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1983 Supplement to
**Atlas of colonial waterbirds
of North Carolina estuaries**

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By James F. Parnell and Donald A. McCrimmon, Jr.



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1983 SUPPLEMENT

To

ATLAS

of

COLONIAL WATERBIRDS OF NORTH CAROLINA ESTUARIES

JAMES F. PARNELL

Department of Biological Sciences
The University of North Carolina at Wilmington
Wilmington, North Carolina 28403

DONALD A. McCRIMMON, JR.*

National Audubon Society Research Department
Laboratory of Ornithology
Cornell University
Ithaca, New York

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* Present Address: Point Reyes Bird Observatory, 4990 Shoreline Highway,
Stinson Beach, California 94970

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INTRODUCTION

In 1976 and 1977, the North Carolina estuaries and barrier islands were surveyed, and all nesting sites for gulls, terns, pelicans, herons, egrets and ibises, birds known generally as colonial waterbirds, were located. One of the results of that study was an Atlas of Colonial Waterbirds of North Carolina Estuaries published by the North Carolina Sea Grant Program (Parnell and Soots 1979). The Atlas was designed to provide information on location, species composition and size of nesting colonies of colonial waterbirds for agencies involved in the management of North Carolina's estuaries. It had been shown in earlier studies (Soots and Parnell 1975, Parnell and Soots 1978) that plant succession, erosion, habitat manipulation by man and other factors resulted in the movement of colonies, and by the early 1980s it became apparent that the 1979 Atlas would soon begin to lose much of its usefulness. Aerial surveys in 1982 (McCrimmon and Parnell 1983) confirmed this. We therefore secured funds from the North Carolina Sea Grant Program and the United States Army Corps of Engineers to conduct a new set of breeding colony surveys in 1983.

This supplement is designed to bring the Atlas up-to-date. The basic information on biology and management in the 1979 Atlas is still pertinent and will not be repeated here. This publication will provide some basic population size and distribution comparisons between the 1977 and 1983 censuses. Of primary importance is the updated series of maps showing 1983 colony locations. We anticipate that this base of information will allow resource managers to know with renewed certainty where nesting colonies are now located and which colony sites are most heavily used. We plan to make detailed comparisons between sites used in 1977 and 1983, but these

comparisons are beyond the scope of this publication. We anticipate that this supplement will need updating again in about five years.

METHODS

Colonies were defined as nesting groups of four or more active nests of a species at a location. As in 1977, aerial surveys were used in 1983 to locate colony sites, and each site was subsequently visited by a team of biologists. Data were gathered in essentially the same manner in 1983 as in 1977. In 1983, the field survey team consisted of five people, occasionally supplemented by volunteers. Census methodology is reported in detail in the 1979 Atlas. The 1983 surveys differed from 1977 efforts in that each site was visited only once rather than on two or three occasions. This was necessitated by monetary constraints and by a desire to develop a method that could be more easily repeated in the future. We thus visited each site once--at or near the peak of incubation. All nests were counted in the smaller colonies of ground nesters and in all heronries. Large colonies of Laughing Gulls were sampled using strip census techniques. These colonies were measured, mapped and then sampled by counting nests in a series of transects across the colony site. Sample densities were extrapolated to the entire colony site. While there are recognizable problems with this method (e.g. patchy nesting distributions may result in error of estimated totals), it is relatively easy to repeat, requires little equipment and can be duplicated by observers with little training. It also minimizes time in the colony and keeps observer damage low.

Heronries were sampled by the same method of nest counts and apportioning of unknown nests on the basis of sample counts of adults overhead discussed in the 1979 Atlas (Parnell and Soots 1979).

The 1983 surveys provide what we refer to as peak nesting population counts. Both 1977 and 1983 were dry summers. During dry summers, many birds

begin nesting during a relatively short period of time, and there is minimal renesting and late nesting for most species. Cattle Egrets and Black Skimmers are notable exceptions, and estimates of numbers of these species will be less reliable than for most others. Single censuses, timed to coincide with the peak of incubation, will provide an index to nesting numbers that should allow trends to be detected, show major shifts in numbers or locations of nesting colonies and do not require the time and money needed to field a research team for an entire season. Peak period counts will be confounded by long periods of wet, cool weather which result in many nest failures and repeated renesting attempts by many species. Therefore, future censuses should be designed with sufficient flexibility to allow an entire census year to be postponed should weather conditions warrant.

Censuses were conducted in 1983 between May 16 and June 15. The first set of censuses in 1977 also began on May 16 and was completed by June 22. Surveys were begun in southeastern North Carolina both years with the work proceeding northward to the Virginia line.

RESULTS AND DISCUSSION

The pages facing the 24 regional maps that comprise Figures 3 through 26 list the species and numbers of birds nesting at each colony site in 1983. Table 1 summarizes these data. The 1977 data were recalculated from first-visit data to allow direct comparison with the 1983 data. This approach assumes that the timing of nesting for the two years was close enough so that similar proportions of the nesting populations were censused each year. Any major shift could bias the comparisons between years.

Table 1 indicates that there has been an increase of over 25,000 nests of colonial waterbirds in the North Carolina estuaries since 1977. This represents an increase of 73 percent, primarily in numbers of nests of Great Egrets, White Ibises, Brown Pelicans, Laughing Gulls and Royal Terns. Studies concurrent with this survey show that the increases in numbers of White Ibis and Brown Pelican nesting populations are real and not shifts in time of nesting. The White Ibis has also extended its range along coastal North Carolina, nesting in 1983 as far north as Oregon Inlet.

Final estimates of Royal Tern numbers in 1977 (16,708) (Parnell and Soots 1979) were, however, very close to the 1983 peak nest estimates of 17,029 nests. If a larger proportion of an earlier nesting population was censused during the 1983 survey than on the first 1977 census, the actual difference may be exaggerated. Less formal monitoring which we have conducted over the past several years also suggests, however, that Royal Tern populations in North Carolina have increased since 1977. The 1983 data are in line with those observations.

The other species showing a large increase in numbers was the Laughing Gull with 22,903 nests in 1983. This is very obvious even if the season total

Table 1. Comparison of peak counts of colonial waterbird nests in North Carolina estuaries in 1977 and 1983.

Species	Number Colonies		Number Nests	
	1977	1983	1977	1983
Little Blue Heron	16	11	802	1,164
Tricolored Heron	18	16	1,479	1,399
Black-crowned Night Heron	13	13	237	269
Green-backed Heron	05	02	42	19
Great Egret	16	18	494	839
Snowy Egret	18	14	1,034	715
Cattle Egret	09	08	1,137	1,448
White Ibis	02	05	1,939	3,815
Glossy Ibis	12	07	404	291
Total Waders	109	94	7,568	9,959
Brown Pelican	02	03	82	1,382
Laughing Gull	16	16	9,369	22,903
Herring Gull	07	12	433	444
Gull-billed Tern	09	09	268	223
Royal Tern	07	08	9,755	17,029
Sandwich Tern	05	07	1,190	1,850
Common Tern	35	24	2,761	2,227
Forster's Tern	26	13	1,138	931
Least Tern	38	31	1,925	1,731
Black Skimmer	17	14	976	733
Total Ground Nesters	162	137	27,897	51,453
Total Colonial Waterbirds	271	231	35,465	59,412

for 1977 (12,516 nests) (Parnell and Soots 1979) is used for comparison rather than the peak count of 9,369 nests.

Several heron species (e.g., Cattle Egret, Black-crowned Night Heron and Little Blue Heron) exhibited small increases in numbers of nests, while numbers of nests of others (e.g., Tricolored Heron, Snowy Egret, Green-backed Heron and Glossy Ibis) were reduced. These wading birds need further monitoring as we cannot be sure whether apparent changes represent trends or seasonal differences between census years.

Numbers of most of the ground-nesting gulls and terns other than the Laughing Gull and Royal Tern were similar in 1977 and 1983. Sandwich Terns increased somewhat, but most other species had about the same or slightly fewer nests in 1983 (Table 1).

It may be significant to note that numbers of Herring Gull nests were essentially the same in 1977 and 1983. The rate of increase for this invading species may thus be slowing. They did occupy more colonies in 1983 than in 1977 but still had not moved south of Pamlico Sound in significant numbers.

Great Black-backed Gulls were seen in increased numbers in 1983, but no nests were found. Most eggs may have already hatched prior to our survey, and we may have failed to differentiate between the similar eggs and nests of this species and the much more abundant Herring Gull. A number of adults exhibited behavior indicating the presence of nests or young and certainly a few pairs nested. Caspian Terns were also present in small numbers in 1983 but did not occur in large enough concentrations to be mapped as colonies. Six nests were located.

It is clear that Brown Pelican populations are increasing dramatically in North Carolina. In 1977 we found only two colonies--both in Pamlico Sound. Peak nest counts were only 82, and the season estimate was only 101. In 1982,

detailed studies of this species (Parnell and Soots, in preparation) indicated the presence of 851 nests in North Carolina. Three colonies were found on the first survey in 1983, and two other sites were occupied later in the year. Peak census numbers were 1,382 nests and certainly the actual number was somewhat greater.

It can be seen from Table 1 that numbers of colonies were somewhat reduced in 1983. Since most colonies develop early, it is unlikely that this represents a seasonal difference, and indicates that there may be a tendency toward larger and more diverse assemblages at fewer colony sites in coastal North Carolina. This is usually viewed as an unhealthy trend (Buckley and Buckley 1976, Soots and Landin 1978) as it can lead to greater damage from human disturbance or natural catastrophe. The transmission of epidemic diseases is also more likely in such cases.

There were also noticeable shifts in usage of the different kinds of sites occupied in 1983. There generally was a tendency toward fewer and smaller colonies on the barrier beaches and fewer but larger colonies on the natural estuarine islands. The shift to dredged material islands continued. There were more larger colonies on these man-made islands in 1983 than in 1977. A comparison of sites used in 1977 and 1983 is the focus of a concurrent study, and more detailed comparisons will be available in the report of that study (Parnell, DuMond and McCrimmon, in preparation).

Readers should be cautioned to view the overall increases in numbers with caution. First, only the very hardy species showed strong increases in numbers, and these may not always represent actual increases. Without detailed knowledge of the population trends in nearby states, we cannot be sure that we are not seeing shifts in breeding birds, rather than real population growth. It is also possible that changes in numbers were masked by

changes in the timing of nesting between years and by changes in census techniques. Censuses planned for 1988 will provide a third data set and will allow greater confidence in determining the direction and magnitude of trends. Until then, caution should be used in evaluation of the apparent trends demonstrated by this data set.

Several species of colonial waterbirds, as can be seen from the data in this report, are relatively abundant along the North Carolina coast. Other species are present in much smaller numbers. Whether abundant or uncommon, they share several biological characteristics that make them of special concern. The fact that they nest in groups, perhaps several thousand birds on a single small island, means that during the reproductive period they are very subject to catastrophe. A single disturbance at a nesting site may affect a significant portion of the population. One summer hail storm, the construction of a fishing shack, an improperly planned dredged material disposal, or even a careless visitor can do great damage.

Most species also require particular combinations of substrate and vegetation, and, for many, the proper conditions exist at a particular site for only a few years during island succession. See Soots and Parnell (1975) for the details of succession on coastal islands in North Carolina. Those species that require sand-shell substrates with little or no vegetation usually nest on overwash fans, newly formed island spits at inlets or, most commonly in North Carolina, on freshly deposited dredged material. They depend on frequent natural disturbances on barrier islands or on redeposition of dredged material on man-made sites (Soots and Parnell 1975, Parnell, DuMond and Needham 1978). On the other hand, species such as herons and egrets, which require well developed thickets for nesting, use older, undisturbed sites.

Table 2 (Parnell and Soots 1979) provides an indication of the habitats required by the most common species in North Carolina.

It is apparent that colonially nesting waterbirds are very dependent on the actions of man. The general well being of several species at present is due at least partly to the fact that their needs are being met, inadvertently, by man's activities along the coast. Those species which are not doing well may be being adversely impacted by man's activities. The point is that these species appear much more dependent on human activities than one might suspect. Coastal managers need to be aware that their actions are influencing these species, perhaps profoundly.

Table 3 (Parnell and Soots 1979) provides an indication of the seasonal period of use of islands by nesting colonial waterbirds. It provides a guide to the period during which activities on and near colony sites should be restricted.

Table 2. Nesting habitats, earliest year of invasion, and estimate of the useful life of nesting sites for colonial seabirds without further modification (Parnell and Soots 1979).

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	7 ¹
5	Herring Gull	Sparse to dense herbs clumped	5
5	Laughing Gull	Moderate to dense herbs	10
10	Hérons and Egrets ²	Dense herbs with scattered shrubs to maritime forests	30+
10	Glossy Ibis	Same as above	30+
20	White Ibis	Shrub thickets to maritime forests	30+

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

²Includes Cattle Egret, Great Egret, Green Heron, Little Blue Heron, Tricolored Heron, Snowy Egret and both Night Herons.

Table 3. Summary of period of colony occupation with an indication of the peak of incubation for colonial waterbirds nesting in North Carolina (Parnell and Soots 1979).

Species	Period Colony Occupation	Peak of Incubation		Incubation Period (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
Tricolored 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	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	21-23
Herring Gull	May to Sept.	NA ³	1-15 June	26
Great Black-backed Gull	May to Sept.	NA	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	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	15-25 May ¹	20
Black Skimmer	May to Oct.	1-15 June ¹	1-15 June	23-25

¹Nesting period prolonged, initiation of incubation erratic, several censuses required.

²Incubation periods referenced in species accounts.

³Species does not nest in this sector.

REGIONAL MAPS

Figures 1 and 2 provide an index to a series of 24 regional maps (Figures 3-36) adapted from United States Department of Commerce National Oceanic and Atmospheric Administration Nautical Charts. Each map locates all 1977 and 1983 colonial waterbird nesting colony sites within the map region. Sites are numbered according to the dual numbering system used in the 1979 Atlas (Parnell and Soots 1979) where the first one or two-digit number refers to the general locality (i.e., Cape Fear River), and the second number refers to the specific site.

Facing each regional map is a key to nesting sites. Sites labeled as inactive were occupied in 1977 but not in 1983. Species lists and numbers of nests are provided for each site active in 1983. The 1983 nest counts should not be compared directly to the 1977 counts as the census methodology differed. See the Methods section for an explanation.

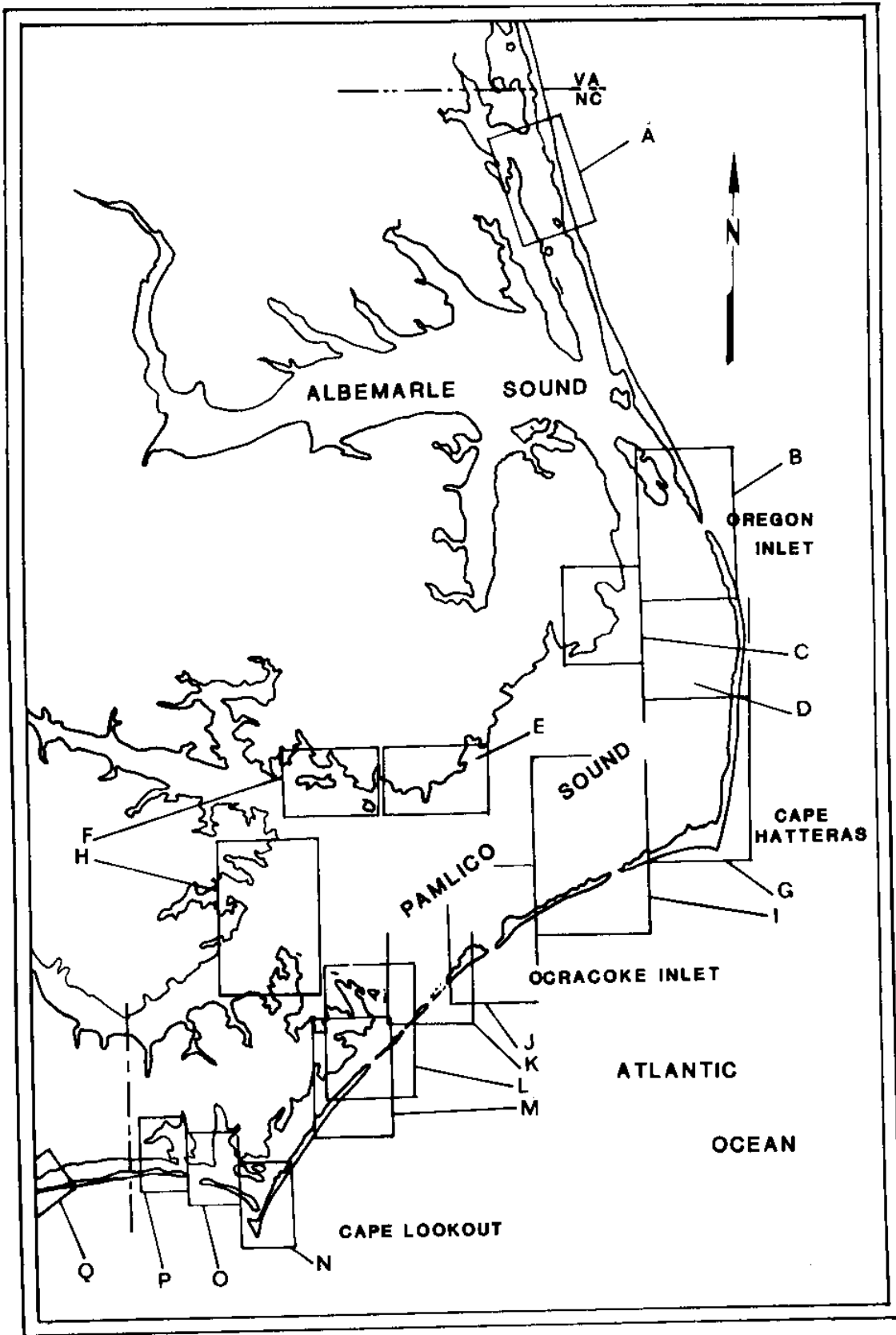


Figure 1. Index to Maps A through P.

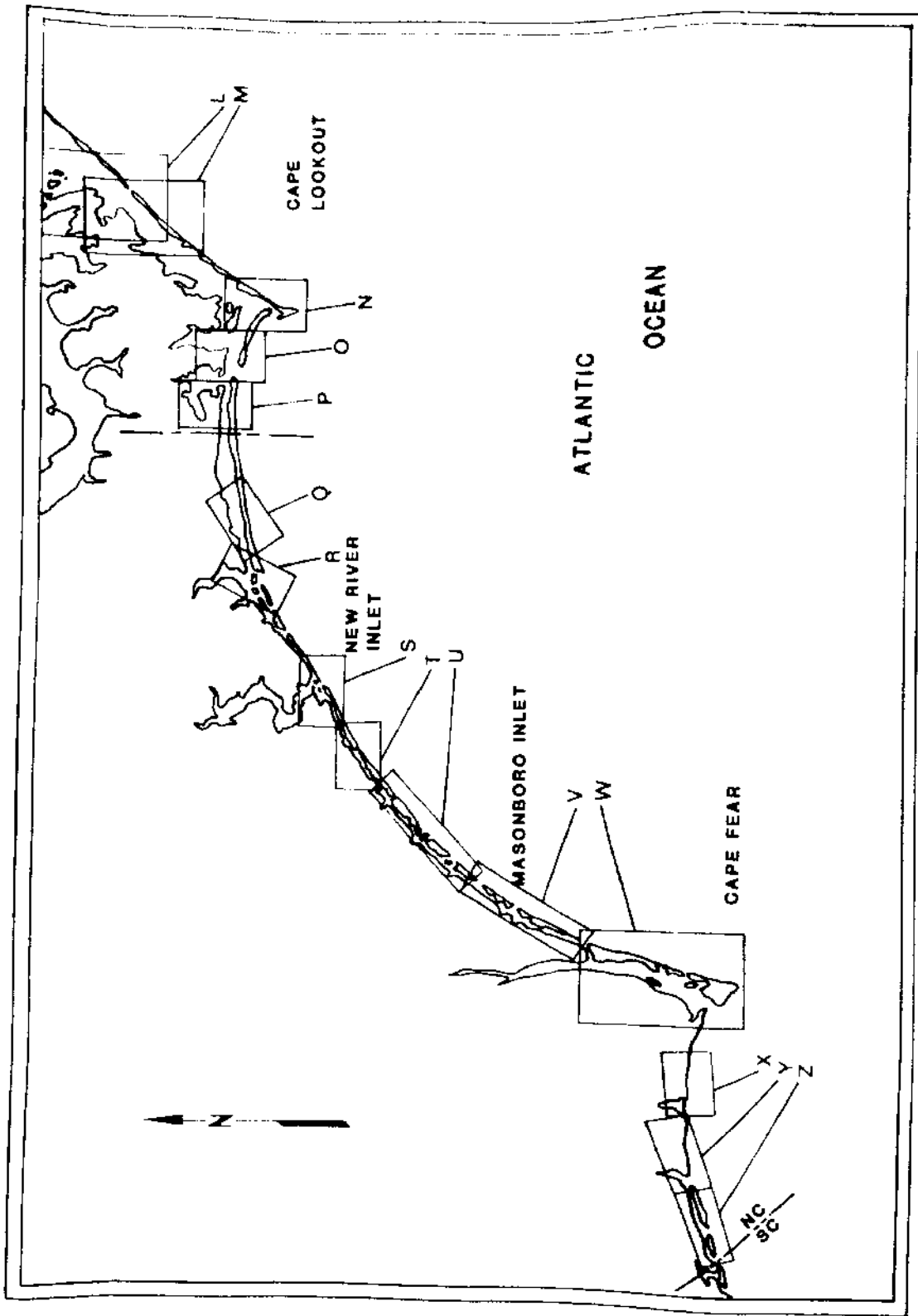


Figure 2. Index to Maps Q through Z.

MAP A

01-01 Natural Estuarine

Great Egret.....	148
Tricolored Heron.....	8
Snowy Egret.....	18
Cattle Egret.....	420
Little Blue Heron.....	95
Green-backed Heron.....	1

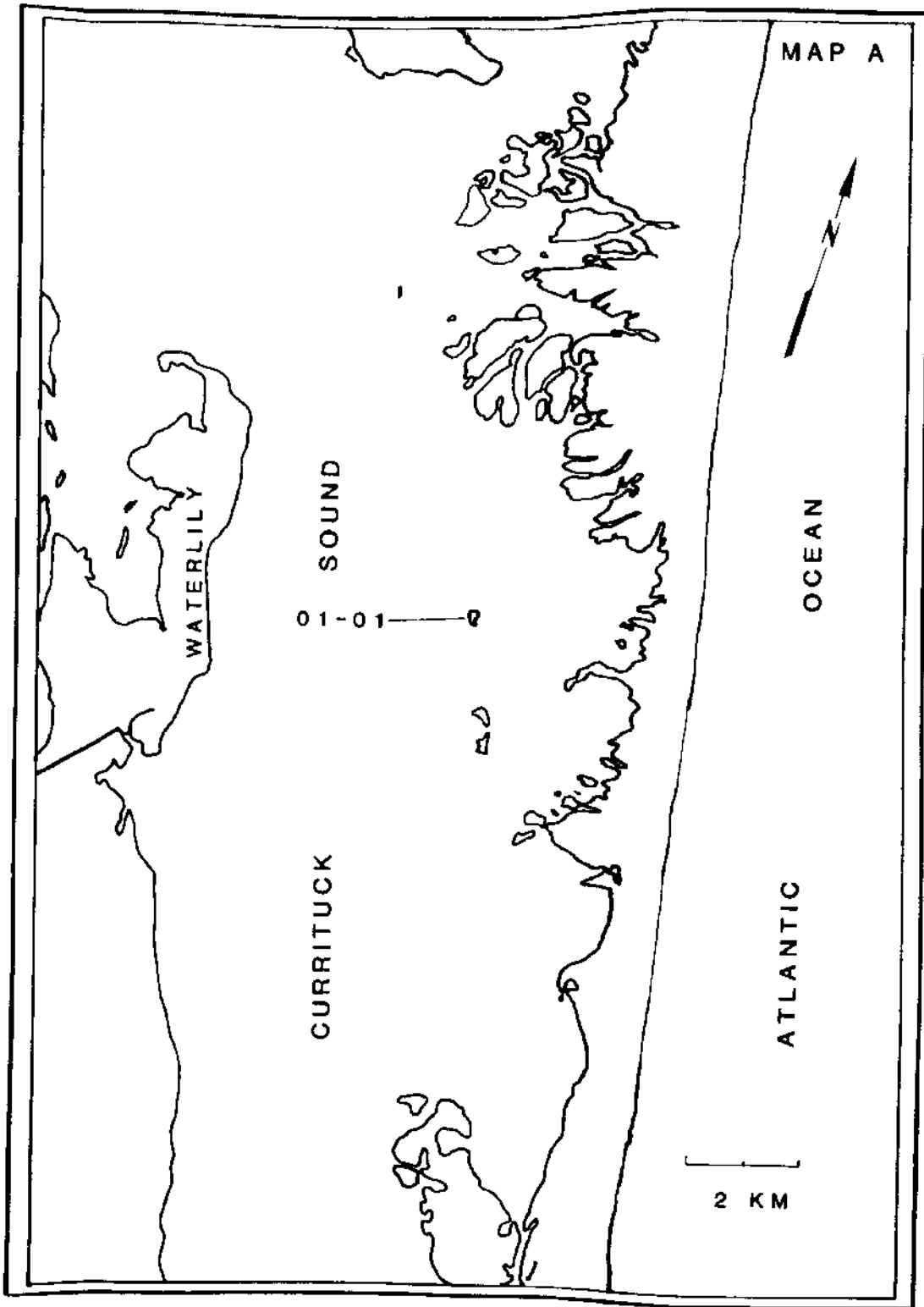


Figure 3. Map A, Currituck Sound.

MAP B

03-01 (Inactive - 83)

03-02 Dredged Material

Herring Gull..... 6

03-04 Dredged Material - Diked

Herring Gull..... 12
 Gull-billed Tern..... 29
 Common Tern..... 38
 Least Tern..... 94
 Black Skimmer..... 13

03-05 (Inactive - 83)

03-06 (Inactive - 83)

03-07 Dredged Material

Herring Gull..... 22

03-08 (Inactive - 83)

03-09 Dredged Material

Herring Gull..... 155
 Laughing Gull..... 591
 Great Egret..... 79
 Tricolored Heron..... 137
 Snowy Egret..... 47
 Cattle Egret..... 51
 Little Blue Heron..... 145
 Black-crowned Night Heron..... 35
 White Ibis..... 1
 Glossy Ibis..... 81

05-01 (Inactive - 83)

05-06 Dredged Material

Caspian Tern..... 4
 Black Skimmer..... 65

06-02 Dredged Material

Herring Gull..... 4
 Laughing Gull..... 1029
 Royal Tern..... 5000
 Sandwich Tern..... 150

06-08 Dredged Material

Brown Pelican..... 3
 Herring Gull..... 94
 Caspian Tern..... 2

06-23 (Inactive - 83)

07-02 (Inactive - 83)

07-03 (Inactive - 83)

07-04 Man-made Island Within
 Diked Impoundment

Great Egret..... 37
 Tricolored Heron..... 91
 Snowy Egret..... 111
 Cattle Egret..... 1
 Little Blue Heron..... 58
 Black-crowned Night Heron..... 27
 White Ibis..... 1
 Glossy Ibis..... 20
 Yellow-crowned Night Heron..... 7

07-05 Man-made Island Within
 Diked Impoundment

Common Tern..... 62*
 Black Skimmer..... 23*

07-06 Man-made Island Within
 Diked Impoundment

Common Tern..... 4

*Based on adult count

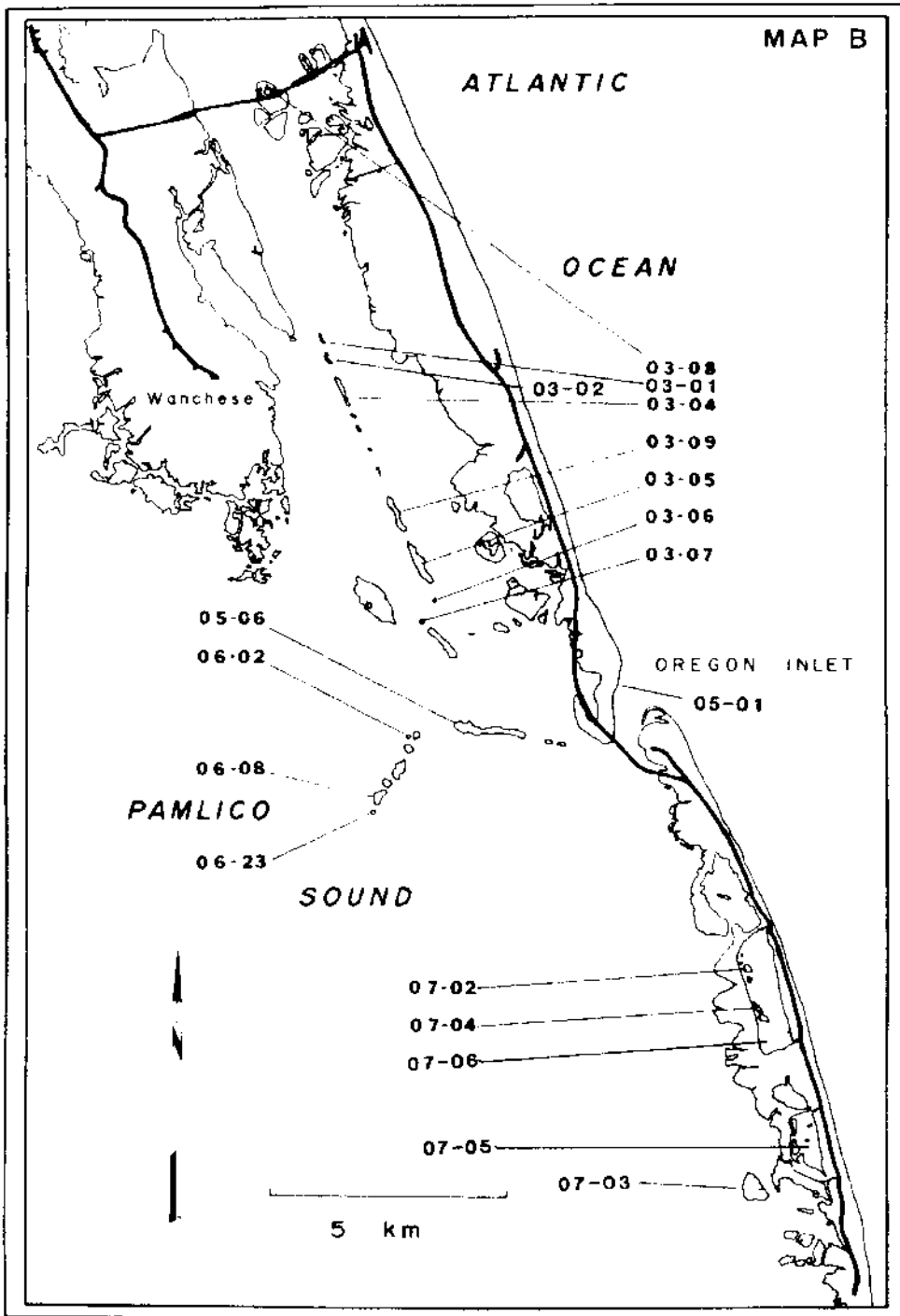


Figure 4. Map B, Oregon Inlet and vicinity.

MAP C

06-09 Dredged Material

Gull-Billed Tern.....	15
Common Tern.....	129
Black Skimmer.....	19

50-03 (Inactive - 83)

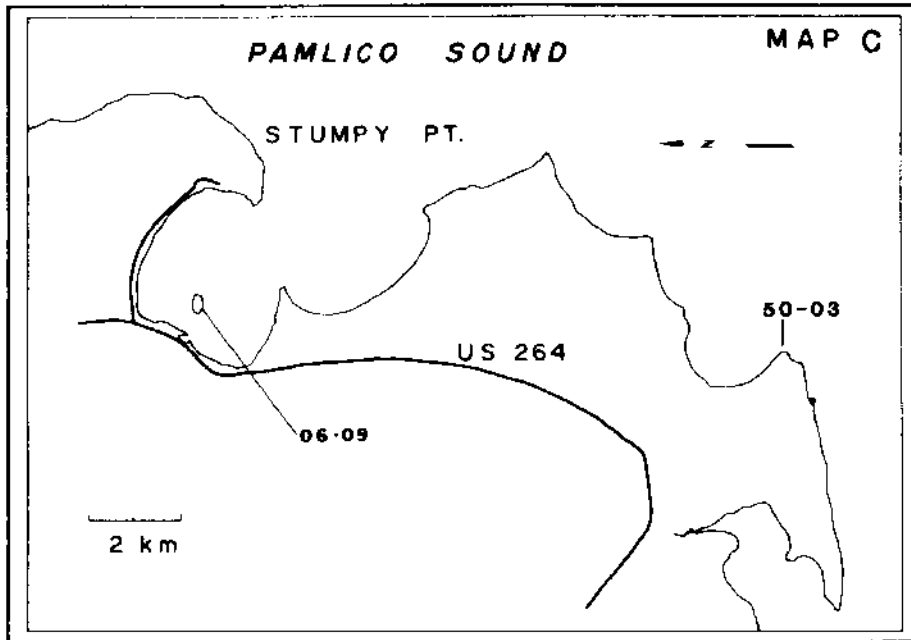


Figure 5. Map C, Stumpy Point and vicinity.

MAP D

06-12 Natural Estuarine

Herring Gull.....	6
Laughing Gull.....	3546
Forster's Tern.....	57
Great Egret.....	3
Tricolored Heron.....	1
Snowy Egret.....	2
Black-crowned Night Heron.....	3

08-0101 Barrier Island

Least Tern.....	24
Black Skimmer.....	3

08-0106 Barrier Island

Least Tern.....	53
-----------------	----

08-0107 Barrier Island

Gull-billed Tern.....	4
Common Tern.....	81
Least Tern.....	44
Black Skimmer.....	3

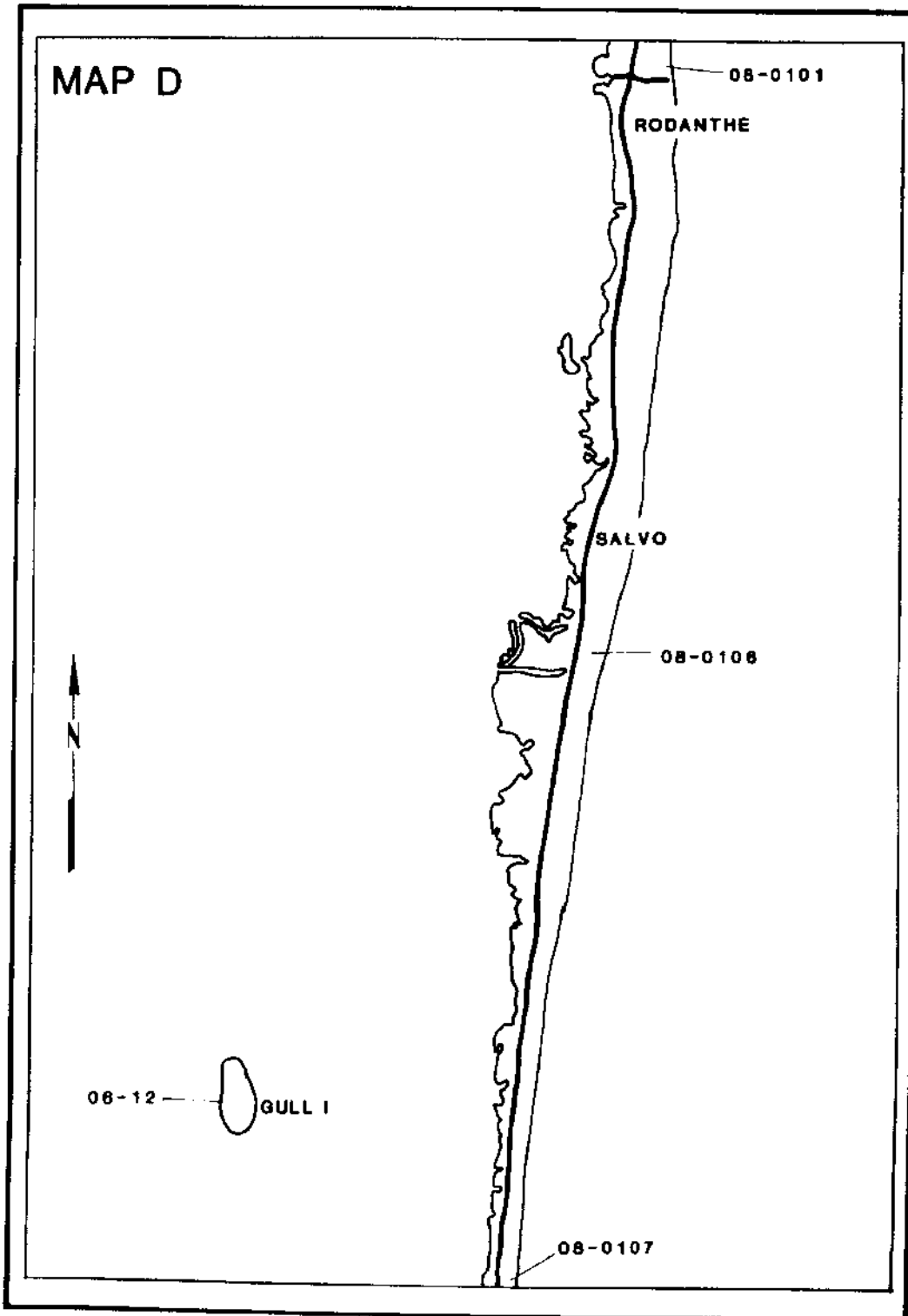


Figure 6. Map D, Salvo and vicinity.

MAP E

06-30 Natural Estuarine

Forster's Tern..... 308

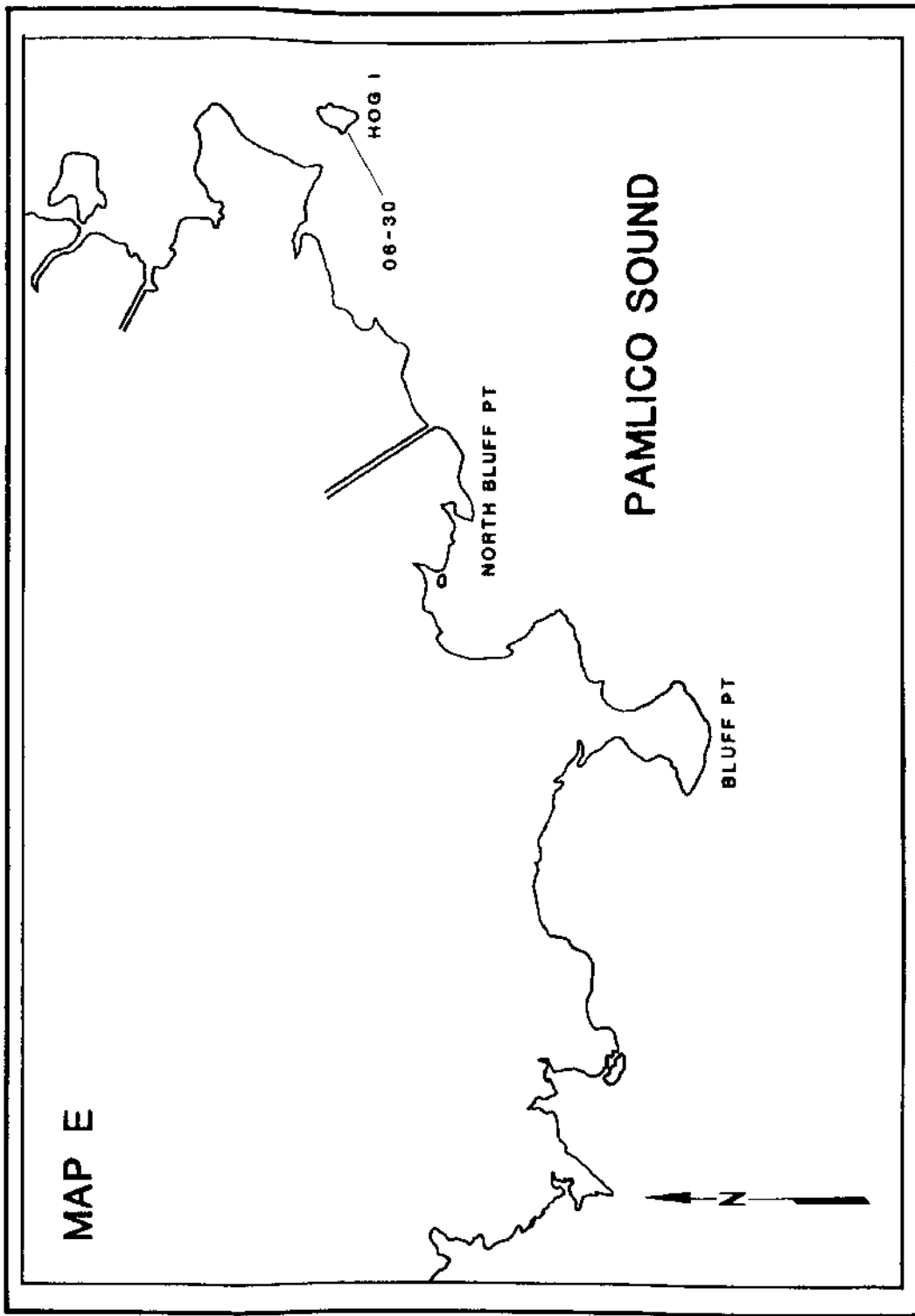


Figure 7. Map E, North Bluff Point and vicinity.

MAP F

06-13 (Inactive - 83)

06-14 Natural Estuarine

Forster's Tern.....	68
Common Tern.....	142

06-15 (Inactive - 83)

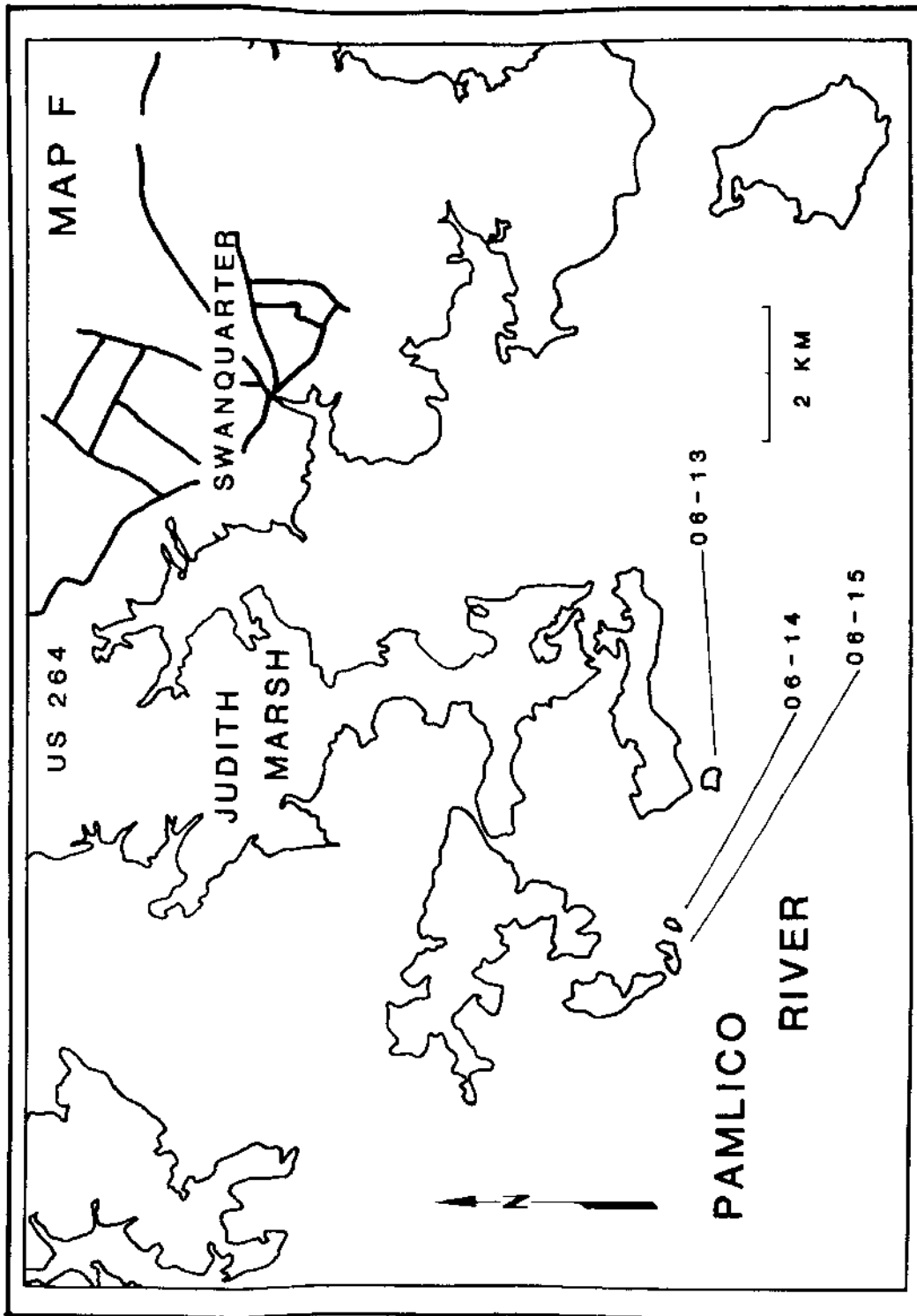


Figure 8. Map F, Judith marsh and vicinity.

MAP G

06-21 (Inactive - 83)

06-22 (Inactive - 83)

08-01 (Inactive - 83)

08-02 Barrier Island

Common Tern.....	7
Least Tern.....	251

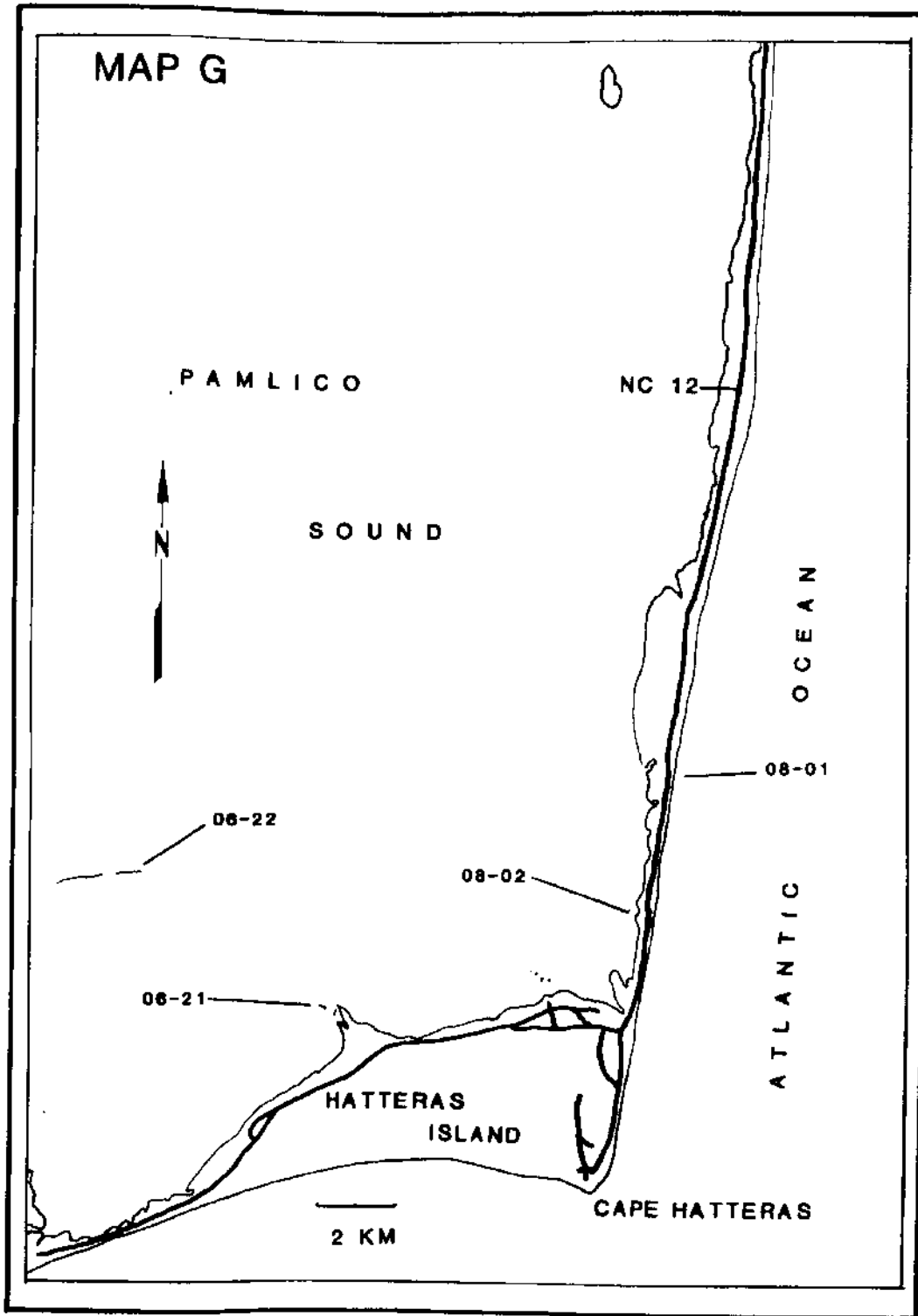


Figure 9. Map G, Cape Hatteras and vicinity.

MAP H

06-16 (Not surveyed - 83)

06-18 (Not surveyed - 83)

06-19 (Inactive - 83)

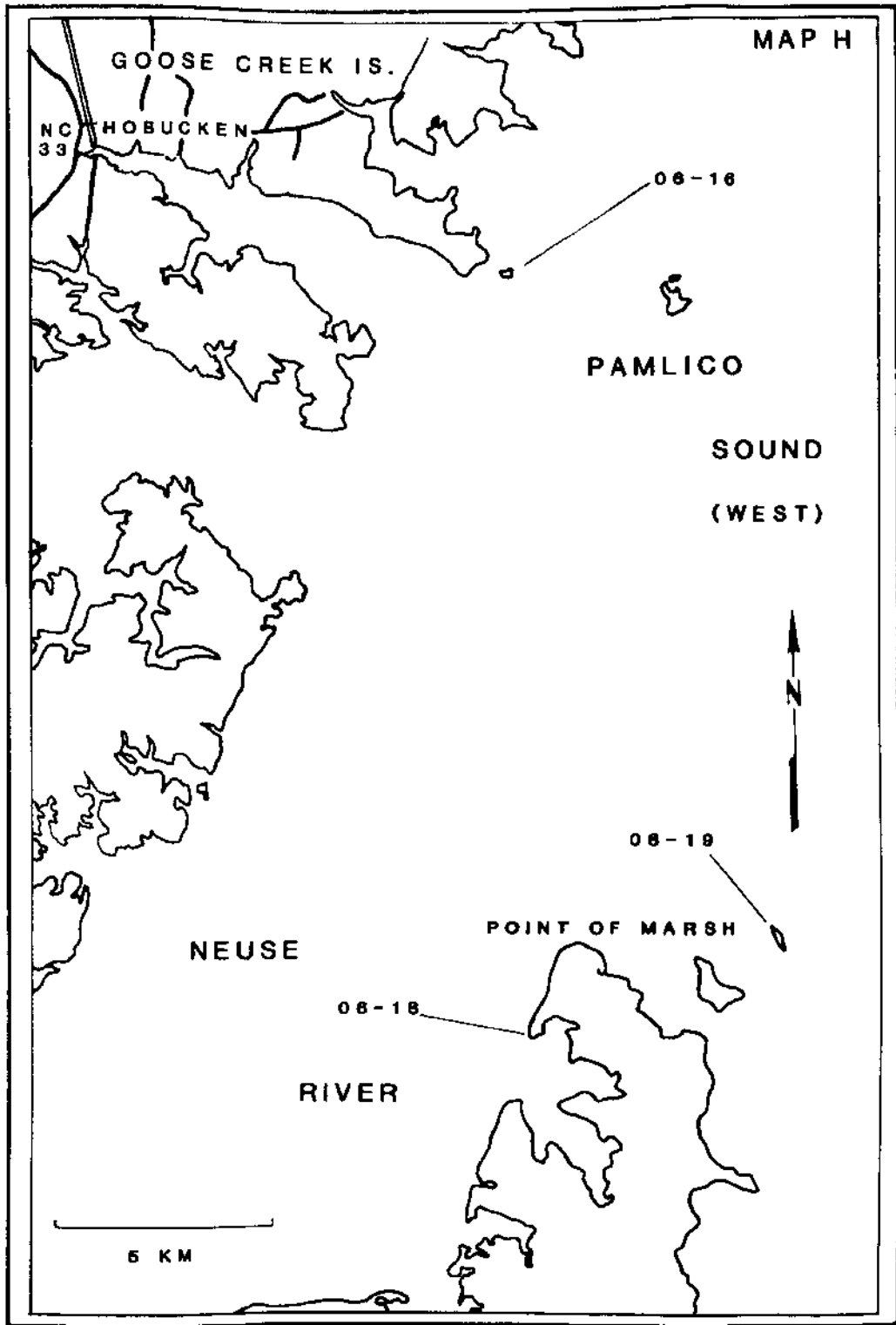


Figure 10. Map H, Neuse River mouth and vicinity.

MAP I

06-10 Dredged Material

Herring Gull.....	9
Forster's Tern.....	91
Common Tern.....	111
Royal Tern.....	1337
Sandwich Tern.....	362
Great Egret.....	7
Tricolored Heron.....	2
Snowy Egret.....	7
Cattle Egret.....	4
Little Blue Heron.....	14

06-11 (Inactive - 83)

09-02 Barrier Island

Common Tern.....	75
Black Skimmer.....	2

09-03 Dredged Material

Laughing Gull.....	2685
Gull-billed Tern.....	7
Forster's Tern.....	116
Common Tern.....	84
Royal Tern.....	2021
Sandwich Tern.....	238
Black Skimmer.....	40

09-04 (Island Eroded Away)

10-02 Natural Estuarine

Herring Gull.....	2
Laughing Gull.....	8
Forster's Tern.....	36
Glossy Ibis.....	15

10-03 Through 10 (Inactive - 83)

10-14 Barrier Island

Black-crowned Night Heron.....	19*
Great Egret.....	07*

10-15 Barrier Island

Great Egret.....	21
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*Based on adult counts

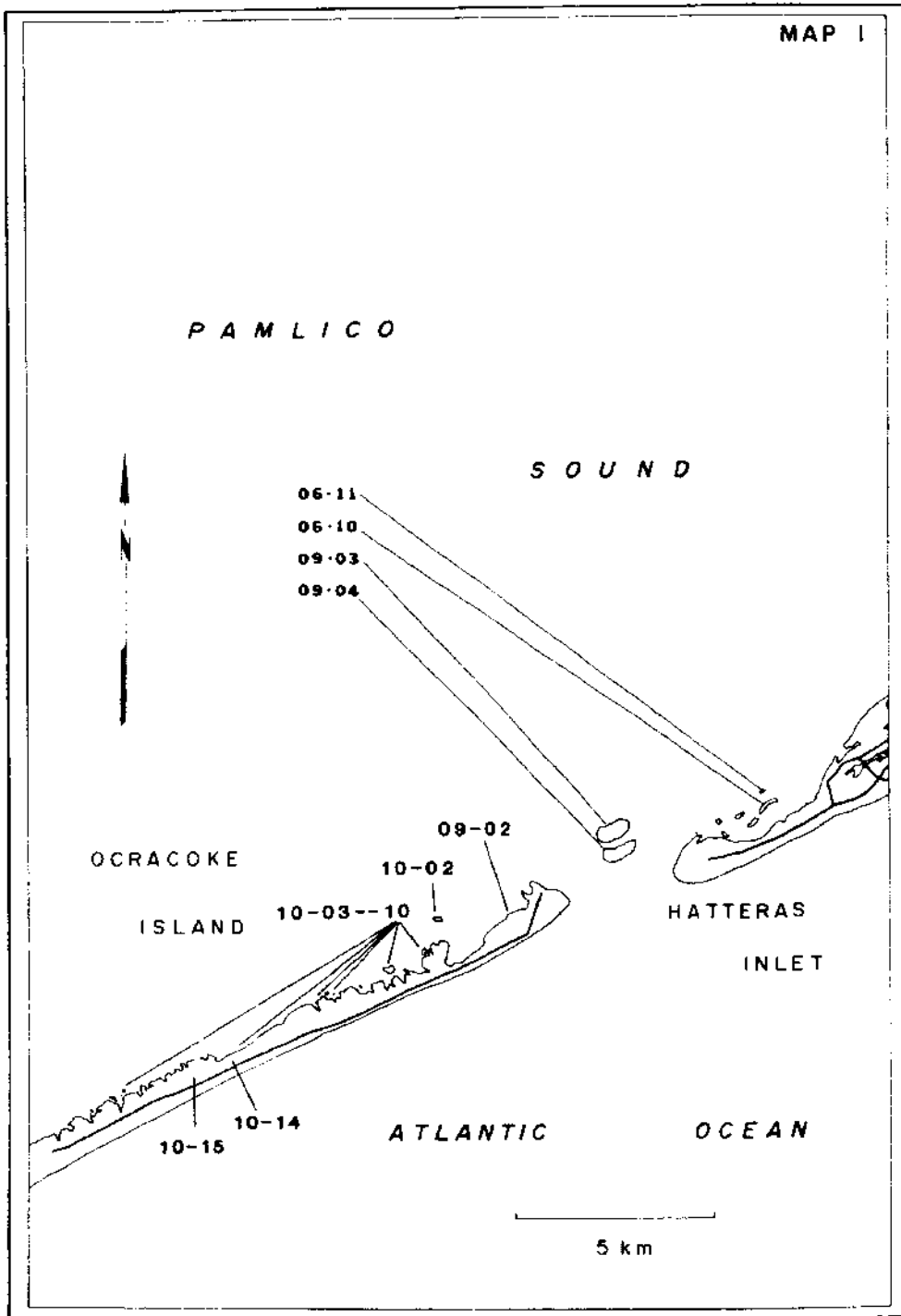


Figure 11. Map I, Hatteras Inlet and vicinity.

MAP J

11-01 Barrier Island

Forster's Tern.....	63
Common Tern.....	526
Least Tern.....	8
Black Skimmer.....	194

11-04 Natural Estuarine

Brown Pelican.....	751
Herring Gull.....	68
Laughing Gull.....	3087
Forster's Tern.....	86

11-05 Man Altered, Origin
Uncertain

Herring Gull.....	15
-------------------	----

11-06 Man Altered, Origin
Uncertain

Herring Gull.....	36
-------------------	----

11-07 Man Altered, Origin
Uncertain

Herring Gull.....	2
Common Tern.....	13
Great Egret.....	2
Tricolored Heron.....	104
Snowy Egret.....	61
Little Blue Heron.....	72
Black-crowned Night Heron.....	6
Glossy Ibis.....	3

12-01 Barrier Island

Common Tern.....	2
Least Tern.....	6

12-02 (Inactive - 83)

12-23 Natural Estuarine

Forster's Tern.....	16
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12-24 Natural Estuarine

Herring Gull.....	17
Royal Tern.....	422

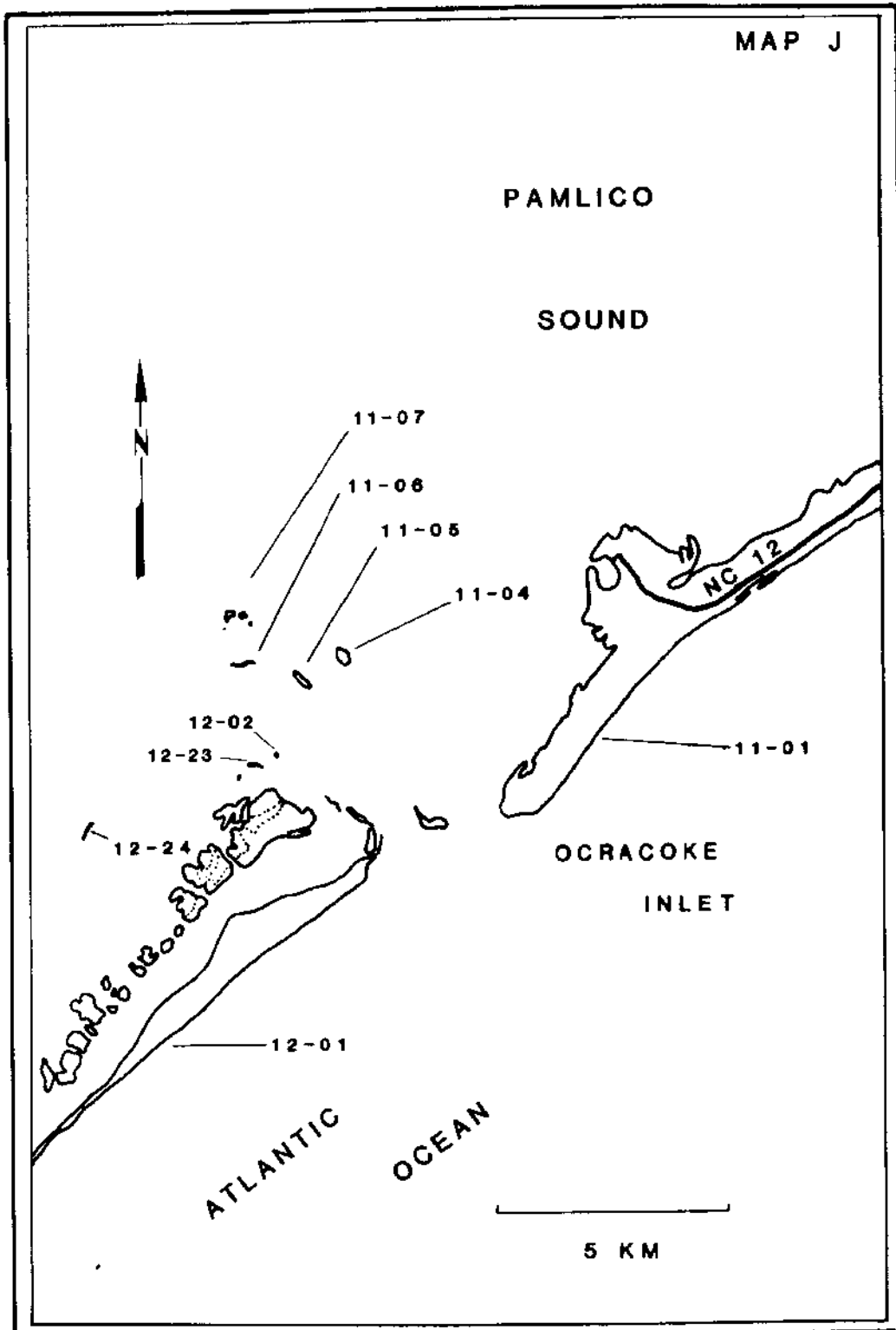


Figure 12. Map J, Ocracoke Inlet and vicinity.

MAP K

12-14 Natural Estuarine

Forster's Tern..... 31

12-16 Through 19 (Inactive - 83)

13-01 Natural Estuarine

Forster's Tern..... 40

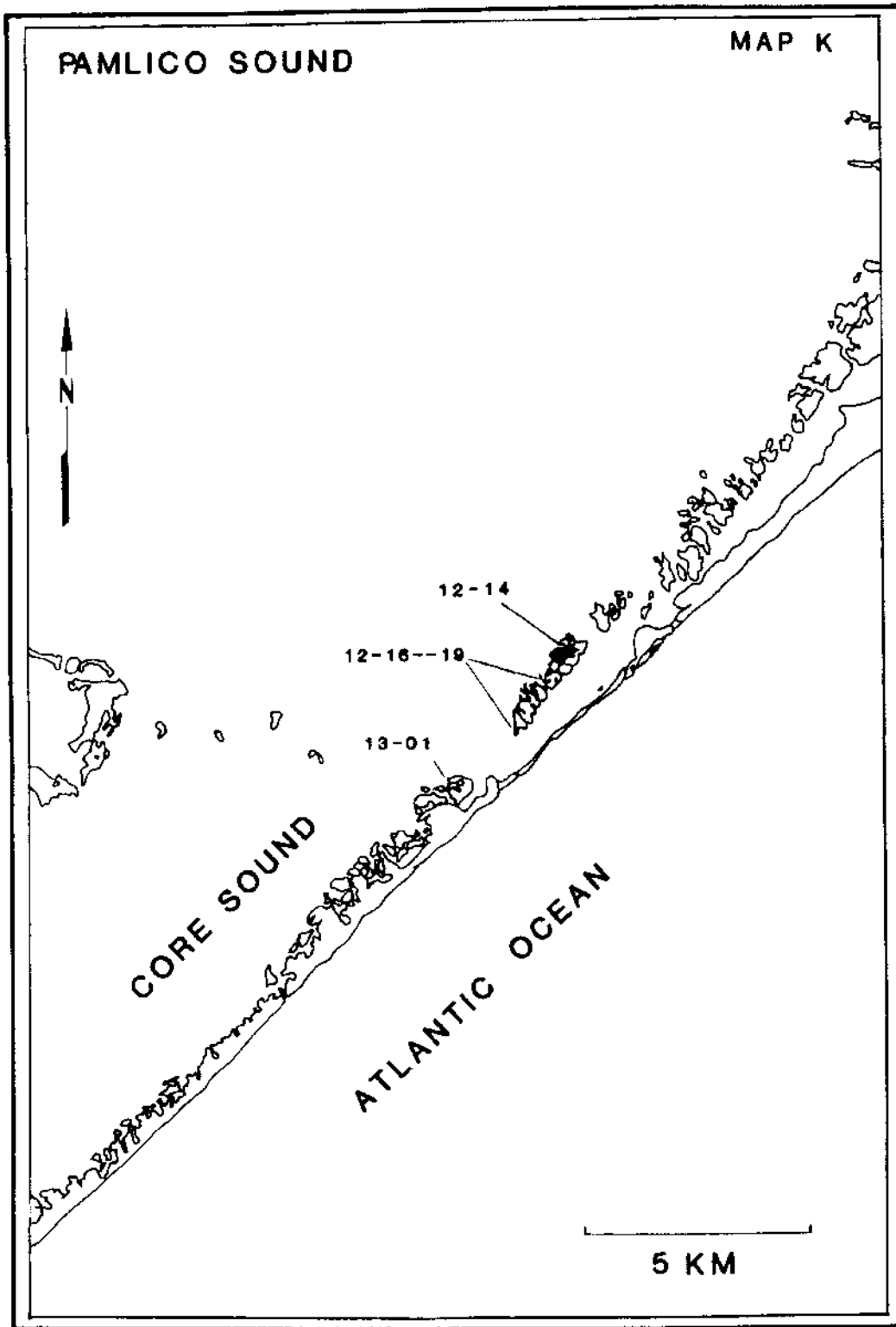


Figure 13. Map K, North Core Sound and vicinity.

MAP L

06-20 Natural Estuarine

Herring Gull.....	2
Laughing Gull.....	35
Common Tern.....	4
Black Skimmer.....	4

14-01 Natural Estuarine

Laughing Gull.....	4
Forster's Tern.....	3
Common Tern.....	2

14-02 Dredged Material

Great Egret.....	19
Tricolored Heron.....	5
Snowy Egret.....	11
Little Blue Heron.....	6
Black-crowned Night Heron.....	5

14-03 Natural Estuarine

Herring Gull.....	1
Common Tern.....	2

14-04 Dredged Material - Diked

Brown Pelican.....	2
Laughing Gull.....	9796
Royal Tern.....	3072
Sandwich Tern.....	958
Great Egret.....	1
Tricolored Heron.....	15
Snowy Egret.....	1

14-05 (Inactive - 83)

14-10 (Inactive - 83)

14-12 (Inactive - 83)

15-11 (Inactive - 83)

16-01 Dredged Material

Common Tern.....	44
Black Skimmer.....	29

16-02 (Inactive - 83)

16-03 (Inactive - 83)

16-04 Natural Estuarine

Forster's Tern.....	15
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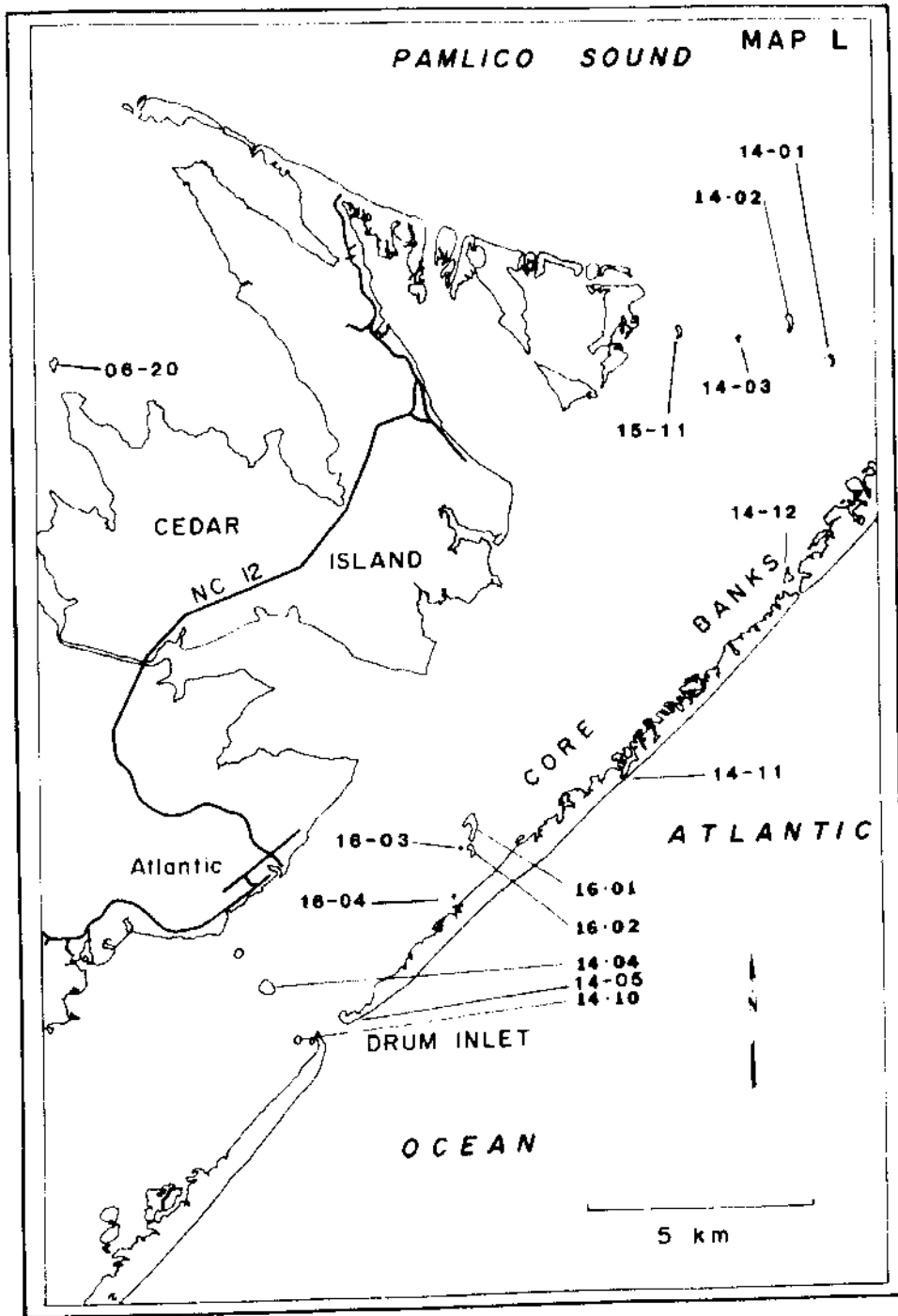


Figure 14. Map L, Drum Inlet and vicinity.

MAP M

14-13 Barrier Island

Least Tern..... 1

14-17 Barrier Island

Least Tern..... 120
Common Tern..... 12
Gull-billed Tern..... 3
Black Skimmer..... 8

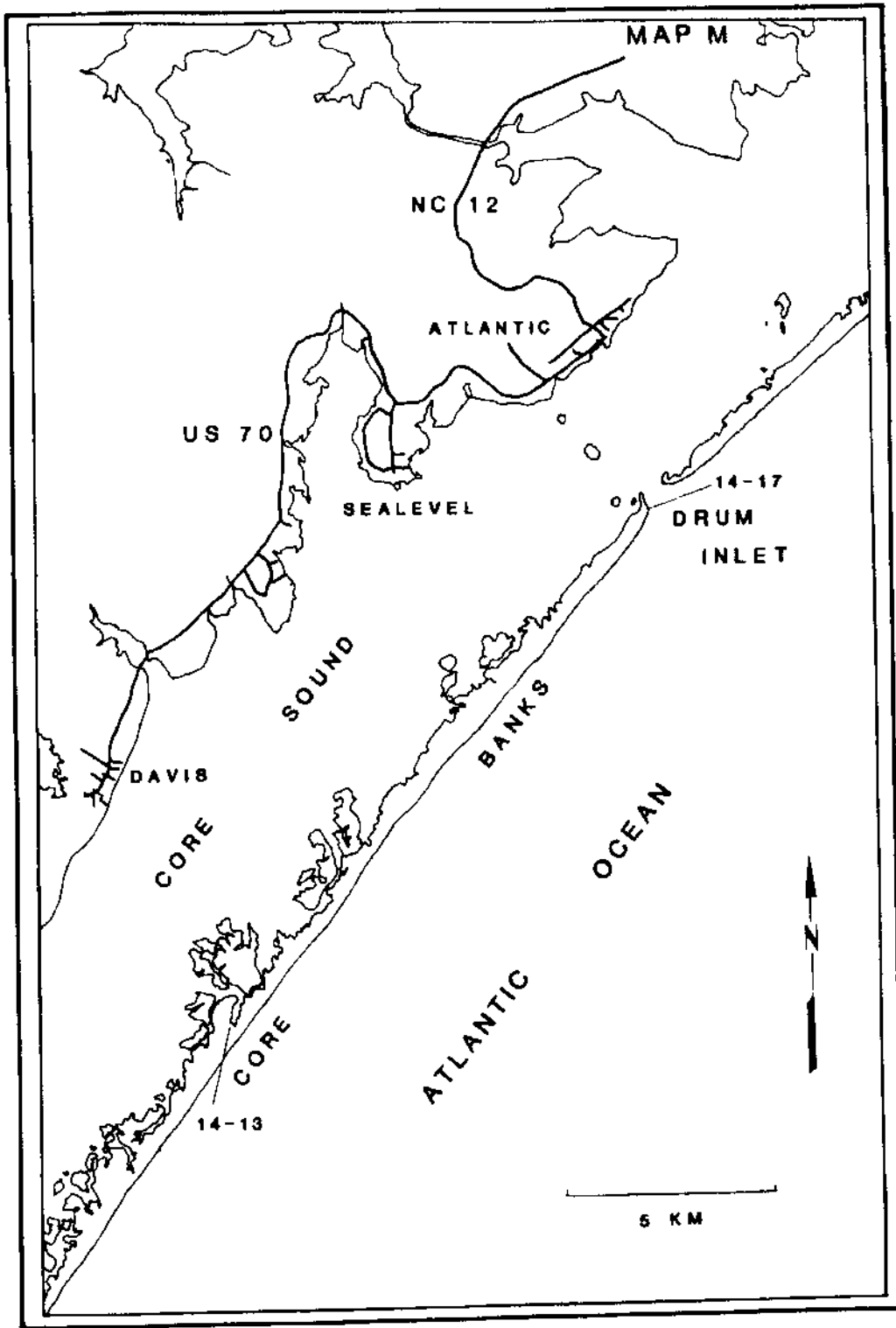


Figure 15. Map M, Davis and vicinity.

MAP N

<u>14-14</u> (Inactive - 83)	
<u>14-22</u> Barrier Island	
Least Tern.....	7
<u>14-24</u> Barrier Island	
Least Tern.....	132
<u>14-25</u> Barrier Island	
Least Tern.....	4
<u>17-01</u> Dredged Material - Diked	
Laughing Gull.....	64
Gull-billed Tern.....	6
Common Tern.....	8
Black Skimmer.....	14
Great Egret.....	2
Tricolored Heron.....	12
Little Blue Heron.....	3
Black-crowned Night Heron.....	3
Snowy Egret.....	8
<u>17-03</u> Dredged Material	
Laughing Gull.....	402
<u>17-07</u> Dredged Material	
Laughing Gull.....	191
Gull-billed Tern.....	5
Common Tern.....	74
Royal Tern.....	1555
Sandwich Tern.....	95
Black Skimmer.....	84
<u>17-08</u> Dredged Material	
Laughing Gull.....	23

<u>18-11</u> Natural Estuarine	
Forster's Tern.....	2
Common Tern.....	10
<u>18-12</u> Natural Estuarine	
Forster's Tern.....	4
Common Tern.....	3
<u>18-20</u> Natural Estuarine	
Common Tern.....	14
<u>18-25</u> (Inactive - 83)	

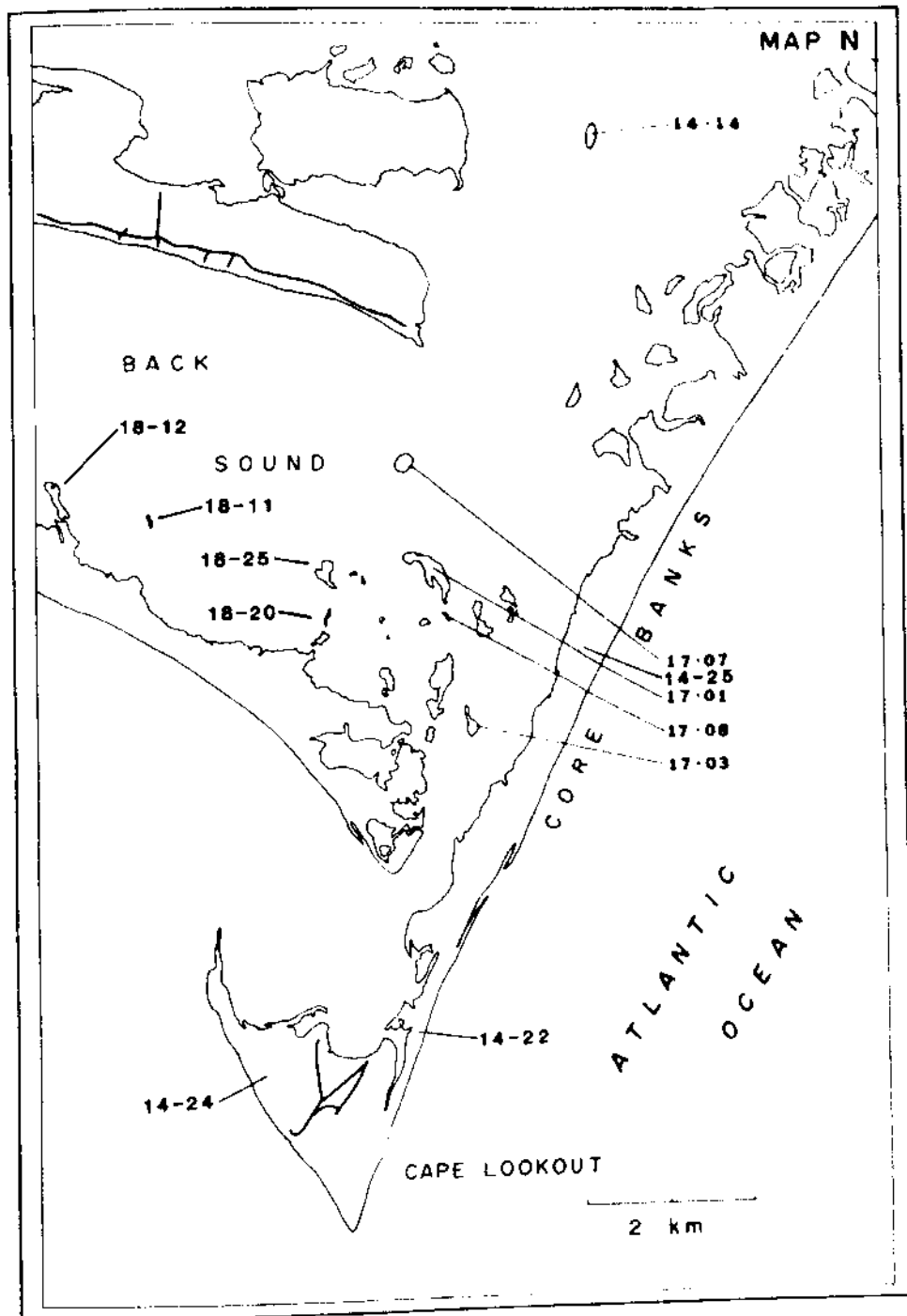


Figure 16. Map N, Back Sound and vicinity.

MAP 0

18-07 (Inactive - 83)

18-08 Natural Estuarine

Common Tern..... 73

18-13 Vegetation Study Site

18-14 Vegetation Study Site

18-15 Natural Estuarine

Great Egret..... 38
Tricolored Heron..... 118
Snowy Egret..... 48
Little Blue Heron..... 33
Black-crowned Night Heron..... 11
Glossy Ibis..... 4

20-05 (Inactive - 83)

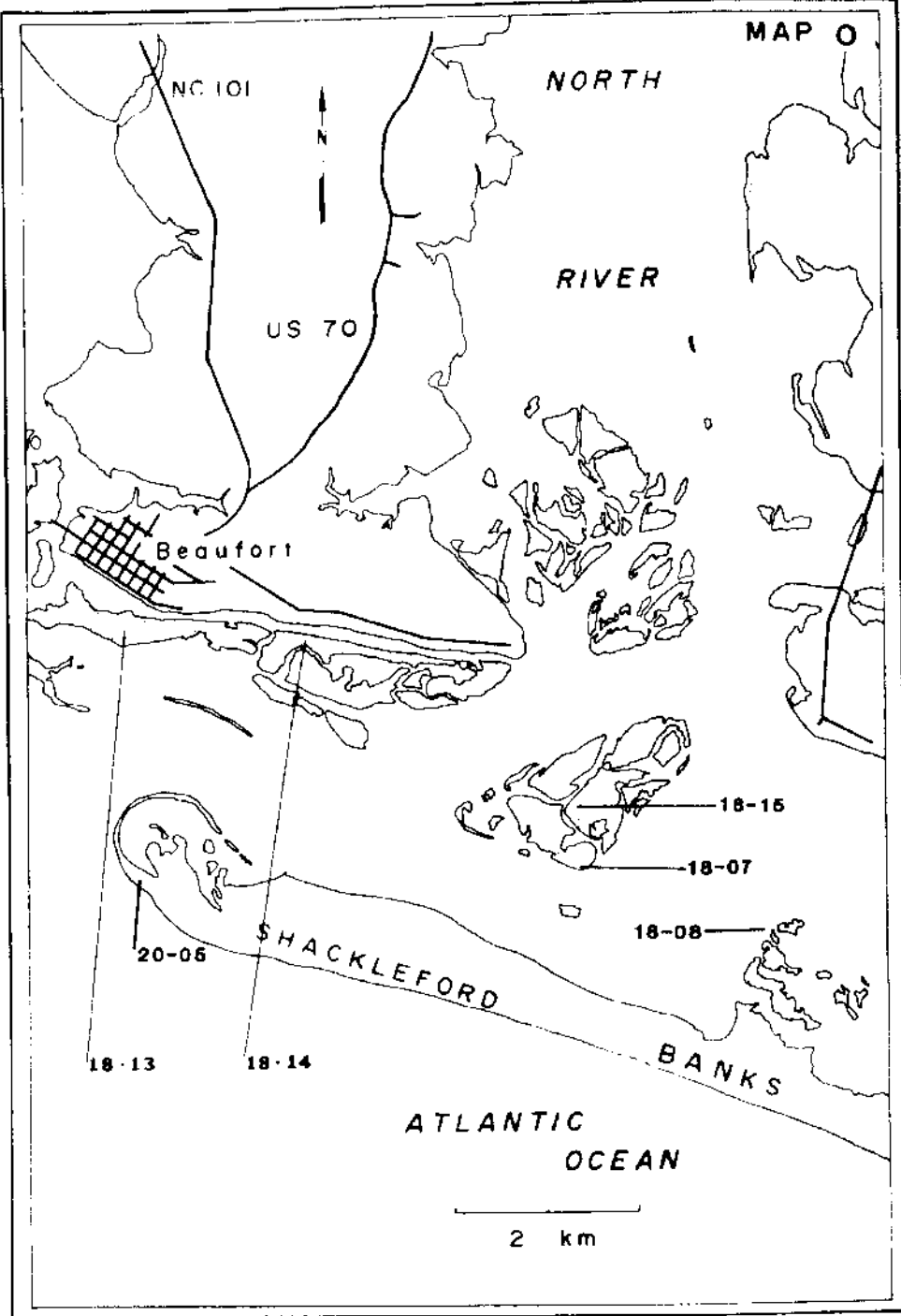


Figure 17. Map O, Beaufort and vicinity.

MAP P

20-02 (Inactive - 83)

20-03 (Inactive - 83)

20-06 Dredged Material - Diked

Gull-billed Tern.....	64
Common Tern.....	576
Least Tern.....	58
Black Skimmer.....	157

21-01 Dredged Material - Diked

Least Tern.....	24
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21-03 Dredged Material - Diked

Great Egret.....	11
Tricolored Heron.....	141
Snowy Egret.....	39
Cattle Egret.....	518
Little Blue Heron.....	269
Black-crowned Night Heron.....	80
White Ibis.....	85
Yellow-crowned Night Heron.....	2

21-04 Dredged Material

Great Egret.....	142
Tricolored Heron.....	25
Cattle Egret.....	15
Green-backed Heron.....	1
Black-crowned Night Heron.....	10
White Ibis.....	1

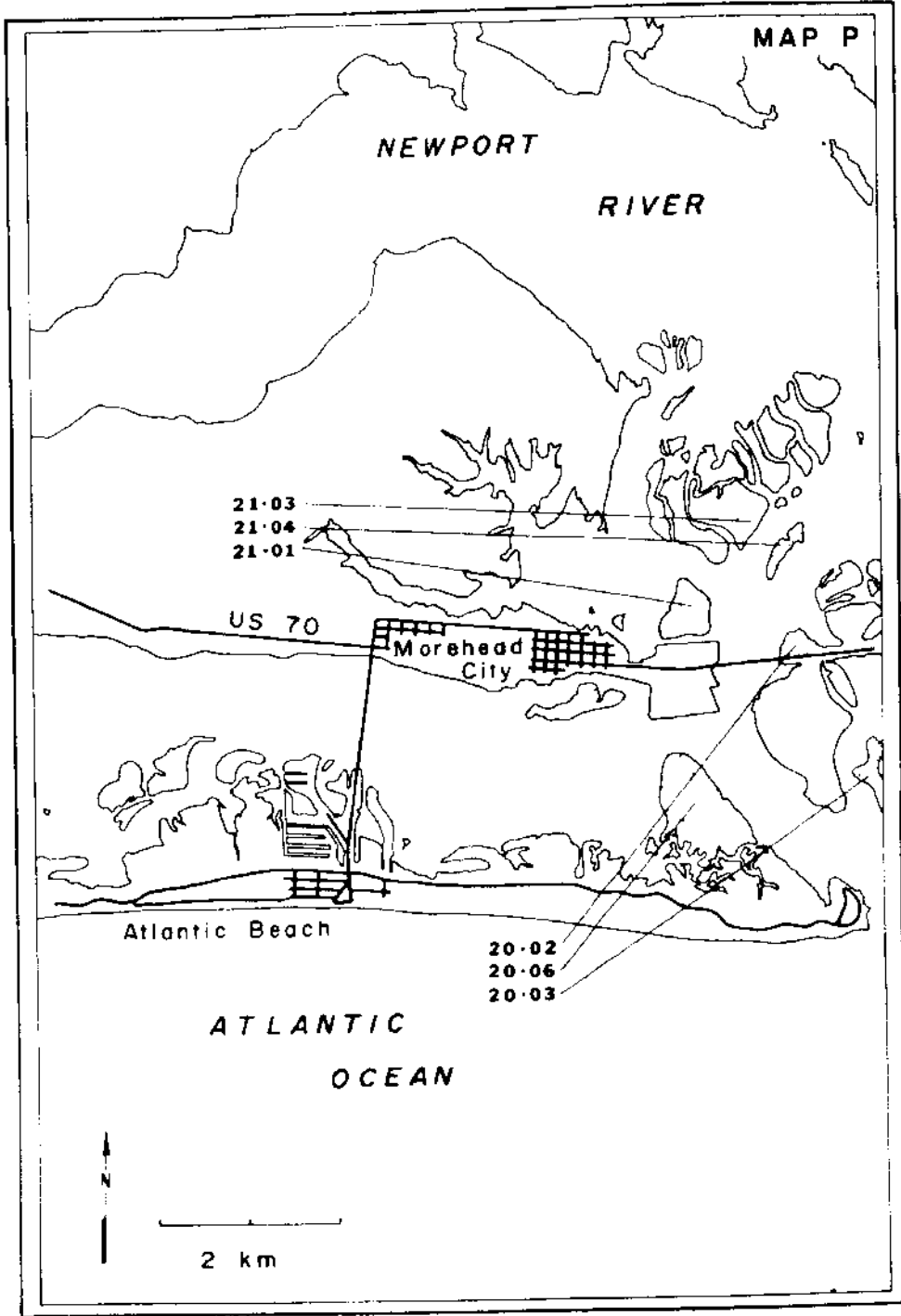


Figure 18. Map P, Morehead City and vicinity.

MAP Q

22-08 (Inactive - 83)

22-22 Vegetation Study Site

22-25 Vegetation Study Site

22-26 (Inactive - 83)

22-39 Dredged Material - Diked

Least Tern.....	37
Common Tern.....	1

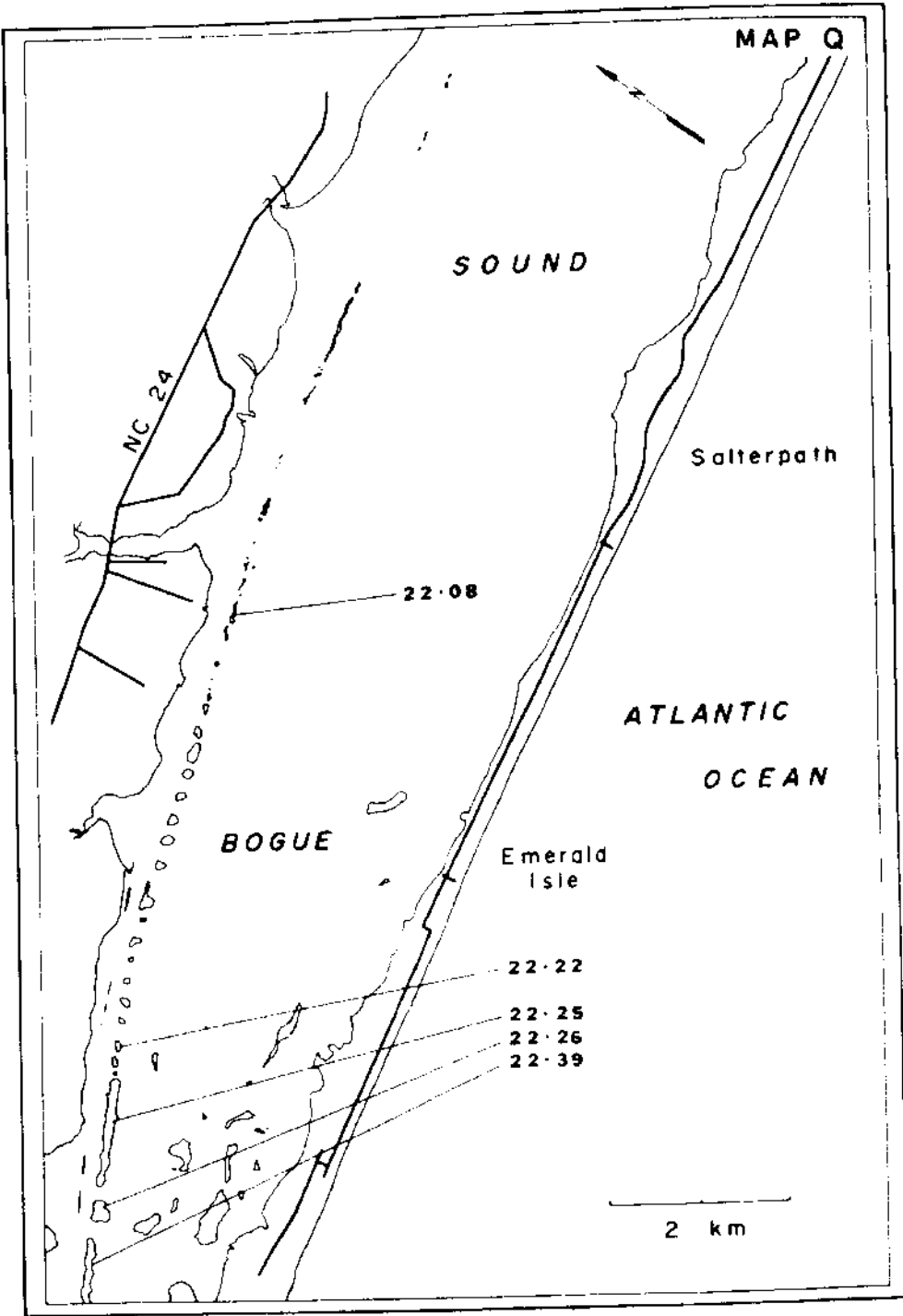


Figure 19. Map Q, Bogue Sound and vicinity.

MAP R

22-40 (Inactive - 83)

22-41 Dredged Material

Great Egret.....	68
Tricolored Heron.....	8
Little Blue Heron.....	8
Green-backed Heron.....	1

22-42 Dredged Material

Great Egret.....	21
Cattle Egret.....	133
Snowy Egret.....	30
Green-backed Heron.....	4
Tricolored Heron.....	327
Little Blue Heron.....	265
Black-crowned Night Heron.....	9

22-44 Dredged Material - Diked

Least Tern.....	10
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22-45 Dredged Material - Diked

Least Tern.....	92
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23-07 Vegetation Study Site

23-10 (Inactive - 83)

23-14 (Inactive - 83)

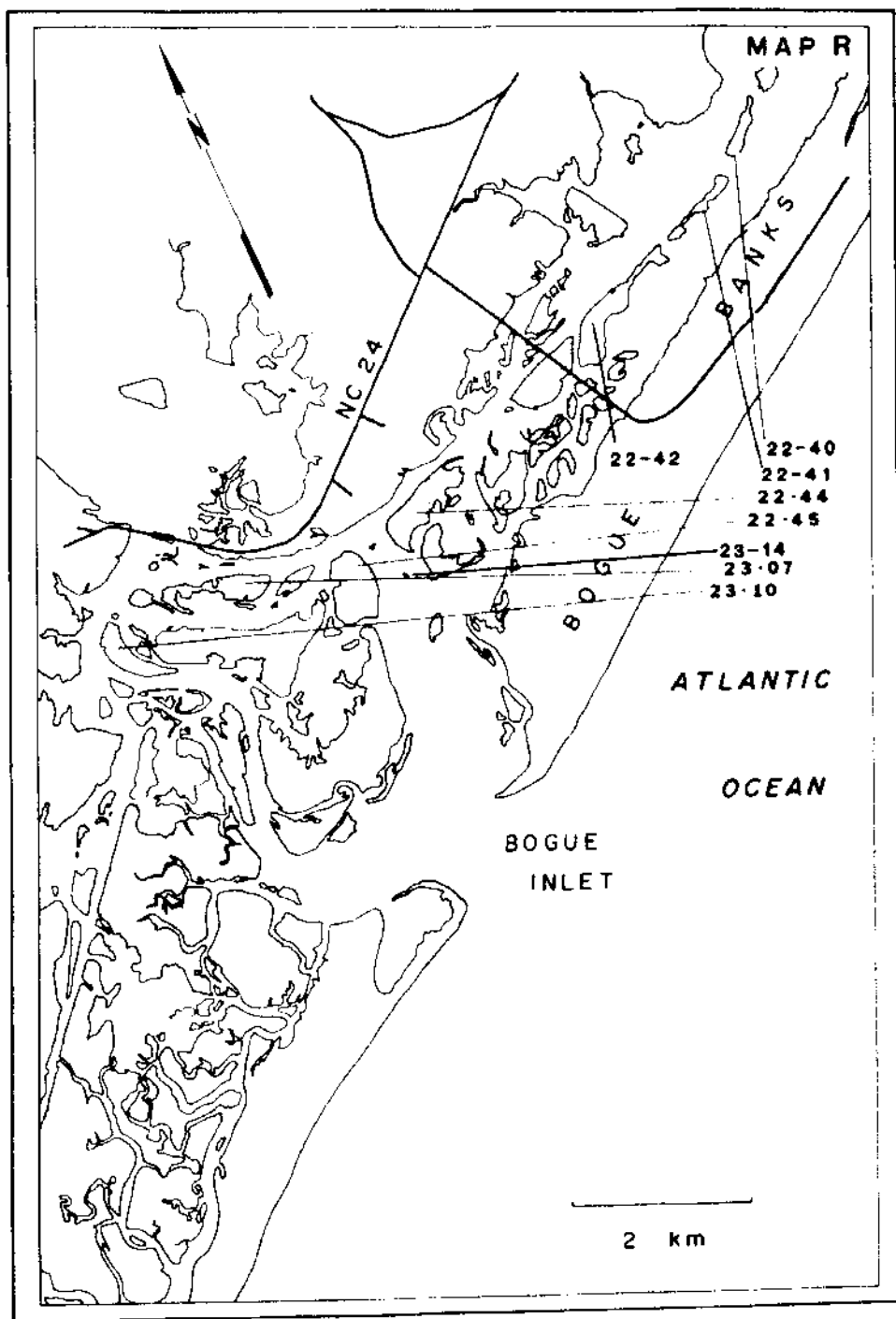


Figure 20. Map R, Bogue Inlet and vicinity.

MAP 5

26-01 (Inactive - 83)

26-06 Dredged Material - Diked

Least Tern..... 55

26-07 Dredged Material - Diked

Common Tern..... 2

Least Tern..... 96

Green-backed Heron..... 15

27-03 (Inactive - 83)

27-04 (Inactive - 83)

27-06 (Inactive - 83)

27-07 (Inactive - 83)

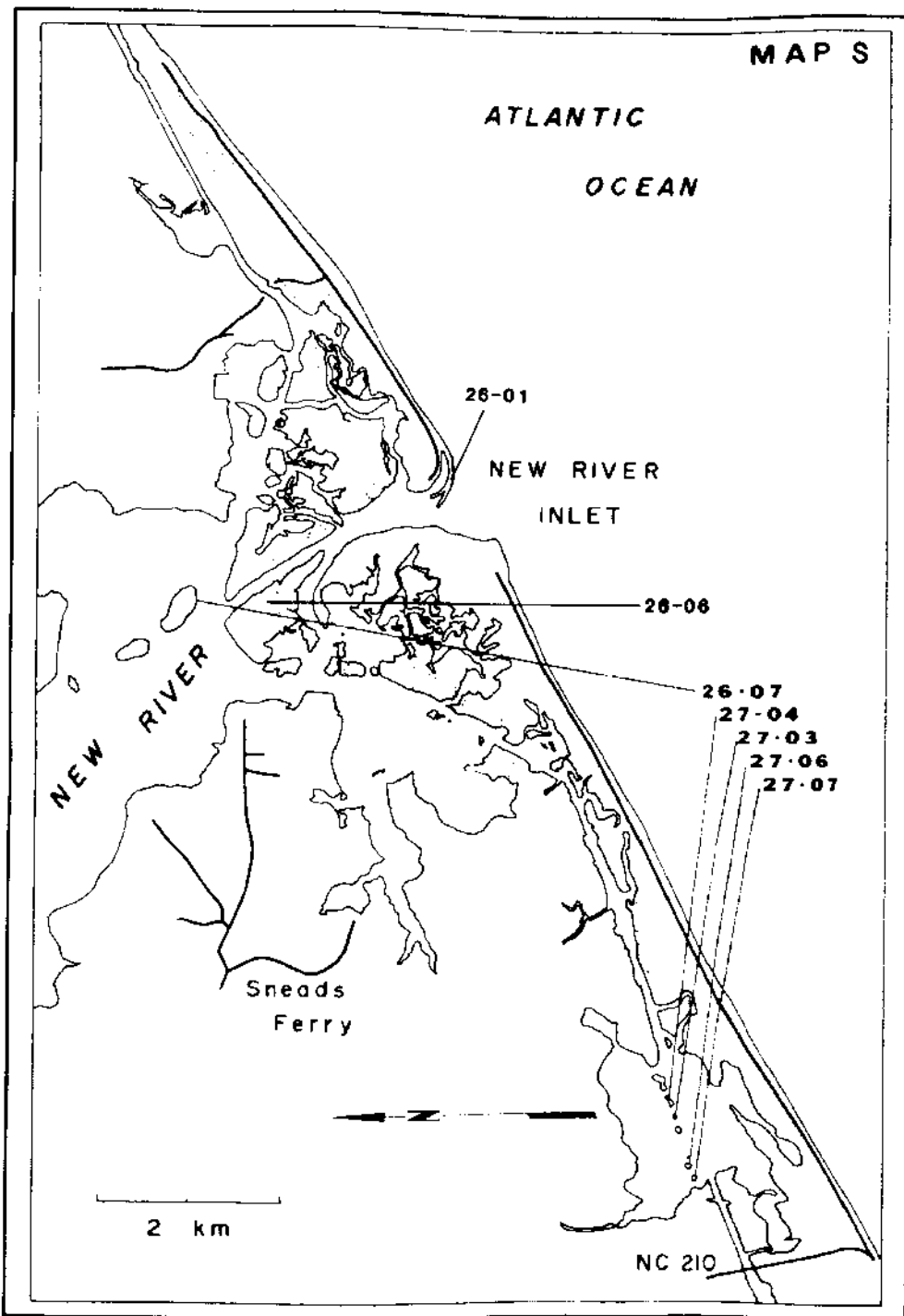


Figure 21. Map S, New River Inlet and vicinity.

MAP T

28-01 Vegetation Study Site

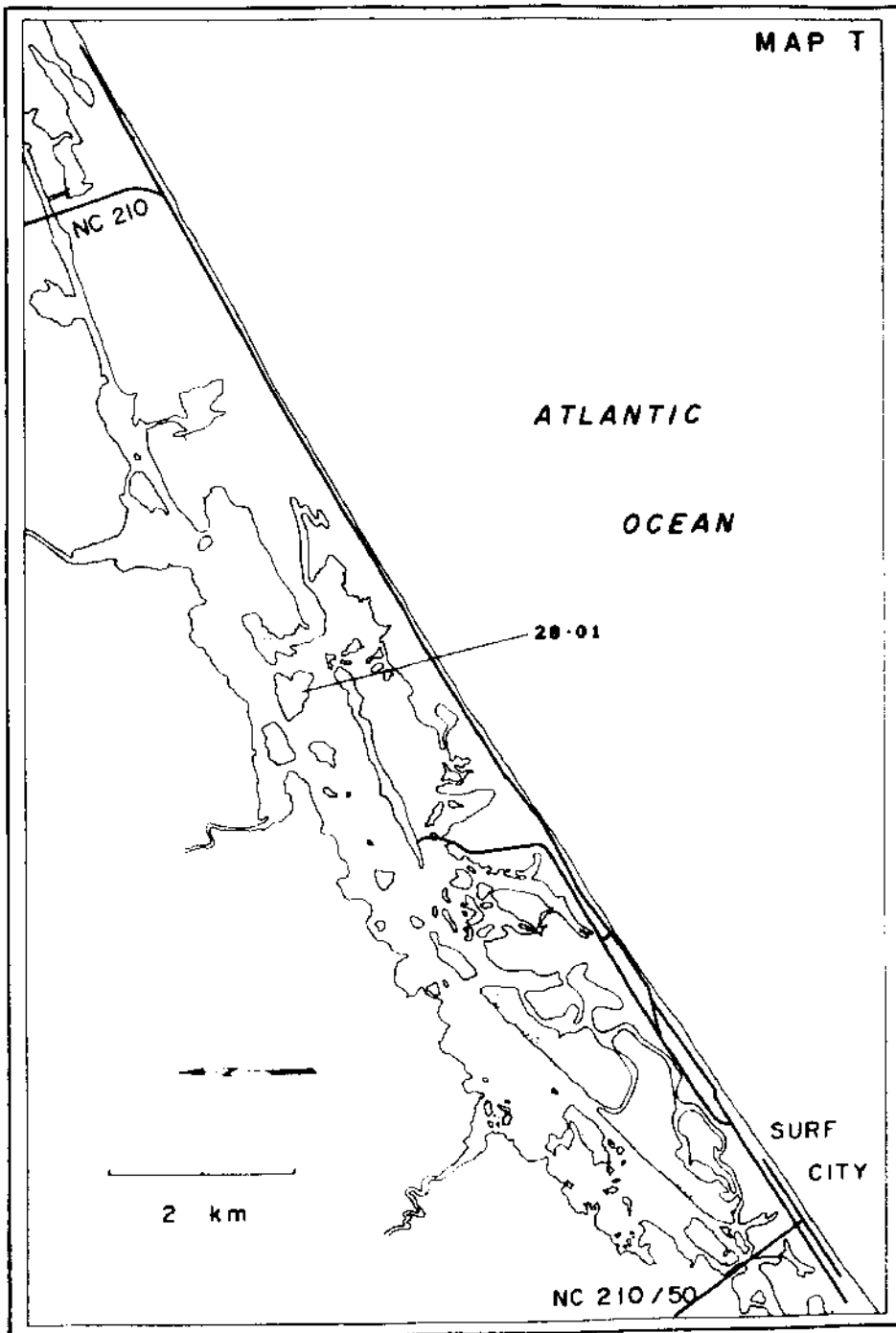


Figure 22. Map T, Surf City and vicinity.

MAP U

29-25 (Inactive - 83)

29-29 Vegetation Study Site

29-43 Dredged Material - Diked

 Least Tern..... 5

30-01 Barrier Island

 Least Tern..... 49

30-02 Barrier Island

 Least Tern..... 7

31-01 (Inactive - 83)

32-01 Barrier Island

 Least Tern..... 92

 Common Tern..... 96

 Black Skimmer..... 38

32-02 Barrier Island

 Least Tern..... 7

33-22 (Inactive - 83)

MAP V

33-15 (Inactive - 83)

33-16 Dredged Material - Diked

 Least Tern..... 16

35-02 Barrier Island

 Common Tern..... 36

 Least Tern..... 32

 Black Skimmer..... 39

36-03 Dredged Material - Diked

 Least Tern..... 7

36-13 Vegetation Study Site

36-14 Vegetation Study Site

37-01 Vegetation Study Site

37-09 Vegetation Study Site

37-10 (Inactive - 83)

37-12 Vegetation Study Site

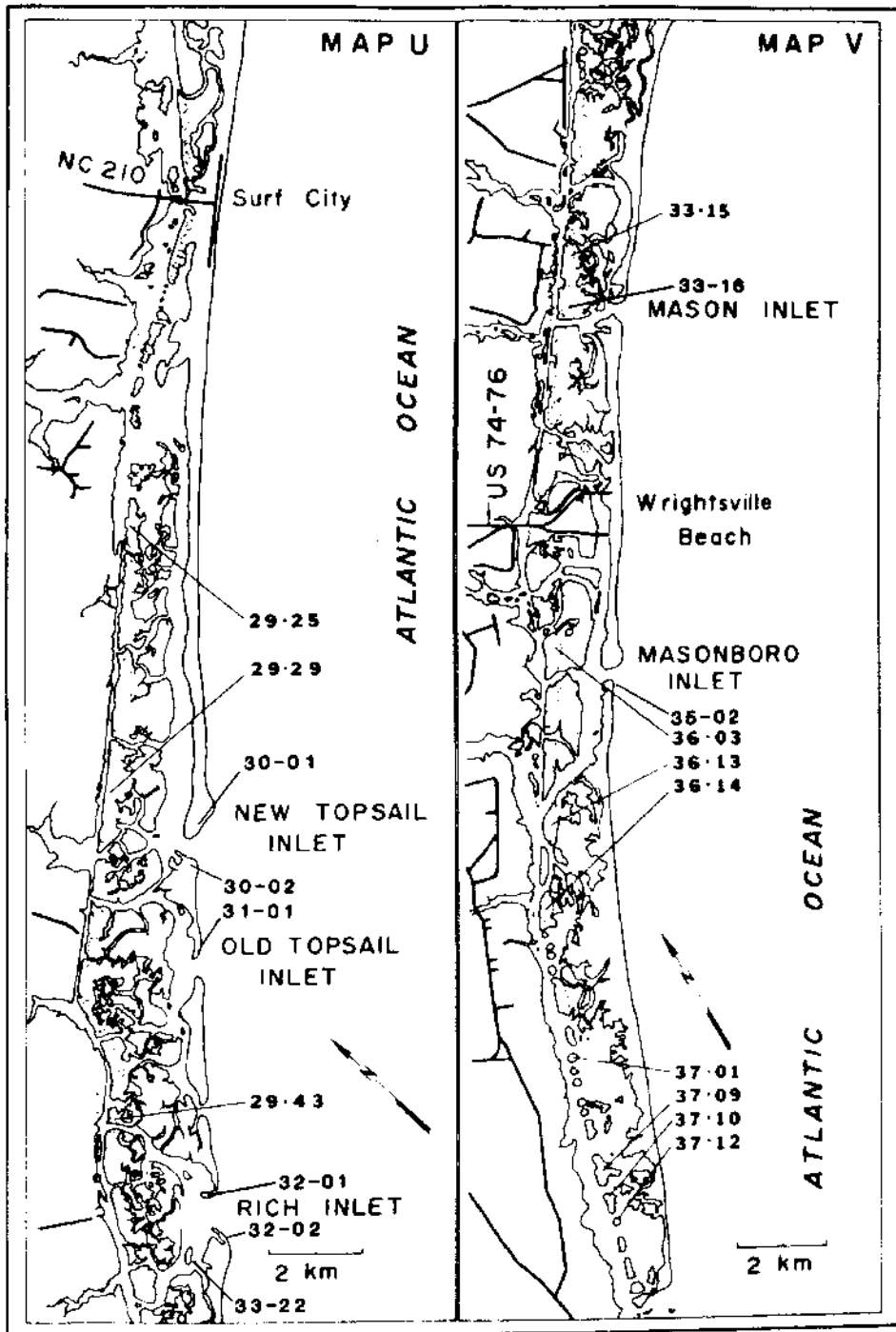


Figure 23. Maps U and V, Surf City to Masonboro Island.

MAP W

37-18 Dredged Material

Least Tern..... 25

39-23 Vegetation Study Site

39-25 Dredged Material - Diked

Least Tern..... 27
Gull-billed Tern..... 41

39-26 (Inactive - 83)

39-28 (Inactive - 83)

39-29 (Inactive - 83)

39-30 Dredged Material

Laughing Gull..... 247

39-32 Dredged Material

Brown Pelican..... 355
Laughing Gull..... 531
Royal Tern..... 1651
Sandwich Tern..... 18

39-33 Dredged Material - Diked

Black Skimmer..... 3

39-34 Vegetation Study Site

39-35 Eroded Away

39-36 Dredged Material

Gull-billed Tern..... 52

39-37 Dredged Material

Brown Pelican..... 222
Laughing Gull..... 664
Royal Tern..... 1971
Sandwich Tern..... 29

39-46 Natural; Subsequently
Receiving Dredged Materials

Great Egret..... 42
Tricolored Heron..... 239
Snowy Egret..... 100
Little Blue Heron..... 196
Green-backed Heron..... 2
Black-crowned Night Heron..... 27
White Ibis..... 3737
Glossy Ibis..... 31

39-49 Barrier Island

Least Tern..... 80

39-51 Natural; Subsequently
Receiving Dredged Materials

Great Egret..... 191
Tricolored Heron..... 166
Snowy Egret..... 232
Cattle Egret..... 306
Black-crowned Night Heron..... 34
Glossy Ibis..... 137

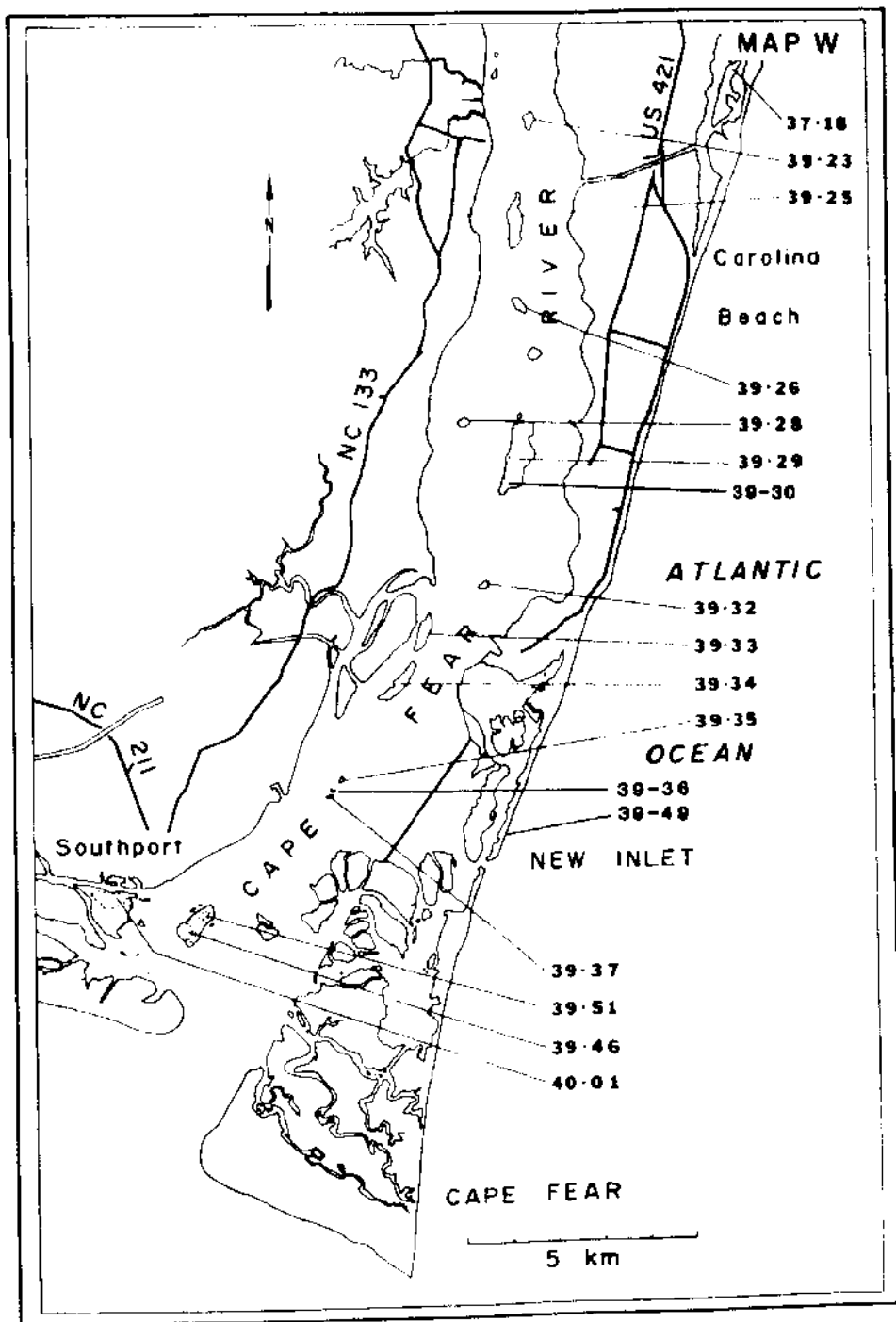


Figure 24. Map W, Lower Cape Fear River and vicinity.

MAP X

40-46 Vegetation Study Site

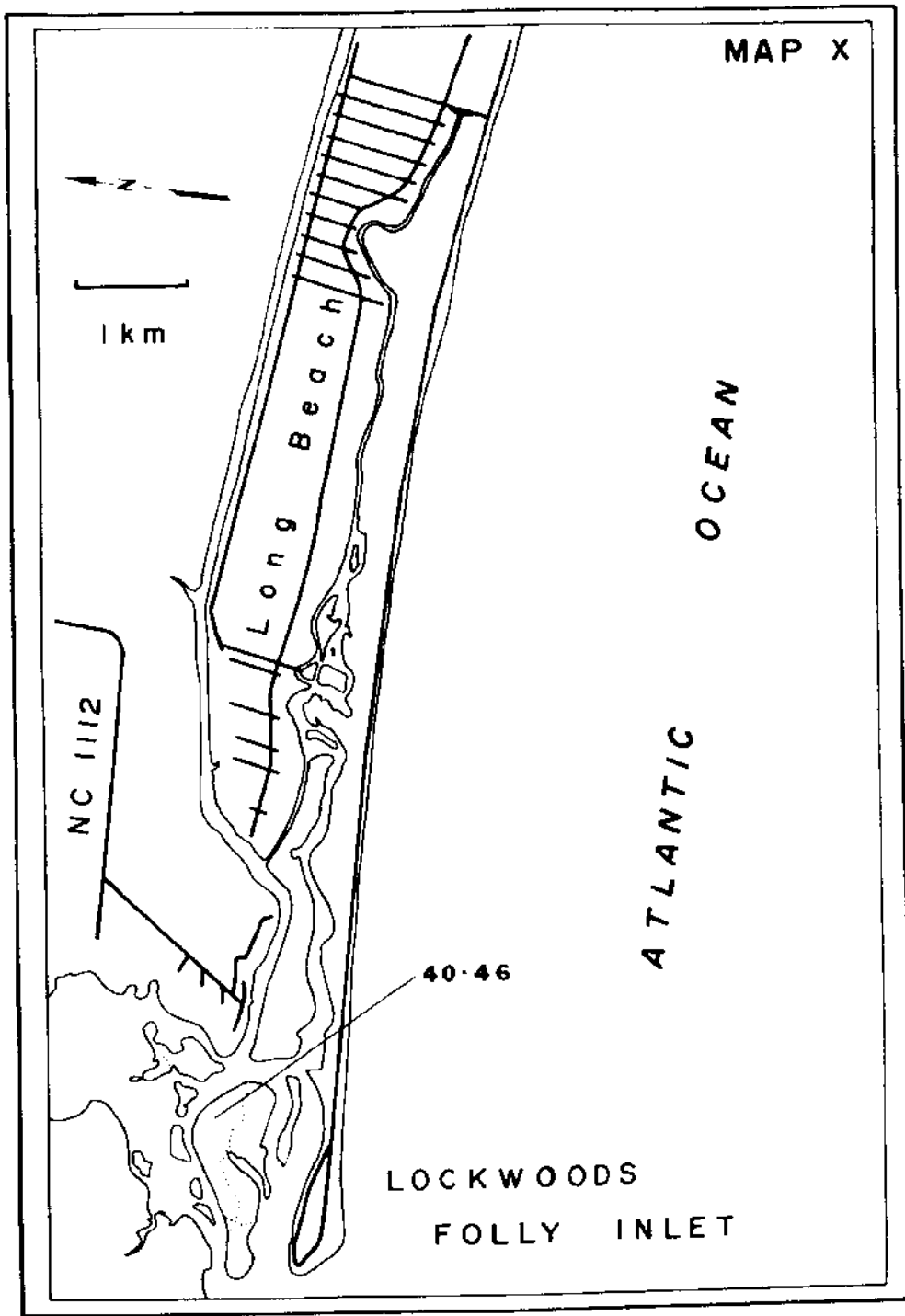


Figure 25. Map X, Long Beach and vicinity.

MAP Y

43-04 Vegetation Study Site

43-05 Vegetation Study Site

43-06 (Inactive - 83)

43-09 Dredged Material - Diked

Least Tern..... 42

43-10 Vegetation Study Site

50-04 (Inactive - 83)

MAP Z

45-07 (Inactive - 83)

47-01 (Inactive - 83)

47-08 (Inactive - 83)

48-06 (Inactive - 83)

48-07 (Inactive - 83)

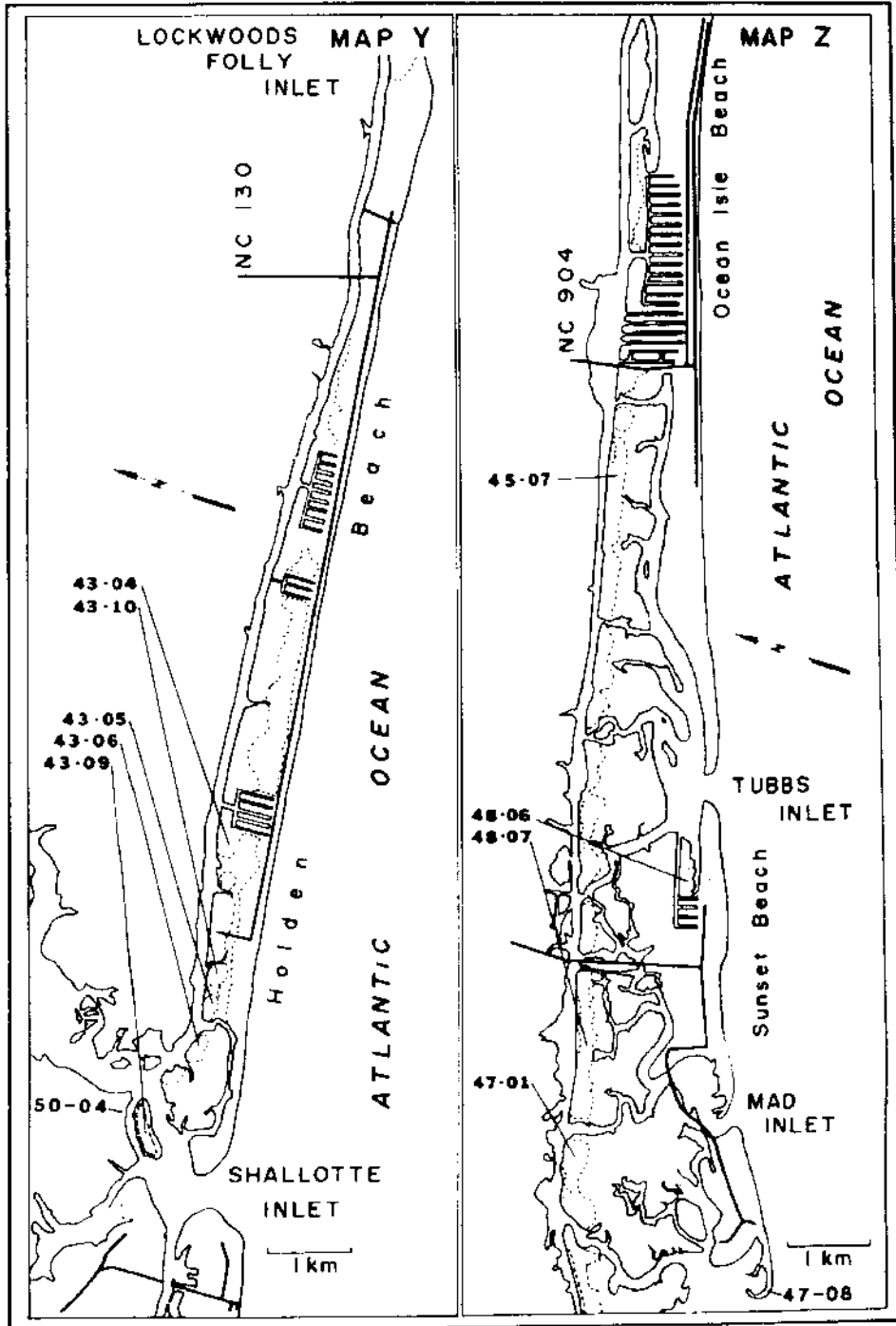


Figure 26. Maps Y and Z, Lockwoods Folly Inlet to South Carolina.

LITERATURE CITED

- Buckley, P. A. and F. G. Buckley. 1976. Guidelines for protection and management of colonially nesting waterbirds. National Park Service, Boston, Mass.
- McCrimmon, D. A., Jr. and J. F. Parnell. 1983. The breeding distribution of five colonial waterbird species in coastal North Carolina. *Colonial Waterbirds* 6:168-177.
- Parnell, J. F., D. M. DuMond and R. N. Needham. 1978. A comparison of plant succession and bird utilization of diked and undiked dredged material islands in North Carolina estuaries. Tech. Rept. D-78-9. Waterways Experiment Station, Vicksburg, Miss.
- Parnell, J. F. and R. F. Soots, Jr. 1978. The use of dredge islands by wading birds. Pages 105-111 in A. Sprunt, IV; J. C. Ogden; and; S. Winckler, editors. *Wading Birds*. National Audubon Society, Research Report No. 7, New York, N. Y.
- Parnell, J. F. and R. F. Soots, Jr. 1979. Atlas of colonial waterbirds of North Carolina estuaries. UNC Sea Grant Publication UNC-SG-78-10. Raleigh, N. C.
- Soots, R. F., Jr. and M. Landin. 1978. Development and management of avian habitat on dredged material islands. Tech. Rept. DS-78-18. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.
- Soots, R. F., Jr. and J. F. Parnell. 1975. Ecological succession of breeding birds in relation to plant succession on dredge islands in North Carolina. UNC Sea Grant Publication UNC-SG-75-27. Raleigh, N. C.