942) is the only indication of the earlier population levels. Since 1942 the species has extended its nesting range south to the Shallotte River and populations appear to be increasing.

Breeding Biology

Breeding Phenology: Common Terns arrive in North Carolina waters by early April. By early May they may be seen loafing and courting in the vicinity of their nesting sites. By mid-May egg laying has begun and may continue until mid-July. The incubation period is 21 days (Jones 1906), and the young require about 4 weeks after hatching to reach

flight (Reilly 1968). Sites may thus be occupied from early April until well into August.

Fig. 44. Common Tern nests in saltmeadow cordgrass.

Critical Features: The Common Tern is one of 4 species that still nests in substantial numbers on natural sites. Such sites are generally low in elevation, and a major factor in colony loss is flooding by storm tides. Nest destruction due to human disturbance, especially in beach colonies, is also a factor. Predation by rats or gulls has also caused site abandonment.

Nesting Habitat

Substrate: Common Terns nest primarily on substrates composed of a mixture of sand and shell. They also occasionally nest on substrates composed entirely of shell or dead plant materials.

Topography: Common Terns will nest in a variety of topographic situations. On beaches they utilize both beach flats and "haycock" dunes, while on island sites they nest most often on drift ridges, but also nest on slopes and domes. They prefer to place individual nests on sites slightly elevated above the surrounding topography.

Vegetation: Common Terns nest occasionally on completely bare sites, but appear to prefer the presence of a sparse cover of low plants. Saltmeadow cordgrass, sea rocket, American beachgrass, and seaside goldenrod were most often found in colony sites. The average vegetative cover was about 20 percent.

Fig. 45. Typical nesting habitat of the Common Tern (North Rock Island, Site 11-07).

Management

Critical Factors: The most critical factor in the management of this species is the prevention of disturbance. Most losses appear to relate to disturbance of beach colonies by four-wheel-drive vehicles or from predation by Laughing Gulls, Herring Gulls, and Norway Rats.

Availability of Suitable Habitat: Habitat availability is tied closely

to control of vehicular traffic on beaches and to the pattern of dredged material disposal. At present, habitat on dredged material islands appears adequate.

Management Methods Available: Dredged material sites become suitable for Common Terns in 2 to 6 years. Habitat may then be present for 3 to 6 years assuming no subsequent disposal. Beach colonies need protection from disturbance from time of establishment until the fledging of the last young. It may also be advisable to remove Norway rats from certain island sites.

LEAST TERN (Sterna albifrons)

Fig. 46. Adult Least Tern on nest.

Identification

This is the smallest of the terns being only about 22 to 24 centimeters in length. The small size and yellow bill will easily separate it from all other terns.

Range

Worldwide: Breeds along coast lines and river systems in North and South America, Europe, Asia, and Africa (AOU 1957).

North America: Breeds along the Pacific coast from central California southward. Inland it nests along river systems in Nebraska, Iowa, Indiana, Missouri, Tennessee, and Kentucky. It nests along the Atlantic coast from Massachusetts to Florida, and from Florida to Texas along the Gulf coast. Least Terns winter in Central and South America (AOU 1957).

North Carolina: The Least Tern is a summer resident along the entire length of the barrier beaches and throughout the estuaries south of Currituck Sound. Least Terns do not winter in North Carolina.

1977 Colony Sites: 03-08, 05-06, 06-22, 08-01, 09-03, 11-01, 12-01, 14-05, 14-08, 14-11, 14-14, 17-07, 20-02, 20-03, 20-06, 21-01, 22-08, 22-25, 22-26, 22-40, 22-44, 22-45, 23-10, 26-07, 29-25, 30-01, 30-02, 32-02, 33-15, 35-02, 36-03, 36-13, 37-10, 37-18, 39-33, 39-49, 43-06, 43-09, 45-07, 47-01, 48-06, 48-07, 50-03, 50-04, 50-06 (51 nests near Aurora, not mapped).

Taxonomy and Status

There are 3 subspecies recognized in North America. Sterna albifrons antillaram breeds along the Atlantic and Gulf coast, and Sterna a. athalossos occurs on rivers of the interior. The west coast subspecies of the Least Tern, Sterna albifrons browni, is on the Federal Endangered Species List, and there is considerable concern among biologists over population levels of all subspecies. The Least Tern is considered "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	10(1)[1]	26	896	38
Natural Estuarine Islands	1	3	22	1
Man-made/Modified Sites	24(6)[1]	63	1349	57
Mainland	3[2]	8	99	4
Totals	38(7)[1]	100	2366	100

[1]Sites with fewer than 4 nests
[2]Two of these occurred on dredged material

Population Trends

Least Terns were nearly extirpated from North Carolina by plume hunters in the late 1800's. By early in the 1900's protective laws were in effect and populations were beginning to recover (Pearson et al. 1919). In 1939 a systematic search of the North Carolina coast was made. Twenty-three nesting colonies were located, and a rough estimate of 25,000 pairs of Least Terns was made (Pearson et al. 1942). It is likely that this estimate was much too high. Downing (1973) estimated breeding populations of about 1,300 pairs of birds in North Carolina in 1973. His search was known, however, to be incomplete. There are no other estimates of region-wide populations prior to the current study. Our count of 2,367 nests in 1977 indicates a downward trend in populations since the 1939 estimate.

It is likely that Least Tern populations in North Carolina will continue to decline slowly over the next several years as beach habitat continues to be lost.

Breeding Biology

Breeding Phenology: Least Terns arrive in North Carolina waters in April. By late April courtship is usually underway, and by early May egg laying has generally begun. Egg laying will continue through mid-July. The incubation period averages 19 days and time to fledging averages 21 days (Massey 1974). Colony sites may thus be occupied from late April until late August.

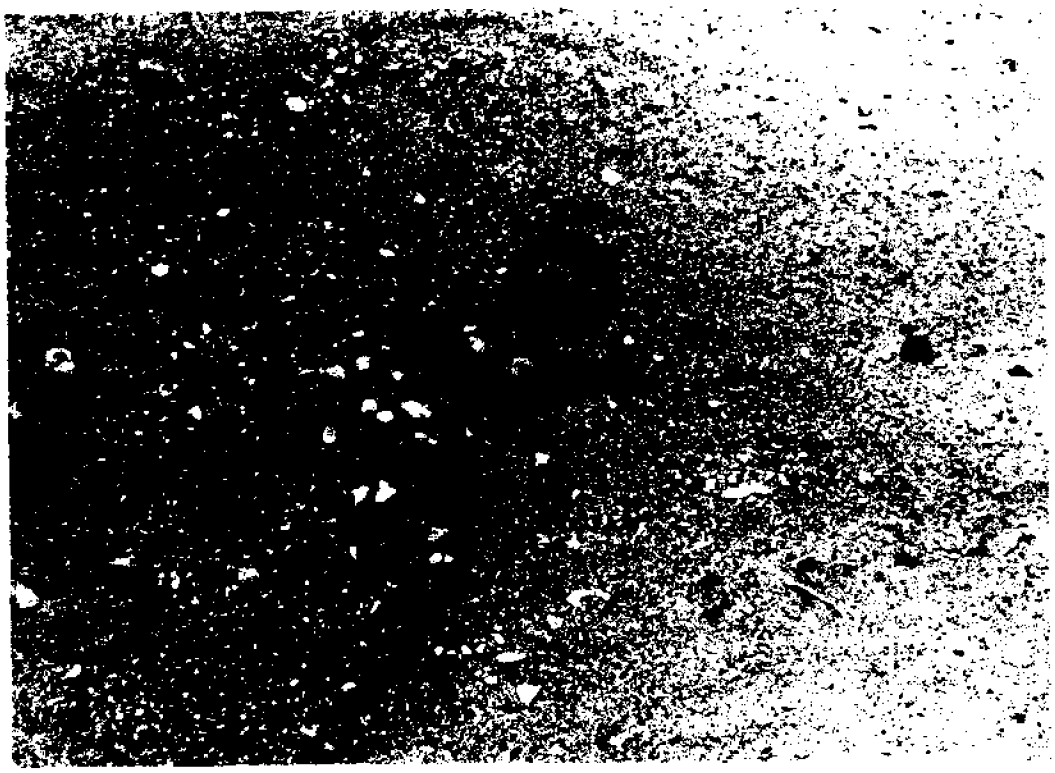

Fig. 47. Least Tern nest with well camouflaged eggs.

Critical Features: Least Terns are opportunistic species often nesting in areas recently stripped of vegetation by man or by overwash. They generally nest in loose colonies with nests often spaced at intervals of several meters. They generally do not associate with nesting colonies of other colonially nesting species. Least Tern nests are very susceptible to destruction by flooding from storm tides and by adverse weather

conditions. Prolonged periods of rain and cool cloudy weather may lead to a complete lack of production of young. They will, however, make several attempts to renest after colonies are destroyed.

Nesting Habitat

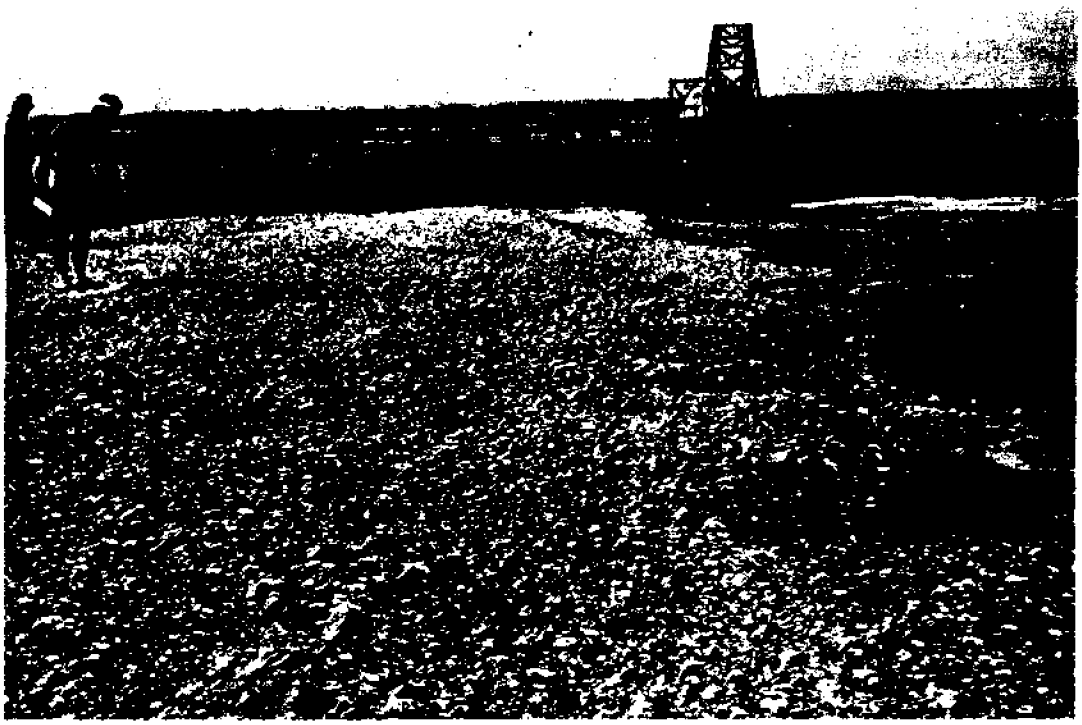

Fig. 48. Ideal Least Tern nesting habitat on a dredged material island (Site 09-03).

Substrate: The preferred nesting substrate consists of a mixture of sand and shell which has been wind sorted and which has become relatively stable.

Topography: Appropriate substrate materials arranged in low linear ridges or low elevated lumps are preferred to flat featureless topography.

Vegetation: Least Tern colonies are usually found on sites lacking vegetation or on sites vegetated by scattered forbs averaging about 8 cm. in height. The most frequent plants in colony sites were evening primrose, horseweed, camphorweed and sea oats (Jernigan *et al.* 1978).

Management

Critical Factors: The most critical factors in the maintenance of populations of this species in North Carolina appear to be the continued availability of suitable habitat, and the prevention of human disturbance in beach colonies.

Availability of suitable habitat: Habitat does not appear to be critical at present. Habitat availability on dredged material islands is, however, tied very closely to the present pattern of dredged material disposal. Much suitable beach habitat has become unusable in recent years primarily due to the increased human use of beaches during the nesting season and to continued beach front development. Habitat availability will become critical without management.

Management Methods Available: Management should involve the maintenance or creation of habitat and the protection of colonies from human disturbances. Beach colonies within public beach areas should be closed to people and vehicles. Close surveillance is important. Dredging schedules should be set to avoid the deposition of dredged materials during the period of 1 April to 1 August on known Least Tern nesting sites. The placement of dredged materials should be coordinated so as to maintain numberous island sites as Least Tern nesting habitat. This will generaally mean that surfaces at such sites should be between 1 and 4 years old. As sites pass this age, redeposition will be needed.

ROYAL TERN (Sterna maxima)

Fig. 49. Royal Tern in breeding plumage.

Identification

A large tern with a bright orange bill and a moderately forked tail.

Range

Worldwide: Breeds along the Pacific coast of North America in Baja California, along the east coast of North America from Maryland to Georgia, locally in the West Indies, and on the west coast of Africa (AOU 1957).

North America: Breeds in Baja California, along the Gulf coast, and

along the Atlantic coast from Georgia north to Maryland. Winters from Central California south and from North Carolina south to Florida and along the entire Gulf of Mexico coast (AOU 1957).

North Carolina: Breeds in scattered colonies from Oregon Inlet to the Cape Fear River. Winters in small numbers along the entire coast.

1977 Colony Sites: 05-06, 06-02, 06-10, 06-22, 11-05, 14-01, 14-04, 14-10, 17-01, 39-28, 39-32.

Taxonomy and Status

A single subspecies Sterna maxima maximc occurs in North America. The Royal Tern is listed as "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Populations

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	1(1)[1]	12	1392	8
Man-made/Modified Sites	7(2)[1]	88	15316	92
Totals	8(3)[1]	100	16708	100

[1]Sites with fewer than 4 nests

Population Trends

There were no estimates of Royal Tern populations in the North Carolina estuaries prior to this study. We do know that a large colony existed in Pamlico Sound in 1909, and that in 1939 there were at least 4 colonies in Pamlico Sound which were estimated to contain a total of over 6,000 nests (Pearson et al. 1959). Royal Terns apparently were not as eagerly sought by the plume hunters as were the smaller species and probably have been relatively common in North Carolina estuaries at least since the early 1900's. Their traditional nesting sites have been on the natural beaches and shoals associated with inlets. In recent years they have moved almost entirely to dredged material islands. The availability of these islands has undoubtedly been an important factor in their continued success. Royal Terns appear to be unaffected by the vagaries of summer weather, and as long as colonies are elevated above storm tide levels they are usually successful. Populations appear to be increasing slightly.

Breeding Biology

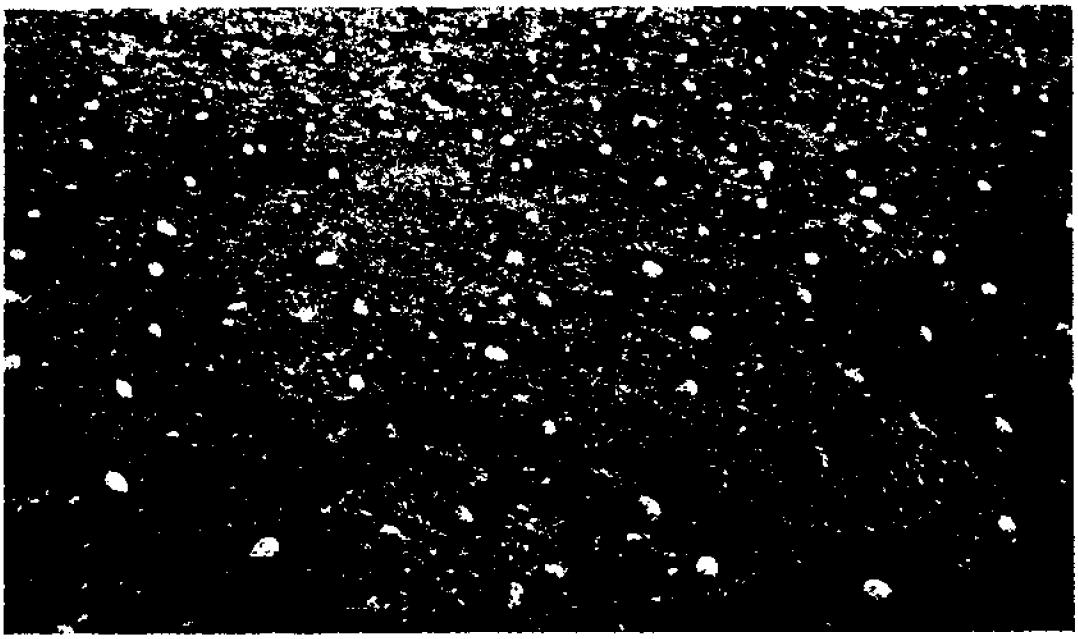

Fig. 50. Typical nest spacing in a Royal Tern colony.

Breeding Phenology: Some Royal Terns spend the winter in North Carolina while most move to more southerly locations. By late April, however, courtship will be underway, and Royal Terns will be gathering in the vicinity of the nesting sites. By early May the first breeders will have begun laying eggs, and by the end of May egg laying has generally been completed. Incubation requires 30 to 31 days (Buckley and Buckley 1972), and the first chicks usually are hatched by early June. Royal Terns are very precocial, and in 2 or 3 days after hatching the young terns will leave the nests and gather in a large group near the colony sites and along bare island beaches. They remain in this large group until they attain flight at about 30 days of age (Buckley and Buckley 1972). Young birds continue to return to the breeding island to be fed and to roost for several days after first flight. Royal Tern colony sites may thus be occupied from late April until early to mid-August.

Critical Features: Royal Terns require bare or nearly bare sandy or shelly sites for nesting. Adverse weather is generally not a problem for these birds so long as nesting sites are elevated well above the levels of storm tides. They nest in very large colonies in dense aggregations and average between 6 and 7 nests per meter^2 at most sites. Thus it becomes important to protect all sites, as a single colony might contain nearly one-third of the state's nesting population in a given season.

Nesting Habitat

Fig. 51. Royal Tern colony site on dredged material island (Site 06-08).

Substrate: The preferred substrate is a mixture of sand and shell.

Topography: The dome shaped undiked dredged material islands appear ideal. Royal Terns usually choose sites near the top of such islands.

Vegetation: Royal Terns appear to prefer sites totally lacking vegetative cover. They will tolerate considerable cover of annual plants if such plants become established after the birds have laid their eggs. They also appear to have a strong site tenacity and will return to previously used sites for several years after vegetation has become such that it would not be tolerated on a new site. This is especially true when alternate bare sites are not available. Nitrophilic species such as Mexican tea and dog fennel frequently invade colony sites and ultimately cause abandonment of it.

Management

At least 2 elevated bare islands or parts of islands should be maintained in the following areas: Oregon Inlet, Hatteras Inlet, Ocracoke Inlet, northern part of Core Sound, Channel to Bardens Inlet, and the lower Cape Fear River. One of these islands would serve as the colony site and the other as an alternate in case of disruption.

SANDWICH TERN (Sterna sandvicensis)

Fig. 52. Sandwich Terns intermingled with Royal Terns (in background) on colony site.

Identification

A medium sized tern (35 to 41 centimeters in length) with a bicolored bill, the tip being yellow and the base black.

Range

Worldwide: Breeds along the coast of the southeastern United States, in the Caribbean, the Bahamas, along the coast of Europe from Denmark to Sweden and south to northern Africa (AOU, 1957).

North America: Breeds along the Atlantic coast from Virginia to South Carolina and along the Gulf coasts of Texas and Louisiana. Winters from Florida southward (AOU, 1957).

North Carolina: Breeds in association with Royal Terns from Oregon Inlet to the Cape Fear River. Winters in small numbers along the coast.

1977 Colony Sites: 06-02, 06-10, 11-05, 14-01, 17-01, 39-32.

Taxonomy and Status

Sterna sandvicensis acuflavidus is the only subspecies occurring in North America. It is listed as "of special concern" in North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	1	17	94	5
Man-made/Modified Sites	5	83	1847	95
Totals	6	100	1941	100

Population Trends

In the late 1800's this species was considered an uncommon visitor in North Carolina (Pearson et al. 1919). It was first discovered breeding near Ocracoke in 1907. In 1908, 126 eggs were counted in this colony (Pearson et al. 1919). Records since that time indicate that the Sandwich Tern has probably nested regularly among the coastal Royal Tern colonies. Data are insufficient to allow the establishment of trends. Data taken by us during the past several years do indicate that the breeding population is highly mobile and that surveys of a single state may be inadequate to determine trends.

Breeding Biology

Breeding Phenology: Sandwich Terns always nest in association with colonies of Royal Terns in North Carolina. Adults often arrive at the colony sites after the Royal Terns have begun nesting. The incubation period is 20 to 23 days and age at first flight is about 5 weeks (Reilly 1968). Sandwich Terns occupy nesting sites from late April through July. Renesting or late nesting may extend occupancy into August.

Critical Features: Sandwich Terns always nest on bare or nearly bare sites among colonies of Royal Terns. They may, however, shift from one site to another in successive years for reasons unknown to us. Numbers at particular sites thus fluctuate greatly. Given suitable habitat and the absence of mammalian predators, they appear to do well. Like Royal Terns, they are little affected by adverse weather.

Nesting Habitat

Fig. 53. A large aggregation (creche) of Sandwich and Royal Tern chicks adjacent to nesting site.

See Royal Tern account

Management

See Royal Tern account

CASPIAN TERN (Sterna caspia)

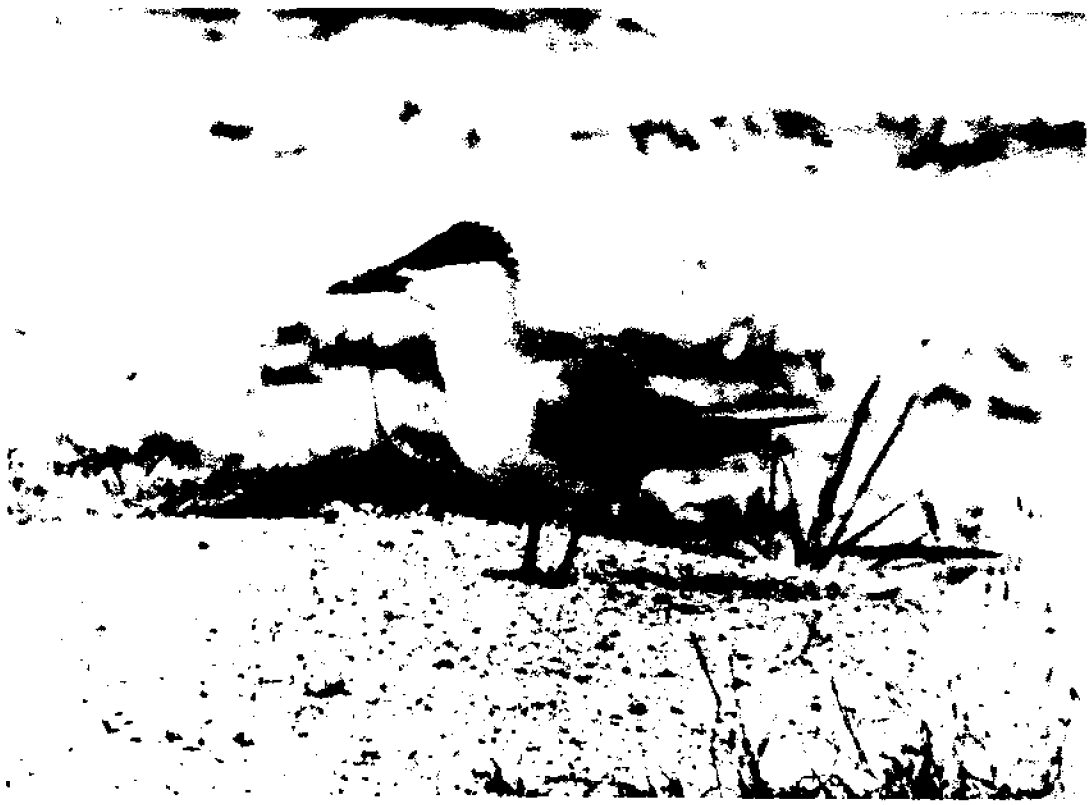

Fig. 54. Adult Caspian Tern at nesting site.

Identification

This large tern is similar in appearance to the Royal Tern. It is distinguished by its bright red bill and shallowly forked tail.

Range

Worldwide: Breeds at scattered sites across North America, Europe, Asia, Africa, and Australia (AOU 1957).

North America: Breeds at widely scattered locations from California across the interior to the Great Lakes and along the Atlantic and Gulf coasts (AOU 1957).

North Carolina: This tern was first recorded nesting in North Carolina in 1972 when 2 nests were found at Oregon Inlet (Parnell and Soots 1976). It still nests there in small numbers and has also nested at Hatteras Inlet. Caspian Terns are fairly common winter residents along the southeastern North Carolina coast and may occasionally be seen at all seasons along the entire North Carolina coast.

1977 Colony Sites: 03-07, 06-02, 06-08.

Taxonomy and Status

There are no geographic races of the Caspian Tern. It is not on the Federal List of Rare and Endangered Species or on the list of Endangered and Threatened birds of North Carolina (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	0	0	0	0
Natural Estuarine Islands	0	0	0	0
Man-made/Modified Sites	1(2)[1]	100	10	100
Totals	1(2)[1]	100	10	100

[1]Sites with fewer than 4 nests

Population Trends

Pearson et al. (1919) reported that the Caspian Tern was an uncommon migrant along the North Carolina coast. Records since that time indicate that the species also occurs along the coast during the winter, but until the discovery of the nests at Oregon Inlet in 1972, there was no indication that it nested in the state. It has, however, been known to nest in both Virginia and South Carolina (AOU 1957). It is currently a fairly common winter resident that nests in very small numbers in the state. The nesting population seems to be slowly increasing, and this species may be in the process of becoming a regular breeding species on the North Carolina coast.

Breeding Biology

Breeding Phenology: From very limited data, it appears that in North Carolina young Caspian Terns hatch during late May and early June. Assuming an incubation period of 20 days (Bent 1963), nests would have been started by early to mid-May. The young require about 4 to 5 weeks to attain flight (Reilly 1968). Caspian Terns may be expected at the nesting sites from early May to middle or late August.

Fig. 55. Typical sparsely lined Caspian Tern nest.

Critical Features: We do not have sufficient data to ascertain the key features in the breeding biology of this species. It appears to be similar in its biology to the Royal Tern.

Nesting Habitat

Substrate: The Caspian Tern appears to prefer the same sand and shell substrates preferred by the Royal Tern.

Topography: Elevated island domes.

Vegetation: This species appears to prefer unvegetated sites but will tolerate sparse low cover such as that provided by scattered basal rosettes of seaside goldenrod or by sandgrass.

Management

Nesting habitat does not appear to be limiting at present. Management

practices designed to provide breeding habitat for the Royal Tern should also be effective in assuring continued habitat for this species.

BLACK SKIMMER (Rynchops niger)

Fig. 56. Black Skimmer on nest.

Identification

A large tern-like bird, dark above and white below, that has a bright red scissors-like bill with the lower mandible longer than the upper.

Range

Worldwide: Occurs along the western Atlantic coast from the northern United States south to Yucatan and along the eastern Pacific coast from Mexico to the Strait of Magellan (AOU 1957).

North America: Breeds along the Atlantic coast from Massachusetts to Florida and across the Gulf coast to Texas. Winters from North Carolina southward (AOU 1957).

North Carolina: Breeds commonly from Roanoke Sound to the South Carolina state line. Winters commonly in the southeastern portions of the state.

1977 Colony Sites: 03-07, 06-02, 06-08, 06-09, 06-11, 06-20, 06-22, 06-23, 09-03, 09-04, 11-01, 12-01, 14-04, 14-05, 14-14, 17-03, 17-07, 20-03, 20-06, 23-14, 31-01, 32-02, 33-22, 35-02, 39-26, 39-49, 43-09, 47-08.

Taxonomy and Status

The subspecies, Rynchops niger niger occurs in North America. In North Carolina the Black Skimmer is listed as "of special concern" due to its colonial breeding status (Parnell et al. 1977).

1977 Breeding Population

	Colonies		Nests	
	Number	Percent	Number	Percent
Beaches	7	29	664	34
Natural Estuarine Islands	1(2)[1]	4	29	2
Man-made/Modified Sites	16	67	1232	64
Totals	24(2)[1]	100	1925	100

[1]Sites with fewer than 4 nests

Population Trends

This species appears to have been a relatively common nesting bird in the sounds and along the beaches of Dare, Hyde, and Carteret Counties in the early 1900's (Pearson et al. 1919). Since that time the species has spread southward to nest along the entire coast. There are no indications of present trends. Skimmers nest in many scattered colonies both on dredged material islands and on natural islands and beaches. These factors mean that it is less likely to suffer from a major catastrophe than are some of the species which nest in fewer, larger aggregations.

Breeding Biology

Breeding Phenology: Black Skimmers are very erratic nesters. They begin courtship in late April or early May, and by late May birds in some colonies will have begun laying eggs. In 1977, however, two-thirds of all colonies still had incubating birds in late July. The incubation period is about 23 days (Erwin 1977), and the fledging period is 23 to 25 days. Skimmer colonies will often have flightless young well into September. This species often nests in close association with Common Terns and Gull-billed Terns.

Fig. 57. Eggs and young of the Black Skimmer in characteristic unlined nesting scrape.

Critical Features: The erratic breeding schedule of the Black Skimmer presents a special problem. Some sites will be occupied early, but other important sites may not be occupied until well into summer. This makes the protection of colony sites more difficult. Black Skimmers also still nest on the open beach at several locations (see maps) and often place their nests at very low elevations where flooding is likely to occur. They also appear to be subject to reproductive failure during extended periods of cloudy cool weather. Skimmers do, however, readily renest after nest failures, and this may be a major factor leading to the extended breeding period.

Nesting Habitat

Substrate: Substrate in skimmer colonies ranged from fine sand to coarse shell. Most colonies were on sandy sites.

Topography: The preferred topography was either the upper beach, often where overwash had occured, or on the slopes and domes of dredged material islands. Open flats or small lumps were most heavily utilized for acutal nest placement.

Vegetation: Black Skimmers preferred bare sites or sites sparsely vegetated (generally less than a 25 percent cover) by such plants as salt-meadow cordgrass, sea rocket, American beachgrass, or seaside goldenrod.

Fig. 58. Black Skimmer nest adjacent to debris, as is typical when colony sites are unvegetated.

Management

As with the other ground nesters, habitat maintenance and protection from disturbance are the key factors. Skimmers still regularly nest on beaches, usually near inlets or at recent overwash zones, and protection from human disturbance is important. On dredged material island sites, the maintenance of islands in either bare or sparsely vegetated condition is important. Habitat management for Common Terns, Gull-billed Terns, and Black Skimmers can be coordinated as the 3 species often nest together.

COLONY SITE DESCRIPTIONS

In 1977, colonies of waterbirds were present at about 125 sites in the North Carolina estuaries. A few sites were on the mainland but most were on dredged material islands, natural estuarine islands or the barrier beaches. In this section each site has been located and described. The bird habitats are discussed and the history and present use of the site briefly outlined. The potential for continued use by colonial waterbirds is addressed, and recommendations concerning management are offered.

Each site was numbered using a dual numbering system. The first number (01 to 99) indicates a region such as a major sound, barrier island, or definable section of the Atlantic Intracoastal Waterway. For example, Currituck Sound was designated region 01 and the Cape Fear River as region 39. Within each region sites containing nesting colonies were numbered consecutively from north to south during the first year of the study (01 to 99). New sites in each region were added as colonized, with numbering continuing consecutively. Islands were defined as uplands surrounded by water at high tide. Islands not utilized by colonial waterbirds were not numbered. Thus, after three years of study, sites within a region were usually numbered from north to south but with some lack of ordination when colonies moved or when new sites were established late in the study. Islands are dynamic and ephemeral entities and this numbering system will need constant revision. A statewide system maintained by a state agency and agreed upon by all interested agencies would be very helpful.

All sites are numbered and located on maps in the Colony Site Map section. The map designation and page number are provided for cross referencing. If the first entry under a site number is in all upper case letters, the site is named on these charts. If this entry is in upper and lower case letters, the name represents a nearby landmark named on the Nautical Charts.

Entries under Site Characteristics provide information on the nature of the nesting island. Size estimates are provided for the smaller islands where the nesting site occupied a significant portion of the island. Where islands were very large, for example the barrier islands, no size measurement is provided. Maximum elevations are provided as a base for future measurements where erosion or dredged material placement are likely to significantly alter this important characteristic. Again, no elevation is provided for large islands where maximum elevations may have no relationship to specific colonies. Substrate is an important factor in site selection and a brief general description is provided for each site. The surroundings of a colony site are important in that such information provides an indication of the ease of access by predators and people and also may provide a clue to the nearby availability of important habitat factors such as feeding grounds. The short descriptions of nesting habitats briefly characterize the plant communities of the sites. On the

dredged material and natural islands, these descriptions characterize the entire island, not just the actual sites used by colonial birds. On the barrier beach and mainland sites, only the colony sites are described.

For each site a brief discussion of Colonial Species Present is given. This provides information on the history of bird utilization of important sites and indicates which species were present in 1977 at all sites.

The Site Potential for each island is also briefly discussed. It provides an estimate of the likelihood of the continued use of each site by colonial waterbirds. It also points out known deterrents to continued use.

It is expected that Management of certain sites will continue, either incidental to ongoing operations or planned by management agencies. While we are not yet prepared to recommend a management plan, specific management tools are available which can extend the life of a site or improve a site. Such specific recommendations have been made when warranted.

SITE: 01-01

MONKEY ISLAND, Currituck County
36°24' latitude, 75°52' longitude. Map A, page 221

Fig. 59. One of the few natural estuarine islands in North Carolina with well developed forest.

Site Characteristics

Site Type: Natural estuarine island
Size: About 2 hectares
Substrate: Sand and silt
Surroundings: Shallow open water
Nesting Habitats: The island was dominated by a well developed forest of loblolly pine, hackberry, live oak, red cedar, and yaupon. Tree height reached 15 to 25 meters. Shrub thickets occurred around the perimeter of the island. Dominant species were wax myrtle, willow, and silverling. A shallow fresh water marsh occurred in a cove along the perimeter. Smartweed, cattail, and three square dominated. Vegetative cover approached 100 percent in all habitat types.

Colonial Species Present

Herons, Egrets: This mixed species colony contained about 400 Cattle Egret, Little Blue Heron, Green Heron, Snowy Egret, Great Egret, and Louisiana Heron nests in 1977. It was located in the forest community which extended over most of the northern part of the island. Nest placement extended from the low shrubs to the top of the canopy.

Site Potential

There appeared to be the potential for considerable growth of this colony. Nest density was not high and unused habitat was available. The vegetation supporting the colony appeared healthy and the potential for the continuation of this colony appeared good. There was no suitable habitat on this island for ground nesting seabirds. The island has been the site of a duck club for many years. A caretaker has lived on the island for several years. In 1977 the Nature Conservancy purchased the island and it thus may pass into public ownership.

Management

At present the island perimeter is protected from wave erosion by a wooden groin which should be maintained. The colony may receive some protection by the presence of a caretaker.

SITE: 03-01

Roanoke Sound, Dare County
35°51' latitude, 75°36' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: 0.5 to 1 hectare, max. elev. 0.3 meter in 1976
Substrate: Sand and shell
Surroundings: This island was bordered by a navigation channel and shallow open water flats
Nesting Habitats: This small island was dominated by a sparse to medium cover of grasses and herbs. The most important species were saltmeadow cordgrass, American beachgrass, crabgrass, panic grasses, and seaside goldenrod.

Colonial Species Present

Terns, Skimmers: No colonial birds nested on this island in 1977. It was used by Common Terns and Black Skimmers in 1976. The reason for abandonment in 1977 was unknown, but may have related to human disturbance.

Site Potential

This site was about 50 percent covered with grasses and herbs. It was in good condition for Common Terns. Vegetation may be expected to become too dense for use by this species by 1980 to 1985. The site is undergoing rapid erosion and likely will not be a usable site beyond 1982 to 1985. Human disturbance was frequent.

Management

The deposition of fresh dredged materials within the next five years is recommended.

SITE: 03-05

Roanoke Sound, Dare County
35°48' latitude, 75°35' longitude. Map B, page 223

Fig. 60. Characteristic plant communities of dredged material islands between 10 and 15 years of age.

Site Characteristics

Site Type: Dredged material island
Size: 20 to 30 hectares, max. elev. 3.5 meters in 1976
Substrate: Sand and shell
Surroundings: A navigation channel and open water flats
Nesting Habitats: This large, long island was characterized by a series of alternating domes and swales. Dense stands of saltmeadow cordgrass were in the swales and on the lower slopes. On the upper slopes and domes a sparse cover of panic grass clumps, seaside goldenrod, evening primrose, and horseweed was present. Several scattered thickets comprised primarily of bayberry and wax myrtle occurred in the swales along the east side of the island.

Colonial Species Present

Herons, Egrets, Ibises: The shrub thickets of this island have contained a scattered mixed species colony since the early 1970's. In 1977 there were 382 nests of 7 species. This colony appeared to be growing.

Gulls, Terns, Skimmers: In the early 1970's this island was occupied by Black Skimmers, Gull-billed and Common Terns, Laughing and Herring Gulls. By 1975 the skimmers and terns had abandoned the site as the vegetation became too dense. In 1977 this island contained a large colony of Herring and Laughing Gulls and was the site of three Great Black-backed Gull nests. As the Herring Gull population has increased, there has been a corresponding decrease in population size and extent of nesting by Laughing Gulls. In 1978 no Laughing Gulls nested on this island.

Site Potential

The shrub thicket habitat was expanding, and nesting habitat for herons, egrets, and ibises was increasing. The potential for continued use of this island is good. The colony will likely continue to grow. The population of Herring Gulls declined greatly on this island in 1977 and 1978. This may have been due to the increasing density of plant cover on the upper slopes and domes occupied by the Herring and Great Black-backed Gulls. Laughing Gulls abandoned the island in 1978 even though their preferred habitat, the densely grassed swales, appeared ideal. In 1976 and 1977 there was a noticable increase in numbers of Nutria and Norway Rats. The actual impact of these mammals is unknown, but was correlated in time with the decreases in populations noted above. Thus, the potential for continued use of this island by gulls is uncertain.

Management

Shrub thickets in the vicinity are not abundant and these should be protected. Deposition of dredged material well away from the thickets would benefit ground nesting species if coupled with control of mammalian predators.

SITE: 03-06

Roanoke Sound, Dare County
35°50' latitude, 75°36' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: 1 to 2 hectares, max. elev. 2.3 meters in 1976
Substrate: Sand and shell
Surroundings: See 03-05
Nesting Habitats: This island consisted of a single dome sloping to swales along the perimeter. Vegetation was very similar to 03-05, except that there were no thickets present.

Colonial Species Present

Gulls, Terns: In the early 1970's a sizable Royal Tern colony was present on this island. A few Herring Gulls and Laughing Gulls also nested. Recently the Royal Tern colony abandoned the site apparently due to Herring Gull predation and vegetative succession. Numbers of nesting Herring Gulls and Laughing Gulls have increased, and in 1977 two Great Black-backed Gulls also nested.

Site Potential

It appears that this island will continue to be suitable for Herring and Laughing Gulls for several years. While there were no signs of the problems seen on 03-05, the islands are separated only by a narrow expanse of open water. Predator movement between the islands should not be difficult.

Management

See 03-05

SITE: 03-07

Roanoke Sound, Dare County
35°48' latitude, 75°35' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: 20 to 30 hectares, max. elev. 2.8 meters in 1976
Substrate: Sand and shell
Surroundings: See 03-05

Nesting Habitats: This long island was very much like 03-05 except that it was slightly younger and less densely vegetated. The domes were very similar but stands of saltmeadow cordgrass in the swales were not as dense. A fresh deposit of dredged material was placed on the southern tip of the island in 1975. By 1977 this area was lightly vegetated with saltmeadow cordgrass and seaside goldenrod.

Colonial Species Present

Gulls, Terns, Skimmers: Herring Gulls have nested on this island at least since the early 1970's. Their numbers have generally increased each year through 1977. Laughing Gulls nested in small numbers in 1976 and again in 1977. Black Skimmers, Common Terns, Gull-billed Terns, and Least Terns nested on the fresh dredged material deposit at the south end of the island in 1975 and 1976. By 1977 only the Black Skimmers remained and their numbers were much reduced. Caspian Tern nests were present in 1976, 1977 and 1978, and Great Black-backed Gulls nested in 1977.

Site Potential

Herring and Great Black-backed Gulls should continue to find this island suitable for several years. The site should become more attractive to Laughing Gulls and should continue to be usable for 5 to 10 years. As the shrub thickets develop, the site may prove suitable for herons, egrets, and ibises. The site will not likely be used again by skimmers or terns until new dredged material deposition is accomplished. An exception may be the continued use by scattered pairs of Caspian Terns which may nest in small clearings on the domes.

Management

The deposition of fresh dredged material on either end of the island would create habitat diversity and would likely lead to use by Common Terns, Gull-billed Terns, Least Terns, and Black Skimmers. The thickets and swales should be protected as habitat for wading birds and Laughing Gulls

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SITE: 03-08

WHALEBONE ISLAND, Dare County
35°54' latitude, 75°37' longitude. Map B, page 223

Site Characteristics

Site Type: Natural site subsequently receiving dredged materials
Size: About 2 hectares, max. elev. 1.2 meters in 1976
Substrate: Sand and shell

Surroundings: Dense grasses and shrub thickets
Nesting Habitats: This site consisted of a diked dredged material deposit along the edge of one of the natural causeway islands. The dredged material deposit was nearly bare but with light stands of salt-meadow cordgrass, evening primrose, horseweed, American beachgrass, and sandgrass. The area outside of the dike was densely vegetated with phragmites or shrub thickets.

Colonial Species Present

Terns: In 1976 a colony of Least Terns was present. By 1977, vegetation was encroaching on the site and the colony was much reduced.

Site Potential

Without additional deposition of dredged materials it is unlikely that this site will be used again. With deposition, Least Terns will likely continue to nest.

Management

None recommended

SITE: 03-09

Roanoke Sound, Dare County
35°49' latitude, 75°35' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: 20 to 30 hectares, max. elev. 1.3 meters in 1976
Substrate: Sand and shell
Surroundings: See 03-05
Nesting Habitats: This island was very similar to island 03-05 except that the surface was more densely vegetated than 03-05. A fresh deposit of dredged material was placed along the west edge of the island in 1975. This low dome and slope was sparsely vegetated primarily with sea rocket.

Colonial Species Present

This island has been utilized for several years by Herring and Laughing Gulls. In 1977 a single Great Black-backed Gull nest was present. In 1976 Least Terns, Common Terns, Black Skimmers, and Herring Gulls nested on the one year old deposit. Only the Herring Gulls remained on this deposit in 1977. In 1978 a large colony of Laughing Gulls was established.

Management

Fresh deposition of dredged materials on the 2 year old deposit would likely benefit the terns and skimmers. The older island surface will likely remain usable to Laughing Gulls for 5 to 10 years assuming no further disturbance to the habitats.

SITE: 05-01

BODIE ISLAND, Dare County
35°47' latitude, 75°37' longitude. Map B, page 223

Site Characteristics

Site Type: Natural beach
Size: Not measured
Substrate: Sand and shell
Surroundings: Colony site bounded by ocean and foredunes
Nesting Habitats: This colony site was located on the newly formed sand flats just north of Oregon Inlet. The area was generally bare, unstable, sand-flat between the high tide zone and the beginnings of a broken series of low grass covered dunes.

Colonial Species Present

This site was occupied by Least Terns in 1975 and 1976.

Site Potential

The habitat should remain suitable for several years. The major problem appeared to be the use of the colony site by beach vehicles causing some nest destruction. The site is within the Cape Hatteras National Seashore and was posted in 1976 and 1977.

Management

The elimination of human disturbance should be the major goal. The present posting may be adequate. Evaluation of this management technique is needed.

SITE: 05-06

Oregon Inlet, Dare County
35°46' latitude, 75°34' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: Not measured, max. elev. 4.1 meters in 1977
Substrate: Sand and shell
Surroundings: Boat channel and shallow open water
Nesting Habitats: This large island was over 4 meters in elevation and had varied habitat units. In 1977 about 50 percent of the island was covered by dredged material deposited in 1974 and 1976 and was essentially devoid of vegetation. Those parts of the island not covered by dredged material were covered by grass or grass-forb communities with a 25 to 50 percent coverage of vegetation. Dominant species were salt-meadow cordgrass, sea rocket, and seaside goldenrod. Shrub thickets of wax myrtle and marsh elder were beginning to develop. A small brackish water pond was present.

Colonial Species Present

Gulls, Terns: In 1977 a colony of Royal Terns occupied one bare dome while Least Terns nested on the opposite end of the island on a second bare dome. Common and Gull-billed Terns nested in sparse grass-forb habitats on the lower slopes of the island. A single Herring Gull nest was present. In 1978 only a small Least Tern colony remained.

Site Potential

The potential for continued use by the pioneer species is good, as dredged material deposition apparently occurs regularly. It is unlikely that dense vegetation will develop. The potential may begin to decline as island elevation continues to increase resulting in a decline of substrate stability. An intermittently occupied house indicates a strong liklihood of some human disturbance. Vehicles present on the island in 1978 probably caused the Royal Terns to abandon the site.

Management

The current dredging practices offer positive management for the pioneer ground nesting species. If elevations continue to increase, efforts to increase surface stability may be desirable. Colony sites should be posted to prevent human disturbance.

SITE: 06-02

Old House Channel, Dare County
35°46' latitude, 75°35' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: About 5 to 10 hectares, max. elev. 2.1 meters in 1977
Substrate: Sand and shell
Surroundings: Boat channel and shallow open water
Nesting Habitats: The 2 domes of this island were bare of vegetation. The slopes and swales were generally sparsely vegetated by a mixture of seaside goldenrod, crabgrass, sea rocket, wild rye, sea beach orach, panic grass, and saltmeadow cordgrass. Isolated clumps of marsh elder were the only shrubs present.

Colonial Species Present

Gulls, Terns, Skimmers: This site was occupied by colonies of several pioneer species. A small colony of Royal Terns (232 nests) was present at this site for the first time in 1977. This was a most unusual colony in that there were more Sandwich Terns (422) than Royals. In 1978 this colony was greatly enlarged having received the Royal Terns from island 05-06. The Royal and Sandwich Terns occupied the bare dome along with 3 Caspian Tern nests. The sparsely vegetated slopes were occupied in 1976 and 1977 by large colonies of Common Terns and Black Skimmers. Small numbers of Gull-billed Terns were also present. A small colony of Laughing Gulls nested in the thicker portions of the grass-forb habitat. In 1978 the Laughing Gull colony had grown considerably and the Common Terns and Black Skimmers had abandoned the site.

Site Potential

This site will likely continue to be used by terns for 2 to 3 years. The Laughing Gull colony will likely grow and may be expected to persist for 5 to 10 years. Herring Gulls will likely invade the island very soon and should persist for 5 to 10 years. The presence of the large Laughing Gull colony probably caused the Common and Gull-billed Terns and the Black Skimmers to abandon.

Management

Dredged material deposition would maintain habitat for the terns and skimmers and would discourage gulls.

SITE: 06-08

Old House Channel, Dare County
35°46' latitude, 75°36' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: About 5 to 10 hectares, max. elev. 1.6 meters in 1976
Substrate: Sand and shell
Surroundings: See 06-02
Nesting Habitats: This island had a single dome which was devoid of vegetation in 1977. The lower slopes were very sparsely vegetated by sea rocket, panic grasses, and saltmeadow cordgrass.

Colonial Species Present

Gulls, Terns, Skimmers: Colonies of Black Skimmers, Common Terns, and Gull-billed Terns were present on this site in 1977. There were also 2 Caspian Tern nests and 3 Herring Gull nests.

Site Potential

The potential for continued use of this site by the pioneer ground nesting species is good. Nesting by terns and skimmers should continue for at least 3 to 5 years. Herring Gulls should be expected to increase in numbers as cover of vegetation increases.

Management

See 06-02

SITE: 06-09

Stumpy Point Bay, Dare County
35°42' latitude, 75°46' longitude. Map C, page 225

Site Characteristics

Site Type: Dredged material island
Size: 1 to 2 hectares, max. elev. 2.5 meters in 1976
Substrate: Sand and shell
Surroundings: Open water
Nesting Habitats: This island was mostly covered by a sparse to moderate growth of mixed grasses and forbs. Dominant species were saltmeadow cordgrass, seaside goldenrod, and peppergrass. There were patches

of open ground, and in the swales low thickets of marsh elder were beginning to develop.

Colonial Species Present

Terns, Skimmers: In both 1976 and 1977 this site was occupied by colonies of Common and Gull-billed Terns and Black Skimmers. In 1977 there was considerable mortality and evidence of predation.

Site Potential

Vegetation on this island will soon become too dense for the pioneer species. Terns and skimmers may nest for another year or 2, but will likely soon abandon the site. There was also evidence in 1977 of predators taking adult and juvenile birds. This may speed abandonment. The site appears suitable for Laughing Gulls, but this species has not been found nesting on the western side of the sound.

Management

If this site is to be maintained as a nesting site for terns and skimmers, the vegetative succession should be returned to an earlier stage. Deposition of dredged material would be helpful. Predator control may be needed.

SITE: 06-10

Hatteras Village, Dare County
35°12' latitude, 75°36' longitude. Map E, page 229

Site Characteristics

Site Type: Dredged material island
Size: 3 to 5 hectares, max. elev. 2.7 meters in 1976
Substrate: Sand and shell
Surroundings: A dredged boat channel and shallow water flats
Nesting Habitats: This island had 2 bare domes. The slopes were lightly covered by mixed grasses and forbs including saltmeadow cordgrass, seaside goldenrod, and pennywort. The lower slopes and swales were covered by moderate to dense growths of saltmeadow cordgrass and panic grass, or by developing thickets of silverling, marsh elder, and wax myrtle up to 3 meters in height.

Fig. 61. Typical Royal and Sandwich Tern (bare domes) and Laughing Gull (grassy swales) nesting habitat.

Colonial Species Present

Herons, Egrets, Ibises: In 1977 a small colony of wading birds was established in the shrub thicket. Twenty-six nests of 4 species were present.

Gulls, Terns: For several years this island has been the site of large colonies of Royal and Sandwich Terns and Laughing Gulls. Each year smaller colonies of Common and Forster's Terns have also been present. In 1977 a single Herring Gull nest was present.

Site Potential

Vegetation on the swales and lower slopes was becoming quite dense and the shrub thicket was spreading. Nesting conditions for Laughing Gulls should be maintained for 5 to 10 years. The heronry should grow as the thicket spreads. Vegetation was encroaching on the Royal Tern colony in 1977 and it will likely move in 2 to 3 years. The Common and Forster's Terns have occupied drift ridges and upper beach habitats that may not follow regular successional patterns. Their continued use of the

island appears somewhat dependent on the action of the tides in preventing the lush growth of vegetation just above the beaches and in depositing the drift material needed as nesting substrate by the Forster's Terns. Numbers of nesting Herring Gulls is likely to increase.

Management

This island is adjacent to a heavily used boat channel and some protection from disturbance may be beneficial. Careful deposition of a limited amount of dredged material on the island dome would likely prolong use by Royal and Sandwich Terns. The island may have greater value, however, as a nesting site for Laughing Gulls and wading birds as their preferred habitats are not as readily available in the vicinity of Hatteras Inlet as are the sparsely vegetated or bare sites preferred by the terns.

SITE: 06-11

Hatteras Village, Dare County
35°12' latitude, 75°43' longitude. Map E, page 229

Site Characteristics

Site Type: Dredged material island
Size: 1 to 2 hectares, max. elev. 2.9 meters in 1977
Substrate: Sand and shell
Surroundings: A deep water channel and shallow open water flats
Nesting Habitats: This island received deposits of dredged materials in 1976 and 1977. In 1977 about 80 percent of the island was devoid of vegetation. About 20 percent of the island was sparsely vegetated by American beachgrass, saltmeadow cordgrass and Paspalum sp.

Colonial Species Present

Terns, Skimmers: In 1976 and 1977 this site was occupied by colonies of Common and Gull-billed Terns and Black Skimmers.

Site Potential

This site was subject to moderate erosion but should provide habitat for pioneer species for several years depending on the frequency of dredged material deposition.

Management

This site has received frequent depositions of dredged material since its construction. If this continues, the most important management tool will be the avoidance of deposition during the breeding season.

SITE: 06-12

GULL ISLAND, Dare County
35°28' latitude, 75°31' longitude. Map D, page 227

Site Characteristics

Site Type: Natural estuarine island
Size: Large island, not measured, max. elev. 0.8 meter in 1976
Substrate: Silt and sand
Surroundings: Open shallow water
Nesting Habitats: Most of this island was covered with dense stands of black needle rush, salt grass, smooth cordgrass, or saltmeadow cordgrass. Along the western fringe there were low shrub thickets comprised primarily of marsh elder and sea ox-eye. Large deposits of dead grass stems provided habitat for Forster's Terns.

Colonial Species Present

Herons, Egrets: In 1976 and 1977 small colonies of Louisiana Herons, Snowy Egrets, Great Egrets, and Black-crowned Night Herons nested in the marsh elder thickets.

Gulls, Terns: In 1976 a colony of about 730 Royal and Sandwich Terns nested on a small bare shell deposit on the western edge of the island. In 1977 the site was abandoned. In both 1976 and 1977 fairly large colonies of Forster's Terns, Common Terns and Laughing Gulls nested at this site. Small numbers of Herring Gulls nested both years.

Site Potential

This island is the site of an active duck club, and a hunting lodge is maintained. There was no evidence, however, of human disturbance or of the presence of mammalian predators. The potential for continued use appears good.

Management

None recommended

SITE: 06-13, 14, 15

Judith Island, Hyde County
35°20' to 21' latitude, 76°22' longitude. Map F, page 231

Site Characteristics

Site Type: Natural estuarine island
Size: 1 to 2 hectares, max. elev. 0.1 to 0.3 meter in 1976
Substrate: Sand and silt
Surroundings: Extensive marshes and open water
Nesting Habitats: These islands were covered with dense stands of salt-meadow cordgrass and salt grass. Patches of black needle rush, smooth cordgrass, and marsh elder were present. Extensive mats of dead drift materials were also present.

Colonial Species Present

Terns: In 1976 colonies of Common Terns were present at all 3 sites. In 1977 site 06-13 was not utilized.

Site Potential

Plant communities may be expected to persist. Some disturbance by fishermen occurs. Access by predators is possible. The potential for continued use, however, appears good.

Management

Information signs near colonies may reduce interference by fishermen. No other management is recommended.

SITE: 06-16

SOW ISLAND, Pamlico County
35°13' latitude, 76°30' longitude. Map G, page 233

Site Characteristics

Site Type: Natural estuarine island
Size: About 1 hectare, max. elev. 0.2 meter in 1976
Substrate: Sand and silt
Surroundings: Open water
Nesting Habitats: Most of this island was covered by a tall dense stand of giant cordgrass. Low narrow bands of salt grass and saltmeadow cordgrass along the island perimeter provided the nesting habitat.

Colonial Species Present

Herons: This site was used as a roost by an unknown number of herons and egrets. No nests were found.

Terns: Small colonies of Common and Forster's Terns nested in 1976 and 1977.

Site Potential

See 06-13

Management

None recommended

SITE: 06-18

Rattan Bay, Carteret County
35°03' latitude, 76°29' longitude. Map G, page 233

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare, max. elev. 0.1 meter in 1976
Substrate: Silt and sand
Surroundings: Extensive marshes and open water
Nesting Habitats: See 06-13

Colonial Species Present

Terns: This site was occupied by Common Terns in 1976 and 1977.

Site Potential

This island is within a military aircraft firing range. Habitat is expected to persist. Potential for continued use appears good.

Management

None recommended

SITE: 06-19

SWAN ISLAND, Carteret County
35°05' latitude, 76°25' longitude. Map G, page 233

Site Characteristics

Site Type: Natural estuarine island
Size: 8 to 12 hectares
Substrate: Silt and sand
Surroundings: Open water
Nesting Habitats: This island was vegetated by tall stands of giant cordgrass or low dense stands of saltmeadow cordgrass, sea ox-eye, and marsh elder.

Colonial Species Present

Herons, Egrets: In 1977 a small colony of 42 Louisiana Heron and 2 Snowy Egret nests was located in the giant cordgrass.

Terns: Forster's Terns attempted to nest at this site in 1976 and 1977. In 1976 the colony was destroyed by flooding and in 1977 only a single nest was present.

Site Potential

Disturbance appeared minimal and isolation from extensive marshes should minimize predation. The site is very low and subject to flooding. The potential for continued use appears good, but reproductive success of terns will likely remain poor.

Management

None recommended

SITE: 06-20

TUMP ISLAND, Carteret County
34°59' latitude, 76°23' longitude. Map J, page 239

Site Characteristics

Site Type: Natural estuarine island
Size: 1 to 2 hectares, max. elev. 0.6 meter in 1976
Substrate: Silt and sand
Surroundings: Open water
Nesting Habitats: See 06-19

Colonial Species Present

Gulls, Terns, Skimmers: In 1976 and 1977 this site contained small nesting colonies of Laughing Gulls, Common Terns, and Forster's Terns. Three Black Skimmer nests were present.

Site Potential

See 06-19

Management

This island is within the boundaries of the Cedar Island National Wildlife Refuge. No specific management is recommended.

SITE: 06-21

KING ISLAND, Dare County
35°16' latitude, 75°36' longitude. Map D, page 227

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare, max. elev. 0.5 meter in 1976
Substrate: Sand and shell
Surroundings: Open water
Nesting Habitats: Most of this small island was very low and either bare or sparsely vegetated by a low stand of smooth cordgrass.

Colonial Species Present

Terns: This site was occupied by Common Terns in both 1976 and 1977.

Site Potential

Nests were placed at very low elevations and there was evidence of damage by flooding in both 1976 and 1977. While the site appears to be attractive to Common Terns, it is unlikely that reproductive success was good. There was no indication of human disturbance although the site is only about 0.5 kilometer from a soundside development. The potential for successful breeding does not appear good.

Management

This site is near a maintained boat channel. The deposition of dredged materials would elevate the site and likely lead to increased use and success.

SITE: 06-22

BIRD ISLANDS, Dare County
35°22' latitude, 75°40' longitude. Map D, page 227

Site Characteristics

Site Type: Natural estuarine island
Size: Not measured
Substrate: Sand and shell
Surroundings: Open shallow water
Nesting Habitats: This low shoal was completely devoid of plants in 1977.

Colonial Species Present

Terns, Skimmers: In 1977 this low shoal was occupied by small colonies of Least, Common, Forster's, and Royal Terns and Black Skimmers.

Site Potential

This low site is very isolated and free from mammalian predators and human disturbance. The low elevation and exposed placement indicate a strong liklihood of nest destruction by flooding.

Management

None recommended

SITE: 06-23

Old House Channel, Dare County
35°42' latitude, 75°46' longitude. Map B, page 223

Site Characteristics

Site Type: Dredged material island
Size: 5 to 10 hectares
Substrate: Sand and shell
Surroundings: See island 06-08
Nesting Habitats: This island consisted of a single elongate dome. Most of the dome and slopes were sparsely vegetated, while vegetation on the lower slopes was of moderate density. Crabgrass was the dominant species.

Colonial Species Present

Terns, Skimmers: This island was occupied in 1977 by small colonies of Common and Gull-billed Terns and Black Skimmers.

Site Potential

See 06-08

Management

See 06-02

SITE: 07-02

Pea Island National Wildlife Refuge, Dare County
35°43' latitude, 75°30' longitude. Map B, page 223

Site Characteristics

Site Type: Man made island within diked impoundment
Size: About 2 hectares, max. elev. 2.0 meters in 1976
Substrate: Silt and sand
Surroundings: The site was bordered on one side by a borrow pit. Elsewhere shallow water flats were present.
Nesting Habitats: This island, located within an impoundment, was almost completely covered by a well developed maritime shrub thicket between 3 and 7 meters in height. Dominant species were wax myrtle, bayberry, and silverling. Small openings were present in the interior of the island. These were covered by dense stands of grasses, primarily saltmeadow cordgrass.

Colonial Species Present

Herons, Egrets, Ibises: In 1976 there was a thriving nesting colony at this site. By 1977 most individuals had moved a few hundred meters to island 07-05. Only 23 nests of 5 species remained in 1977. This was the only site that contained nesting Yellow-crowned Night Herons in 1977.

Site Potential

Vegetation appeared suitable and disturbances are minimal. The reason for the shift of this colony to island 07-05 is unknown. Predator access to either island is similar, but predators may have discovered this site and caused abandonment.

Management

The site is managed as a part of the Pea Island National Wildlife Refuge. Protection from human disturbance is provided and the habitat appears suitable. If 07-05 is abandoned, refuge personnel should initiate efforts to determine whether or not mammalian predators have discovered the sites.

SITE: 07-03

JACK SHOAL, Dare County
35°41' latitude, 75°30' longitude. Map B, page 223

Site Characteristics

Site Type: Natural estuarine island
Size: About 18 hectares, max. elev. 0.4 meter in 1977
Substrate: Silt and sand
Surroundings: Open water and extensive marshes
Nesting Habitats: This island is adjacent to the Pea Island marshes. It was covered with dense stands of grasses and forbs, primarily smooth cordgrass, salt grass, saltmeadow cordgrass, black needle rush, and sea ox-eye. Small clumps of marsh elder were also present.

Colonial Species Present

Gulls, Terns: This island was occupied by a large nesting colony of Forster's Terns and a small colony of Laughing Gulls in 1977. Neither was present in 1976.

Site Potential

See 06-13

Management

This island is within the boundaries of the Pea Island National Wildlife Refuge. No specific management is recommended.

SITE: 07-05

Pea Island National Wildlife Refuge, Dare County
35°42' latitude, 75°30' longitude. Map B, page 223

Site Characteristics

Site Type: Man made island within diked impoundment
Size: About 2 hectares, max. elev. 0.5 meter in 1977
Substrate: Silt and sand
Surroundings: See island 07-02
Nesting Habitats: Maritime shrub thicket (see island 07-02)

Colonial Species Present

Herons, Egrets, Ibises: Most of the birds nesting on island 07-02 in 1976 moved to this site in 1977. In 1977 a colony estimated to contain 282 nests of 7 species was present.

Site Potential

See 07-02

Management

See 07-02

SITE: 08-01

Hatteras Island, Dare County
(35°29' latitude, 75°20' longitude); (35°24' latitude, 75°29' longitude); (35°23' latitude, 75°30' longitude); (35°22' latitude, 75°30' longitude); (35°17' latitude, 75°31' longitude). Map D, page 227

Site Characteristics

Site Type: Barrier beach
Size: Not measured
Substrate: Sand and shell
Surroundings: Ocean and barrier dunes
Nesting Habitats: Least Terns nested at many scattered sites along the North Carolina beaches. Nesting sites often change from year to year, but the terns generally choose either the sand flats adjacent to inlets or areas of recent oceanic overwash. Habitats were generally devoid of vegetation but most often contained large amounts of shell in the substrate. Sites were generally located between the high tide line and the base of the foredunes.

Colonial Species Present

Terns: Small colonies of Least Terns nested at these widely scattered sites in 1976 or 1977. Often nests were distributed widely over a linear distance of 100 meters or more.

Site Potential

As long as overwash occurs and inlets continue to migrate, Least Tern habitat will be present on the outer beaches. Inlet and dune stabilization will tend to reduce habitat. Human disturbance also increasingly disrupts colonies as the number of people using the beaches increases.

Management

Habitat should be maintained by artificial means (substrate disturbance) to compensate for losses due to dune building, beach development, and inlet stabilization. Suitable sites should be posted to prevent human disturbances.

SITE: 08-02

Hatteras Island, Dare County
35°13' latitude, 75°41' longitude. Map D, page 227

Site Characteristics

Site Type: Barrier island
Substrate: Sand and shell
Size: Not measured
Surroundings: Shallow open water and grass covered sand flats
Nesting Habitats: This site was a small nearly bare point of land adjacent to the sound. A scattering of clumps of saltmeadow cordgrass and sea rocket was present in 1977.

Colonial Species Present

Terns: Small colonies of Least Terns occupied this site in 1976 and 1977.

Site Potential

Natural plant succession will likely produce cover too dense for Least Terns by 1980.

Management

Vegetation suppression and posting would likely result in the continued suitablility of this site.

SITE: 09-02

Hatteras Inlet, Hyde County
35°11' latitude, 75°47' longitude. Map E, page 229

Site Characteristics

Site Type: Barrier island
Size: Not measured
Substrate: Sand and silt
Surroundings: Extensive marsh and shallow open water
Nesting Habitats: This colony was placed along the edge of the fringing salt marsh. The site was dominated by black needle rush and smooth cordgrass. Nest placement was on rows of drift material.

Colonial Species Present

Terns: In 1977, 17 Forster's Tern nests were present.

Site Potential

The marshes fringing the barrier islands are accessible to mammalian predators and were seldom used as colony sites. Habitat should persist and continue to be suitable where drift rows are formed. Nest success will likely be low.

Management

None recommended

SITE: 09-03

Hatteras Inlet, Dare-Hyde County boundary
35°13' latitude, 75°45' longitude. Map E, page 229

Fig. 62. An example of a dredged material island which frequently receives large deposits.

Site Characteristics

Site Type: Dredged material island
Size: 5 to 10 hectares, max. elev. 9.4 meters in 1977
Substrate: Sand and shell
Surroundings: Shallow open water of Hatteras Inlet
Nesting Habitats: This large island is adjacent to the Hatteras to Ocracoke Ferry channel and receives fresh dredged material almost constantly. The island also erodes rapidly and height and configuration change constantly. Most of the higher portions of this site were bare in 1977. Around the perimeter of the island a sparse cover of sea rocket, saltmeadow cordgrass, and American beachgrass was present.

Colonial Species Present

Gulls, Terns, Skimmers: This site has been heavily used by the pioneer species since at least the early 1970's. In 1977 it was the site of one of the largest Least Tern colonies in North Carolina (313 nests). The island also contained a large assemblage of Common Terns, Forster's Terns, Gull-billed Terns, and Black Skimmers. In 1977 there were also 5 Laughing Gull nests.

Site Potential

The almost constant dredged material deposition, the rapid rate of erosion, and the relatively high elevation of this island will likely prevent the establishment of dense vegetation. It should therefore continue to be a suitable site for the terns and skimmers for several years.

Management

The frequent deposition of dredged materials at this site has included deposition during the breeding season. This is one of the few sites on the North Carolina coast where in recent years dredged material deposition has resulted in the destruction of tern nests. The placement of dredged materials on this island should be designed to avoid actively used nesting sites.

SITE: 09-04

Hatteras Inlet, Dare-Hyde County boundary
35°13' latitude, 75°45' longitude. Map E, page 229

Site Characteristics

Site Type: Dredged material island
Size: 3 to 6 hectares, max. elev. 7.6 meters in 1976
Substrate: Sand and shell
Surroundings: See 09-03
Nesting Habitats: This island was eroding very severely in 1976 and 1977. Island size was being rapidly diminished. The domes were devoid of vegetation while the slopes and swales were vegetated by a sparse to moderate cover of sea oats, saltmeadow cordgrass, orach, and panic grass.

Colonial Species Present

Gulls, Terns, Skimmers: This site was occupied in 1976 and 1977 by colonies of Black Skimmers, Common Terns, and Gull-billed Terns. A small colony of 5 to 10 Laughing Gull nests was present both years.

Site Potential

This island is subject to severe erosion and is not receiving dredged materials as frequently as the adjacent site (09-03). Unless there is continued disposal, the site may be lost.

Management

The primary need is for frequent dredged material disposal and avoidance of dumping on active colony sites.

SITE: 10-02

OUTER GREEN ISLAND, Hyde County
35°11' latitude, 75°48' longitude. Map E, page 229

Site Characteristics

Site Type: Natural estuarine island
Size: 3 to 6 hectares, max. elev. 0.1 meter in 1976
Substrate: Sand and silt
Surroundings: Shallow open water
Nesting Habitats: This low island was vegetated by a dense growth of saltmeadow cordgrass, sea ox-eye, and smooth cordgrass about 1 meter in height.

Colonial Species Present

Herons, Egrets, Ibises: Since at least 1974 this site has been occupied by a mixed species heronry. In 1977 there were 111 nests of 6 species.

Gulls: Laughing Gulls have nested on this site since at least 1974. In 1977 there were 99 nests. Small numbers of Herring Gulls were present in 1976 and 1977.

Site Potential

The low elevation and subsequent flooding during storm tides will likely prevent plant succession from progressing beyond the present stage. Human disturbance appears minimal, and the potential for continued use of this site is good.

Management

None recommended

SITE: 10-03, 04, 06, 07, 09, 10

Southside Ocracoke Island, Hyde County
35°09' to 11' latitude, 75°49' to 55' longitude. Map E, page 229

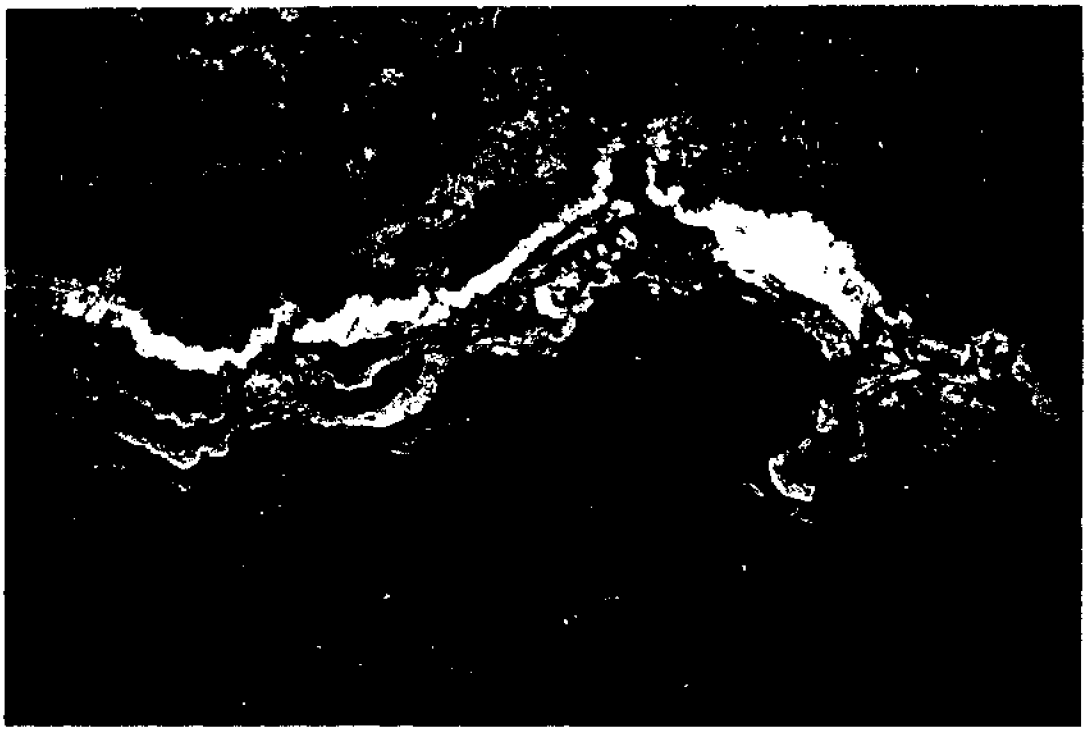

Fig. 63. An example of the low marshy islands that comprise the western fringe of the outer banks.

Site Characteristics

Site Type: Natural estuarine island
Size: Most are less than 1 hectare, max. elev. 0.1 to 0.2 meter in 1976
Substrate: Sand and silt
Surroundings: Extensive salt marshes and shallow open water
Nesting Habitats: These are marsh islands dominated by dense stands of saltmeadow cordgrass, sea ox-eye, smooth cordgrass, and occasionally marsh elder.

Colonial Species Present

Gulls, Terns: There are many of these marshy islands lying adjacent to Ocracoke Island. Each year several colonies of Forster's Terns are established on those islands that have the appropriate accumulation of drift meterial (primarily dead marsh grasses or sea grasses). The nesting sites may be expected to shift considerably from year to year. In 1977

Forster's Tern colonies were present at each of the sites indicated. In 1977 small Laughing Gull colonies were present on islands 10-04 and 10-06, and a single Herring Gull nest was found on 10-04.

Site Potential

These sites are seldom visited by people during the summer and colonies are not likely to be disturbed. Sites are accessible to predators. Vegetation is maintained by storm tide flooding and is unlikely to progress beyond the present stage. Potential for continued use appears good.

Management

None recommended

SITE: 11-01

OCRACOKE FLATS, Hyde County
35°04' to 05' latitude, 76°00' longitude. Map H, page 235

Fig. 64. Good example of the flats that often develop adjacent to inlets.

Site Characteristics

Site Type: Barrier beach
Substrate: Sand and shell
Size: Not applicable
Surroundings: Atlantic Ocean and shallow water of Pamlico Sound
Nesting Habitats: Ocracoke Flats is an extensive area of low sandy flats, often overwashed by storms, and small scattered "haycock" dunes. The flats were generally barren of vegetation while the dunes were sparsely to moderately covered by American beachgrass, sea oats, salt-meadow cordgrass, or sea rocket.

Colonial Species Present

Terns, Skimmers: This area was the site of Common Tern, Black Skimmer, Least Tern and Gull-billed Tern colonies in 1976 and 1977. Groups of nests were scattered from the beach to the sound-side and from the inlet north for 3,000 meters or more. Often nests were concentrated on the "haycock" dunes. The Forster's Tern colony was on drift material in the fringing salt marsh along the edge of the sound.

Site Potential

This is one of the most important beach nesting sites on the North Carolina coast. Overwash and inlet migration appear to be maintaining appropriate habitat for the pioneer ground nesters. The major threat appeared to be the heavy use of the flats by vehicles and flooding during "spring" tides.

Management

The primary management should be the elimination of human disturbance. The area has been posted by the Cape Hatteras National Seashore.

SITE: 11-04

BEACON ISLAND, Hyde County
35°06' latitude, 76°03' longitude. Map H, page 235

Site Characteristics

Site Type: Natural estuarine island
Size: 4 to 6 hectares, max. elev. 0.3 meter in 1976
Substrate: Silt and sand
Surroundings: Open shallow water
Nesting Habitats: Most of this island was covered by dense stands of salt grass, saltmeadow cordgrass, smooth cordgrass or black needle rush. Along the southern perimeter there was an elevated strip with a low shrub thicket consisting primarily of marsh elder.

Colonial Species Present

Pelicans: In the spring of 1978 the Brown Pelican colony, which had been located on islands 11-06 and 11-07 in 1977, moved to this site.

Herons, Egrets, Ibises: A small colony of Louisiana and Little Blue Herons, Snowy Egrets, Great Egrets, and Glossy Ibis have nested at this site since at least the early 1970's. In 1977, 24 nests were counted.

Gulls, Terns: Beacon Island is an important nesting site for Laughing Gulls and Forster's Terns.

Site Potential

This isolated low island is an important site for nesting colonial water birds. It is isolated and there was no indication of mammalian predators. Human disturbance also appeared minimal. The primary danger to nesting birds appears to be from flooding. The potential for continued use appears good.

Management

In view of the presence of the nesting colony of Brown Pelicans, an endangered species, regular patrol by wildlife officers may be helpful. No other management is recommended at present. Further research on the North Carolina Brown Pelican population is underway and may provide information leading to further recommendations.

SITE: 11-05

Wallace Channel, Hyde County
35°06' latitude, 76°03' longitude. Map E, page 235

Site Characteristics

Site Type: Man altered site (site obviously modified heavily by man, origin uncertain)
Size: About 1/4 hectare, max. elev. 0.5 meter in 1976
Substrate: Shell
Surroundings: A deep water channel and extensive shallow open water flats
Nesting Habitats: This long, narrow shell bank was mostly unvegetated. There were, however, a few isolated clumps of sea rocket and saltmeadow cordgrass.

Colonial Species Present

In 1977, a small colony of Royal and Sandwich Terns moved to this site. In addition, there was a colony of Common Terns and 4 Forster's Tern nests. Eighteen Herring Gull nests were also present. In 1978 the Royal Tern colony was absent.

Site Potential

This site has maintained its present character since the early 1970's. Its low elevation and shell substrate will likely prevent rapid growth of vegetation. It will probably remain a suitable nesting site for small numbers of the pioneer species for several years.

Management

Protection from disturbance appears to be the only currently feasible management tool.

SITE: 11-06

SHELL CASTLE ISLAND, Hyde County
35°06' latitude, 76°04' longitude. Map E, page 235

Site Characteristics

Site Type: Man altered site (see 11-05)
Size: 0.5 to 1 hectare, max. elev. 1 meter in 1976
Substrate: Shell and silt

Surroundings: See 11-05
Nesting Habitats: This site was similar to 11-05, but also included patches of sparse to moderately dense grasses and forbs, primarily sea ox-eye, seaside goldenrod, and saltmeadow cordgrass. A few small marsh elder shrubs were also present. A small smooth cordgrass marsh was contiguous to the island.

Colonial Species Present

Pelicans, Gulls, Terns: In 1977, 51 Brown Pelican nests were placed on this island. It also contained small colonies of Forster's Terns and Herring Gulls. In 1978 the site was abandoned by pelicans.

Site Potential

See 11-05

Management

See 11-05

SITE: 11-07

NORTH ROCK ISLANDS, Hyde County
35°07' latitude, 76°04' longitude. Map H, page 235

Site Characteristics

Site Type: Man altered site (see 11-05)
Size: 2 to 5 hectares, max. elev. 0.5 meter in 1976
Substrate: Shell, sand and silt
Surroundings: Extensive shallow water flats
Nesting Habitats: This site is a group of 3 islands separated by only 3 to 5 meters of shallow water. Two of the small islands were primarily shell with sparse to moderate growths of vegetation, dominated by sea ox-eye, saltmeadow cordgrass, Mexican tea, Suaeda sp., and marsh elder. The larger island had a fine sand-silt substrate and was dominated by a dense stand of saltmeadow cordgrass and low marsh elder thickets.

Fig. 65. Remnant of a once more extensive estuarine island.

Colonial Species Present

Herons, Egrets, Ibises: The marsh elder thickets have been the site of a colony of wading birds since at least the early 1970's. In 1977 the colony contained 116 nests of 6 species.

Pelicans, Gulls, Terns: The small shell islands were the site of a Brown Pelican colony for several years (see species account). The site was not used in 1978. Colonies of Common and Forster's Terns have nested here since the early 1970's. A single Herring Gull nest was present in 1977. In 1978 a colony of Royal and Sandwich Terns was established at this site.

Site Potential

Growth of vegetation on the small shell based islands will likely make this site unsuitable for the pioneer species by 1980. The shrub thickets occupied by the wading birds should provide appropriate habitat for many years.

Management

A reduction in the density of vegetation on the two small shell based islands would likely make these sites again attractive to pioneer species. The remoteness of the islands and the extensive shallow water flats surrounding them minimizes disturbances and thus the need for protection.

SITE: 12-01

SWASH INLET, Portsmouth Island, Carteret County
35°01' to 00' latitude, 76°06' to 09' longitude. Map H, page 235

Site Characteristics

Site Type: Natural beach
Substrate: Sand and shell
Size: Not applicable
Surroundings: Atlantic Ocean, marshes, and shallow sounds
Nesting Habitats: The Swash Inlet area is a region of heavy overwash. The topography consisted of low sand flats with isolated low dunes. There was no linear frontal dune system and the flats extended from ocean to sound. Most of the area was devoid of vegetation but sparse patches of sea oats, saltmeadow cordgrass, and sea rocket were present, usually on the low dunes.

Colonial Species Present

Terns, Skimmers: Least Terns established several scattered colonies in this region in both 1976 and 1977. Smaller numbers of Common Terns, Gull-billed Terns, and Black Skimmers were also present. Colony sites shifted considerably between years.

Site Potential

This region appeared very attractive to skimmers and terns. Most colonies were unsuccessful in 1976. The elevation of colony sites was often only about 0.1 meter, and heavy rains or high tides destroyed most colonies in 1976. There was also some evidence of nest destruction by vehicles.

Management

This area is a part of the Cape Lookout National Seashore. Prevention of human interference should be a major goal. Posting of colonies may be effective.

SITE: 12-02

Portsmouth Island, Carteret County
35°05' latitude, 76°04' longitude. Map H, page 235

Site Characteristics

Site Type: Natural estuarine island
Size: 1 to 2 hectares, max. elev. 0.1 meter in 1977
Substrate: Silt
Surroundings: Open water
Nesting Habitats: This small low marsh island was covered by stands of smooth cordgrass, glasswort, and sea oxeye daisy.

Colonial Species Present

Terns: In 1977, 88 Forster's Tern nests were located at this site.

Site Potential

See 10-03

Management

None recommended

SITE: 12-16, 17, 18, 19

Portsmouth Island, Carteret County
34°58' to 59' latitude, 76°08' to 09' longitude. Map I, page 237

Site Characteristics

Site Type: Natural estuarine island
Size: Not measured
Surroundings: Marshes and shallow water flats
Nesting Habitats: These low marsh islands were covered by stands of smooth cordgrass, saltmeadow cordgrass, and salt grass.

Colonial Species Present

Terns: In 1977 small colonies of Forster's Terns nested on drift rows of dead grass stems on each of these sites.

Fig. 66. One of many small marshy islands lying adjacent to the outer banks.

Site Potential

Occupancy of a particular site apparently depends on the availability of drift materials which form a nest substrate. Use of such sites will likely fluctuate greatly from year to year. There is little liklihood of human disturbance, but mammalian predators would have access to nesting sites from Portsmouth Island.

Management

These sites are within the Core Banks National Seashore. No specific management is recommended.

SITE: 12-23

CASEY ISLAND, Carteret County
35°05' latitude, 76°04' longitude. Map H, page 235

Site Characteristics

Site Type: Natural estuarine island
Size: 2 to 4 hectares
Substrate: Silt and sand
Surroundings: Open water
Nesting Habitats: See 12-02

Colonial Species Present

Terns: In 1977, 10 Forster's Tern nests were present.

Site Potential

See 12-16

Management

None recommended

SITE: 13-01

Core Banks, Carteret County
34°58' latitude, 76°10' longitude. Map I, page 237

Site Characteristics

Site Type: Natural estuarine island
Size: Not measured
Substrate: Sand and silt
Surroundings: See 12-16
Nesting Habitats: See

Colonial Species Present

Terns: In 1977, 14 Forster's Tern nests were present.

Site Potential

See 12-16

Management

See 12-16

SITE: 14-01

SHELL ISLAND, Carteret County
34°59' latitude, 76°12' longitude. Map J, page 239

Site Characteristics

Site Type: Natural estuarine island
Size: 0.5 to 1 hectare, max. elev. 0.5 meter in 1976
Substrate: Sand and shell
Surroundings: Open shallow water
Nesting Habitats: Parts of the beaches of this long narrow island were bare, but most of the area was covered with a moderate to dense stand of saltmeadow cordgrass and sea oxeye daisy. Elongate narrow thickets of marsh elder were developing along the central ridge of the island.

Colonial Species Present

Pelicans: Brown Pelicans have been observed loafing on this island each year since 1972. In 1976, 3 nests were begun but no eggs were laid.

Herons, Egrets: In 1976, there were 6 Louisiana Heron and Snowy Egret nests in the small marsh elder thicket. They did not return in 1977.

Gulls, Terns: This has been an important nesting site for gulls and terns for many years. Laughing Gulls have nested each year at least since 1972. Royal and Sandwich Terns also nested each year since 1972 in what appeared to be very marginal habitat. Nests were placed in a long strip along the beach just above high tide line. In the early 1970's, Gull-billed and Common Terns also nested, but their habitat has become overgrown. A single Herring Gull nest was present in 1977.

Site Potential

Flooding should maintain this site in low dense vegetation suitable for Laughing Gulls. While the site is attractive to Royal Terns, habitat is marginal and the colony is not expected to persist. Human disturbance or mammalian predation do not appear to be problems.

Management

A bare site suitable for Royal Terns is apparently needed along the lower edge of Pamlico Sound. Removal of vegetation from a portion of this island would likely restore it as a usable site for this species.

SITE: 14-02

WAINRIGHT ISLAND, Carteret County
34°59' latitude, 76°12' longitude. Map J, page 239

Fig. 67. An old dredged material island which has received deposits very infrequently.

Site Characteristics

Site Type: Dredged material island
Size: 4 to 6 hectares, max. elev. 0.6 meter in 1976
Substrate: Sand and shell
Surroundings: Shallow open water and boat channel
Nesting Habitats: This site received a deposit of dredged material in 1976. That part of the island was bare in 1977. The remainder of the

island was vegetated by a complex mixture of dense grasses or forbs, or dense shrub thickets. Primary species were giant cordgrass, saltmeadow cordgrass, sea ox-eye, Mexican tea, marsh elder, and silverling.

Colonial Species Present

Herons, Egrets, Ibises: A wading bird nesting colony has existed at this site at least since the early 1970's. In 1977, 355 nests of 7 species were present.

Gulls: Laughing Gulls have nested at this site for several years. In 1977, 4 Herring Gull nests and 1 Common Tern nest were also found.

Site Potential

This site contained one of the best developed shrub thickets in the lower Pamlico-upper Core Sound region. Unless dredged material is deposited over the thicket it should remain suitable for use by wading birds. The Laughing Gull habitat, dense saltmeadow cordgrass, is being slowly replaced by giant cordgrass or shrub thicket vegetation and the site may become unsuitable for Laughing Gulls in 5 to 10 years. The bare dredged material deposited in 1976 offers potential habitat for the pioneer species and eventual habitat for Laughing Gulls.

Management

The isolated nature of this island minimizes human disturbance. Future dredged materials should not be allowed to destroy the shrub thickets.

SITE: 14-03

HARBOR ISLAND, Carteret County
34°59' latitude, 76°13' longitude. Map J, page 239

Site Characteristics

Site Type: Natural estuarine island - modified by man
Size: 0.5 to 1 hectare, max. elev. 1.5 meters in 1976
Substrate: Sand, shell, and rock
Surroundings: Open water
Nesting Habitats: This island was the site of an oyster-rock cement building in the past. The ruins remain and a cabin has been built within the walls of the older building. Natural habitats present were small bare sites, dense low stands of grasses and forbs dominated by saltmeadow cordgrass, Ptilimnium sp., seaside goldenrod, orach, and sea ox-eye. Small shrub thickets were dominated by marsh elder and prickly ash.

Colonial Species Present

Gulls, Terns: In 1976 a small colony of Laughing Gulls nested at this site. They were not present in 1977. Small numbers of Herring Gulls nested both years. Small colonies of Common Terns nested among the rubble of the building ruins both years.

Site Potential

Human activity associated with the cabin may have been a factor in the reduced use of this site in 1977. Habitat remains appropriate, but the potential for continued use is not good.

Management

This site appears too small to allow both extended human use and bird nesting. Any management should begin with public ownership.

SITE: 14-04

Drum Inlet, Carteret County
34°52' latitude, 76°20' longitude. Map J, page 239

Site Characteristics

Site Type: Dredged material island - diked
Size: 5 to 10 hectares, max. elev. 5.5 meters in 1977
Substrate: Sand and shell
Surroundings: Boat channel and shallow open water flats
Nesting Habitats: This site has received frequent deposits of dredged materials, the last in 1976. About 95 percent of the island was bare in 1977. Adjacent to the dike there were small patches of sparse grass-forb habitats. Dominant plants were American beachgrass and sea rocket.

Colonial Species Present

Terns, Skimmers: This island has been occupied by Common and Gull-billed Terns and Black Skimmers, and in some years Least Terns, since the early 1970's. In 1977 all were present except Least Terns. A small colony of 33 pairs of Royal Terns also nested at this site in 1977.

Site Potential

The frequent deposition of dredged material and the relatively high elevation has resulted in very slow colonization of this site by plants. This slowed rate of plant succession will likely continue. Thus, this site should be available to the pioneer species for a longer period of time than is usual.

Management

There is heavy small boat traffic nearby and protection from human disturbance may be of value. Stabilization of the loose sands that cover the higher parts of the island would make the site more attractive.

SITE: 14-05

Drum Inlet, Carteret County
34°51' latitude, 76°19' longitude. Map J, page 239

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Core Sound, Drum Inlet, grassy swales
Nesting Habitats: This site is the north shore of Drum Inlet. It is a low sandy spit nearly devoid of vegetation in 1977 except for a few clumps of sea rocket.

Colonial Species Present

Terns, Skimmers: This was the site of large Least Tern colonies in 1976 and 1977. Colonies of Black Skimmers, Common Terns, and Gull-billed Terns were also present.

Site Potential

This appeared to be an important Least Tern nesting site. Occasional flooding should maintain the open habitat. The elevation reached 1 meter in 1977, and flooding was not as severe at this site in 1976 as at the lower Swash Inlet sites. There was evidence of considerable vehicular traffic. The potential for continued use is good.

Management

Posting of the site against vehicular traffic should help prevent colony disturbances.

SITE: 14-08

CORE BANKS, Carteret County
34°53' latitude, 76°17 to 31' longitude. Map K, page 241

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean and dunes
Nesting Habitats: There was a series of small Least Tern colonies scattered along this beach. Colonies were located between the high tide line and the foot of the frontal dune system. This sandy area was generally devoid of vegetation.

Colonial Species Present

Terns: Several small scattered Least Tern colonies were present in 1976 and 1977. Colony sites varied between years.

Site Potential

This beach did not appear to be an important nesting area. Habitat will likely remain bare and apparently suitable for Least Terns.

Management

Human disturbance is likely a factor. Posting of colony sites may be helpful.

SITE: 14-10

Drum Inlet, Carteret County
34°51' latitude, 76°20' longitude. Map J, page 239

Site Characteristics

Site Type: Dredged material island
Size: 1 to 1.5 hectares, max. elev. 0.3 meter in 1977
Substrate: Sand
Surroundings: Marsh and shallow open water
Nesting Habitat: About 30 percent of this island was bare in 1977. The remainder was covered by a moderate cover of smooth cordgrass and sea rocket.

Colonial Species Present

Terns: This site was occupied in 1976 and 1977 by colonies of Common Terns. In 1977 Forster's Terns also nested, as did 1 pair of Royal Terns.

Site Potential

This low island was subject to moderate erosion and frequent overwash. While it appeared to be attractive, especially to Common Terns, nesting success is questionable. The island appeared to be following a successional pattern leading to a smooth cordgrass marsh. As such, there will likely be little use by colonial birds other than Forster's Terns.

Management

The deposition of dredged material would elevate the island and make it a safer nesting site.

SITE: 14-11

Core Banks, Carteret County
34°90' latitude, 76°15' longitude. Map J, page 239

Site Characteristics

Site Type: Barrier beach
Size: Not measured
Substrate: Sand and shell
Surroundings: Ocean and dunes
Nesting Habitats: See 14-08

Colonial Species Present

Terns: In 1977 a small mixed colony of Least, Common, and Gull-billed Terns was present.

Site Potential

See 14-08

Management

See 14-08

SITE: 14-12

Core Banks, Carteret County
34°56' latitude, 76°12' longitude. Map J, page 239

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare
Substrate: Sand and silt
Surroundings: Extensive marshes and shallow open water
Nesting Habitats: See 12-16

Colonial Species Present

Terns: In 1977 there were 9 Forster's Tern nests present.

Site Potential

See 12-16

Management

See 12-16

SITE: 14-14

Marshallberg, Carteret County
34°35' latitude, 76°30' longitude. Map L, page 243

Site Characteristics

Site Type: Dredged material island
Size: About 1 hectare, max. elev. 1 meter in 1977
Substrate: Sand and shell
Surroundings: Shallow open water flats
Nesting Habitats: This island was constructed in 1977 and was completely devoid of vegetation.

Colonial Species Present

Terns, Skimmers: Very small numbers of Common Terns, Gull-billed Terns, Least Terns and Black Skimmers nested in 1977.

Site Potential

This small island will likely be utilized by the pioneer species for several years if it proves relatively stable.

Management

Prevention of human disturbance and maintenance of stability will be important.

SITE: 15-11

CHAIN SHOT ISLAND, Carteret County
34°59' latitude, 76°14' longitude. Map J, page 239

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare, max. elev. 0.7 meter in 1976
Substrate: Sand and shell
Surroundings: Open water
Nesting Habitat: This site was covered by dense stands of grasses and forbs, primarily saltmeadow cordgrass, sea ox-eye, and pennywort, or stands of giant cordgrass and marsh elder.

Colonia Species Present

Gulls, Terns: In 1977 this site was occupied only by Laughing Gulls and a single Herring Gull nest. In previous years, however, Forster's Terns have also nested.

Site Potential

This isolated island appears to offer good nesting habitat for Laughing Gulls and Forster's Terns. There appeared to be little human disturbance. Herons and egrets have been observed roosting at the site and a heronry may develop. Potential for continued use appears good.

Management

None recommended

SITE: 16-01

DUMP ISLAND, Carteret County
34°54' latitude, 76°17' longitude. Map J, page 239

Fig. 68. A large complex dredged material island that has been heavily utilized by nesting colonial waterbirds.

Site Characteristics

Site Type: Dredged material island
Size: 4 to 6 hectares, max. elev. 3.2 meters in 1976
Substrate: Sand and shell
Surroundings: Shallow open water flats
Nesting Habitats: This island had a complex pattern of vegetation. The domes were nearly bare or were sparsely vegetated with low grasses and forbs. The slopes and swales were moderately to densely covered with grasses and forbs. The dominant species were saltmeadow cordgrass, fescue, pennywort, melic grass, and seaside goldenrod. A thicket of silver popular, 3 to 7 meters in height was present as were several small low thickets of marsh elder, silverling, and wax myrtle.

Colonial Species Present

This island has been used by most species of colonial waterbirds since the early 1970's.

Herons, Egrets, Ibises: Thickets at this site have been occupied by waders at least since the early 1970's. In 1977 nearly 200 Cattle Egret nests and several Black-crowned Night Heron nests were located in the poplar thicket, while a mixed colony of about 175 nests of 6 species of wading birds was located in the low scattered shrub thickets.

Gulls, Terns: In recent years most of the terns, including Royal and Sanswich Terns, nested on this island. By about 1975, plant succession eliminated most of the bare or nearly bare sites required by the pioneers. In 1976 and 1977, however, this island was occupied by the largest Laughing Gull colony in North Carolina (3,511 nests in 1977). There were 2 Herring Gull nests in 1977.

Site Potential

This site should remain as suitable Laughing Gull nesting habitat for at least 5 to 10 years. As the shrub thickets spread, the site should be able to accomodate increasing numbers of waders. Numbers of Herring Gull nests will also likely increase.

Management

This island is privately owned and receives some protection. A return of portions of the island to bare or nearly bare substrate would likely again make the island attractive to the pioneer species.

SITE: 16-02

Old Drum Inlet, Carteret County
34°53' latitude, 76°17' longitude. Map J, page 239

Site Characteristics

Site Type: Dredged material island
Size: 4 to 6 hectares, max. elev. 3.2 meters in 1977
Substrate: Sand and shell
Surroundings: Marsh and shallow open water
Nesting Habitats: Most of this site was covered by a moderate to dense low growth of sea oats, saltmeadow cordgrass, pennywort, and seaside goldenrod. A low flat on the east end of the island was sparsely vegetated by sea rocket and seaside goldenrod. Thickets of wax myrtle, marsh elder, and silverling were developing in the swales.

Colonial Species Present

Gulls, Terns: Forster's and Common Terns have nested along the drift lines on this island for several years. In 1977 the Common Terns were absent. A small colony of Laughing Gulls probably represented an overflow from the large colony on the adjacent site (16-01). A single Herring Gull nest was present in 1977.

Site Potential

This island should provide suitable habitat for nesting Laughing Gulls for at least 5 to 10 years. Its continued availability to Forster's Terns is dependent on the availability of drift materials. The site has become too densely vegetated for most pioneer species.

Management

A return of plant succession to bare of nearly bare conditions on a portion of the island would likely result in Common Terns and Black Skimmers recolonizing the site.

SITE: 16-03

Core Banks, Carteret County
34°53' latitude, 76°17' longitude. Map J, page 239

Site Characteristics

Site Type: Natural estuarine island
Size: About 1 hectare, max. elev. 0.1 meter in 1977
Substrate: Sand and silt
Surroundings: Open shallow water and marshes
Nesting Habitats: This low marsh island was covered primarily by a low stand of smooth cordgrass.

Colonial Species Present

Terns: In 1977, 7 Forster's Tern nests were present.

Site Potential

See 12-16

Management

None recommended

SITE: 17-01

MORGAN ISLAND, Back Sound, Carteret County
34°40' latitude, 76°32' longitude. Map L, page 243

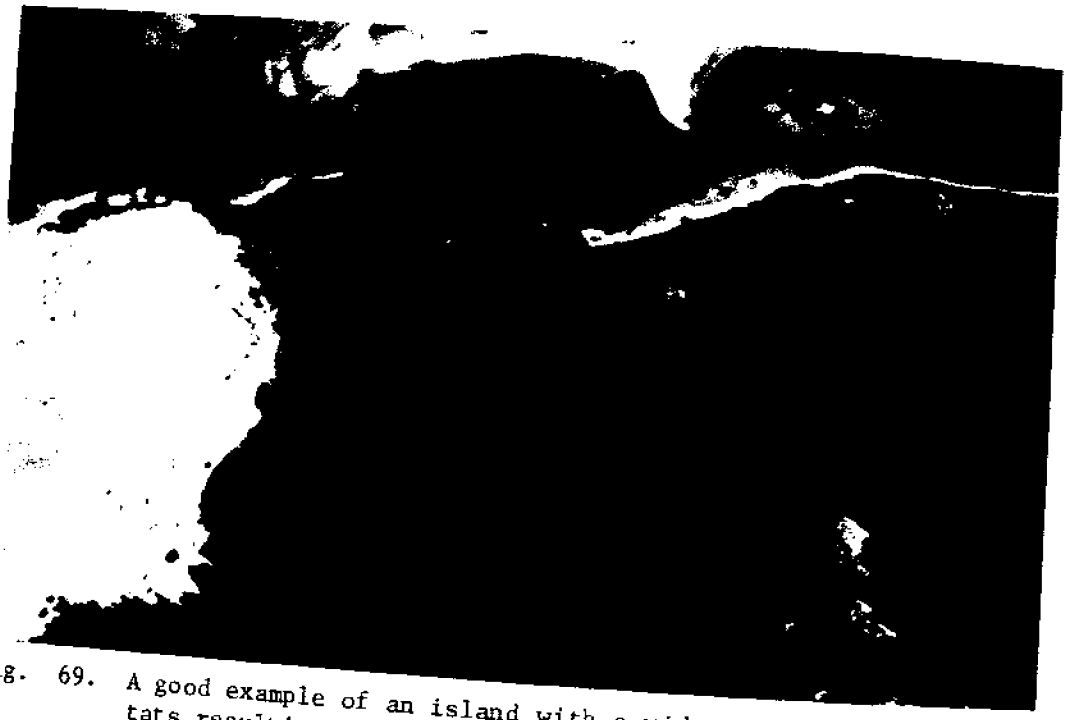

Fig. 69. A good example of an island with a wide range of nesting habitats resulting from frequent deposition on a portion of an old island.

Site Characteristics

Site Type: Dredged material island - diked
Size: 4 to 6 hectares, max. elev. 3.0 meters in 1976
Substrate: Sand and shell
Surroundings: Deep water channel, marsh, and shallow water flats
Nesting Habitats: This complex island contained several habitats. About two-thirds of the island was diked. This area was primarily a large unvegetated dome. The dikes in 1977 were vegetated by a sparse cover of saltmeadow cordgrass, sea rocket, sand grass, and Russian thistle. The area not enclosed by the dike was low in elevation and sparse to densely covered by grasses and forbs, primarily saltmeadow cordgrass, pennywort, and Mexican tea. A small shrub thicket 1 to 3 meters in height consisting of wax myrtle, marsh elder, and silverling was also present.

Colonial Species Present

Herons, Egrets, Ibises: A small nesting colony of wading birds has been present in the thicket for several years. Numbers appear to be increasing. In 1977, there were 146 nests of 6 species.

Gulls, Terns, Skimmers: This site has been occupied intermittently by a large colony of Royal and Sandwich Terns at least since the early 1970's, depending on the cover of vegetation on the dome. The low grassy areas outside of the dike have been occupied for several years by a colony of Laughing Gulls. Common and Gull-billed Terns and Black Skimmers have nested on the dike in recent years but were not present in 1977.

Site Potential

This site had a large and diverse nesting aggregation of colonial waterbirds. Dredged material has been deposited regularly maintaining the diked part of the island in a bare or nearly bare condition. If habitat diversity is maintained, the potential for continued use by both ground nesters and wading birds is good.

Management

This island is adjacent to the heavily used boat channel to the Cape Lookout bight. Some protection from disturbance may be needed. The primary management tool should, however, be the maintenance of habitat diversity. The shrub thicket should be protected from destruction by dredged material deposition and deposition should continue behind the dike. Removal or lowering of a section of dike to allow young Royal Terns access to the beach would be helpful.

SITE: 17-03

Lighthouse Bay, Carteret County
34°39' latitude, 76°32' longitude. Map L, page 243

Site Characteristics

Site Type: Dredged material island
Size: 1 to 2 hectares, max. elev. 2.1 meters in 1976
Substrate: Sand and shell
Surroundings: See 17-01
Nesting Habitats: Most of the island was covered by a sparse to moderately dense mixture of saltmeadow cordgrass, pennywort, and camphorweed. A small area adjacent to the beach was bare.

Colonial Species Present

Gulls, Terns, Skimmers: This island has been an important nesting site for Laughing Gulls, Common Terns, Gull-billed Terns, and Black Skimmers for several years. The site was abandoned during 1975 and partially abandoned in 1976 due to predation by Norway Rats. In 1977, 64 Common Tern nests, 11 Black Skimmer nests and only 2 Gull-billed Tern nests were present. Laughing Gulls did not nest at this site in 1976 or 1977.

Site Potential

This site contained suitable habitat for Common Terns and Laughing Gulls. The potential for use by Laughing Gulls would be good for 5 to 10 years if the rats were removed. It is unlikely that Common Terns would use the site beyond 1980 due to the increasing density of vegetation. Small numbers of Black Skimmers may continue to find suitable nesting areas along the beaches but this habitat is tenuous at best.

Management

Removal of Norway Rats is of major importance. Protection from human disturbance may also be helpful. A reduction of the density of the vegetation would make the site usable for the pioneer species.

SITE: 17-07

Back Sound, Carteret County
34°40' latitude, 76°31' longitude. Map L, page 243

Site Characteristics

Site Type: Dredged material island
Size: About 1 hectare, max. elev. 0.6 meter in 1977
Substrate: Sand and shell
Surroundings: Open water
Nesting Habitats: This small low island was constructed in 1976. In 1977 the island was devoid of vegetation except for new plantings of saltmeadow cordgrass, smooth cordgrass, and Iva imbricata.

Colonial Species Present

Terns, Skimmers: In 1977 this island was colonized by small numbers of Black Skimmers, Common Terns and Least Terns.

Site Potential

This island represents a new technique of dredged material stabilization by the United States Army Corps of Engineers. Dredged material was deposited in open water within a ring of sandbags. The island should be relatively stable and should provide nesting habitat for the pioneer species for several years, unless plant succession is advanced by plantings.

Management

This site will likely receive regular deposits of dredged materials. Dredging should be coordinated to prevent destruction of existing colonies.

SITE: 17-08

Back Sound, Carteret County
34°40' latitude, 76°31 longitude. Map L, page 243

Site Characteristics

Site Type: Dredged material island
Size: Less than 1 hectare, max. elev. 0.6 meter in 1977
Substrate: Sand and shell
Surroundings: See 17-01
Nesting Habitats: This small island is closely adjacent to 17-01. It was vegetated by patches of saltmeadow cordgrass, seaside goldenrod, and Iva imbricata. Cover ranged from zero to 100 percent.

Colonial Species Present

Terns: This island has been occupied during most years since 1971 by small colonies of Common and Gull-billed Terns and Black Skimmers. In 1977, however, only a colony of Common Terns was present.

Site Potential

This site should continue to be occupied by small colonies of the pioneer species for at least 3 to 5 years.

Management

This island appears too small to attract nesting Laughing Gulls. A reduction in cover of vegetation would extend its useful life for Common Terns.

SITE: 18-07

Middle Marsh, Carteret County
34°41' latitude, 76°37' longitude. Map M, page 245

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare, max. elev. 1.0 meter in 1976
Substrate: Sand and silt
Surroundings: Extensive marshes and open water
Nesting Habitats: Most of this long narrow island was covered with a dense maritime shrub thicket dominated by live oak, yaupon, silverling, and marsh elder. The fringes consisted of dense stands of grasses, primarily saltmeadow cordgrass.

Colonial Species Present

Herons, Egrets: In the early 1970's this island and nearby 18-15 were the sites of active nesting colonies of wading birds. In 1976 the numbers of nests diminished significantly and in 1977 the site was abandoned.

Site Potential

Vegetation at this site appears suitable for nesting wading birds. The island is easily accessible to boats and is within a large marsh which may harbor mammalian predators. The cause of colony abandonment is unknown.

Management

None recommended

SITE: 18-08

BOTTLE RUN POINT, Back Sound, Carteret County
34°41' latitude, 76°35' longitude. Map M, page 245

Site Characteristics

Site Type: Natural estuarine island
Size: Not measured, max. elev. 0.5 meter in 1976
Substrate: Sand, silt, and shell
Surroundings: Shallow open water and marsh islands
Nesting Habitats: See 18-20

Colonial Species Present

Terns: Sixty Common Tern nests were present in 1977.

Site Potential

See 18-20

Management

See 18-20

SITE: 18-11

Back Sound, Carteret County
34°40' latitude, 76°32' longitude. Map L, page 243

Site Characteristics

Site Type: Natural estuarine island
Size: About 1 hectare
Substrate: Sand and shell
Surroundings: Shallow open water
Nesting Habitats: See 18-20

Colonial Species Present

Terns: Thirty-one Common Tern nests were present in 1977.

Site Potential

See 18-20

Management

See 18-20

SITE: 18-12

Back Sound, Carteret County
34°40' latitude, 76°34' longitude. Map L, page 243

Site Characteristics

Site Type: Natural estuarine island
Size: About 5 hectares, max. elev. 0.5 meter in 1976
Substrate: Sand and shell
Surroundings: Shallow open water and marshes
Nesting Habitats: See 18-20

Colonial Species Present

Terns: Ten Common Tern nests were present in 1977.

Site Potential

See 18-20

Management

See 18-20

SITE: 18-15

Middle Marsh, Carteret County
34°42' latitude, 76°37' longitude. Map M, page 245

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare, max. elev. 1.0 meter in 1976
Substrate: Sand and silt
Surroundings: Extensive marshes
Nesting Habitats: See 18-07

Colonial Species Present

See 18-07

Site Potential

See 18-07

Management

See 18-07

SITE: 18-20

BARE GRASS, Back Sound, Carteret County
34°39' latitude, 76°32' longitude. Map L, page 243

Site Characteristics

Site Type: Natural estuarine island
Size: 0.5 to 1 hectare, max. elev. 0.6 meter in 1977
Substrate: Sand and shell
Nesting Habitats: Parts of this small island were bare, but most was covered by a low stand of saltmeadow cordgrass, smooth cordgrass, sea ox-eye, salt grass, and scattered clumps of marsh elder.

Colonial Species Present

Terns: There are a series of these small low islands scattered throughout Back Sound and adjacent to Shackleford Banks. Common Terns, Gull-billed Terns, and Black Skimmers nest on several each year. In 1977 this site was occupied by Common Terns.

Site Potential

This low island appeared to be visited regularly by wild horses from Shackleford Banks. Human disturbance was apparently infrequent. Nesting sites appear to flood frequently and nesting success is likely poor. While the habitat will probably remain unchanged, the potential for successful nesting does not appear good.

Management

The management of nearby more elevated dredged material islands may result in less use of these marginal sites.

SITE: 18-25

Back Sound, Carteret County
34°39' latitude, 76°32' longitude. Map L, page 243

Site Characteristics

Site Type: Natural estuarine island
Size: Not measured
Substrate: Sand and shell
Surroundings: See 18-20
Nesting Habitats: See 18-20

Colonial Species Present

Terns: See 18-20. Small Common Tern colony present in 1977.

Site Potential

See 18-20

Management

See 18-20

SITE: 20-02

Radio Island, Carteret County
34°43' latitude, 76°41' longitude. Map N, page 247

Site Characteristics

Site Type: Dredged material deposit
Size: Large island, not measured
Substrate: Sand and shell
Surroundings: Marsh, shallow water, and uplands
Nesting Habitats: Most of this deposit was devoid of vegetation. The lower elevations were sparsely vegetated by sand grass and sea rocket in 1977.

Colonial Species Present

Terns: This site was used by small colonies of Least Terns and Common Terns in 1977.

Site Potential

This site has received frequent deposits of dredged materials. The substrate was very loose and unstable. The site was also open to access by mammalian predators and humans. The potential for this site becoming an important nesting area is not good.

Management

None recommended.

SITE: 20-03

Bird Shoal, Carteret County
34°43' latitude, 76°41' longitude. Map N, page 247

Site Characteristics

Site Type: Dredged material island
Size: About 40 to 60 hectares, max. elev. 5.5 meters in 1976
Substrate: Sand and shell
Surroundings: Extensive mud flats, marshes, and open water
Nesting Habitats: This site is a large dredged material deposit at the west end of Bird Shoal. Dredged material was deposited last in 1975 and much of the site remained bare in 1977. Parts of the site not covered by dredged materials in 1975 were sparsely vegetated by grasses or grass-forb communities dominated by seaside goldenrod, evening primrose, camphorweed, and Russian thistle.

Colonial Species Present

Terns, Skimmers: This site has been an important nesting area for Least Terns, Common Terns, and Black Skimmers for several years. In 1977 numbers of Least Terns were reduced, but a sizable mixed colony of Common and Gull-billed Terns and Black Skimmers was present.

Site Potential

The potential for the continued use of this site by the pioneer species appears good. The present rate of dredged material deposition should assure the continued presence of bare or nearly bare habitats. The wild horses of Bird Shoal have access to the colony site and may trample some nests.

Management

Dredging has maintained this site in good condition for the pioneer species. There was heavy human use of adjacent waters, and some protection from interference may be needed in future years.

SITE: 20-05

SHACKLEFORD POINT, Carteret County
34°41' latitude, 76°39' longitude. Map M, page 245

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean, inlet, and grass covered flats
Nesting Habitats: The region just to the north of the Beaufort Ship Channel consisted of sand flats and scattered clusters of dunes. The flats were generally devoid of vegetation, while the dunes were sparsely to moderately vegetated with sea oats, saltmeadow cordgrass, and sea rocket.

Colonial Species Present

Terns, Skimmers: In 1976 Common and Gull-billed Terns and Black Skimmers were present. In 1977 the site was not utilized.

Site Potential

The habitat appears suitable for the pioneer species. Shackleford is, however, occupied by feral horses and sheep as well as mammalian predators. Human disturbance appeared minimal. The potential for future utilization is not clear.

Management

None recommended.

SITE: 20-06

BRANT ISLAND, Morehead Channel, Carteret County
34°42' latitude, 76°42' longitude. Map N, page 247

Fig. 70. An example of a large, elevated, diked island with a very unstable substrate resulting from the frequent deposition of large volumes of dredged materials.

Site Characteristics

Site Type: Dredged material island - diked
Size: 80 to 100 hectares, max. elev. 8.3 meters in 1976
Substrate: Sand and shell
Surroundings: Marshes, mud flats, and a deep water channel
Nesting Habitats: The frequent deposition of dredged material (80 percent of the site was covered in 1975), and high elevation have kept much of the island bare. Patches of sea oats and scattered clumps of sea rocket were present in 1977.

Colonial Species Present

Terns, Skimmers: This site has been an important nesting area for the pioneer ground nesters at least since the early 1970's. In 1977, 770 nests of Common Terns, Black Skimmers, Gull-billed Terns, and Least Terns were present.

Site Potential

This site is apparently very attractive to the pioneer ground nesters. Nesting success, however, appears to be poor. The problem is primarily due to a very loose unstable substrate. Winds move the loose sands constantly, and it was not uncommon to see nests with eggs completely covered by the shifting sands. In spite of the annual presence of relatively large numbers of nests, few young appear to have been produced. The potential for the maintenance of the bare or nearly bare site conditions preferred by the terns and skimmers is good. The likelihood of increasing the stability of the substrate is not good. Terns and skimmers will likely continue to nest, but success will probably remain low.

Management

Increased substrate stability is the primary need at this site. The deposition of dredged material should be avoided during the nesting season.

SITE: 21-01

Morehead City, Carteret County
34°44' latitude, 76°42' longitude. Map N, page 247

Site Characteristics

Site Type: Dredged material island
Size: Not measured, max. elev. 6.9 meters in 1976
Substrate: Sand and shell
Surroundings: Marshes and open water
Nesting Habitats: This site was a large dredged material deposit with a complex set of plant communities including a bare dome, dense grasses, and shrub thickets. Only the bare dome has been utilized as nesting habitat by colonial birds.

Colonial Species Present

Terns: Six pairs of Least Terns nested at this site in 1976 and in 1977.

Site Potential

The proximity of extensive marshes and Morehead City make it probable that mammalian predators regularly visit this site. It is not likely to become an important site although the pioneer species may utilize it in small numbers as long as appropriate habitat is available.

Management

None recommended.

SITE: 21-03

Newport River, Carteret County
34°44' latitude, 76°42' longitude. Map N, page 247

Site Characteristics

Site Type: Dredged material island - partly diked
Size: Not measured, max. elev. 5.2 meters in 1976
Substrate: Sand, shell, and silt
Surroundings: A deep water channel and extensive marshes
Nesting Habitats: This island was partially diked in 1974. The dike, which included the central part of the island, encloses habitats that were bare or sparsely covered with grasses and forbs in 1977. Salt-meadow cordgrass, evening primrose, and camphorweed were dominant. Around the perimeter of the island, outside of the dike, dense shrub thickets were present. These thickets were dominated by wax myrtle, silverling, yaupon, marsh elder, red cedar, and loblolly pine.

Colonial Species Present

Herons, Egrets, Ibises: This colony has nested at this site, or across the Newport River channel on island 21-04 since the 1960's (McCrimmon 1978). In 1975 and 1976 most nests were on island 21-03, but in 1977 most birds nested on island 21-04, leaving only about 71 nests of 7 species at this site. About 50 White Ibis nests were present at this site in 1976, but only 3 nests were found in 1977.

Site Potential

It is not clear why this colony has shifted periodically between islands 21-03 and 21-04. Both sites appear suitable. Island 21-03 has been diked, and dredged materials were deposited in 1974. However, the colony site was not affected, and the birds remained to nest in large numbers until 1977. The potential for continued use of both sites appears good.

Management

The maintenance of the shrub thicket habitats and protection from disturbance appear to be the most important considerations. Public ownership of island 21-04 could provide long term protection for the existing colony.

SITE: 21-04

Newport River, Carteret County
34°44' latitude, 76°41' longitude. Map N, 247

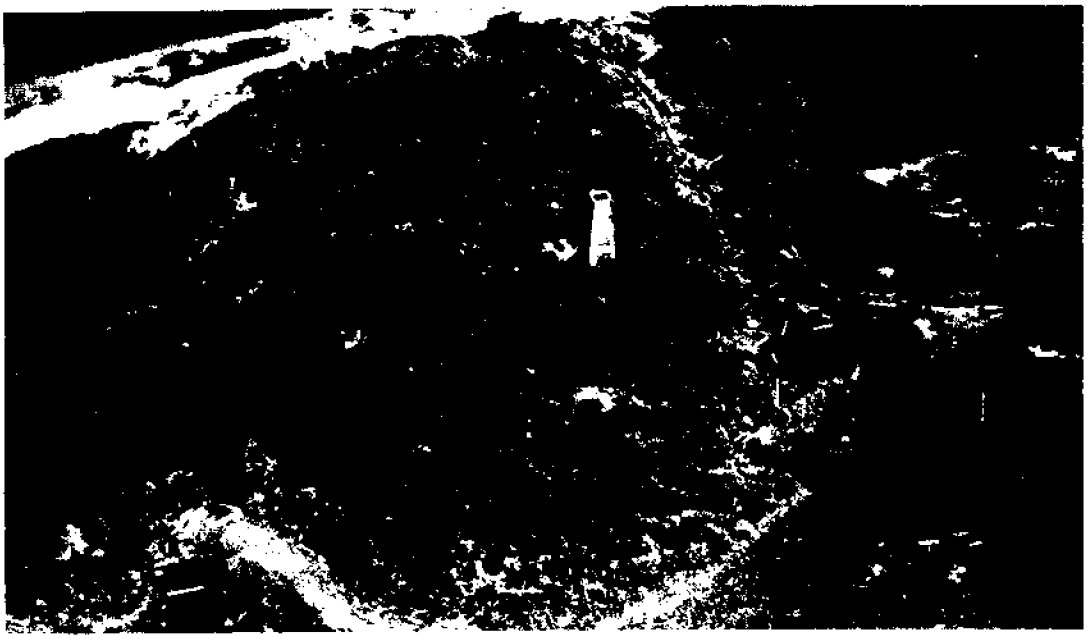

Fig. 71. A well developed shrub forest on an island of uncertain origin.

Site Characteristics

Site Type: Origin uncertain, has received dredged materials.
Size: 1 to 2 hectares, elevation not measured
Substrate: Sand, silt, and shell
Surroundings: See 21-03
Nesting Habitats: This island was covered by a dense maritime shrub forest dominated by yaupon, paper mulberry, eastern red cedar, white mulberry, and marsh elder (McCrimmon 1978).

Colonial Species Present

Herons, Egrets: See 21-03. In 1977 this island was the site of a colony of about 263 nests of 6 species.

Site Potential

See 21-03

Management

See 21-03

SITE: 22-08

Bogue Sound, Carteret County
34°43' latitude, 76°57' longitude. Map O, 249

Site Characteristics

Site Type: Dredged material island - relict
Size: Less than 1 hectare, max. elev. 0.4 meter in 1976
Substrate: Shell
Surroundings: The Atlantic Intracoastal Waterway (AIWW) and shallow open water
Nesting Habitats: Most of this long narrow island was bare in 1977. Patches of low grasses, forbs, and shrubs, primarily marsh elder, sea ox-eye, seaside goldenrod, saltmeadow cordgrass, and sea rocket were present.

Colonial Species Present

This shell bank was occupied by Common Terns in 1976 and 1977. In 1977 a small colony of Least Terns was also present.

Site Potential

This site appears to be a shell relict of a more extensive dredged material deposit. Without further deposition it will likely retain its present character with occasional storm tides preventing the establishment of a dense cover of vegetation. It will thus likely remain a usuable site for Common and Least Terns.

Management

Should dredging of this stretch of the AIWW be necessary, a larger more elevated island would provide additional protection from flooding. Some protection from human disturbance may be desirable as the island is immediately adjacent to a heavily used waterway.

SITE: 22-25

Bogue Sound, Carteret County
34°41' latitude, 77°00' longitude. Map O, page 249

Fig. 72. A diked island showing a complex arrangement of plant communities that is typical of many islands between Bogue Sound and the Cape Fear River.

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 1.2. meters in 1977
Substrate: Sand and shell
Surroundings: AIWW and shallow open water
Nesting Habitats: This elongate island had a complex pattern of dredged material deposits of varying ages. In the early 1970's the entire island was diked. Habitats ranged from bare substrate through dense stands of grasses and forbs dominated by saltmeadow cordgrass, to well developed shrub thickets dominated by wax myrtle and silverling.

Colonial Species Present

Terns: A small colony of Least Terns nested on a bare site in 1977.

Site Potential

From this point to the Cape Fear River, only the Least Tern, of the ground nesting gulls, terns, and skimmers, regularly nested on the complex dredged material islands adjacent to the AIWW. Black Skimmers, Common Terns and Gull-billed Terns occasionally used such sites.

Generally such islands are inhabited by mammalian predators such as raccoons, and human disturbances are regular. Usage by birds fluctuates greatly from year to year with a few small to moderate sized Least Tern colonies being established on appropriate sites. As long as the present level of dredging along the AIWW continues, there should be a series of such suitable bare sites available for the ground nesting species.

Management

It may occasionally be desirable to provide protection at colony sites where human disturbances are severe.

SITE: 22-26

Bogue Sound, Carteret County
34°41' latitude, 77°01' longitude. Map O, page 249

Site Characteristics

Site Type: Dredged material island - diked
Size: Not measured, max. elev. 3.3 meters in 1976
Substrate: Sand and shell
Surroundings: See 22-25
Nesting Habitats: See 22-25

Colonial Species Present

Terns: Eight Least Tern nests were present in 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 22-40

Bogue Sound, Carteret County
34°41' latitude, 77°03' longitude. Map P, page 251

Site Characteristics

Site Type: Dredged material island - diked
Size: Approx. 1 to 2 hectares, max. elev. 1.7 meters in 1976
Substrate: Sand and shell
Surroundings: See 22-25
Nesting Habitats: See 22-25

Colonial Species Present

Terns: In 1976 a small mixed colony of Common, Gull-billed, and Least Terns was present. In 1977 only the Least Terns returned.

Site Potential

See 22-25

Management

See 22-25

SITE: 22-41

Emerald Isle, Carteret County
34°41' latitude, 77°02' longitude. Map P, page 251

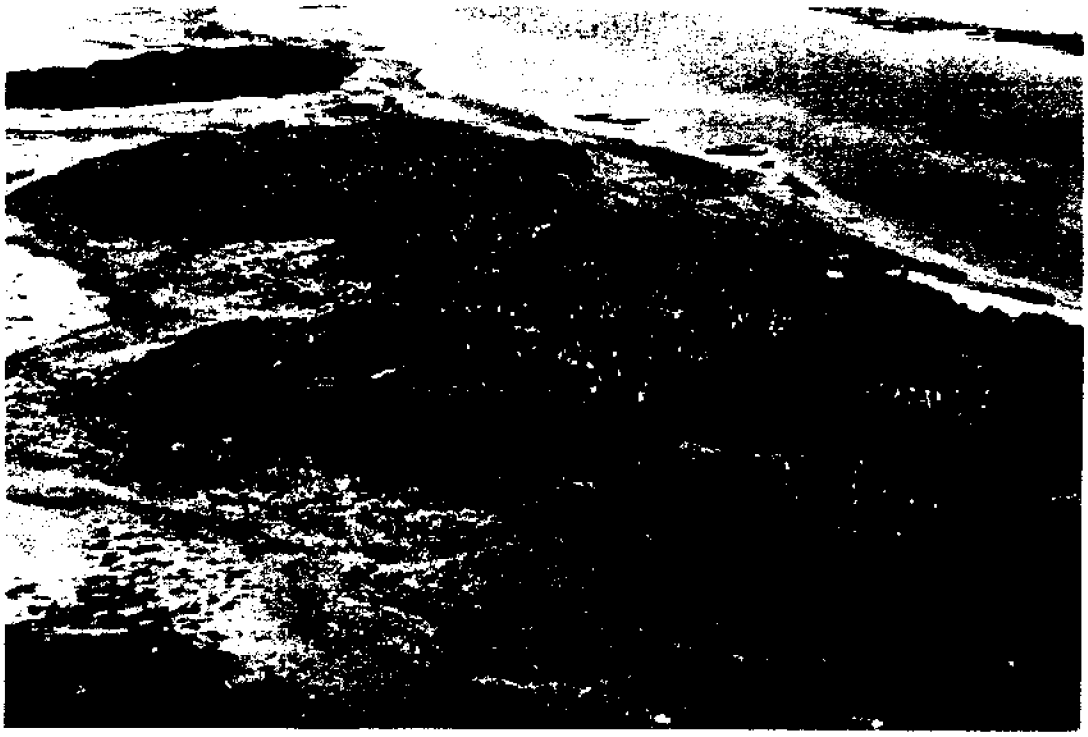

Fig. 73. An old undiked island typical of those between Morehead City and the boundary between North and South Carolina which have not received dredged materials subsequent to their construction.

Site Characteristics

Site Type: Dredged material island
Size: Large island, not measured, max. elev. 1.3 meters in 1976
Substrate: Sand and shell
Surroundings: See 22-25
Nesting Habitats: Most of this island was covered by dense thickets dominated by wax myrtle, silverling, and red cedar. Several domes were vegetated with mixed grasses, primarily saltmeadow cordgrass.

Colonial Species Present

Herons, Egrets, Ibises: This island contained the second largest nesting colony of wading birds in North Carolina during 1976 and 1977. In 1977 over 1,300 nests of 8 species were present. This was the site of the only Great Blue Heron nest in an estuarine colony in 1977.

Site Potential

The potential for continued use of this site is good. The nesting colony was not utilizing all available habitat in 1977. The colony appeared to be growing.

Management

Some protection from human disturbance may be needed. A mobile home on a raft has been present on the island at least since 1976 but appears to have been abandoned.

The primary management needed is the maintenance of the shrub thicket habitat by preventing further deposition of dredged material on the island.

SITE: 22-45

Bogue Inlet, Onslow County
34°40' latitude, 77°06' longitude. Map P, page 251

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 5.2 meters in 1976
Substrate: Sand and shell
Surroundings: See 22-25
Nesting Habitats: See 22-25

Colonial Species Present

A small colony of Least Terns was present in 1976 and 1977. A single Common Tern nest was present in 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 23-10

Swansboro, Onslow County
34°41' latitude, 77°06' longitude. Map P, page 251

Site Characteristics

Site Type: Dredged material island - diked
Size: Not measured, max. elev. 3.5 meters in 1977
Substrate: Sand and shell
Surroundings: See 22-25
Nesting Habitats: This diked site received fresh dredged material in 1976. Most of the diked area was devoid of vegetation in 1977.

Colonial Species Present

Terns, Skimmers: This site was occupied by Common, Gull-billed and Least Terns and Black Skimmers in 1976. In 1977 only the Least Terns nested.

Site Potential

This was an important Least Tern site in 1977 with 152 nests present. The site should be usable for 3 to 5 years without further dredged material disposal.

Management

There is need for a bare site in the vicinity of Bogue Inlet. This island or a nearby one should be maintained in a nearly bare condition.

SITE: 23-14

Bogue Inlet, Carteret-Onslow County line
34°40' latitude, 77°06' longitude. Map P, page 251

Site Characteristics

Site Type: Natural estuarine island
Size: Less than 1 hectare, max. elev. 0.4 meter in 1976
Substrate: Sand
Surroundings: Open water and marshes
Nesting Habitats: This small shoal was devoid of vegetation except for sparse clumps of smooth cordgrass, sea rocket, and orach.

Colonial Species Present

Terns, Skimmers: This site was occupied in 1976 and 1977 by small colonies of Common Terns and Black Skimmers.

Site Potential

This shoal was formed adjacent to the Bogue Inlet channel. It may persist or be washed away. If it persists it will likely be vegetated by smooth cordgrass and soon become unavailable to ground nesting colonial birds. Potential for long term use is not good.

Management

None recommended

SITE: 26-01

Camp LeJeune, Onslow County
34°32' latitude, 77°20' longitude. Map Q, page 253

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean, inlet, and grass covered dunes
Nesting Habitats: This low sandy spit was adjacent to the northern side of New River Inlet. It was nearly devoid of vegetation.

Colonial Species Present

Terns: In 1976 a small colony of Least Terns was present. In 1977 the site was not utilized. Other small Least Tern colonies were attempted along the beach north of this site in 1976 but apparently were not successful.

Site Potential

This site is a part of the Camp LeJeune Military Base. Habitat appears suitable for continued use by Least Terns. Human interference may be a problem.

Management

Colony sites should be posted and human interference minimized.

SITE: 26-07

New River, Onslow County
34°34' latitude, 77°21' longitude. Map Q, page 253

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 5.6 meters in 1976
Substrate: Sand and shell
Surroundings: Open water
Nesting Habitats: The lower slopes and swales of this large island were covered by a moderate to dense cover of grasses and forbs, primarily saltmeadow cordgrass and pennywort. Thickets of wax myrtle and marsh elder were developing. The upper slopes and domes were either bare or covered with a sparse to moderate growth of horseweed and camphorweed.

Colonial Species Present

Terns, Skimmers: In the early 1970's this was an important nesting site for Least Terns, Gull-billed Terns, Common Terns, and Black Skimmers. In 1976 numbers were much reduced, and in 1977 the site contained only 2 Least Tern and 1 Common Tern nests.

Site Potential

The reasons for abandonment of this island were not clear. Habitat appeared suitable, although the island has been diked. The site is used by the Camp LeJeune Military base, and disturbance levels may have been increased in recent years.

Management

There is a need for a bare or nearly bare site in the New River area. This island is the most apparently suitable. An effort should be made to determine the cause of abandonment and to take corrective action.

SITE: 27-03, 04, 06, 07

Alligator Bay, Onslow County
34°30' latitude, 77°25' longitude. Map Q, page 253

Site Characteristics

Site Type: Dredged material island
Size: Less than 1 hectare each, max. elev. less than 1 meter in 1977
Substrate: Sand and shell
Surroundings: AIWW and shallow open water
Nesting Habitats: There are 7 small islands in Alligator Bay. Island 27-02 had several large hackberry trees present, but most islands were covered by shrub thickets dominated by wax myrtle, silverling, and marsh elder.

Colonial Species Present

Herons, Egrets: A mixed species heronry was present on one or more of these islands as early as 1939 (Grant 1967). The colony has apparently been continuously active since that time. In 1970 the site contained 369 nests (Grant 1971). However, since that time the colony has steadily been reduced in numbers and species present. In 1977 there were 12 Green Heron nests, 2 Little Blue Heron nests, and 1 Great Egret nest.

Site Potential

The plant communities on this group of islands appeared suitable for continued use. However, on several occasions in 1975, 1976, and 1977, evidence of mammalian predation was observed. A Gray Fox was seen on 2 occasions. The islands were closely adjacent to the mainland, and at low tide access was across a narrow mud flat. Thus, even though the site has apparently been used for over 30 years, its potential for further use as a nesting site for herons and egrets is not good.

Management

The primary damaging factor appears to have been mammalian predation. Predator control during the nesting season may prove helpful to the few pairs that remain. Protection from the deposition of dredged materials is also important.

SITE: 29-25

Sloop Point, Pender County
34°24' latitude, 77°37' longitude. Map S, page 257

Site Characteristics

Site Type: Dredged material island - diked
Size: Not measured, max. elev. 3.2 meters in 1976
Substrate: Sand and shell
Surroundings: The AIWW and extensive smooth cordgrass marshes
Nesting Habitats: See 22-25

Colonial Species Present

Terns: This site was occupied by small Least Tern colonies in both 1976 and 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 30-01

TOPSAIL BEACH, Pender County
34°21' latitude, 77°39' longitude. Map S, page 257

Site Characteristics

Site Type: Barrier beach modified by man
Size: Not measured
Substrate: Sand and shell
Surroundings: Urban development and dunes
Nesting Habitats: This site consisted of a series of cleared residential lots. Much of the area was bare. Scattered clumps of sea oats and seaside goldenrod were present.

Colonial Species Present

Terns: In 1977 a colony of over 70 Least Tern nests was present.

Site Potential

Use of this site gives a good indication of the opportunistic nature of Least Terns. They readily utilize such sites for a year or 2 and move on as development proceeds. Success is usually poor at such sites due to disturbance or destruction of nests.

Management

None recommended

SITE: 30-02

New Topsail Inlet, Pender County
34°21' latitude, 77°39' longitude. Map S, page 257

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean, dunes, inlet
Nesting Habitats: This sandy flat was nearly devoid of vegetation. Sparse clumps of saltmeadow cordgrass and sea rocket were present. The site used was the low flat between the high tide line and foredunes.

Colonial Species Present

Terns: This site was occupied by 80 Least Tern nests in 1977.

Site Potential

Suitable nesting habitat for Least Terns frequently occurs adjacent to inlets. Such habitat may be expected to persist for many years. These areas are also attractive to people and disturbances may be frequent. While such areas are attractive to the pioneer species, especially Least Terns, success is often low.

Management

The primary management tool at inlet sites should be the prevention of human disturbances.

SITE: 31-01

Old Topsail Inlet, Pender County
34°20' latitude, 77°40' longitude. Map S, page 257

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean, dunes, inlet
Nesting Habitats: See 30-02

Colonial Species Present

Terns, Skimmers: The site was occupied in 1977 by colonies of Common Terns and Black Skimmers.

Site Potential

See 30-02

Management

See 30-02

SITE: 32-02

Rich Inlet, Pender-New Hanover County line
34°18' latitude, 77°43' longitude. Map S, page 257

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: See 31-01
Nesting Habitats: See 30-02

Colonial Species Present

Terns: This site was occupied by colonies of Least Terns in 1976 and 1977. In 1977, 7 Common Tern nests were present.

Site Potential

See 30-02

Management

See 30-02

SITE: 33-15

Mason Inlet, New Hanover County
34°15' latitude, 77°46' longitude. Map T, page 257

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 2.9 meters in 1977
Substrate: Sand and shell
Surroundings: See 29-25
Nesting Habitats: See 22-25

Colonial Species Present

Terns: A small Least Tern colony of 4 nests was present in 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 33-22

Rich Inlet, New Hanover County
34°18' latitude, 77°44' longitude. Map T, page 257

Site Characteristics

Site Type: Natural estuarine
Size: Less than 1 hectare, max. elev. 1.2 meters in 1977
Substrate: Sand
Surroundings: Shallow open water and marsh
Nesting Habitats: This sand shoal was just inside Rich Inlet. Most of the site was bare. The lower areas were vegetated with sparse stands of smooth cordgrass and sea rocket.

Colonial Species Present

Terns, Skimmers: Since 1972 this island has been intermittently utilized by nesting Black Skimmers, Common Terns, and Gull-billed Terns. In 1977 no nests were present.

Site Potential

This island is adjacent to a heavily utilized boat channel, and human disturbance is probably moderate. In addition, the site is subject to overwash during storm tides. In at least one year most nests were flooded. The potential for nesting success is not good.

Management

None recommended

SITE: 35-02

Masonboro Inlet, New Hanover County
34°11' latitude, 77°49' longitude. Map T, page 257

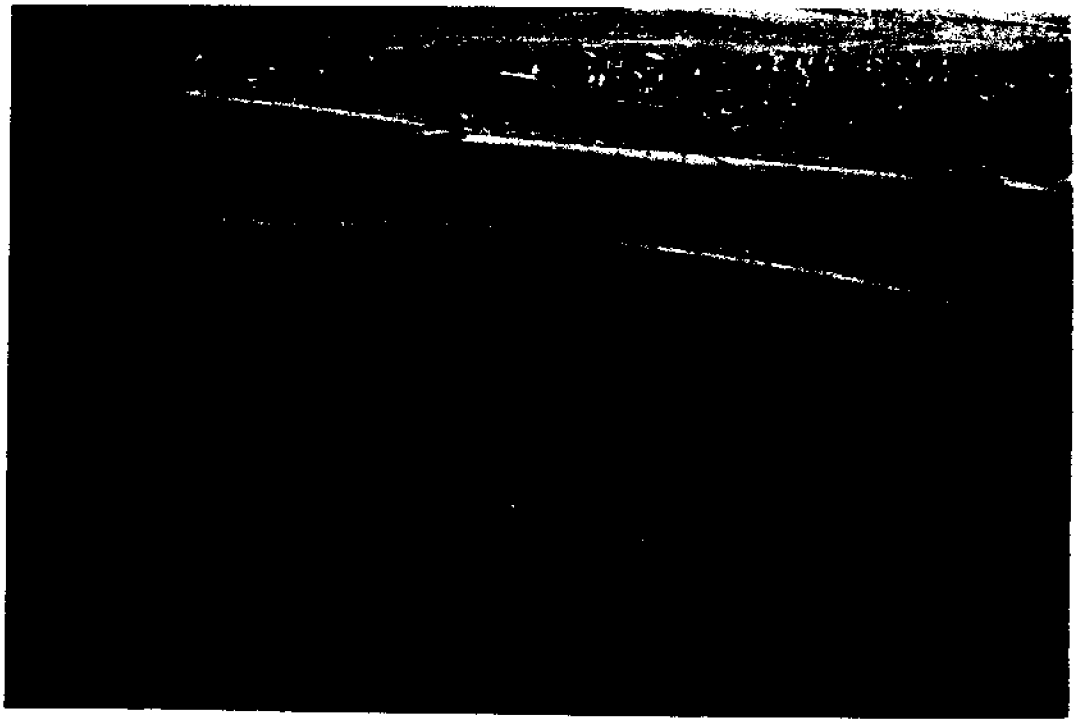

Fig. 74. An example of a sparsely vegetated, shelly site which when adjacent to inlets provides important nesting habitat for Least Terns.

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: See 30-02
Nesting Habitats: This area was similar to the other inlet sites but had scattered clumps of sparse to moderately dense saltmeadow cordgrass and sea rocket.

Colonial Species Present

Terns, Skimmers: This has been an important Least Tern colony site for several years. In 1977, 327 nests were present. Small numbers of Common Terns and Black Skimmers also nested in 1977.

Site Potential

This site is very attractive to Least Terns. The habitat may, however, be modified by the construction of a jetty on the south side of Masonboro Inlet. The area is also subject to considerable human disturbance.

Management

The colony site should be posted. If the habitat is adversly modified by jetty construction, an alternate site should be developed nearby.

SITE: 36-03

Money Point, New Hanover County
34°12' latitude, 77°49' longitude. Map T, page 257

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 2.8 meters in 1977
Substrate: Sand and shell
Surroundings: See 22-25
Nesting Habitats: See 22-25

Colonial Species Present

Terns: Very small Least Tern colonies occupied this site in 1976 and 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 37-10

Pickett Rock, New Hanover County
34°06' latitude, 77°52' longitude. Map T, page 257

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 4.1 meters in 1977
Substrate: Sand and shell
Surroundings: See 29-25
Nesting Habitats: Most of the vegetation on this island was killed by dredged material deposition in 1975 and 1976. In 1977 a part of the island was essentially bare, and part was covered by standing dead shrubs.

Colonial Species Present

Terns: In 1977 a small colony of Least Terns was present.

Site Potential

See 22-25

Management

See 22-25

SITE: 39-26

Cape Fear River, New Hanover County
34°03' latitude, 77°56' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 1.3 meters in 1976
Substrate: Silt, sand, and shell
Surroundings: Marsh and open water
Nesting Habitats: Most of this island was covered by a dense stand of phragmites in 1977. A relatively new dredged material deposit on one end of the island was bare or lightly vegetated, primarily with horseweed, in 1977.

Colonial Species Present

Terns, Skimmers: This island was an important nesting site for Gull-billed Terns in both 1976 and 1977. Smaller colonies of Common Terns and Black Skimmers were also present both years. This site was abandoned in 1978.

Site Potential

There are several of these relatively low diked islands on the Cape Fear River. All were covered by dense stands of phragmites prior to recent diking. All have received some dredged materials since diking but amounts have varied greatly. When fresh materials are deposited the sites become attractive to Gull-billed and Common Terns and Black Skimmers. Such newly deposited dredged material usually becomes vegetated by phragmites much more rapidly than when the usual pattern of succession occurs, and the time of availability to the pioneer species is usually only 2 to 3 years. This will vary, however, with the extent of the dredged material deposits.

Most islands in the lower Cape Fear River are heavily infested with fire ants. Their effect on colonial nesters is unknown but apparently is not severe.

Management

For these islands to be usuable by the colonial nesters, phragmites must be controlled. Frequent deposition of dredged material will partially accomplish this. As elevations of the islands increase, a lack of soil moisture would be expected to prevent the upper slopes and domes from being occupied by this invasive species.

SITE: 39-28

Cape Fear River, Brunswick County
34°00 latitude, 77°57' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island - diked
Size: About 1 to 2 hectares, max. elev. 2.2 meters in 1976
Substrate: Sand and silt
Surroundings: Marsh and open water
Nesting Habitats: This island last received dredged material in 1975. Most of the site was covered by phragmites in 1977. There was, however, a small bare area; a small area moderately vegetated with forbs, primarily seaside goldenrod, horseweed, wild rye, and Mexican tea; and an area dominated by a dense stand of saltmeadow cordgrass.

Colonial Species Present

Gulls: This island has been the site of the only sizable Laughing Gull colony in southeastern North Carolina since 1972. In the mid-1970's Common and Gull-billed Terns and Black Skimmers were also present. They did not nest at this site in 1977. A single Royal Tern nest was started but did not succeed.

Site Potential

In 1977 this site was rapidly becoming dominated by a dense stand of phragmites. Unless fresh dredged material is deposited the site will likely be unusable by 1980.

Management

If fresh dredged material is not deposited at this site by 1980, other efforts should be made to return the island to an earlier stage of plant succession.

SITE: 39-32

Cape Fear River, New Hanover County
33°59' latitude, 77°57' longitude. Map U, page 259

Fig. 75. Island typical of those formed by deposition of dredged material adjacent to inlet channels or in rivers. Erosion is usually severe.

Site Characteristics

Site Type: Dredged material island
Size: About 1 hectare, max. elev. 2.2 meters in 1976
Substrate: Sand and shell
Surroundings: Shallow open water
Nesting Habitats: In 1977 the dome of this island was kept bare by the presence of a large Royal Tern colony. The slopes were covered by a sparse to moderately dense growth of camphorweed, horseweed, dog fennel, and sand grass. In 1978 the site was not used by the Royal Terns and a dense stand of wild geranium covered the nesting site. The swales were occupied in 1977 by a developing shrub thicket dominated by *Iva imbricata*, silverling, and *Rubus sp*.

Colonial Species Present

Terns: This island was occupied from 1975 through 1977 by a large colony of Royal Terns. The colony in 1976 and 1977 was the largest in the state. Small numbers of Sandwich Terns were present. Only about 50 Royal Tern nests were present in 1978. Most of these birds moved to islands 39-35 and 39-36 in 1978. A colony of Gull-billed Terns and Black Skimmers was establisned in 1978.

Site Potential

This island was the most suitable site on the Cape Fear River for Royal Terns. It was isolated from land, was not large enough to harbor mammalian predators, extended well above high tide, and was not diked. Plant growth speeded by excess fertilization from the tern excrement provided a lush growth of wild geranium at the site prior to the arrival of the terns in the spring of 1978 and the birds were forced to nest elsewhere.

Management

This island should be managed specifically for Royal Terns. There is no other good site in the area. In 1978 the birds nested on a very low island where flooding was likely. Vegetation should be removed from the traditional site, either by covering the site with fresh dredged material or by manipulation of the present substrate.

SITE: 39-33

Cape Fear River, Brunswick County
33°58' latitude, 77°57' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 7.5 meters in 1976
Substrate: Sand and shell
Surroundings: Extensive marshes and open water
Nesting Habitats: This island has received large amounts of dredged materials in recent years. Most of the higher parts of the island were composed of coarse sand and plant establishment and growth has been slow. Most of the upper parts of the island were devoid of vegetation in 1977. The lower slopes and swales were covered by moderate to dense stands of saltmeadow cordgrass and sea oats. Small thickets of marsh elder and Daubentonia punicea were present in the swales.

Colonial Species Present

Terns, Skimmers: This site was occupied by colonies of Gull-billed, Common, and Least Terns in 1976. In 1977 only a small Least Tern colony was present.

Site Potential

Habitat at this site appears suitable for all of the pioneer species. The site, however, is adjacent to an extensive smooth cordgrass marsh which provides access for predators from the mainland. Colonies at this site and nearby 39-34 have suffered considerable mortality over the past several years. Thus, while the site appears suitable, the potential for successful nesting is not good.

Management

A program of predator management will likely be needed for nesting efforts to be successful.

SITE: 39-34

Cape Fear River, Brunswick County
33°57' latitude, 77°58' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island - partly diked
Size: Large island, not measured, max. elev. 5.7 meters in 1976
Substrate: Sand
Surroundings: See 39-33
Nesting Habitats: Habitats within the dike were very similar to 39-33. The undiked portion of the island was covered in 1977 by a moderate to dense growth of grasses and forbs, primarily saltmeadow cordgrass, seaside goldenrod, and camphorweed. Shrub thickets were beginning to develop along the perimeter of the island.

Colonial Species Present

Terns, Skimmers: In recent years Black Skimmers, Common Terns, and Gull-billed Terns have nested on this island. No colonial species nested in 1977.

Site Potential

See 39-33

Management

See 39-33

SITE: 39-35

Cape Fear River, Brunswick County
33°55' latitude, 77°51' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island
Size: Less than 1 hectare, max. elev. 0.5 meter in 1978
Substrate: Sand and shell
Surroundings: Shallow open water
Nesting Habitats: In 1978 most of this site was vegetated by a sparse to moderate cover of mixed grasses, forbs, and low shrubs. Dominant species were Iva imbricata and saltmeadow cordgrass.

Colonial Species Present

Pelicans, Gulls, Terns: During 1971 through 1974 the Cape Fear River population of Royal Terns nested on this site. The terns abandoned the rapidly eroding island due to vegetative encroachment. In 1978 Royal Terns returned to this site and to adjacent island 39-36 to nest. In addition, a colony of Brown Pelicans was established at this site. This was the first recorded instance of this species nesting in southeastern North Carolina. Small numbers of Laughing Gulls nested here in 1978.

Site Potential

This island has undergone rapid erosion which has significantly reduced both area and elevation. It is a tenuous site for ground nesting birds. The potential for occupation by any species beyond 1980 is not good.

Management

This portion of the Cape Fear River appears to be very attractive to nesting terns. This island and islands 33-35 and 33-36 just to the north are eroding severely. The construction of one or more new islands in this vicinity would provide needed habitat in an area known to be heavily utilized.

SITE: 39-36

Cape Fear River, Brunswick County
33°56' latitude, 77°51' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island
Size: Less than 1 hectare, max. elev. 0.5 meter in 1978
Substrate: Sand and shell
Surroundings: Shallow open water
Nesting Habitats: See 39-35

Colonial Species Present

Pelicans, Gulls, Terns: This site has not been occupied by colonial nesting birds in recent years. In 1978 Royal Tern and Brown Pelican colonies were established at this site and on adjacent 39-35. Small numbers of Laughing Gulls also nested here in 1978.

Site Potential

See 39-35

Management

See 39-35

SITE: 39-37

Cape Fear River, Brunswick County
33°56' latitude, 77°51' longitude. Map U, page 259

Site Characteristics

Site Type: Dredged material island
Size: Less than 1 hectare, max. elev. 0.4 meter in 1976
Substrate: Sand, shell, and marl
Surroundings: Open shallow water
Nesting Habitats: This small, low island was vegetated by a sparse to moderate patchy cover dominated by seaside goldenrod, Polygonum glaucum, and marsh elder. The beaches and low areas of overwash were bare in 1977.

Colonial Species Present

Gulls, Terns: This island has been an important nesting site for Gull-billed Terns since at least the early 1970's. In most years small numbers of Common Terns have also nested. In 1977 both species were present. Gull-billed Terns and small numbers of Laughing Gulls were present in 1978.

Site Potential

This low island is a very attractive nesting site for Gull-billed Terns. It is, however, subject to flooding and is eroding rapidly. The rate of plant succession is slowed, apparently by flooding, and the habitat will likely remain usable for several years unless the island is lost to erosion or receives fresh dredged material.

Management

See 39-35

SITE: 39-46

BATTERY ISLAND, South, Brunswick County
33°54' latitude, 78°01' longitude. Map U, page 259

Site Characteristics

Site Type: Natural island subsequently receiving deposit(s) of dredged materials
Size: 5 to 10 hectares, max. elev. 2.0 meters in 1976
Substrate: Sand and shell
Surroundings: River and salt marsh
Nesting Habitats: The island was dominated by 2 plant communities. Slopes, dome, and swales adjacent to Cape Fear River were vegetated by a dense cover of grasses and forbs, primarily saltmeadow cordgrass. Along the lower slopes and swales of the eastern side of the island there were several patches of maritime shrub thicket. These were dominated by toothache tree, yaupon, live oak, red cedar, wax myrtle, silverling, and marsh elder. In some thicket units there was an indication of die-back of certain species due to excess fertilization.

Colonial Species Present

Herons, Egrets, Ibises: Battery Island has been the site of a mixed species colony of wading birds since 1928. In 1938 the adult population was estimated at 600 individuals of 5 species (Pearson, et al. 1942). Since that time the size of the colony has grown and new species have been added. It was the first North Carolina nesting site for the Glossy Ibis (1940), the Cattle Egret (1956), and the White Ibis (1963) (Pearson et al. 1942, Quay and Adams 1956, Adams 1963).

Battery Island south and Battery Island north (39-51) combined form the largest heronry in North Carolina. In 1977 a total of 2,460 nests of 9 species were counted at Battery Island south. One thousand nine hundred forty six of these were White Ibis nests. The colony occupied all parts of the shrub thickets and isolated red cedars.

Site Potential

This colony appeared to be near its maximum possible size. All portions of the thickets were heavily used, especially by the White Ibis. The thickets were expanding slowly, however, and this will allow for modest increases in numbers of nests. Vegetation was generally in good condition in the younger thickets. In the older segments there was some vegetative die-back due to excess fertilization. There appeared to be no reason not to expect continued use of the site.

There were no ground nesting colonial seabirds utilizing the site. Habitat appeared to be suitable for Laughing Gulls. Terns have been known to use the island prior to the development of dense vegetation on the dome.

The island appeared to be relatively stable. It is across the river from the town of Southport and some human disturbance occurs. The island passed into state ownership in 1978.

Management

Protection and possible shrub thicket plantings appear to be the most viable management possibilities. Carefully controlled deposition of small volumes of dredged materials or vegetation suppression on portions of the island away from the thickets could create nesting habitat for colonial ground nesting seabirds.

SITE: 39-49

New Inlet, Brunswick County
33°54' latitude, 77°56' longitude. Map U, page 259

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean and shallow sound waters
Nesting Habitats: This site was along a point being formed as New Inlet migrates southward. Much of the area consisted of low bare sand flats. Where small dunes were forming, scattered clumps of Iva imbircata, sea oats, evening primrose, spurge, and horseweed were present.

Colonial Species Present

Terns, Skimmers: Colonies of Black Skimmers have nested on this beach site since at least the early 1970's. Smaller colonies of Least Terns were present in 1976 and 1977.

Site Potential

Habitat will likely be maintained for several years depending on the rate of inlet migration. A major threat is destruction of nests by beach vehicles. With protection, the potential for continued use is good.

Management

The colony sites, which move each year, should be posted.

SITE: 39-51

BATTERY ISLAND, North, Brunswick County
33° 54' latitude, 78°01' longitude. Map U, page 259

Fig. 76. An old and apparently natural island that has been modified by the deposition of dredged materials.

Site Characteristics

Site Type: Natural island subsequently receiving deposit(s) of dredged materials
Size: About 1 hectare, max. elev. 0.3 meter in 1976
Substrate: Sand and silt
Surroundings: Extensive salt marshes
Nesting Habitats: This island was covered by a dense maritime thicket comprised primarily of yaupon, live oak, red cedar, silverling, and marsh elder. A small central opening was dominated by giant foxtail.

Colonial Species Present

Herons, Egrets, Ibises: This island, along with Battery Island south (39-46), comprises the largest nesting colony of wading birds in North Carolina. Cattle Egrets were the most abundant of 7 species present. The total nesting population in 1977 was approximately 1,831 nests. This colony has been nearly stable for the past 4 years.

Site Potential

The potential for continued use of this site appeared good. The thickets were healthy in 1977 with no obvious die-back. There appeared to be some room for colony expansion.

Management

Protection from human disturbance is the only management that appears to be needed.

SITE: 43-06

Long Point, Brunswick County
33°55' latitude, 78°22' longitude. Map W, page 263

Site Characteristics

Site Type: Dredged material island - diked
Size: Less than 1 hectare, max. elev. 1.7 meters in 1977
Substrate: Sand and shell
Surroundings: The AIWW and extensive salt marshes
Nesting Habitats: This small island was diked and received fresh dredged material in 1976. In 1977 most of the site was devoid of vegetation. A sparse growth of seaside goldenrod was present.

Colonial Species Present

Terns: A small colony of Least Terns was present in 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 43-09

MONKS ISLAND, Brunswick County
33°55' latitude, 78°23' longitude. Map W, page 263

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 3.8 meters in 1977
Substrate: Sand and shell
Surroundings: See 43-06
Nesting Habitats: This large, complex island has frequently received large amounts of dredged material in recent years. Large expanses were bare in 1977. Lower areas not recently covered by dredged material were covered by sparse to dense stands of mixed grasses and forbs, primarily saltmeadow cordgrass, pigweed, and horseweed.

Colonial Species Present

Terns, Skimmers: This has been the major nesting site for Least Terns between the Cape Fear River and the South Carolina line. In 1977 over 460 Least Tern nests was present. Smaller colonies of Black Skimmers, Gull-billed Terns and Common Terns were also present in 1977.

Site Potential

This site will likely continue to have the bare or nearly bare habitats preferred by the pioneer species for several years unless dredged material deposition stops. Parts of the island are reaching elevations which are conducive to decreased surface stability and reduced nesting success. The island will likely continue to be an important nesting site for at least 5 to 10 years unless substrates become unstable.

Management

This vicinity appears to be a preferred nesting area for terns and Black Skimmers. The bare or nearly bare habitat required by these species should be maintained either on this or a nearby island. If this cannot be accomplished by periodic dredged material deposition, other means of surface modification should be attempted.

SITE: 47-01

Mad Inlet, Brunswick County
33°53' latitude, 78°32' longitude. Map X, page 263

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 1.5 meters in 1977
Substrate: Sand, silt, shell
Surroundings: See 43-06
Nesting Habitats: Most of this island was recently covered by fresh dredged material. Most of the surface was bare in 1977.

Colonial Species Present

Terns: Thirty-five Least Tern nests were present in 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 47-08

BIRD ISLAND, Brunswick County
33°51' latitude, 78°32' longitude. Map X, page 263

Site Characteristics

Site Type: Barrier beach
Size: Not applicable
Substrate: Sand and shell
Surroundings: Ocean, inlet, shallow waters, and dunes
Nesting Habitats: See 30-02

Colonial Species Present

Skimmers: A small colony of 22 Black Skimmer nests was present in 1977.

Site Potential

Assuming no disturbance by humans or erosion by storms, the site will remain suitable for the pioneer ground nesting species.

Management

None recommended

SITE: 48-07

Mad Inlet, Brunswick County
33°53' latitude, 78°31' longitude. Map X, page 263

Site Characteristics

Site Type: Dredged material island - diked
Size: Large island, not measured, max. elev. 3.1 meters in 1977
Substrate: Silt and sand
Surroundings: See 43-06
Nesting Habitats: See 22-25

Colonial Speices Present

Terns: A small colony of Least Terns was present in 1977.

Site Potential

See 22-25

Management

See 22-25

SITE: 50-03

LONG SHOAL POINT, Dare County
35°35' latitude, 76°47' longitude. Map C, page 225

Site Characteristics

Site Type: Point of mainland
Size: Less than 1 hectare, max. elev. 0.5 meter in 1976
Substrate: Sand and shell
Surroundings: Mainland marshes and open water
Nesting Habitats: This long narrow point was nearly devoid of vegetation. There were scattered sparse patches of smooth cordgrass.

Colonial Species Present

Terns: There were small colonies of Least Terns at this site in 1976 and 1977.

Site Potential

Habitat appeared suitable for the pioneer species and will likely be maintained by storm action. Access by predators and human disturbance reduce the potential of the site.

Management

None recommended

SITE: 50-04

Bowen Point, Brunswick County
33°55' latitude, 78°15' longitude. Map X, page 263

Site Characteristics

Site Type: Mainland dredged material deposit - diked
Size: About 4 hectares, max. elev. 4.6 meters in 1977
Substrate: Sand and shell
Surroundings: Mainland forests, marshes, and the AIWW
Nesting Habitats: This site was nearly devoid of vegetation in 1977.

Colonial Species Present

Terns: A small colony consisting of 28 Least Tern nests was present in 1977.

Site Potential

The habitat should remain suitable for Least Terns for 3 to 5 years. The easy accessibility of mammalian predators will likely reduce reproductive success.

Management

None recommended

SITE: 50-06

Aurora, Beaufort County
35°24' latitude, 76°47' longitude. Not mapped

Site Characteristics

Site Type: Mainland, dredged material deposit
Size: Not applicable
Substrate: Sand and shell
Surroundings: Pamlico river and industrial complex
Nesting Habitats: This site was on the Texas Gulf Sulphur Plant property. The colony was located on leveled dredged material, some of which had been planted to an experimental orchard. Most of the area consisted of interspersed patches of bare substrate and sparse to moderate stands of coastal Bermuda grass and saltmeadow cordgrass.

Colonial Species Present

Terns: In 1977 a loose colony comprised of about 51 Least Tern nests was present.

Site Potential

Without habitat manipulation, this site will likely be too densely vegetated for use by Least Terns by 1980. There is also a danger from mammalian predators.

Management

Personnel at Texas Gulf Sulphur indicated an interest in maintaining the site. Reduction in density of vegetation, and protection from disturbance appear to be the primary needs.

REGIONAL MAPS

Figures 77 and 78 provide an index to a series of regional maps adapted from United States Department of Commerce National Oceanic and Atmospheric Administration Nautical Charts and identified by letter. Each map locates all 1977 colonial waterbird colony sites within the map region. Each map also provides at least one map feature allowing a reader to locate the "vicinity" on a North Carolina road map. Sites are numbered according to the system described on page 115.

On the opposing page of each regional map is a list of the species and numbers of nests found at each colony site in 1977. The origin of each site is indicated when known. Each entry is referenced by page to the section on Colony Site Descriptions where a detailed account of the site will be found. Those sites which contained fewer than 4 nests were not located on the maps but were used in obtaining species totals. Thus summations from the maps may not always total the same as the figures in the species accounts.

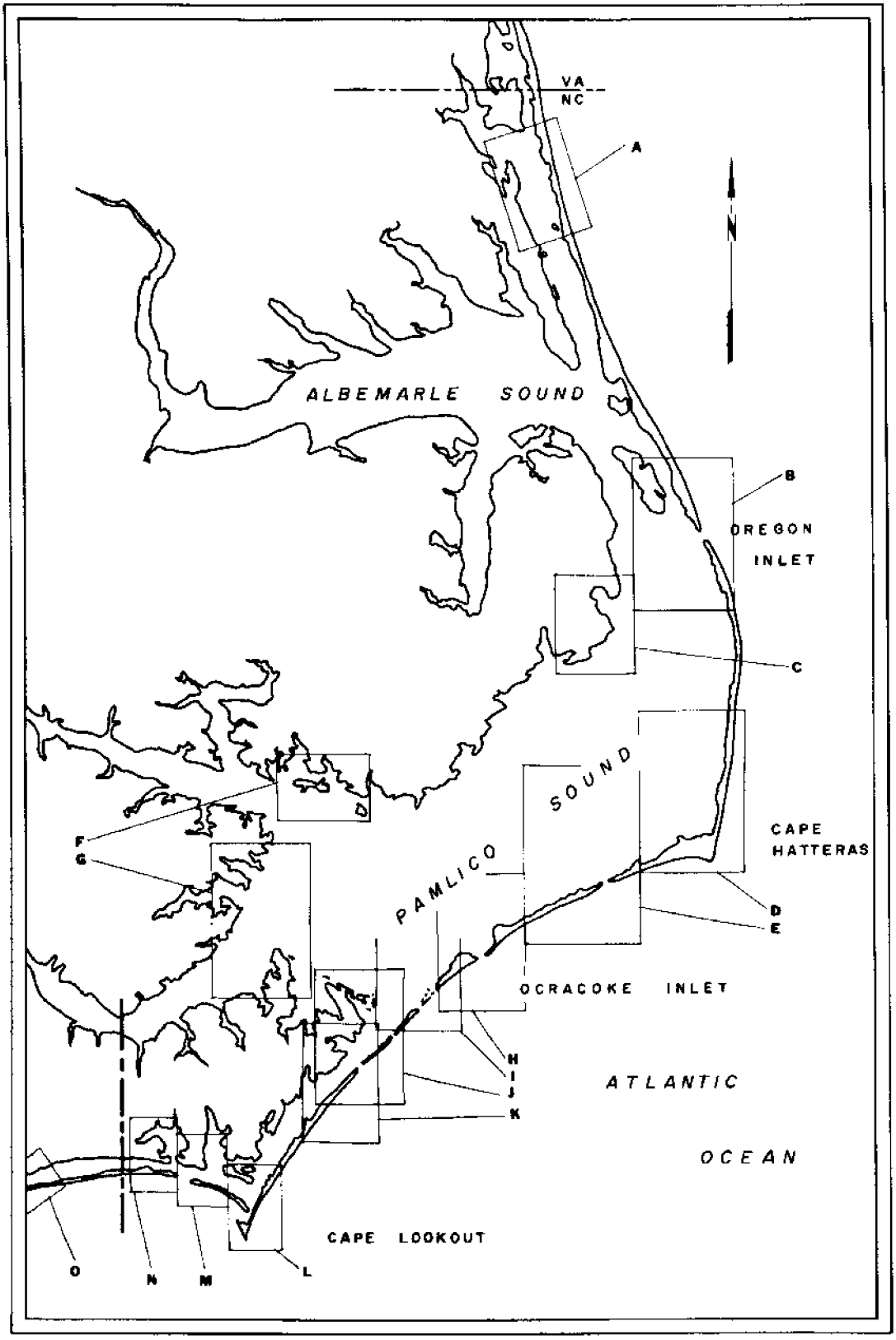

Fig. 77. Index for regional maps A through N.

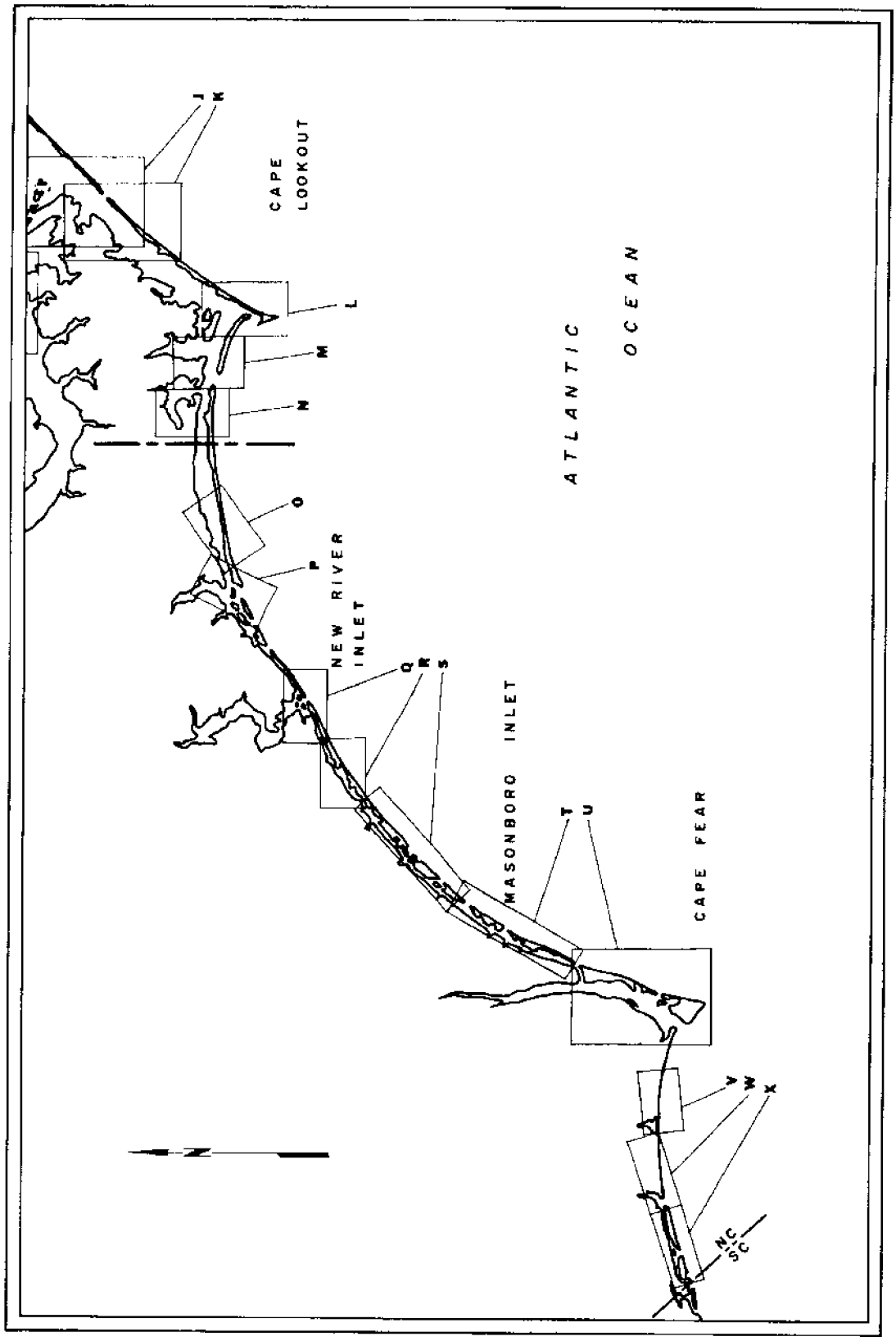

Fig. 78. Index for regional maps 0 through X.

Map A

01-01 Natural Estuarine p. 117

Cattle Egret	230
Little Blue Heron	83
Great Egret	48
Louisiana Heron	15
Snowy Egret	14
Green Heron	13
	403

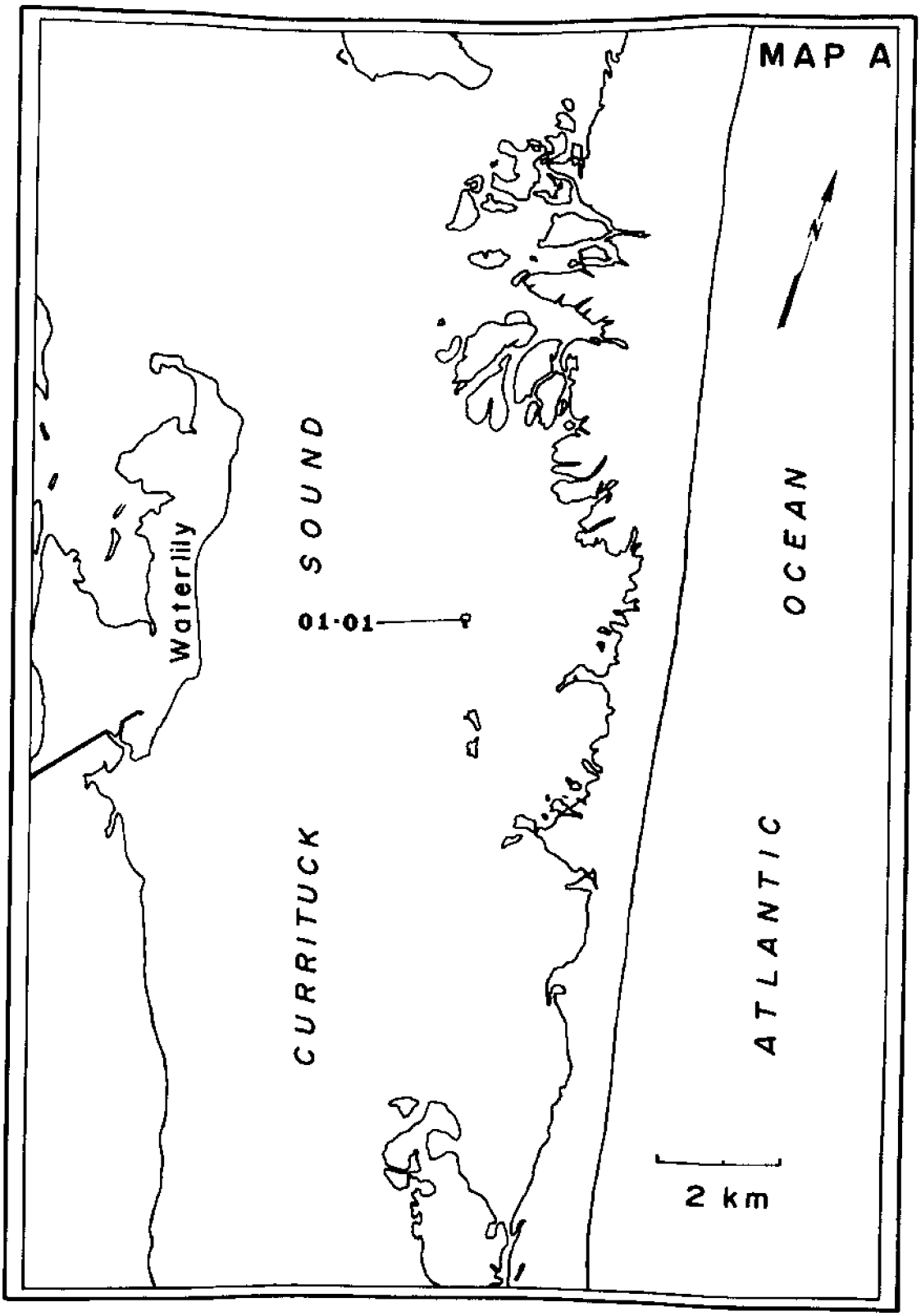

Fig. 79. Currituck Sound and vicinity.

MAP B

03-01 Dredged Material
No colony in 1977 p. 118

03-05 Dredged Material p. 119

Laughing Gull	926
Herring Gull	180
Louisiana Heron	101
Cattle Egret	79
Snowy Egret	64
Glossy Ibis	55
Little Blue Heron	34
Black-crowned Night Heron	26
Great Egret	23
Great Black-backed Gull	3
	1491

03-06 Dredged Material p. 121

Herring Gull	114
Laughing Gull	99
Great Black-backed Gull	2
	215

03-07 Dredged Material p. 121

Herring Gull	48
Laughing Gull	19
Caspian Tern	5
Black Skimmer	5
Great Black-backed Gull	3
	80

03-08 Natural, Subsequently receiving dredged material p. 122

Least Tern 4

03-09 Dredged Material p. 123

Laughing Gull	280
Herring Gull	85
Great Black-backed Gull	1
	366

05-01 Dredged Material
No colony in 1977 p. 124

05-06 Dredged Material p. 125

Royal Tern	2366
Least Tern	45
Gull-billed Tern	22
Common Tern	11
Herring Gull	1
	2445

06-02 Dredged Material p. 126

Common Tern	550
Sandwich Tern	422
Black Skimmer	241
Royal Tern	232
Laughing Gull	102
Gull-billed Tern	4
Caspian Tern	3
	1554

06-08 Dredged Material p. 127

Black Skimmer	103
Common Tern	38
Gull-billed Tern	21
Herring Gull	3
Caspian Tern	2
	167

06-23 Dredged Material p. 136

Black Skimmer	47
Common Tern	34
Gull-billed Tern	4
	85

07-02 Man-made Island Within Diked Impoundment p. 137

Little Blue Heron	10
Great Egret	9
Yellow-crowned Night Heron	2
Louisiana Heron	1
Snowy Egret	1
	23

07-03 Natural Estuarine p. 138

Forster's Tern	211
Laughing Gull	3
	214

07-05 Man-made Island Within Diked Impoundment p. 139

Snowy Egret	86
Little Blue Heron	52
Black-crowned Night Heron	50
Louisiana Heron	49
Glossy Ibis	35
Cattle Egret	5
Great Egret	5
	282

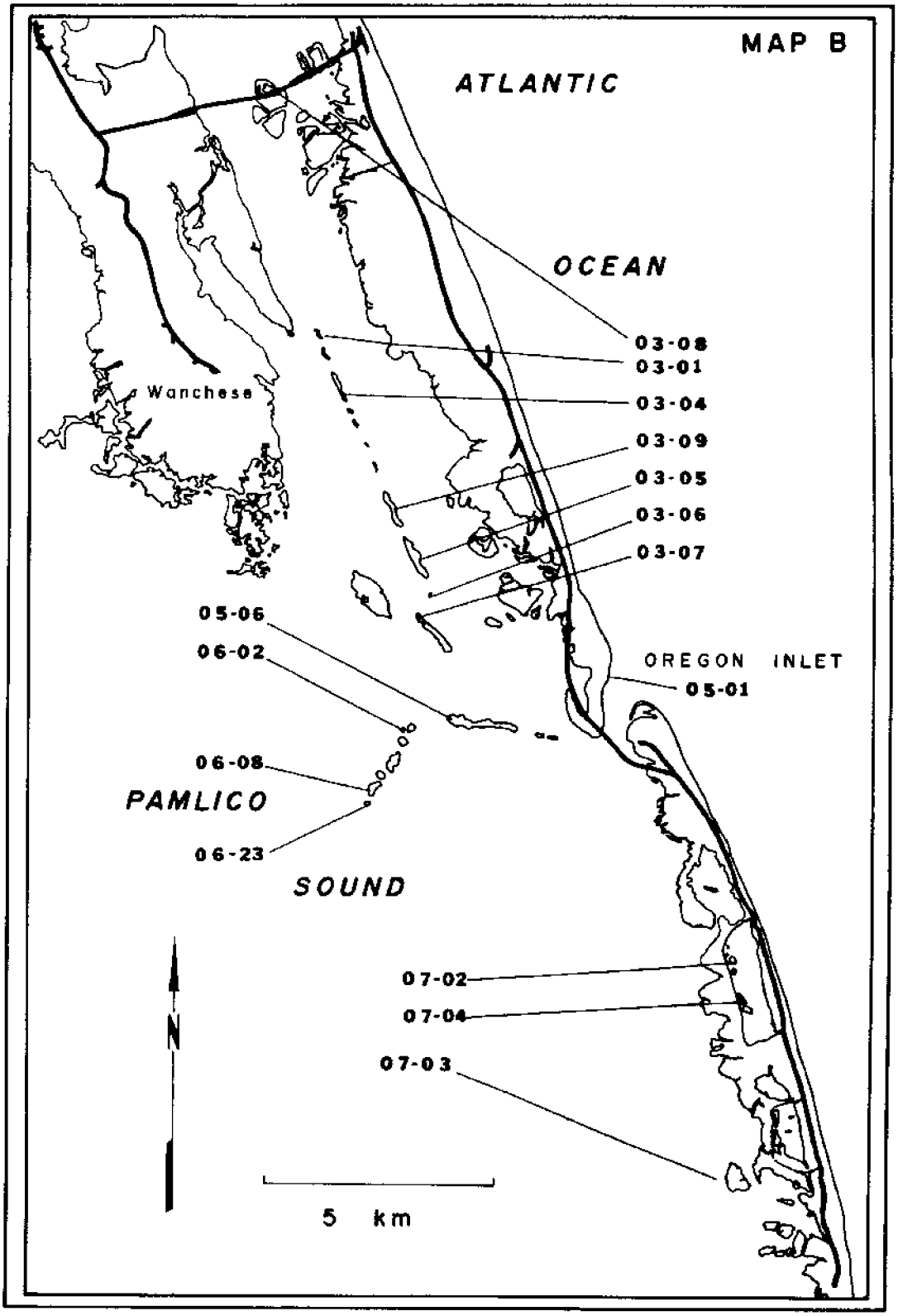

Fig. 80. Oregon Inlet and vicinity.

MAP C

06-09 Dredged Material p. 127

Common Tern	191
Black Skimmer	63
Gull-billed Tern	4
	258

50-03 Mainland-Natural Point p. 214

Least Tern 20

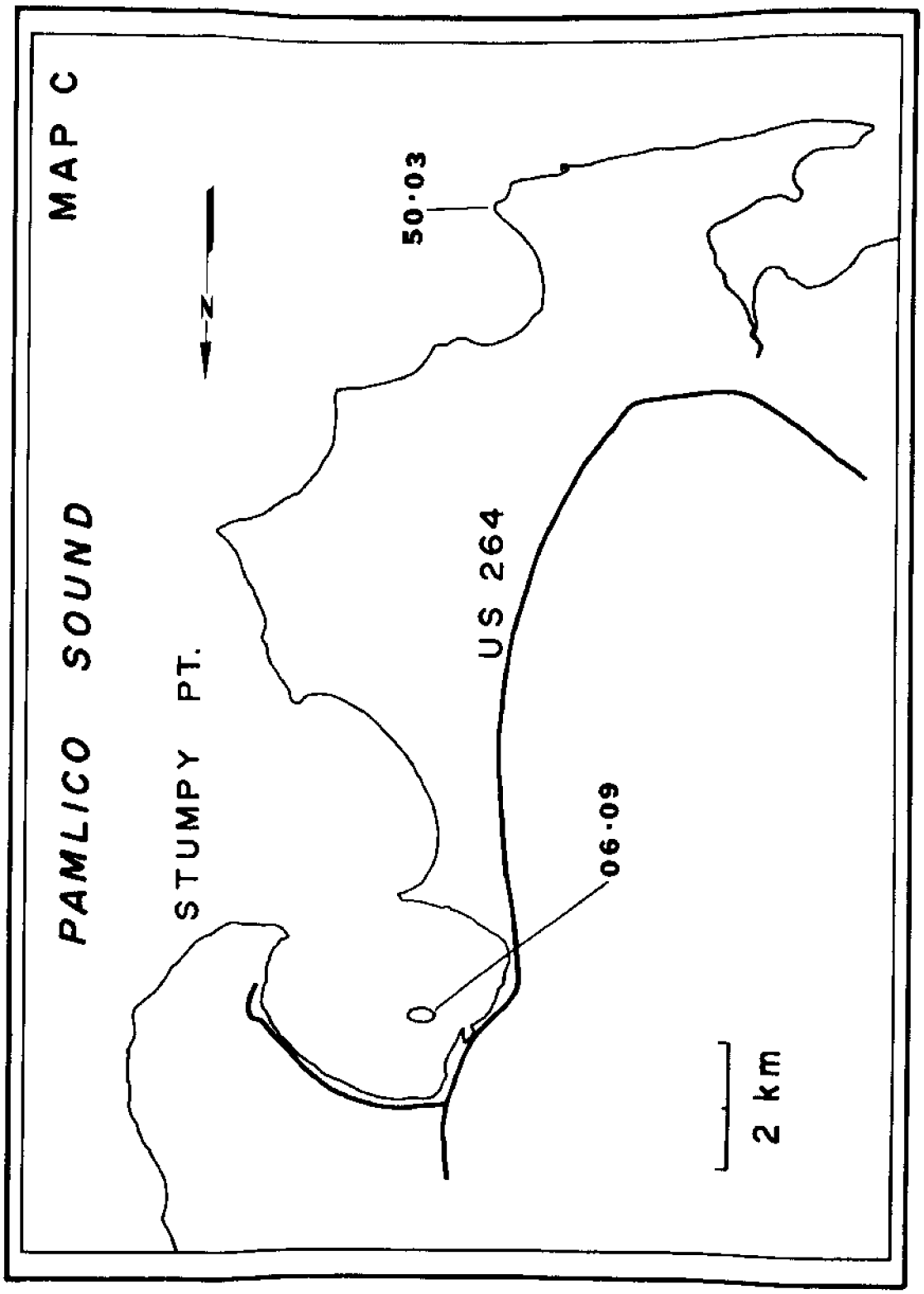

Fig. 81. Stumpy Point.

MAP D

06-12 Natural Estuarine p. 131

Laughing Gull	2396
Forster's Tern	66
Common Tern	57
Herring Gull	9
Louisiana Heron	8
Great Egret	4
Snowy Egret	3
Black-crowned Night Heron	3
	2546

06-21 Natural Estuarine p. 135

Common Tern 85

06-22 Natural Estuarine p. 136

Least Tern	22
Common Tern	20
Forster's Tern	10
Black Skimmer	3
Royal Tern	2
	57

08-01 Barrier Beach p. 139

Least Tern 69

08-02 Barrier Island p. 140

Least Tern 19

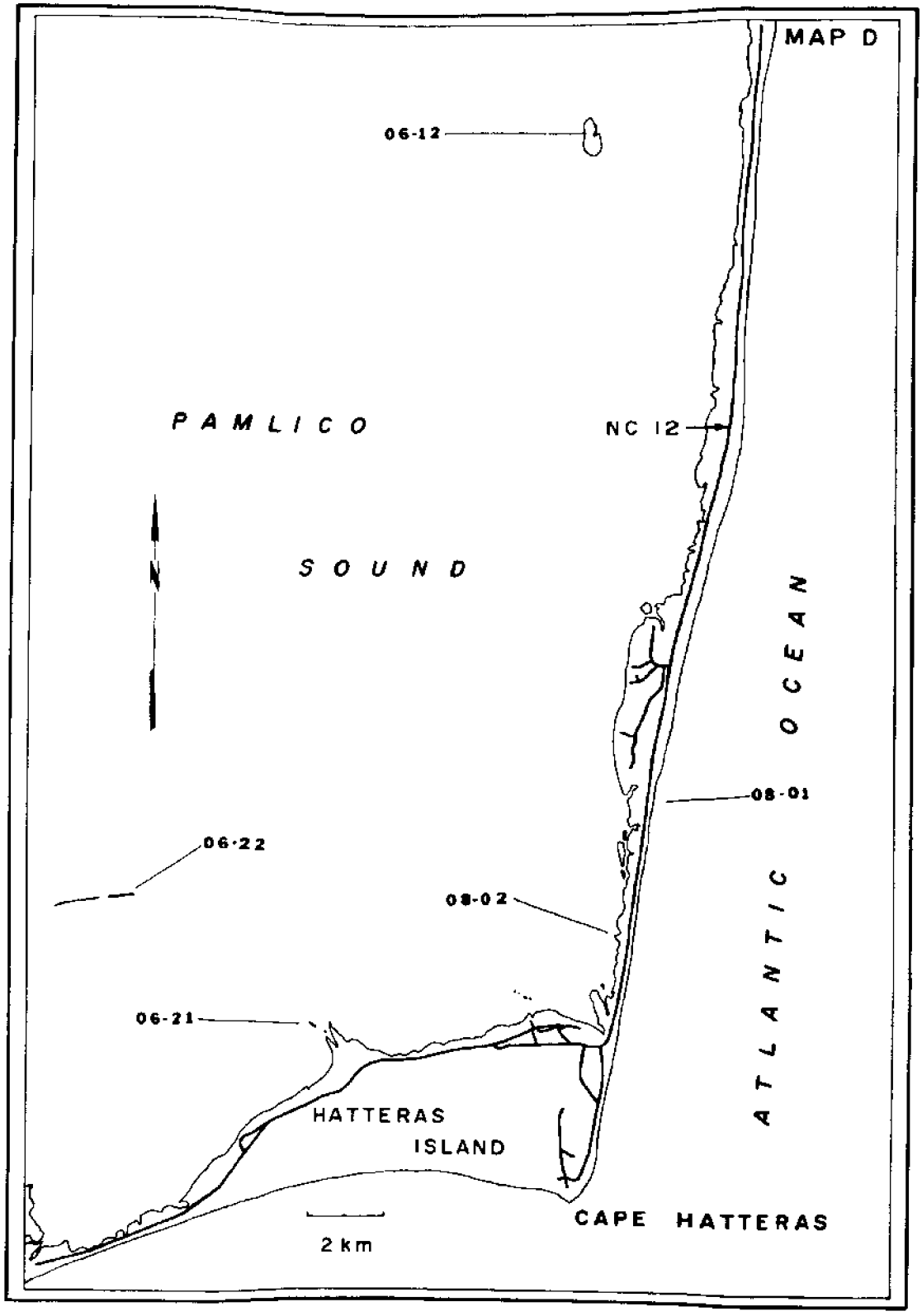

Fig. 82. Hatteras Island vicinity.

MAP E

06-10 Dredged Material p. 128

Royal Tern	2988
Sandwich Tern	897
Laughing Gull	506
Common Tern	65
Forster's Tern	45
Snowy Egret	16
Louisiana Heron	4
Glossy Ibis	4
Little Blue Heron	2
Herring Gull	1
	4528

06-11 Dredged Material p. 130

Common Tern	148
Gull-billed Tern	13
Black Skimmer	7
	168

09-02 Barrier Beach p. 141

Forster's Tern 17

09-03 Dredged Material - Diked p. 142

Common Tern	490
Least Tern	313
Forster's Tern	136
Black Skimmer	119
Gull-billed Tern	36
Laughing Gull	5
	1099

09-04 Dredged Material p. 143

Black Skimmer	177
Common Tern	49
Laughing Gull	9
Gull-billed Tern	8
	243

10-02 Natural Estuarine p. 144

Laughing Gull	99
Louisiana Heron	42
Glossy Ibis	32
Snowy Egret	18
Black-crowned Night Heron	9
Little Blue Heron	5
Great Egret	5
Herring Gull	1
	211

10-03 Natural Estuarine p. 145

Forster's Tern 25

10-04 Natural Estuarine p. 145

Laughing Gull	19
Forster's Tern	6
Herring Gull	1
	26

10-06 Natural Estuarine p. 145

Forster's Tern	120
Laughing Gull	3
	123

10-07 Natural Estuarine p. 145

Forster's Tern 3

10-09 Natural Estuarine p. 145

Forster's Tern 73

10-10 Natural Estuarine p. 145

Forster's Tern 9

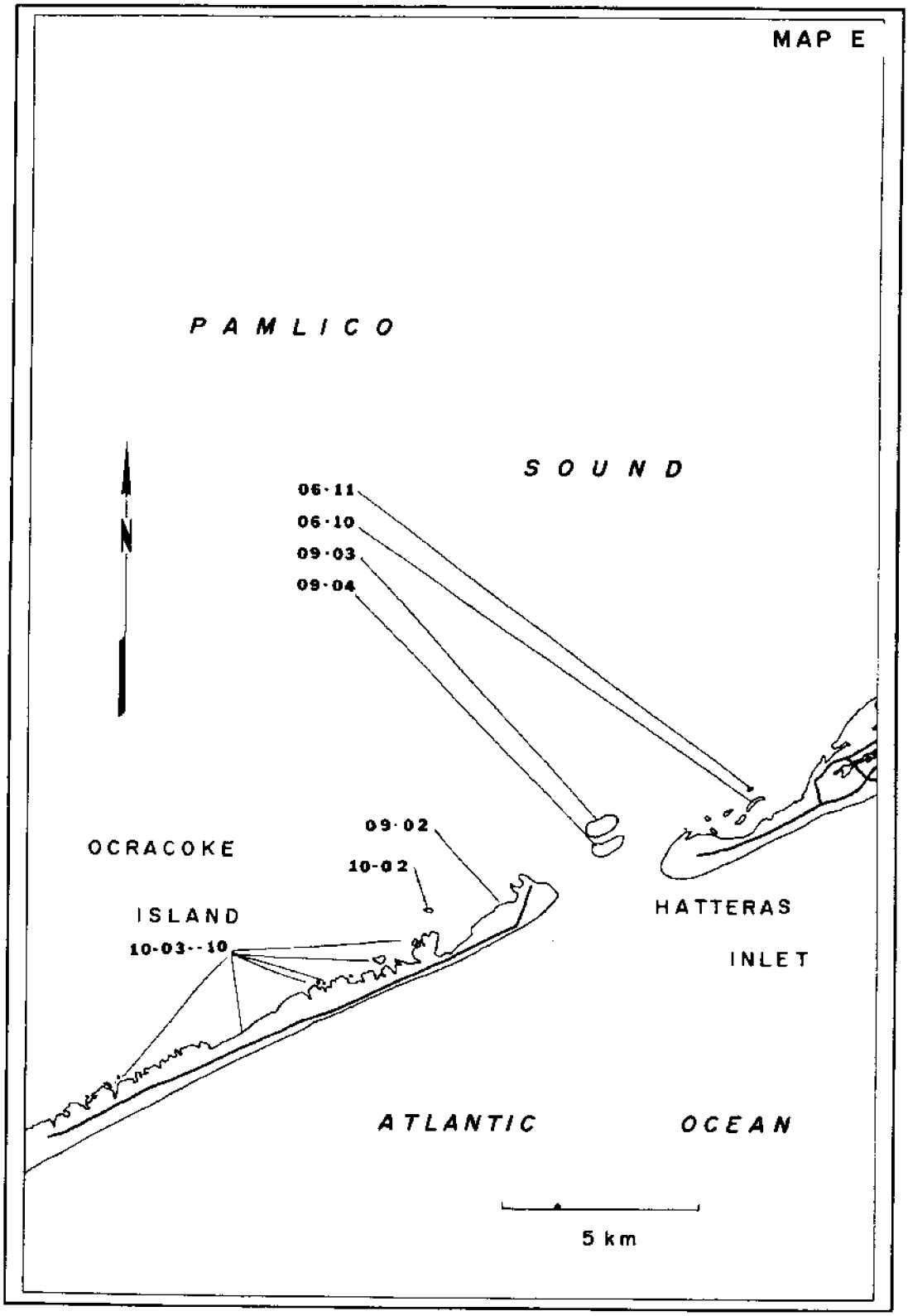

Fig. 83. Hatteras Inlet and vicinity.

MAP F

06-13 Natural Estuarine p. 131
No colony in 1977

06-14 Natural Estuarine p. 131

Common Tern 40

06-15 Natural Estuarine p. 131

Common Tern 164

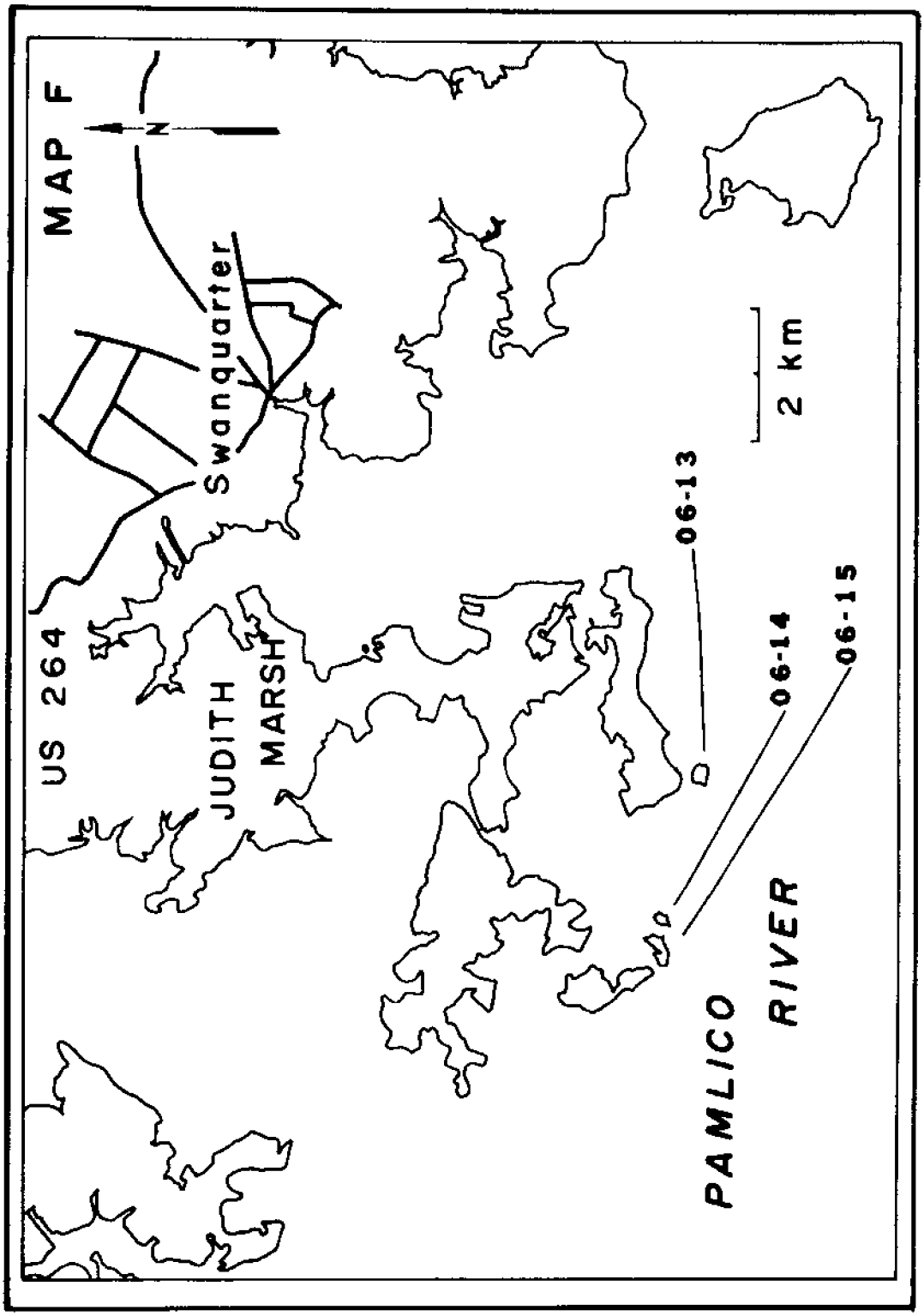

Fig. 84. Swanquarter and vicinity.

MAP G

06-16 Natural Estuarine p. 132

Common Tern	45
Forster's Tern	1
	46

06-18 Natural Estuarine p. 133

Common Tern	49

06-19 Natural Estuarine p. 133

Louisiana Heron	42
Snowy Egret	2
Forster's Tern	1
	45

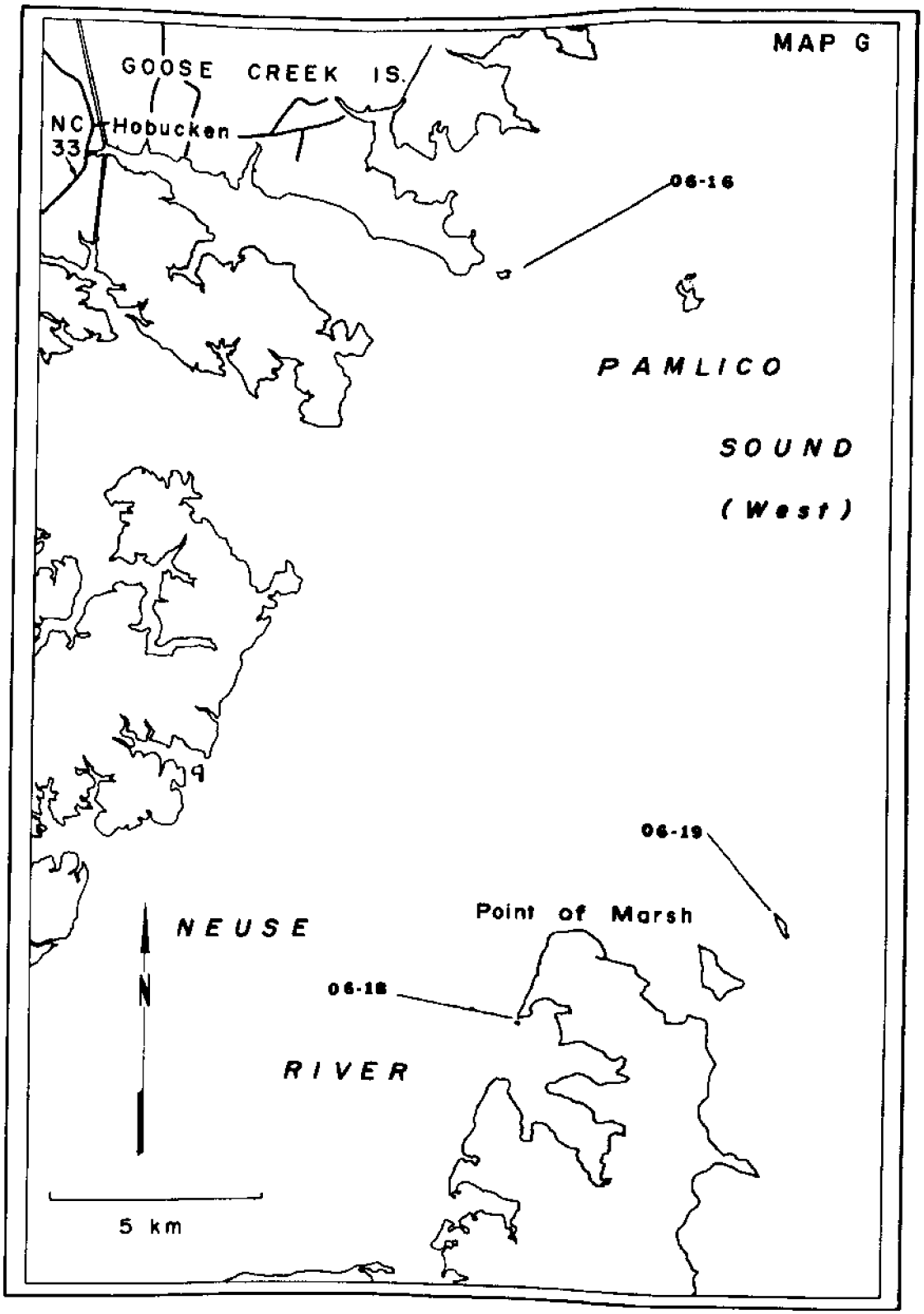

Fig. 85. Pamlico Sound in vicinity of Neuse River mouth.

MAP H

11-01 Barrier Beach p. 146

Common Tern	802
Black Skimmer	286
Forster's Tern	129
Least Tern	33
Gull-billed Tern	27
	1277

11-04 Natural Estuarine p. 148

Laughing Gull	1427
Forster's Tern	165
Snowy Egret	9
Louisiana Heron	5
Little Blue Heron	4
Great Egret	4
Glossy Ibis	2
Herring Gull	1
	1617

11-05 Man-altered, Origin Uncertain p. 149

Royal Tern	305
Common Tern	76
Sandwich Tern	32
Herring Gull	18
Forster's Tern	4
	435

11-06 Man-altered, Origin Uncertain p. 149

Brown Pelican	51
Forster's Tern	46
Herring Gull	13
	110

11-07 Man-altered, Origin Uncertain p. 150

Common Tern	90
Louisiana Heron	58
Brown Pelican	50
Snowy Egret	28
Forster's Tern	24
Black-crowned Night Heron	12
Little Blue Heron	11
Great Egret	4
Glossy Ibis	3
Herring Gull	1
	281

12-01 Barrier Beach p. 152

Least Tern	64
Black Skimmer	21
Gull-billed Tern	15
Common Tern	14
	114

12-02 Natural Estuarine p. 153

Forster's Tern 88

12-23 Natural Estuarine p. 155

Forster's Tern 10

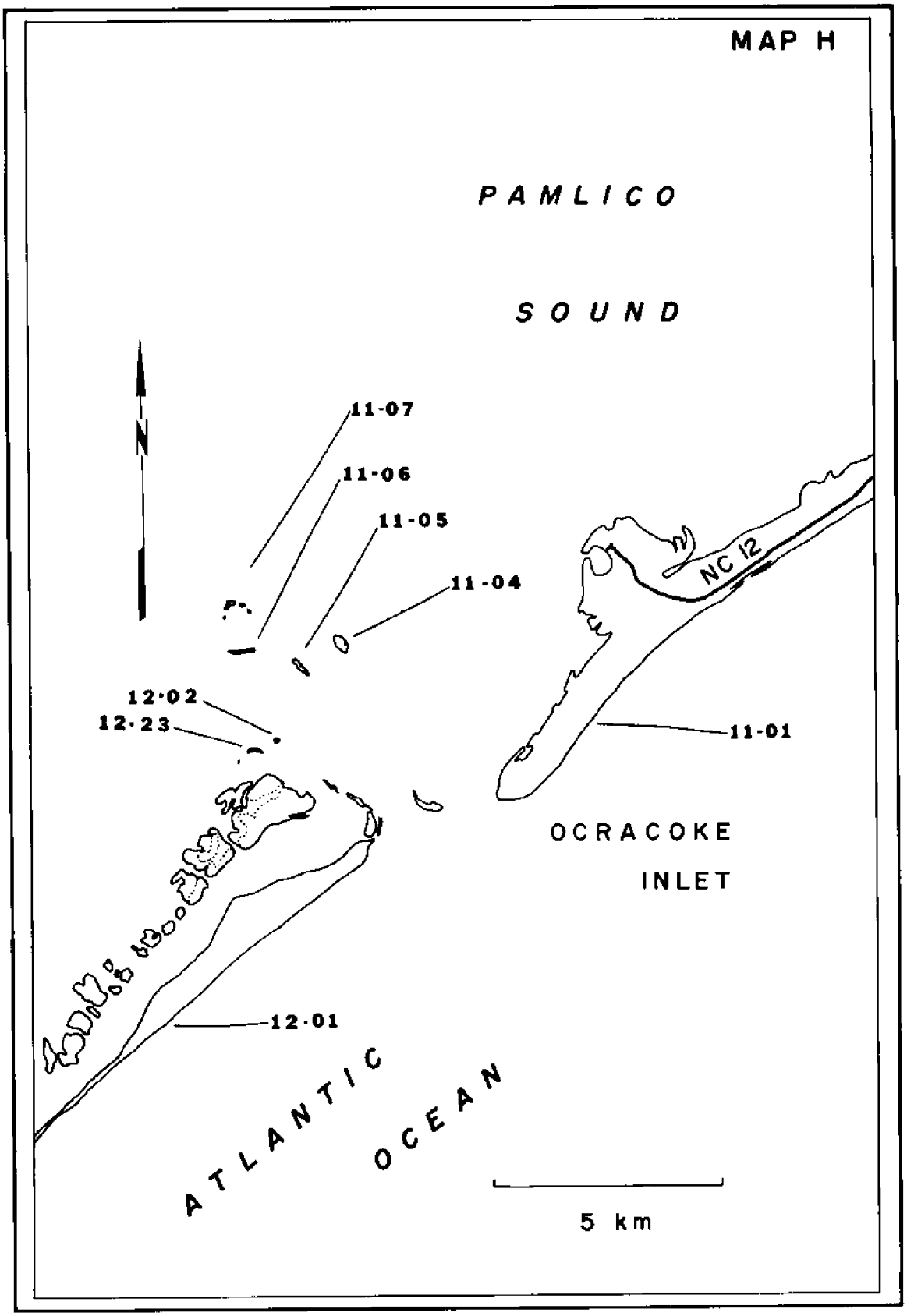

Fig. 86. Ocracoke Inlet and vicinity.

MAP I

12-16 Natural Estuarine p. 153

Forster's Tern 28

12-17 Natural Estuarine p. 153

Forster's Tern 60

12-18 Natural Estuarine p. 153

Forster's Tern 15

12-19 Natural Estuarine p. 153

Forster's Tern 4

13-01 Natural Estuarine p. 155

Forster's Tern 14

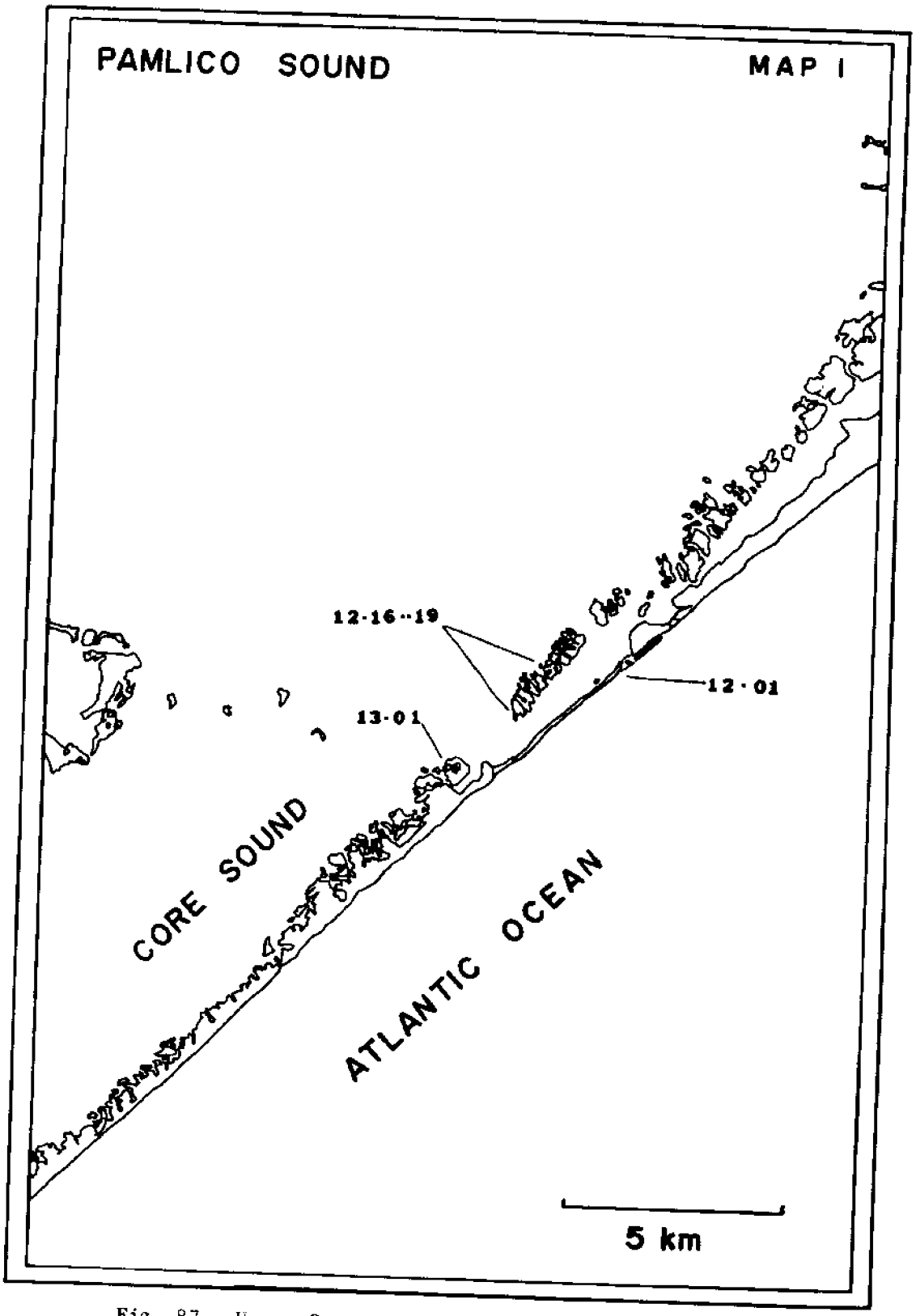

Fig. 87. Upper Core Sound, vicinity of Swash Inlet.

MAP J

06-20 Natural Estuarine p. 134

Laughing Gull	16
Forster's Tern	10
Common Tern	3
Black Skimmer	3
	32

14-01 Natural Estuarine p. 156

Royal Tern	1390
Sandwich Tern	94
Laughing Gull	46
Herring Gull	1
Gull-billed Tern	1
Common Tern	1
	1533

14-02 Dredged Material p. 157

Laughing Gull	160
Little Blue Heron	94
Glossy Ibis	71
Louisiana Heron	62
Snowy Egret	58
Great Egret	33
Black-crowned Night Heron	19
Cattle Egret	18
Herring Gull	4
	519

14-03 Natural Estuarine - Man-altered p. 158

Common Tern	12
Herring Gull	1
	13

14-04 Dredged Material - Diked p. 159

Common Tern	292
Black Skimmer	169
Gull-billed Tern	85
Royal Tern	33
	579

14-05 Barrier Beach p. 160

Least Tern	205
Black Skimmer	167
Common Tern	156
Gull-billed Tern	52
	580

14-10 Dredged Material p. 161

Common Tern	398
Forster's Tern	33
Royal Tern	1
	432

14-11 Barrier Beach p. 162

Least Tern	3
Common Tern	2
Gull-billed Tern	2
	7

14-12 Natural Estuarine p. 163

Forster's Tern	9

15-11 Natural Estuarine p. 164

Laughing Gull	279
Herring Gull	1
	280

16-01 Dredged Material p. 165

Laughing Gull	3511
Cattle Egret	190
Louisiana Heron	98
Glossy Ibis	34
Great Egret	19
Black-crowned Night Heron	16
Snowy Egret	9
Little Blue Heron	8
Herring Gull	2
	3887

16-02 Dredged Material p. 166

Forster's Tern	36
Laughing Gull	12
Herring Gull	1
	49

16-03 Natural Estuarine p. 167

Forster's Tern	7

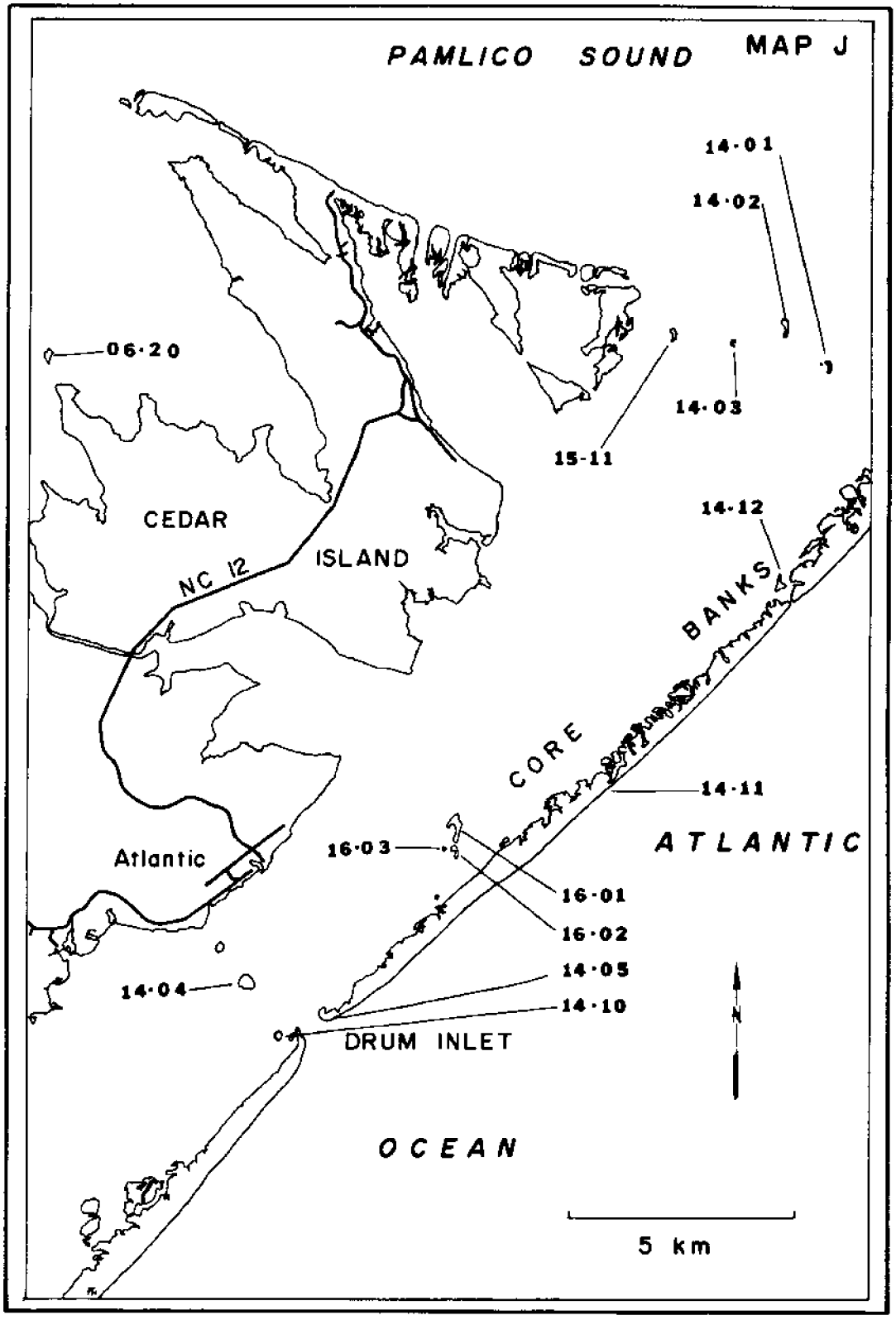

Fig. 88. Core Sound, Drum Inlet to Pamlico Sound.

MAP K

14-08 Barrier Beach p. 161

Least Tern	19
Common Tern	1
	20

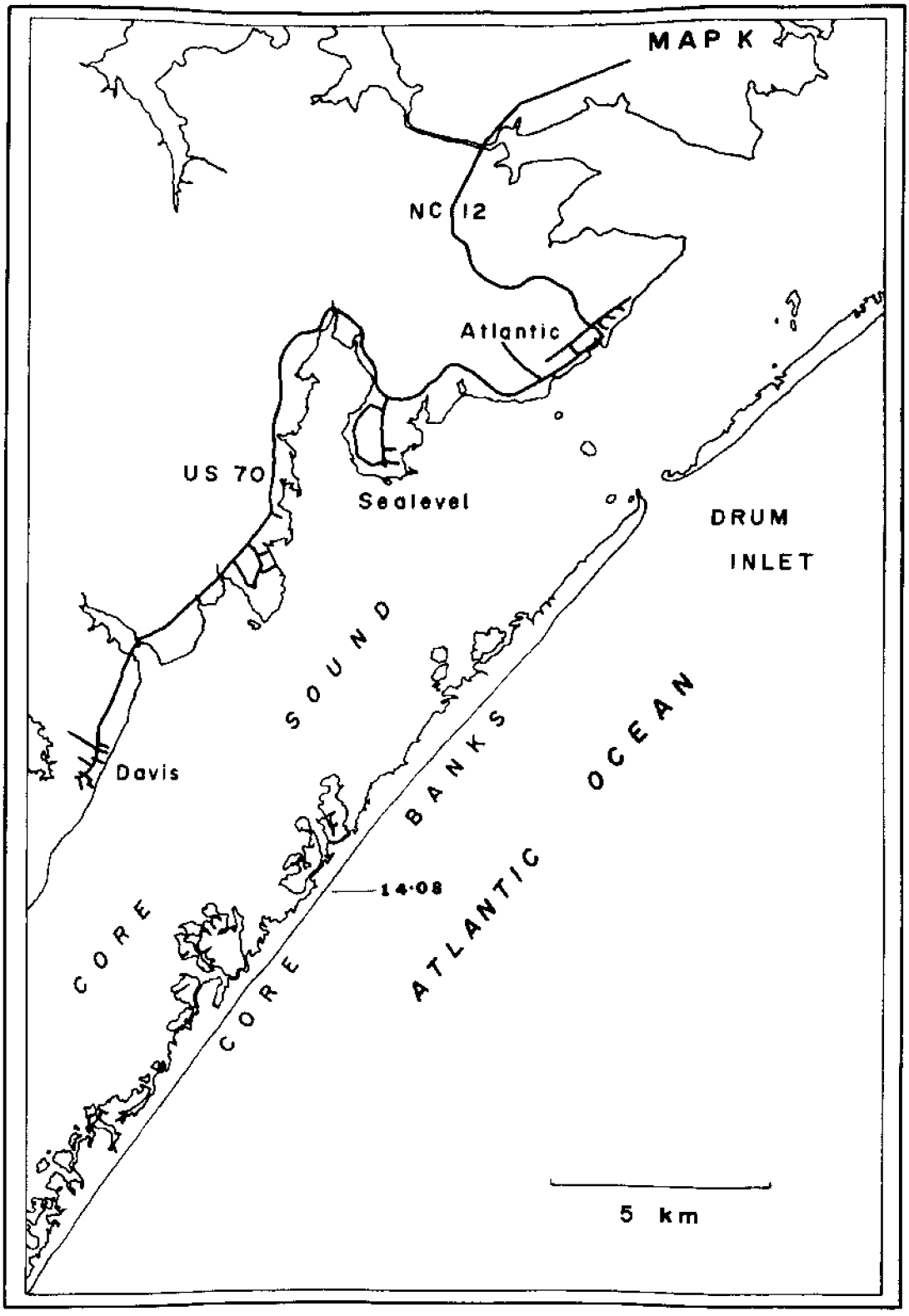

Fig. 89. Core Sound, Davis to Atlantic.

MAP L

14-14 Dredged Material p. 163

Common Tern	8
Black Skimmer	4
Gull-billed Tern	2
Least Tern	1
	15

17-01 Dredged Material - 168
Diked p.

Royal Tern	4319
Laughing Gull	1871
Sandwich Tern	478
Snowy Egret	62
Louisiana Heron	48
Little Blue Heron	23
Great Egret	8
Glossy Ibis	2
Black-crowned Night Heron	1
	6812

17-03 Dredged Material p. 169

Common Tern	64
Black Skimmer	11
Gull-billed Tern	2
	77

17-07 Dredged Material p. 170

Black Skimmer	28
Common Tern	16
Least Tern	14
	58

17-08 Dredged Material p. 171

Common Tern 32

18-11 Natural Estuarine p. 173

Common Tern 31

18-12 Natural Estuarine p. 174

Common Tern 10

18-20 Natural Estuarine p. 175

Common Tern 16

18-25 Natural Estuarine p. 176

Common Tern 11

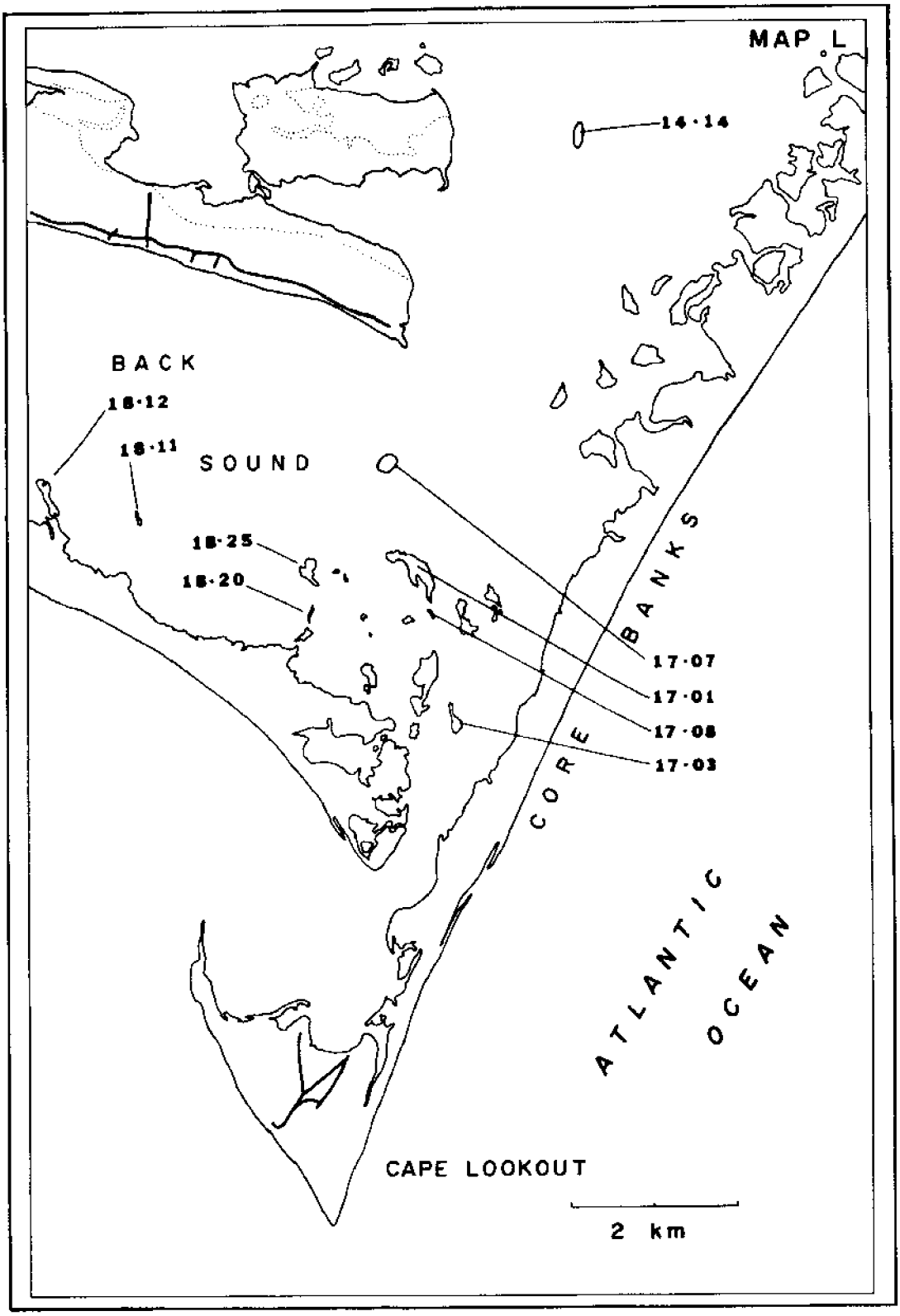

Fig. 90. Cape Lookout and vicinity.

MAP M

18-08 Natural Estuarine p. 172

Common Tern 60

18-07 Natural Estuarine p. 172

No colony in 1977

18-15 Natural Estuarine p. 174

No colony in 1977

20-05 Barrier Beach p. 178

No colony in 1977

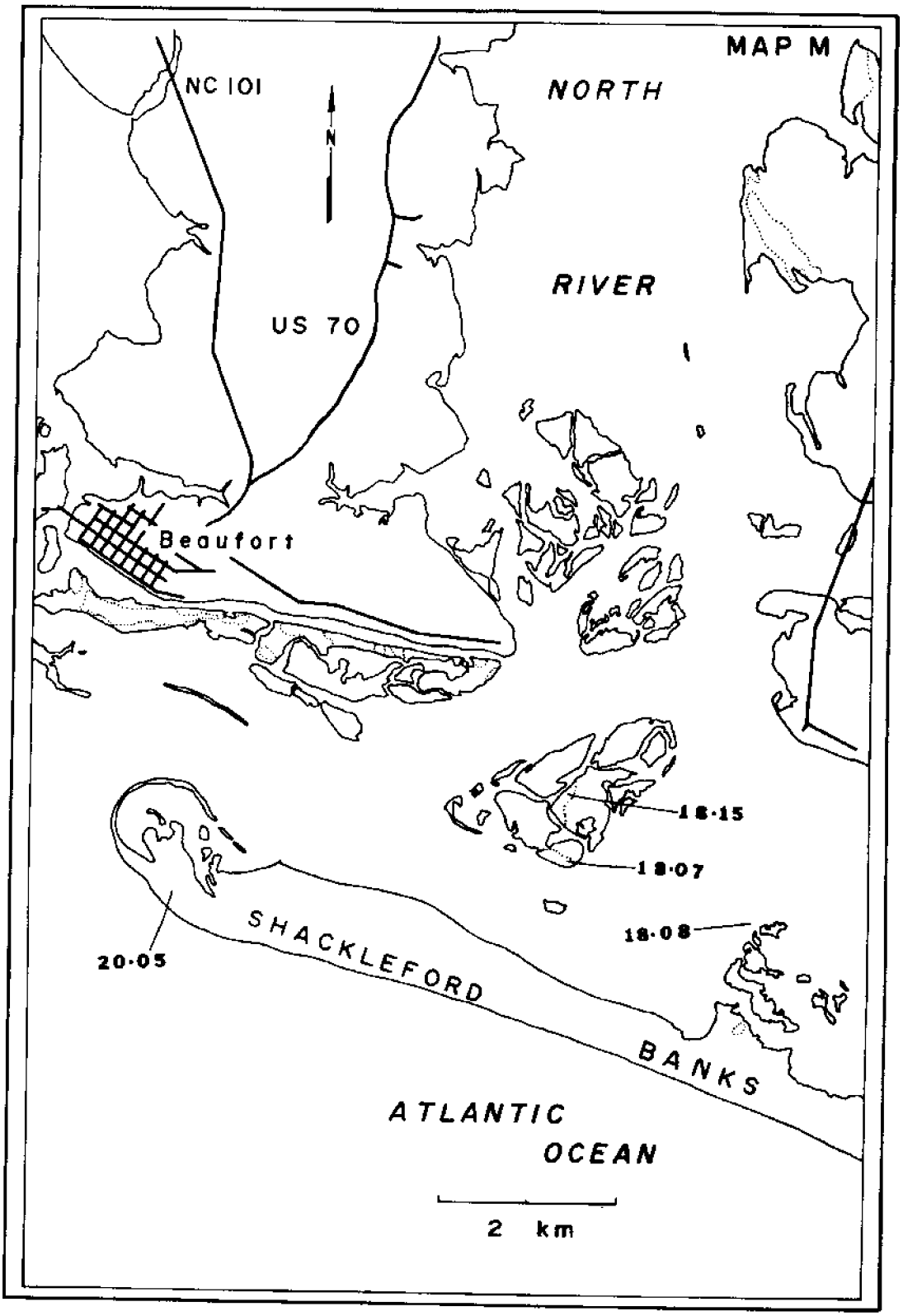

Fig. 91. North River to Shackleford Banks vicinity.

MAP N

20-02 Dredged Material - Diked p. 176

Least Tern	11
Common Tern	5
	16

20-03 Dredged Material - Diked p. 177

Common Tern	133
Least Tern	30
Black Skimmer	30
Gull-billed Tern	6
	199

20-06 Dredged Material - Diked p. 179

Common Tern	426
Black Skimmer	182
Gull-billed Tern	100
Least Tern	62
	770

21-01 Dredged Material - Diked p. 180

Least Tern 6

21-03 Dredged Material p. 181

Glossy Ibis	24
Louisiana Heron	16
Little Blue Heron	15
Snowy Egret	6
Black-crowned Night Heron	6
White Ibis	3
Great Egret	1
	71

21-04 Dredged Material p. 182

Cattle Egret	159
Great Egret	50
Louisiana Heron	29
Little Blue Heron	15
Snowy Egret	9
Black-crowned Night Heron	1
	263

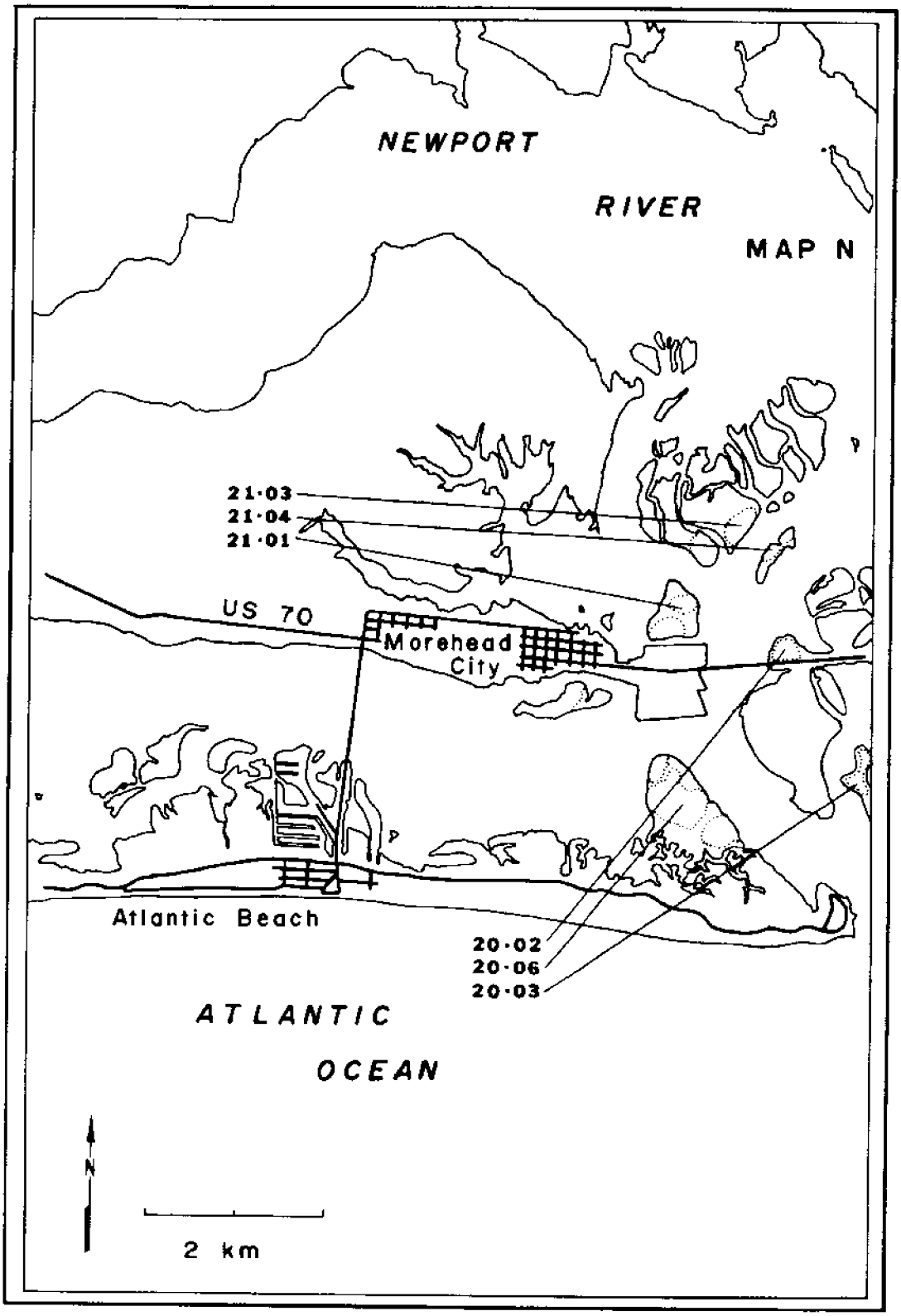

Fig. 92. Morehead City and vicinity.

MAP O

22-08 Dredged Material-relict p. 183

Common Tern	116
Least Tern	9
	125

22-25 Dredged Material - Diked p. 184

Least Tern 23

22-26 Dredged Material - Diked p. 185

Least Tern 8

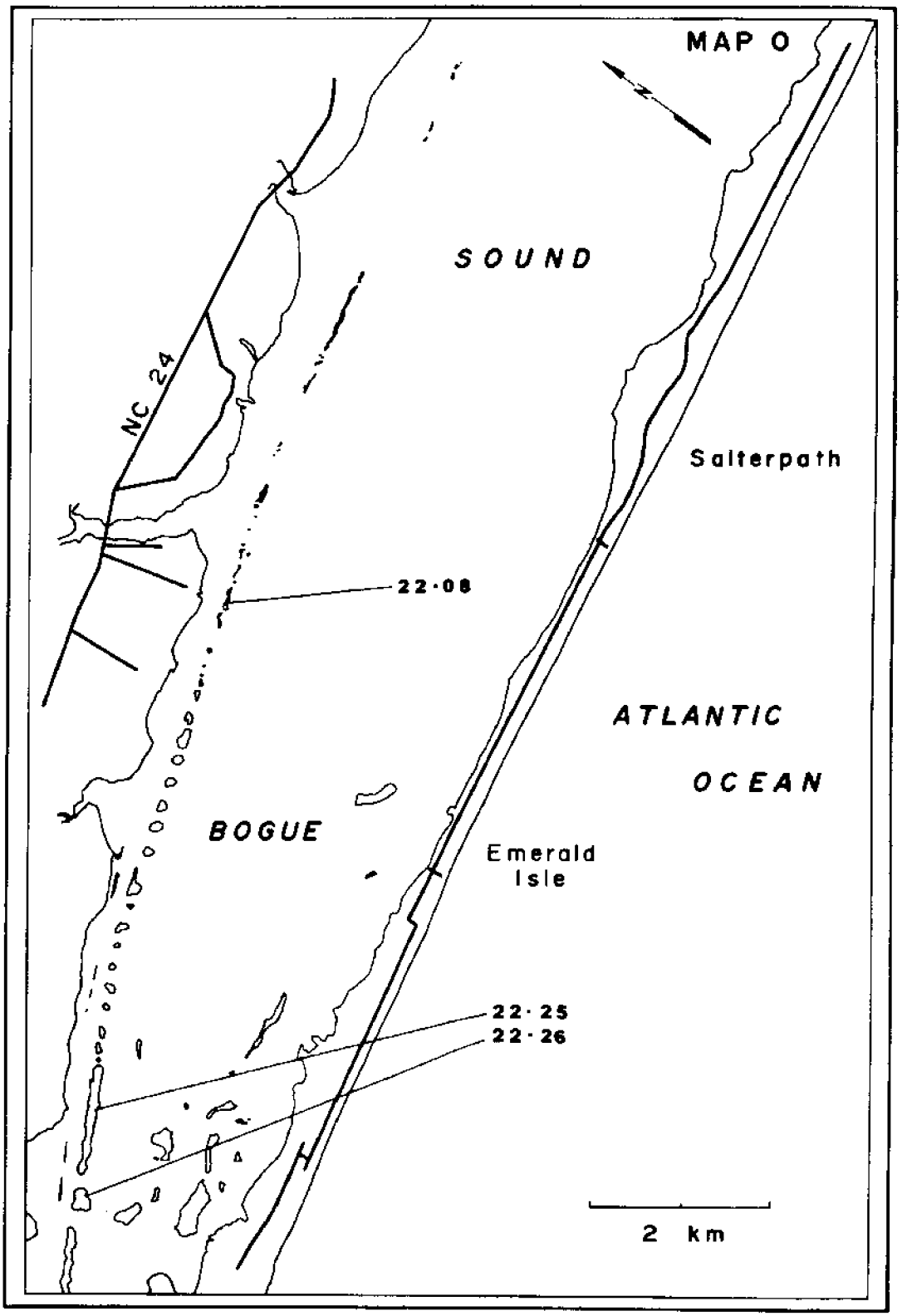

Fig. 93. Bogue Sound.

MAP P

22-40 Dredged Material - Diked p. 186

Least Tern 32

22-41 Dredged Material p. 187

Louisiana Heron	449
Little Blue Heron	362
Cattle Egret	220
Snowy Egret	151
Great Egret	138
Green Heron	18
Black-crowned Night Heron	1
Great Blue Heron	1
	1340

22-45 Dredged Material - Diked p. 188

Least Tern	6
Common Tern	1
	7

23-10 Dredged Material - Diked p. 189

Least Tern 152

23-14 Natural Estuarine p. 189

Black Skimmer	23
Common Tern	14
	37

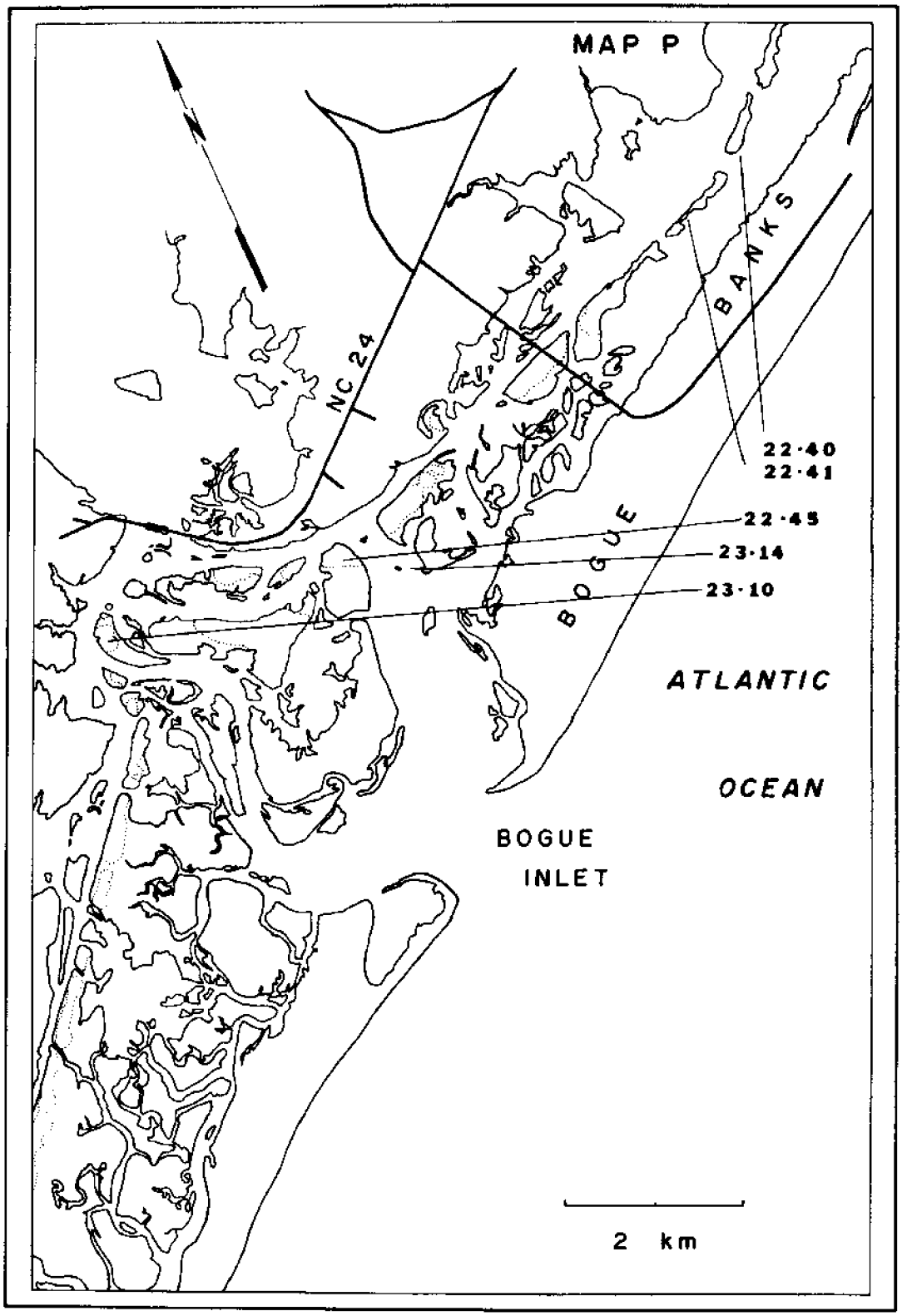

Fig. 94. Bogue Inlet and vicinity.

MAP Q

26-01 Barrier Beach p. 190

No colony in 1977

26-07 Dredged Material - Diked p. 191

Least Tern	2
Common Tern	1
	3

27-03 Dredged Material p. 192

Green Heron	12

27-04 Dredged Material p. 192

Green Heron	19
Little Blue Heron	2
	21

27-06 Dredged Material p. 192

Green Heron	20

27-07 Dredged Material p. 192

Green Heron	3
Great Egret	1
	4

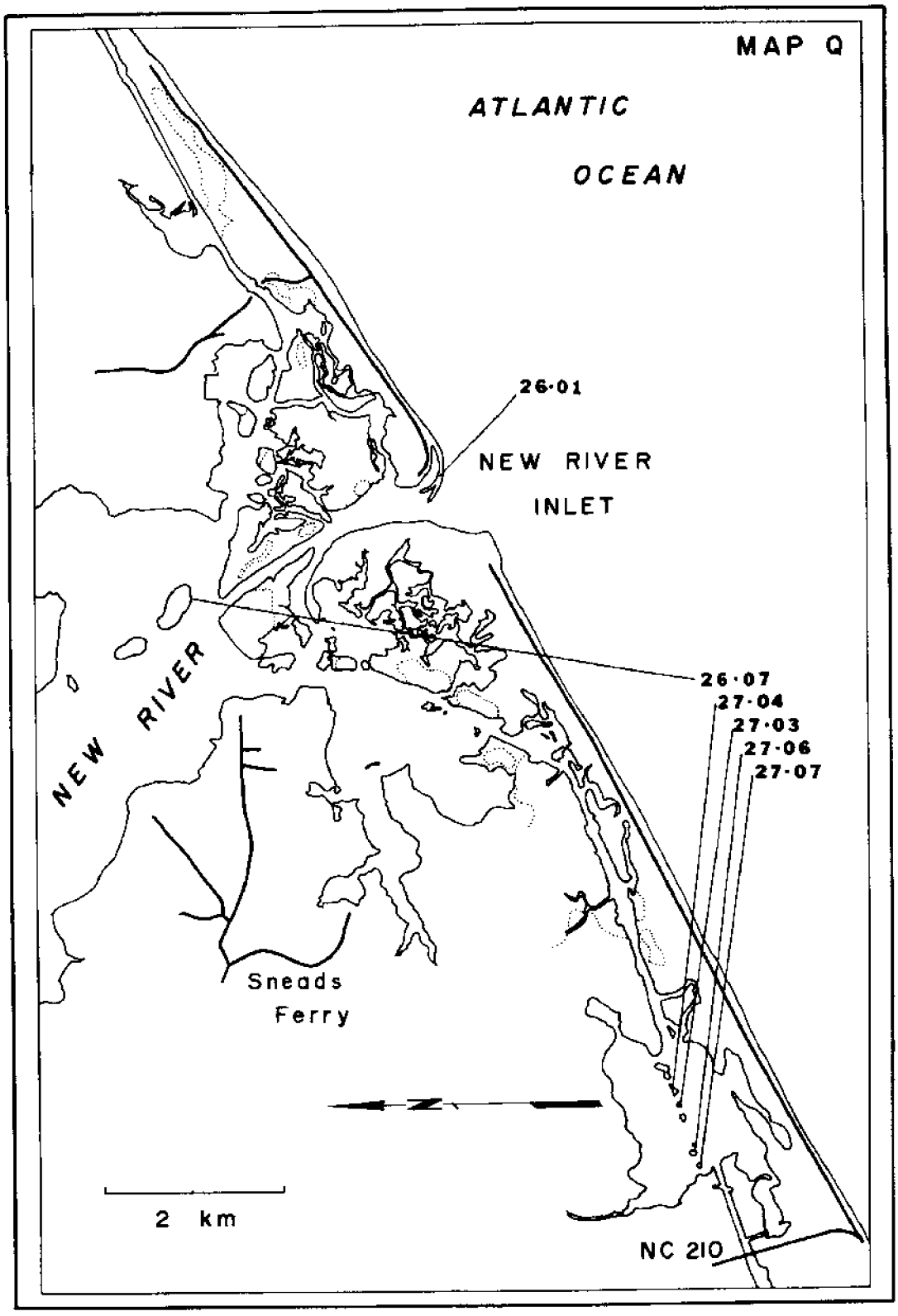

Fig. 95. New River Inlet and vicinity.

MAP R

no nesting colonies.

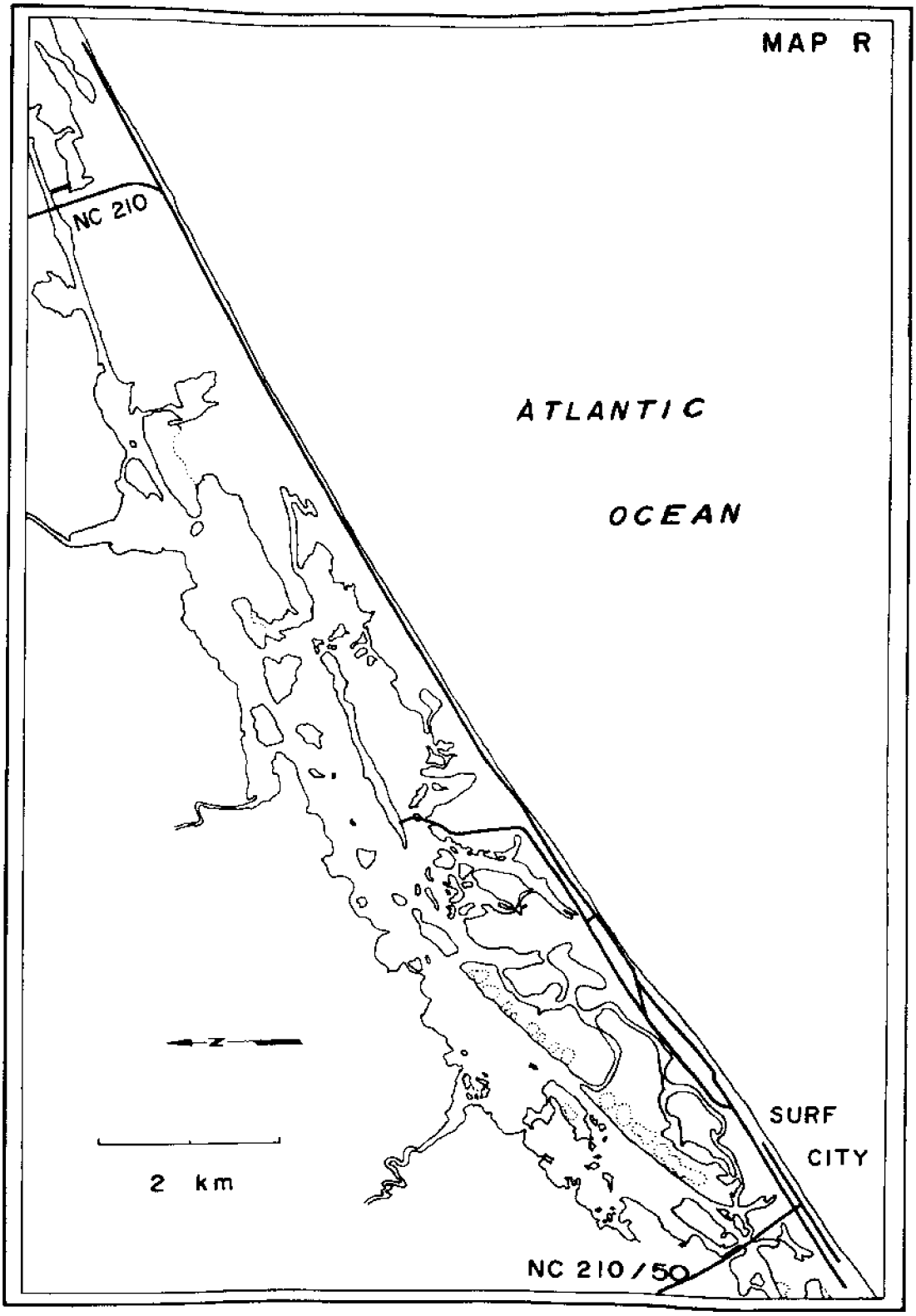

Fig. 96. Topsail Island and vicinity.

MAP S

29-25 Dredged Material - Diked p. 193

Least Tern 20

30-01 Barrier Beach - Modified by Man p. 193

Least Tern 71

30-02 Barrier Beach p. 194

Least Tern 80

31-01 Barrier Beach p. 195

Black Skimmer	52
Common Tern	9
	61

32-02 Barrier Beach p. 195

Least Tern	55
Common Tern	7
	62

MAP T

33-15 Dredged Material - Diked p. 196

Least Tern 4

33-22 Natural Estuarine p. 196

No colony in 1977

35-02 Barrier Beach p. 197

Least Tern	327
Black Skimmer	57
Common Tern	17
	401

36-03 Dredged Material - Diked p. 198

Least Tern 7

37-10 Dredged Material - Diked p. 199

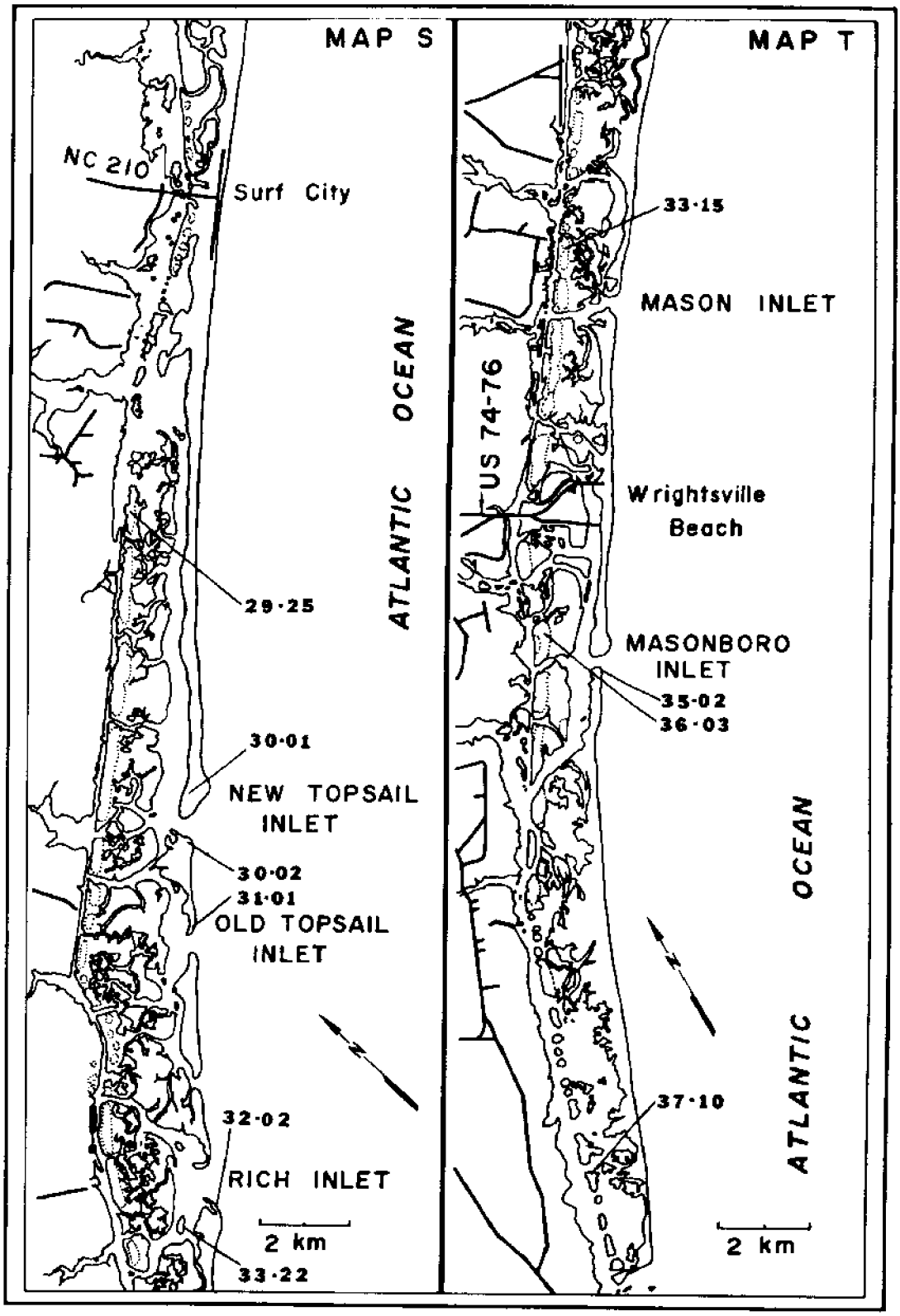

Fig. 97. Surf City to Masonboro Inlet.

MAP U

39-26 Dredged Material - Diked p. 200

Gull-billed Tern	164
Common Tern	22
Black Skimmer	18
	204

39-28 Dredged Material - Diked p. 201

Laughing Gull	728
Royal Tern	1
	729

39-32 Dredged Material p. 202

Royal Tern	5071
Sandwich Tern	18
	5089

39-33 Dredged Material - Diked p. 203

Least Tern 7

39-34 Dredged Material - Diked p. 204

No colony in 1977

39-35 Dredged Material p. 205

No colony in 1977

39-36 Dredged Material p. 205

No colony in 1977

39-37 Dredged Material p. 206

Gull-billed Tern	34
Common Tern	4
	38

39-46 Natural, Subsequently receiving Dredged Materials p. 207

White Ibis	1946
Louisiana Heron	240
Snowy Egret	87
Glossy Ibis	72
Little Blue Heron	72
Black-crowned Night Heron	28
Cattle Egret	7
Green Heron	5
Great Egret	3
	2460

39-49 Barrier Beach p. 208

Black Skimmer	59
Least Tern	22
	81

39-51 Natural, Subsequently receiving Dredged Material p. 209

Cattle Egret	693
Snowy Egret	450
Louisiana Heron	368
Great Egret	144
Glossy Ibis	86
Black-crowned Night Heron	75
Little Blue Heron	13
White Ibis	2
	1831

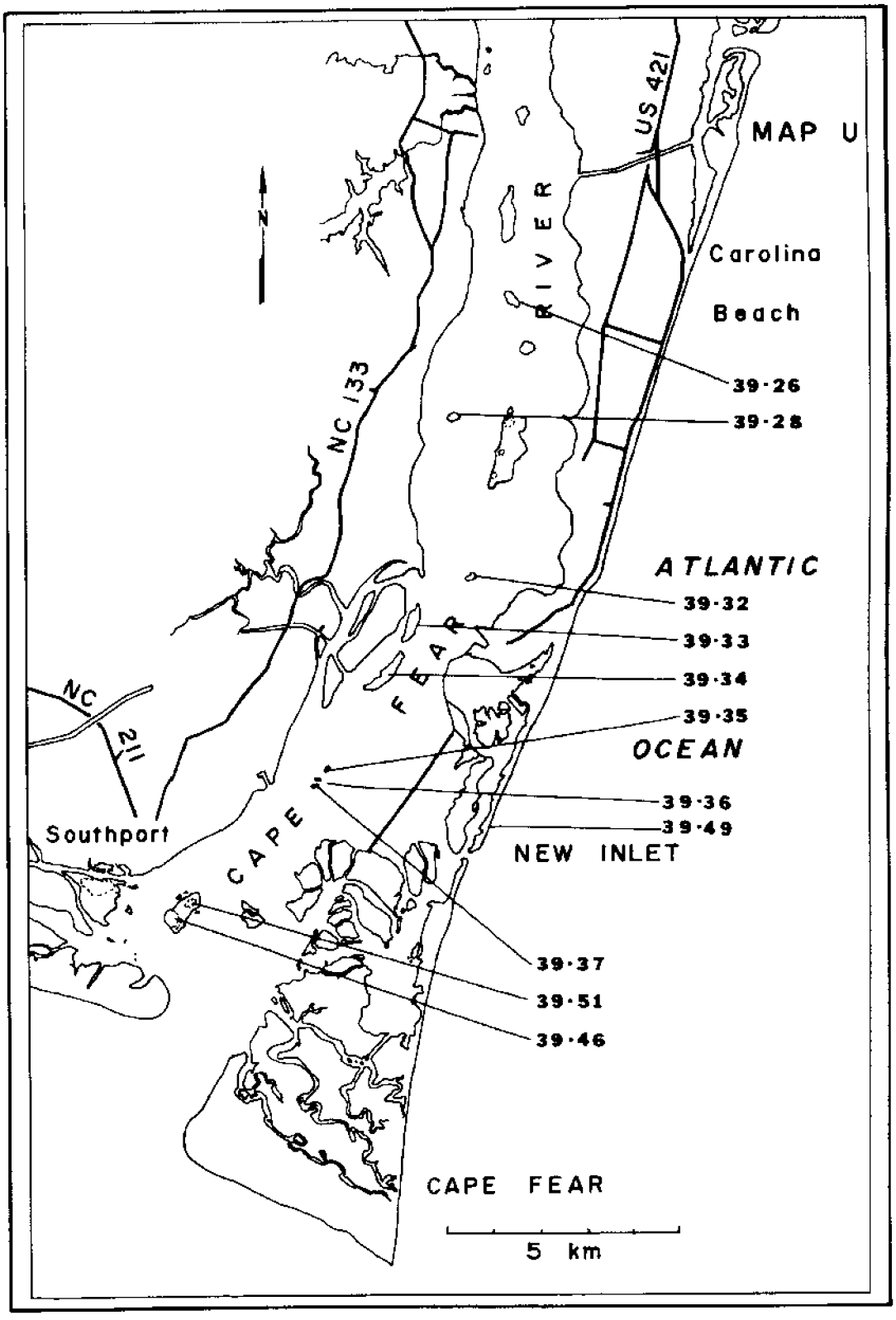

Fig. 98. Cape Fear River Region.

MAP V

no nesting colonies.

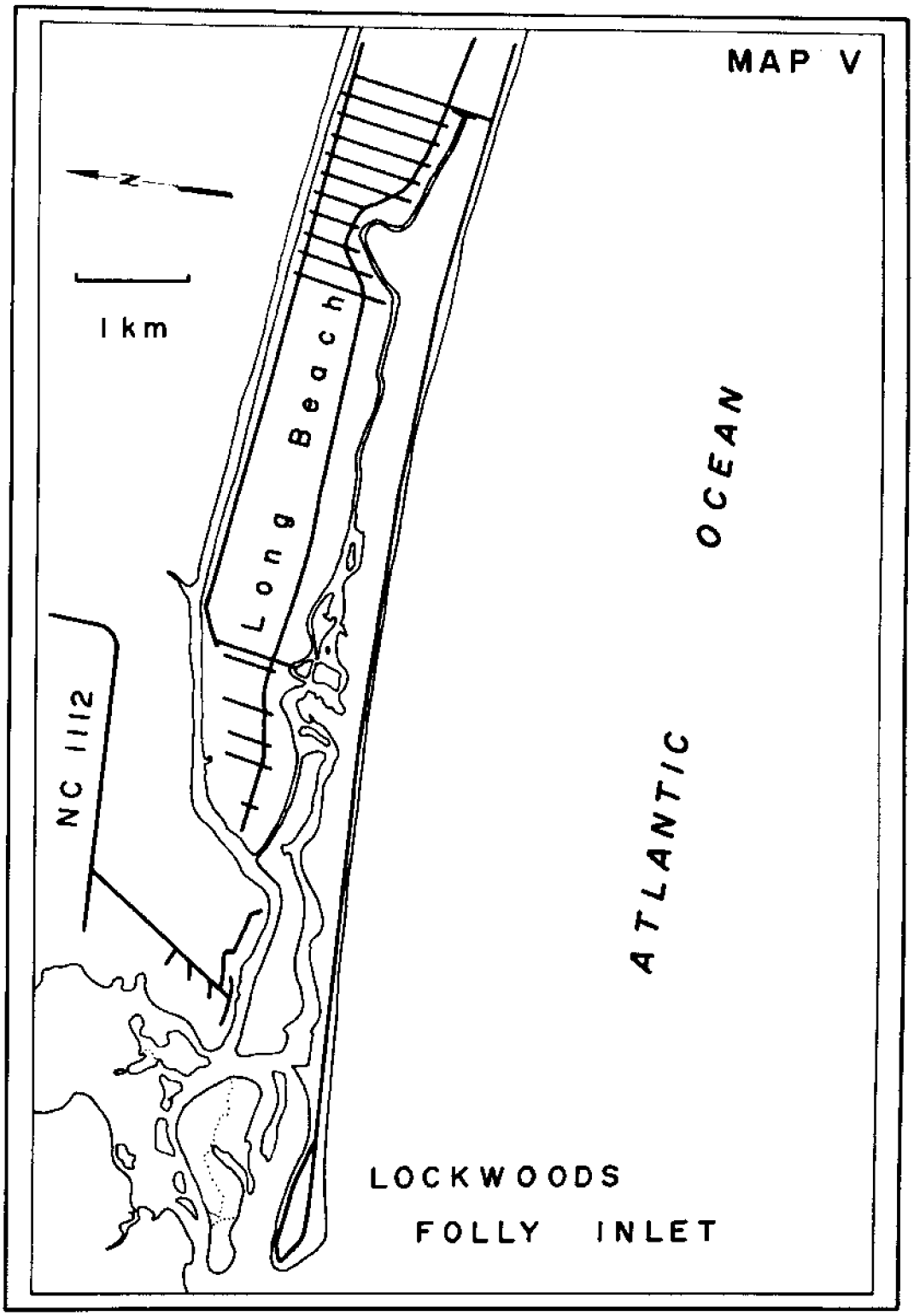

Fig. 99. Long Beach and vicinity.

MAP 9

43-06 Dredged Material - Diked p. 210

Least Tern 12

43-09 Dredged Material - Diked p. 211

Least Tern	427
Black Skimmer	28
Gull-billed Tern	19
Common Tern	9
	493

MAP X

47-01 Dredged Material - Diked p. 212

Least Tern 35

47-08 Barrier Beach p. 213

Black Skimmer 22

48-07 Dredged Material - Diked p. 213

Least Tern 9

50-04 Mainland-Dredged Material Site p. 214

Least Tern 28

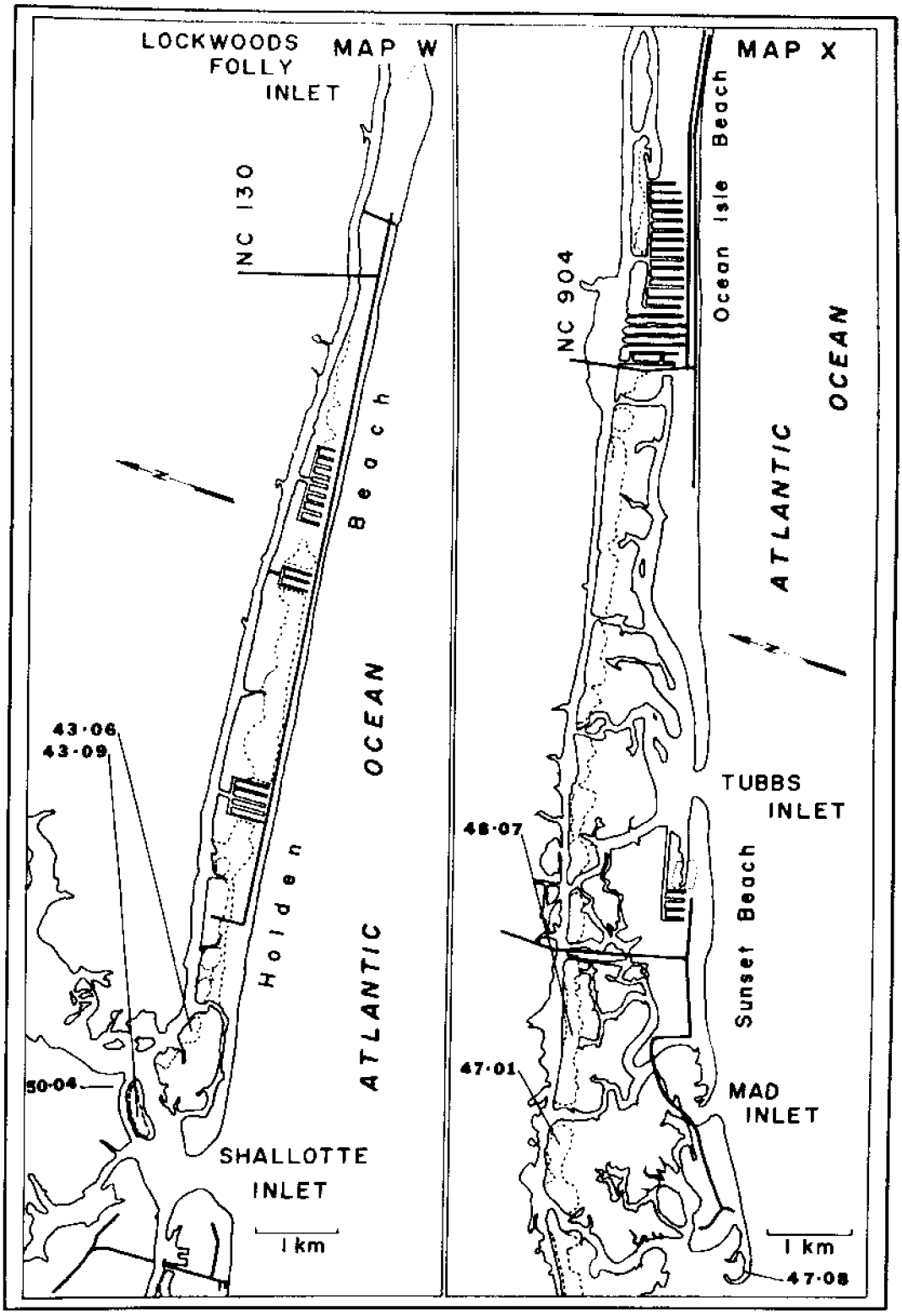

Fig. 100. Lockwoods Folly Inlet to Mad Inlet.

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APPENDIX A. Scientific and common names of flora listed in the text[1].

Apiaceae
- Hydrocotyle bonariensis marsh pennywort
- Ptilimnium sp.

Aquifoliaceae
- Ilex vomitoria yaupon

Asteraceae
- Baccharis halimifolia silverling
- Borrichia frutescens sea ox-eye
- Erigeron canadensis horseweed
- Eupatorium capillifolium dog-fennel
- Heterotheca subaxillaris camphorweed
- Iva frutescens marsh elder
- Iva imbricata
- Solidago sempervirens seaside goldenrod

Brassicaceae
- Cakile harperi sea rocket
- Lepidium virginicum pepper grass

Chenopodiaceae
- Atriplex arenaria seabeach orach
- Atriplex patula orach
- Chenopodium album pigweed
- Chenopodium ambrosioides mexican tea
- Salicornia virginica glasswort
- Salsola kali Russian thistle
- Suaeda sp.

Cornaceae
- Cornus florida flowering dogwood

Cupressaceae
- Juniperus virginiana red cedar

Cyperaceae
- Scirpus sp. three square

Euphorbiaceae
- Euphorbia polygonifolia spurge

Fabaceae
- Daubentonia punicea partridge pea

Fagaceae
- Quercus virginiana live oak

Geraniaceae
Geranium maculatum wild geranium

Hydrocharitaceae
Vallisneria americana eelgrass

Juncaceae
Juncus roemerianus black needle rush

Moraceae
Broussonetia papyrifera paper mulberry
Morus alba white mulberry

Myricaceae
Myrica cerifera wax myrtle
Myrica pensylvanica bayberry

Onagraceae
Oenothera sp. primrose

Pinaceae
Pinus taeda loblolly pine

Poaceae
Ammophila breviligulata American beach grass
Arundo donax giant reed
Cynodon dactylon bermuda grass
Digitaria sanguinalis crabgrass
Distichlis spicata saltgrass
Elymus virginicus wild rye-grass
Festuca octoflora fescue
Melica mutica melic grass
Panicum sp. panic grass
Paspalum sp.
Phragmites communis phragmites
Setaria magna giant foxtail grass
Spartina alterniflora smooth cordgrass
Spartina cynosuroides giant cordgrass
Spartina patens saltmeadow cordgrass
Triplasis purpurea sandgrass
Uniola paniculata sea oats

Polygonaceae
Polygonum sp. smartweed

Rosaceae
Rubus sp. dewberry

Ruaceae
Xanthoxylum americanum prickly ash, toothache tree

Salicaceae
Populus alba silver poplar
Salix nigra black willow

Typhaceae
Typha sp. cattail

Ulmaceae
Celtis laevigata hackberry

[1]Scientific names follow Radford *et. al.* 1964.

APPENDIX B. Scientific and common names of fauna listed in the text.

Birds[1]

Pelecanus occidentalis Brown Pelican
Ardea herodias Great Blue Heron
Casmerodius alba Great Egret
Egretta thula Snowy Egret
Hydranassa tricolor Louisiana Heron

Florida caerulea Little Blue Heron
Butorides stritus Green Heron
Nycticorax nycticorax Black-crowned Night Heron
Nyctanassa violacea Yellow-crowned Night Heron
Bubulcus albus Cattle Egret

Plegadis falcinellus Glossy Ibis
Eudocimus albus White Ibis
Larus argentatus Herring Gull
Larus marinus Great Black-backed Gull
Larus atricilla Laughing Gull

Gelochelidon nilotica Gull-billed Tern
Sterna forsteri Forster's Tern
Sterna hirundo Common Tern
Sterna albifrons Least Tern
Sterna maxima Royal Tern

Sterna caspia Caspian Tern
Rynchops niger Black Skimmer
Sterna sandvicensis Sandwich Tern

Mammals[2]

Rattus norvegicus Norway Rat
Myocastor coypus Nutria
Equus sp. Wild Horse
Ovis sp. Sheep
Procyon lotor Raccoon

Urocyon cinereoargenteus Gray Fox

[1]Bird names conform to Checklist of North American Birds, 5th ed., (AOU 1957) and supplements (AOU 1973) (AOU 1976).

[2]Mammal names follow Blair *et. al.* 1968.