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THE NATURAL RESOURCES ASSOCIATED WITH MOBIL'S PROPOSED EXPLORATORY DRILL SITE

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SEA TURTLES IN NORTH CAROLINA

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In 1973 Congress enacted the Endangered Species Act (PL93-205) immediately listing the leatherback (Dermochelys coriacea), hawksbill (Eretmochelys imbricata), and Kemp's ridley (Lepidochelys kempi) as endangered. In 1978 the loggerhead (Caretta caretta), green (Chelonia mydas), and olive ridley (L. olivacea) were listed as threatened species except that the Florida and Mexican Pacific coast breeding populations of green sea turtles, and the Mexican Pacific coast breeding population of olive ridleys were listed as endangered (U.S. Dep. Commer. 1978). Only the flatback sea turtle of Australia (C. depressa) has not been listed. Of the six species of sea turtles in the Atlantic Ocean, all but one of them, the olive ridley, has been reported from the coast of North America.

The Western Atlantic distribution and ecology of these species are briefly summarized as follows (Mager 1985). The leatherback and loggerhead sea turtles have the broadest distribution - Arctic to Argentina. The hawksbill and green sea turtles have been reported from New England to southern Brazil and Argentina, but are probably the most tropical in range. As adults, Kemp's ridleys are rarely found outside the Gulf of Mexico, but juveniles and sub-adults are found from New England to the Yucatan Peninsula and Panama.

The leatherback is highly pelagic and is usually found in

oceanic and nearshore waters; they infrequently enter inshore waters. The hawksbill is usually associated with coral reefs, although all species have also been reported to occasionally associate with reefs. The green and Kemp's ridley sea turtles are inhabitants of shallow coastal and lagoonal areas, including bays and estuaries. Although, their centers of abundance are also in coastal and inshore waters, loggerheads may also lead a pelagic life.

The largest of the sea turtles, the leatherback, feeds primarily on jellyfish and tunicates. The green sea turtle is herbivorous, feeding on seagrasses, algae and associated organisms. Sponges accounted for the bulk of hawksbills' diets in the Caribbean (Meylan 1988). Kemp's ridley and loggerhead sea turtles feed on crustaceans, molluscs, jellyfish, and fish.

We know more about the loggerhead than any other species of sea turtle in U.S. waters because it is our most abundant sea turtle. We use it to illustrate the general life history pattern of sea turtles in the North Atlantic. Loggerheads nest primarily on continental beaches at night during warm months (Dodd 1988). Although not documented, some females are believed to return to nest in the same general area where they hatched. Approximately 100 eggs are deposited in each nest. A female may nest several times in one season, but seldom nests every season. In the western Atlantic, the most utilized nesting area is a 21 km stretch of beach just south of Melbourne, Florida. Nearly 10,000 clutches are laid annually on that beach, averaging 440 nests per kilometer of beach (Redfoot and Ehrhart 1989). North Carolina's beaches are at the northernmost end of the nesting range and average 1.3-1.5 nests per kilometer of beach (Crouse 1982). Although nesting activity in North Carolina appears insignificant, the peripheral nesting areas of the loggerhead turtle's range may be important to the population. The sex ratio of hatchlings is influenced by the temperature in the nest during a critical period of development (Myrosovsky 1980). Cool temperatures, such as those on North Carolina beaches, tend to produce males; warm temperatures tend to produce females. Thus, North Carolina nests may provide disproportionately high numbers of males to the population.

After an incubation period of approximately 60 days, the hatchlings emerge en-masse from the nest at night. Responding to light cues, they immediately begin a rapid crawl to the ocean. Thus begins the "lost year" in our knowledge of their life history, because except for a few strandings of small hatchlings, loggerhead sea turtles are not seen again along the east coast of the U.S. until they have reached juvenile or sub-adult size (Carr 1987). For about the first 20 hours the swimming activity is virtually non-stop (Salmon and Wyneken 1987). It appears that Western Atlantic hatchlings enter convergence zones such as those found along the shoreward walls of major currents like the Gulf Stream, and begin a pelagic existence lasting perhaps three years or longer, which may take them around the North Atlantic Ocean (Carr 1987). Food, as well as pollutants and debris, are concentrated in these same convergence areas. Juveniles return to the middle and southeastern U.S. where coastal sounds and bays are important developmental habitats. Although the data are sparse, the green

and the Kemp's ridley may embark on a similar pelagic journey. Age of sexual maturity in loggerheads may range from 10 to 30 years (Dodd 1988).

Several aerial surveys have been conducted to determine seasonal distribution and to enumerate loggerhead and leatherback sea turtles along the Atlantic seaboard. The offshore waters between Nova Scotia and Key West were censused in two major surveys: the Cetacean and Turtle Assessment Program (CETAP 1982) and the Southeast Turtle Survey (SETS) (Thompson 1984). Nearshore waters between Cape Charles and Cape Hatteras were surveyed by the Virginia Institute of Marine Science (VIMS) (Keinath et al. 1987; Byles 1988) and north-south transects within a mile of the North Carolina beach were flown by the North Carolina Wildlife Resources Commission (NCWRC) (Crouse 1985). Inshore, Chesapeake Bay (Keinath et al. 1987; Byles 1988) and Pamlico and Core Sounds (Epperly and Veishlow 1989; NMFS unpubl. data) have also been surveyed.

Offshore aerial surveys indicated that loggerhead sea turtles were concentrated over the continental shelf in the South Atlantic Bight but as surface waters warmed, they ranged farther to the north of Cape Hatteras, and with cooling surface water temperatures, retracted to the south (Figures 1 and 2; Table 1). During all but the winter months, turtle density in the nearshore waters off North Carolina generally increased to the north (Table 1 and 2). This is just opposite to the pattern of nesting activity on the state's beaches, where there is increased activity to the south (Crouse 1984) (Figure 3). The shelf area off the North Carolina coast serves as a migration corridor between the south and middle North Atlantic areas for the loggerhead and probably for the leatherback and Kemp's ridley. The narrowing of the shelf to the north, and along the middle Atlantic, may serve to concentrate the individuals and explain the observed pattern of increased density to the north. The large estuarine systems nearby are seasonally important foraging and developmental habitat for the turtles (Table 3) (Crouse 1985; Lutcavage and Musick 1985; Keinath et al. 1987; Byles 1988; Epperly and Veishlow 1989).

Data on the species composition in North Carolina waters comes from two sources: stranding reports and inshore tagging. In July 1988 the National Marine Fisheries Service, Beaufort Laboratory began a cooperative program with inshore fishermen to tag and report sea turtles incidentally captured in their nets. By December 1988, 4 volunteers had tagged 47 turtles, mostly loggerheads (Table 4) and 1989 results are similar (Epperly and Veishlow 1989; NMFS unpubl. data). It is significant to note that immature green and Kemp's ridley sea turtles were also caught. Incidental catches of sea turtles inside the sounds early in the year (May and June) are predominantly loggerhead sea turtles with an infrequent Kemp's ridley; catches throughout the summer are exclusively loggerheads; in the fall the catches are multispecies, including the loggerhead, green and Kemp's ridley sea turtles. These data and volunteers' accounts reveal a seasonal pattern of movement which suggests immigration during the spring, sorting by habitat throughout the summer, and emigration in the fall.

Typically, about 200 strandings are reported annually in North Carolina (Crouse 1985; Schroeder 1987; Schroeder and Warner 1988;

Teas and Martinez 1989) and about 80% of these are loggerheads (Table 5). There are two peaks in North Carolina stranding activity. The first occurs in the late spring and early summer on all but the northernmost beaches. The second occurs in the fall and early winter on the northern beaches (Carteret County and northward), when turtles are concentrated along the narrow shelf area of the northern coast and when turtles are emigrating from Chesapeake Bay and the Pamlico-Albemarle Estuarine Complex. Most of the stranded Kemp's ridley and green sea turtles are reported during the second peak.

In summary, the offshore waters of North Carolina regularly harbor all North American species of sea turtles except the hawksbill, which is infrequently reported. Inshore waters of the Pamlico-Albemarle Estuarine Complex and of the Chesapeake Bay seasonally contain numbers of loggerhead and Kemp's ridley sea turtles, and in Pamlico and Core Sounds, the green sea turtle is also present. The turtles' seasonal abundance in the area is probably a function of water temperature - as the waters warm they immigrate or migrate through, and as the waters cool, they emigrate. Sea turtles are capable of hibernating and sometimes overwinter in cool waters by burying in the substrate (Ogren and McVea 1982). Although there have been a couple of reports of turtles overwintering in North Carolina (T. Henson, N.C. Wildl. Resourc. Comm., pers. commun.), there are no data to indicate the extent to which turtles hibernate in the state's waters.

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Table 1. Surface densities of Caretta caretta along the Atlantic seaboard of the U.S. Values are number of individuals per square kilometer

	Coastwide		North Carolina		
	Nova Scotia to C. Hatteras[1]	C. Hatteras to Key West[2]	VA-NC line to Cape Hatteras[3]	C. Hatteras to New Topsail Inlet[2]	New Topsail Inlet to Little River Inlet[2]
March	———	———		———	———
April	0.009	0.180	0.482	0.140	0.038
May	———	———	0.830	———	———
June	0.032	———	0.054	———	———
July	———	———	0.259	0.038	0.137
August	0.043	0.142	0.264	———	———
September	———	———	0.149	———	———
October	0.000	———	0.172	0.182	0.094
November	———	———	0.213	———	———
December	0.152	0.058	0.081		
January	———	———			
February	0.014	———			
	———	0.046			
		———			

1 CETAP (1981).
2 Thompson (1984).
3 Keinath et al. (1987).

Table 2. Offshore turtle sightings during aerial surveys June-August, 1980-1981. Transects were flown south to north approximately 1/2 mile offshore, twice weekly in 1980 and every 5 days in 1981. Table modified from Crouse (1985).

	1980		1981	
County	Number of turtles sighted	Turtles per km shoreline	Number of turtles sighted	Turtles per km shoreline
Dare	384	2.61	231	1.57
Hyde	33	1.18	7	0.25
Carteret	42	0.31	31	0.23
Onslow (minus Camp Lejeune)	1	0.05	2	0.10
Pender	10	0.40	4	0.17
New Hanover	11	0.23	1	0.02
Brunswick	21	0.18	7	0.06

Table 3. Density of sea turtles on the surface of Chesapeake Bay (Keinath et al. 1987) and on the surface of Pamlico and Core Sounds (Epperly and Veishlow 1989; NMFS unpubl. data).

	Chesapeake Bay		North Carolina Sounds		
	Mid-Bay	Lower Bay	N. Pamlico	S. Pamlico	Core
April	0.0758	0.2378			
May	0.0552	0.2441	0.0052	0.0547	0.3126
June	0.0471	0.4311			
July	0.0562	0.1619	0.0204	0.0561	0.1916
August	0.0081	0.1045	0.0312		0.0904
September	0.0152	0.0731	0.0159		0.1373
October		0	0.0442		0.0472
November (88)				0.0287	0.1739
(89)			0.0166		0.0444

Table 4. Sea turtle tagging summary for North Carolina, July-December 1988 (Epperly and Veishlow 1989).

	Species		
Month	Caretta caretta	Chelonia mydas	Lepidochelys kempi
June	5		
July	6		
August	7		
September	3		
October		5	2
November	9	7	2
December			1
Total	30	12	5

Table 5. North Carolina sea turtle stranding data. (From Teas and Martinez 1989).

Table 5(a). **Marine turtle strandings reported from NORTH CAROLINA, 1 January - 31 December 1988 by species and month of occurrence.**

SPECIES	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
C. caretta	4	0	0	4	28	36	13	4	4	16	27	22	158
C. mydas	0	0	0	0	2	1	0	1	0	4	3	9	20
D. coriacea	0	0	0	0	0	1	0	0	0	0	0	0	1
E. imbricata	0	0	0	0	0	0	0	0	0	0	0	0	0
L. kempi	0	0	2	0	0	0	1	0	0	5	2	1	11
Unidentified	0	0	0	0	1	0	1	0	1	0	0	0	3
TOTAL	4	0	2	4	31	38	15	5	5	25	32	32	193

Table 5(b). **Marine turtle strandings reported from NORTH CAROLINA, 1 January - 31 December 1988 by county and month of occurrence. All species are combined. Only counties from which strandings were reported are included.**

COUNTY	MONTH												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Currituck	0	0	0	0	0	4	0	0	0	7	2	0	13
Dare	2	0	0	0	6	6	2	1	0	3	18	9	47
Hyde	0	0	0	1	0	2	0	0	0	0	0	0	3
Carteret	1	0	2	0	8	16	7	2	3	13	12	23	87
Onlsow	0	0	0	0	2	0	1	0	0	0	0	0	3
Pender	0	0	0	0	0	1	0	0	0	0	0	0	1
New Hanover	0	0	0	0	1	1	0	0	0	0	0	0	2
Brunswick	1	0	0	3	14	5	5	2	2	1	0	0	33
Beaufort	0	0	0	0	0	2	0	0	0	0	0	0	2
Pamlico	0	0	0	0	0	1	0	0	0	1	0	0	2
TOTAL	4	0	2	4	31	38	15	5	5	25	32	32	193

Figure 1. Seasonal distribution of loggerhead sea turtle sightings in the South Atlantic Bight, 1982. (From Thompson 1984)

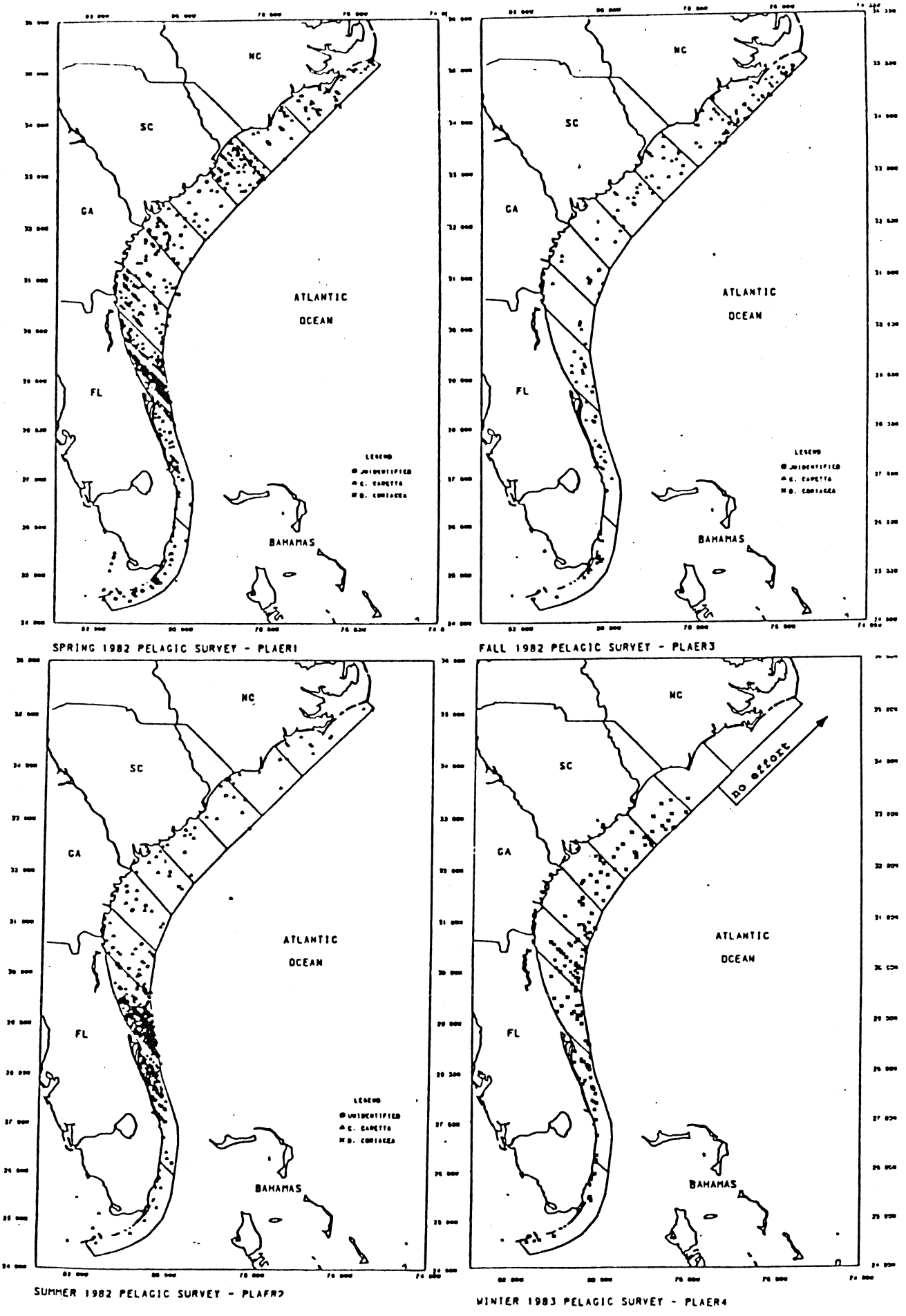

Figure 2. Seasonal distribution of loggerhead sea turtle sightings between Nova Scotia and Cape Hatteras (From CETAP 1982) Values plotted are the number of individuals per unit effort.

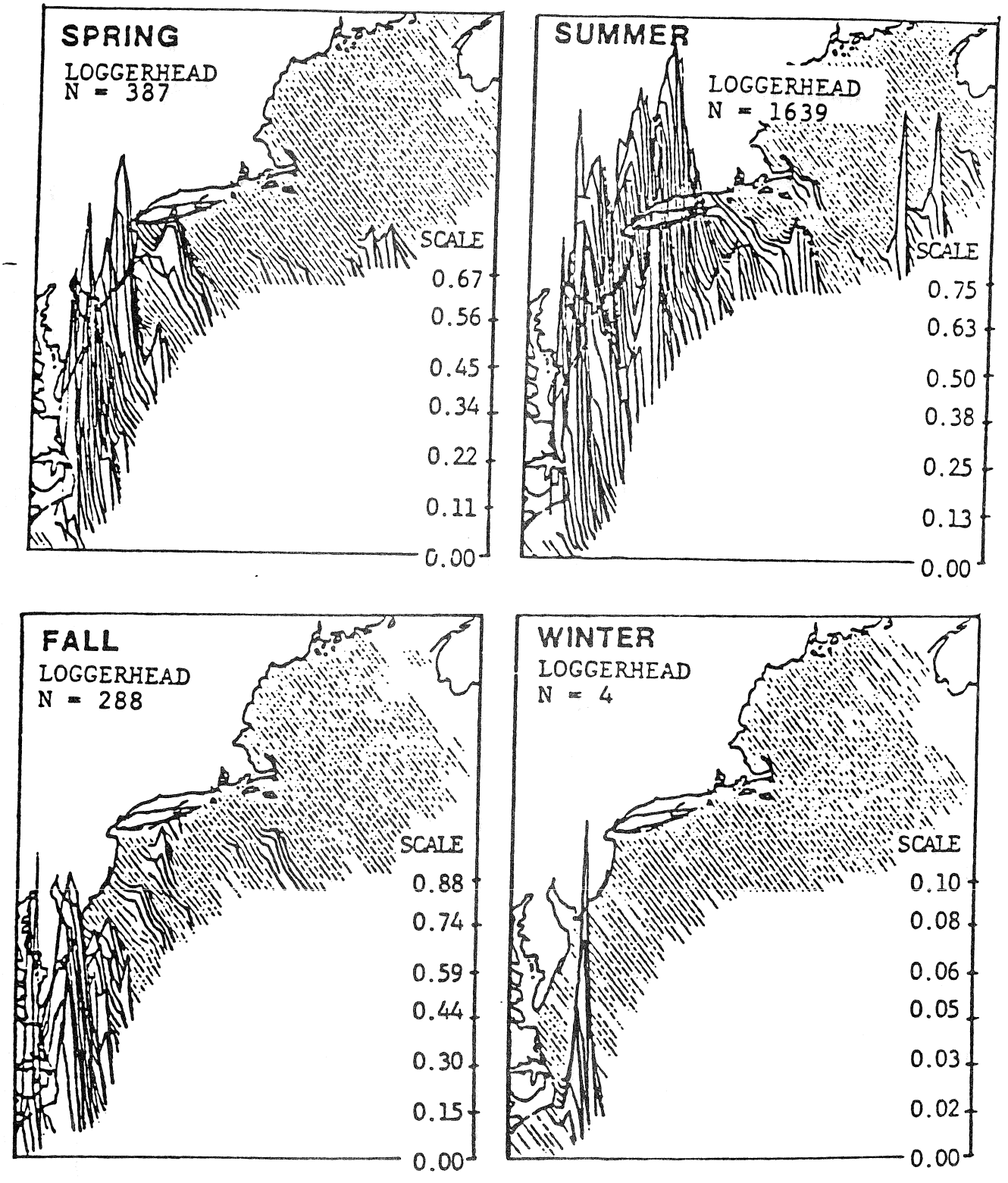
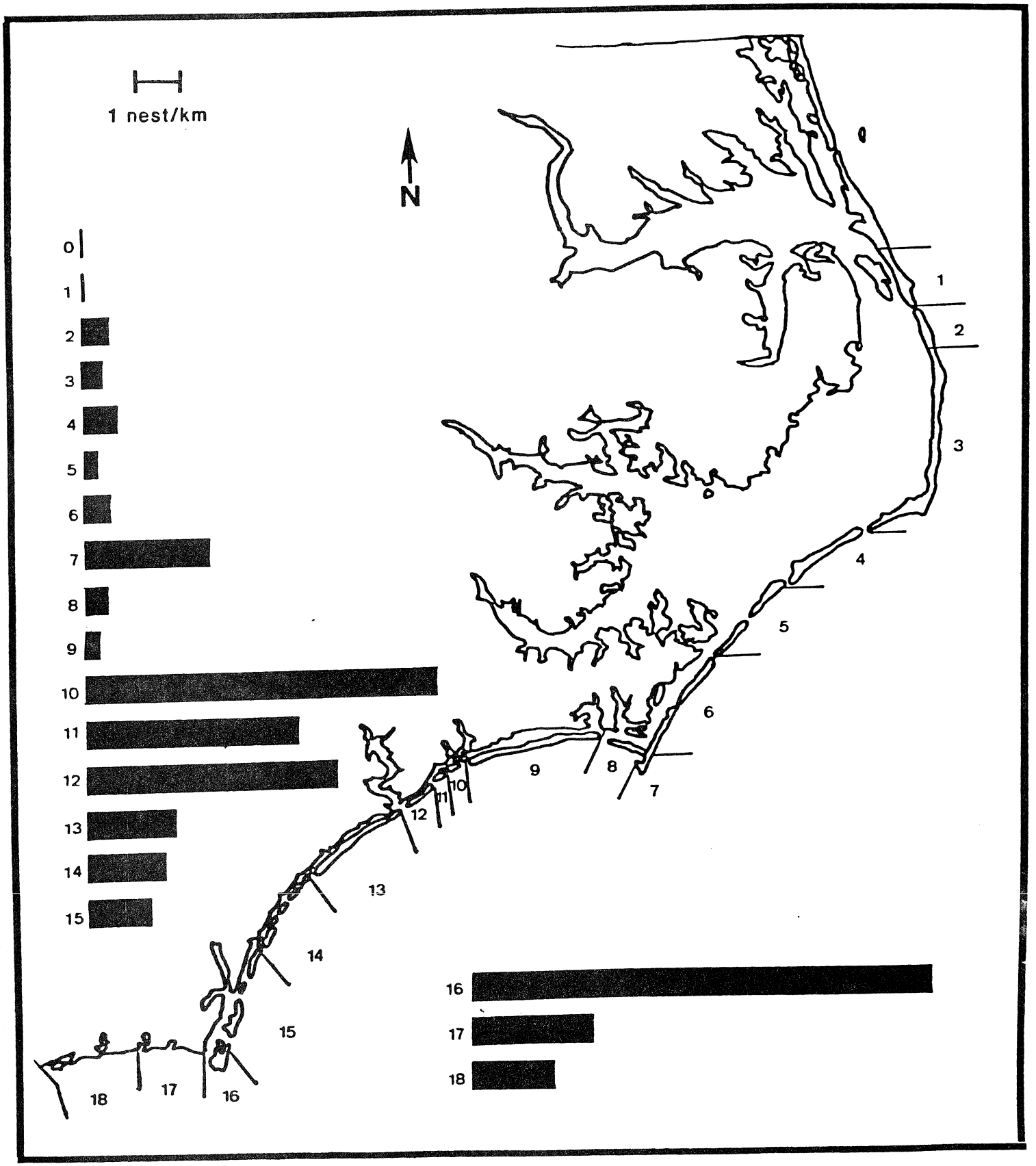
Figure 3. Estimated number of nests in North Carolina per kilometer of beach, 1980. (From Crouse 1981).