DISTRIBUTION AND MIGRATIONS OF IMMATURE KEMP'S RIDLEY TURTLES (*Lepidochelys kempi*) AND GREEN TURTLES (*Chelonia mydas*) OFF FLORIDA, GEORGIA, AND SOUTH CAROLINA

Many aspects of the developmental biology of sea turtles are unknown, particularly the distribution and movements of juveniles and subadults in the nearshore environment. Without this information we are unable to determine seasonal migrations or identify habitats which may be critical during certain stages of their life histories.

This paper presents results of National Marine Fisheries Service (NMFS) sea turtle research at Cape Canaveral, FL from 1978-1984. Captures of Kemp's ridley (*Lepidochelys kempi*) and green turtles (*Chelonia mydas*) were analyzed to determine seasonal occurrence, size composition and movement patterns. For Kemp's ridley, additional capture records from Georgia and South Carolina were included in the analyses for comparative purposes.

STUDY AREA

We defined the Canaveral area as coastal waters of eastern Florida from 28°15′N to 28°30′N latitudes (Figure 1). These limits encompass the Port Canaveral ship channel, where the majority of our sea turtle collecting efforts and captures have occurred. In our analyses of Kemp's ridley turtles, the limits of the study area were extended to included records from the coastal waters of Georgia and South Carolina.

MATERIALS AND METHODS

Capture records of Kemp's ridley and green turtles from all NMFS sea turtle trawling research projects in the southeastern U.S. (1978-1984) were combined for analysis. Although sampling methodologies and objectives of the projects were different, all captured turtles were tagged; the location of capture, date, tag number(s), species, sex, total carapace length and width (straight-line), and condition of animals was recorded.

In addition to turtle captures in NMFS research projects, several green and ridley captures occurred aboard commercial shrimp trawlers. These turtles were tagged, measured and released in the Canaveral area by NMFS observers or NMFS contract vessels, and were included in our analyses. However, no effort data were collected in association with these captures.

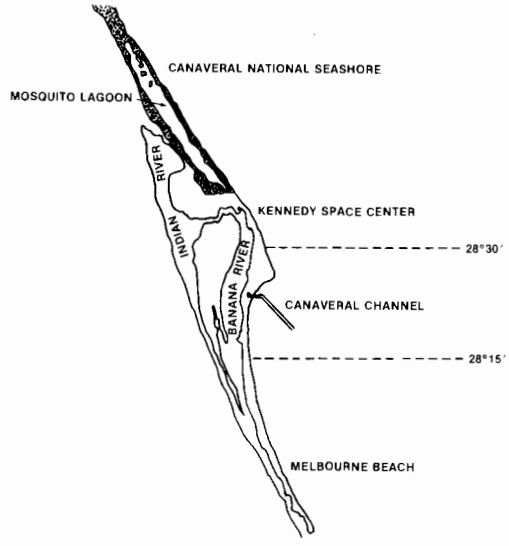

Figure 1. Description of the primary study area including local nesting beaches at Canaveral National Seashore, Kennedy Space Center and Melbourn Beach.

RESULTS AND DISCUSSION

The green turtle (*Chelonia mydas*)

Twenty subadult green turtles were captured in the vicinity of Cape

Canaveral, FL between 1978 and 1984 (Table 1). Green turtles encountered in the Canaveral area ranged in size from 23.6 to 68.1 cm (mean = 33.8 cm) total straight-line (SL) carapace length (Figure 2). Captures occurred during all months of the year except August and November.

When compared to the loggerhead turtle which is abundant throughout the year in the study area (Henwood, 1987), the infrequent capture of green turtles and the lack of seasonality in their occurrence suggests that these animals may represent an itinerant population. None of these turtles have been recaptured despite continued sampling efforts in the vicinity. The mean size of these turtles was smaller than that of the green turtle population found in Mosquito Lagoon, Florida (Mendonca and Ehrhart, 1982), and corresponded to the smallest turtle observed in the Cedar Key-Crystal River feeding pastures on the upper west coast of Florida (Carr and Caldwell, 1956). This suggests that many of the green turtles encountered in the vicinity of Cape Canaveral may be in early developmental stages prior to the shift to herbivory and recruitment to feeding pastures.

The Indian River-Banana River estuarine system historically supported a green turtle fishery (Ehrhart, 1983), which flourished during the late 1800's, but drastically declined at the turn of the century following a severe freeze in the winter of 1894-95 (Wilcox, 1896). Because no grass beds or other known feeding grounds for greens occur offshore of Cape Canaveral, we speculate that the offshore captures are transients that may eventually occupy the shallow marine grass bed habitat of the Indian River-Banana River complex or similar habitats in Georgia and the Carolinas.

The Kemp's ridley turtle (*Lepidochelys kempi*)

During NMFS research in the vicinity of Cape Canaveral, FL, forty Kemp's ridley turtles have been captured. Size of these animals ranged from 24.1 to 66.0 cm (mean = 38.6 cm) total straight-line carapace length (Figure 3). These animals were classified as immature turtles in all but one instance. A 66.0 cm turtle was within the size range of mature nesting females (59.5 - 75.0 cm) and could be classified as an adult (Chavez *et al.*,

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Totals
1978												1	1
1979													
1980				1		1	1		1	1			5
1981	2				1								3
1982													
1983			2			1						1	4
1984	4	2	1										7
Totals	6	2	3	1	1	2	1		1	1		2	20

Table 1. Summary of green turtle (*Chelonia mydas*) captured in the Canaveral area and adjacent shrimping grounds. Records after April 1983 were provided by a single trawler and reflect the incidental capture of green turtles on local shrimping grounds.

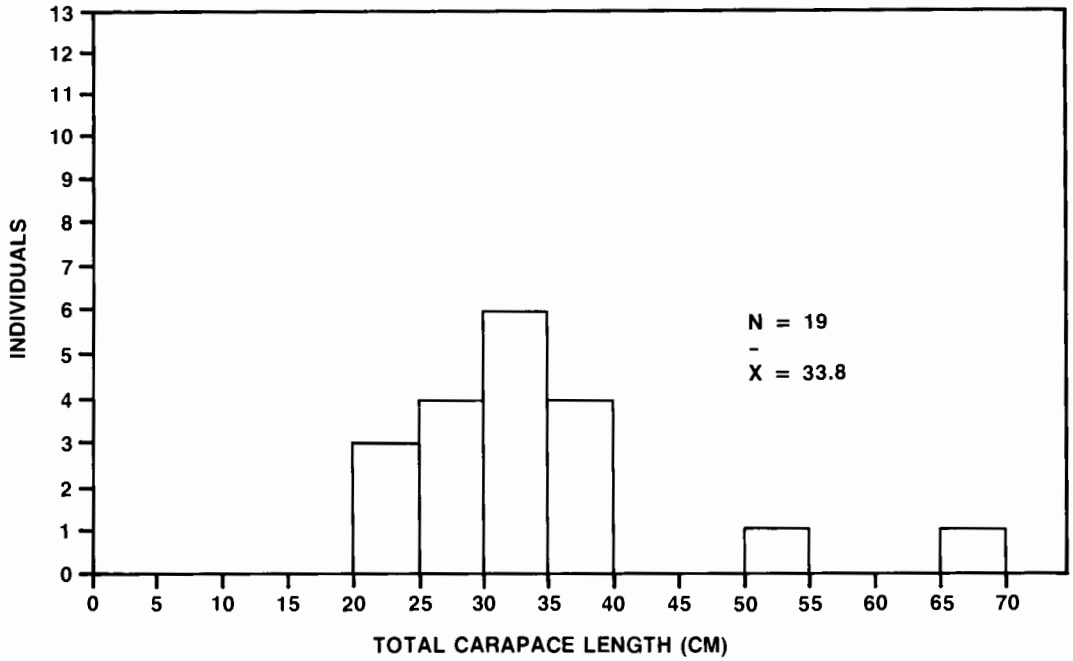

Figure 2. Length frequencies of green turtle, *Chelonia mydas*, captured in the vinicity of Cape Canaveral, Florida.

1967).

Our finding that the majority of turtles (39 of 40) were immature agrees with prior Kemp's ridley records from western Atlantic waters (Carr, 1956, 1957, 1980; Carr and Caldwell, 1958). The capture of an adult-sized ridley outside the Gulf of Mexico, however, was unusual and suggests that mature turtles occasionally forage along the eastern coast

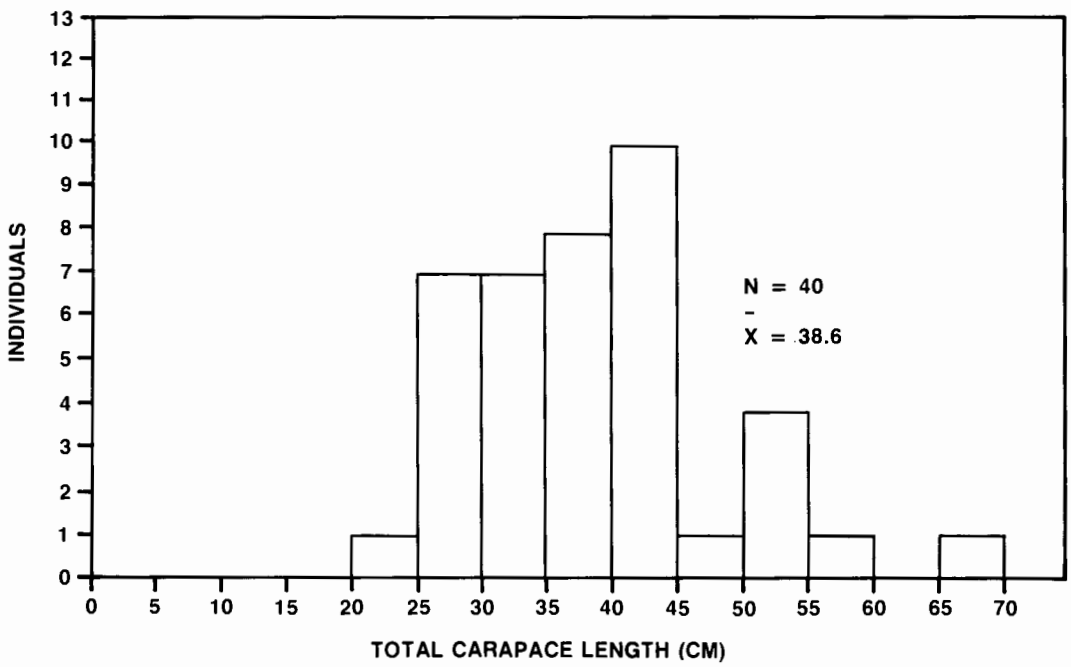

Figure 3. Length frequencies of Kemp's ridley, *Lepidochelys kemp*, captured in the vicinity of Cape Canaveral, Florida.

of Florida. In addition to the single adult turtle, five immature animals were larger than 50 cm carapace length and were probably nearing sexual maturity (Marquez, 1972).

Examination of monthly and yearly captures of Kemp's ridley turtles in the Cape Canaveral area (Table 2), indicated that 93% (37 of 40) of the captures occurred from December through March. Seasonal trend were similiar over all years except 1979. These data suggest that Kemp's ridley turtles occur off Cape Canaveral primarily during winter months and less frequently during the remainder of the year.

In addition to the Kemp's ridley captures in the Cape Canaveral area, 21 turtles have been recorded from off Georgia and South Carolina (Table 3). These turtles were captured incidentally during commercial shrimping activities from June through November. While these data confirm the occurrence of Kemp's ridleys in waters north of Canaveral during summer and fall months, they may not reflect seasonal distribution patterns. Little shrimping effort was expended in these areas during the remaining months of the year, therefore, no data are available regarding ridley turtle occurrence at these times. However, because of the low water temperatures recorded in these waters, occurrence during the winter months is unlikely (Ogren and McVea, 1982).

Total carapace length of Kemp's ridley turtles in Georgia and South Carolina indicated that these turtles were smaller (mean = 34.8; range 20.3 to 57.2 cm) than Cape Canaveral turtles, though not significantly (Figure 4.). A north-south gradient in size of green turtles has been previously noted (Carr, 1952), and our findings suggest that such a gradient may exist in Kemp's ridley turtles as well. This observation is in agreement with the findings of Lazell (1980) for New England waters and Lutcavage and Musick (1985) in Virginia.

Five Kemp's ridley turtles have been recaptured over the study period (Table 4 and Figure 5). Two Kemp's ridley turtles originally tagged in the Cape Canaveral area in February have been recovered to the north. The first turtle was captured in 1981 and recovered after 202 days at large, a distance of 562 nautical miles to the north. The second turtle was captured in 1984 and recovered in May hav-

Table 2. Summary of Kemp's ridley (*Lepidochelys kempi*) captures in the Canaveral area and adjacent shrimping grounds. Records after April 1983 were provided by a single trawler and reflect the incidental capture of ridley turtles on local shrimping grounds.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Totals
1978		1	2										3
1979							1						1
1980			1									2	3
1981		3											3
1982		2	1										3
1983			2	1		1						2	6
1984	5	13	3										21
Totals	5	19	9	1		1	1					4	40

Table 3. Summary of Kemp's ridley (*Lepidochelys kempi*) captures from Georgia and South Carolina.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Totals
1978						1	5	2		1	1		10
1979						3			1	1			5
1980							2			2	1		5
1983										1			1
Totals						4	7	2	1	5	2		21

ing moved 173 nautical miles in 102 days.

Two other recaptures are of importance because they provide evidence of southward movement along the Atlantic coast. They also suggest that these movements may be associated with cooling waters in the higher latitudes. One turtle was captured October 5, 1983 off South Carolina and recovered 200 nautical miles to the south after 61 days at large. The second turtle was captured off South Carolina in June, 1979 and recovered in September, 1980 after 445 days at large, a distance of 37 nautical miles south of the original capture site.

These data, although limited in number, suggest some trends in Kemp's ridley movements. As previously noted, highest concentrations of ridleys occurred off Canaveral from December to March. We suggest that ridley turtles overwintering near Cape Canaveral move along the Atlantic coastline with increasing sea temperatures, foraging at least as far north as the Chesapeake Bay. These same turtles reverse directions as waters begin to cool in the fall, and return to Florida (or further south or west)

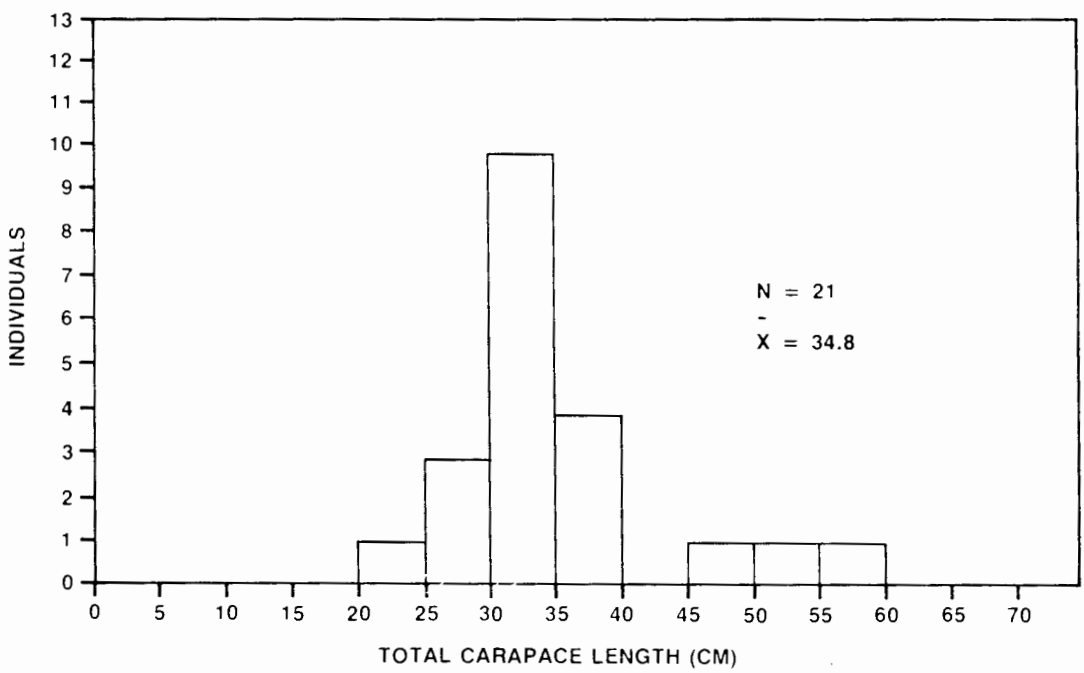

Figure 4. Length frequencies of Kemp's ridley, *Lepidochelys Kempi*, captured off Georgia and South Carolina.

in a southerly direction. Seasonal movements up and down the coast may continue until they reach sexual maturity, at which time the turtles presumably return to the Gulf of Mexico to breed.

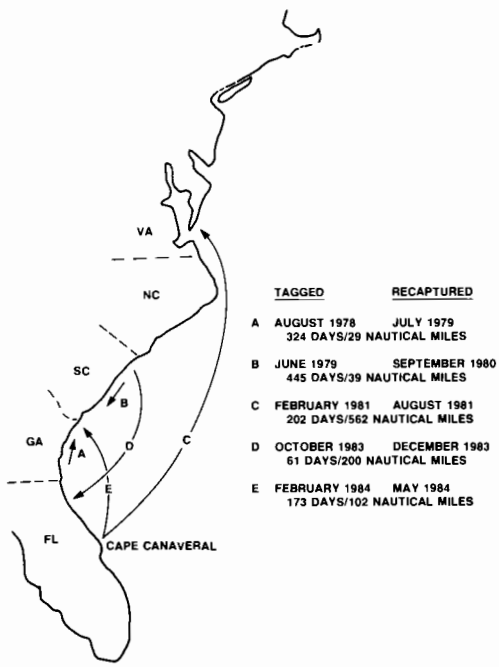

Figure 5. Coastal migrations of five subadult Kemp's ridley, *Lepiodochelys kempi* (see Table 4 for specific capture dates and coordinates).

CONCLUSIONS

Because we were unable to compute catch per unit of effort (CPUE) for many of our captures, we could not demonstrate changes in relative abundance of green and Kemp's ridley turtles over time. Capture records summarized in Tables 1-3 document individual captures by month and year, but may give a biased picture because effort was not considered. Despite this possibility, we believe that for Kemp's ridleys in particular, the preponderence of captures during winter months provides strong circumstantial evidence of seasonality in their occurrence.

Of all turtles captured by trawlers in the vicinity of Cape Canaveral, Florida, green and Kemp's ridley turtles comprised just over one percent; the loggerhead turtle (*Caretta caretta*) was by far the dominant species comprising ninety nine percent of the total. The occurrence of green and ridley turtles, however, indicates that the eastern coast of Florida is within the normal foraging range for both species. The low numbers of individuals that were captured may reflect the real proportional abundance on the eastern coast of Florida, or could reflect different habitat preferences of green and Kemp's ridley turtles.

The low numbers of green turtles captured in the course of these investigations is not unexpected, because these turtles prefer more tropical habitat and are herbivorous during the majority of their lives. They exhibit omnivorous feeding habits during a short phase of their life cycles, and should occur in the Canaveral area only at these times, as transients through the area, or as adults during the nesting season. For this reason, only a small segment of the green turtle population would be present in the sampling area and subject to capture.

In the case of the Kemp's ridley turtle, our catch rates in Florida, South Carolina and Georgia were of significance, considering that breeding by these species has been found only in the Gulf of Mexico. Many researchers (Pritchard and Marquez, 1973; Carr, 1980; Lazell, 1980; Lutcavage and Musick, 1985) believe that passive transportation of young Kemp's ridley turtles via the Gulf Stream up the eastern coast of the U.S. may be the usual dispersal pattern. Our findings support this belief, and suggest that these individuals may remain outside the Gulf of Mexico during much of their early developmental periods and

survive to become part of the breeding population.

ACKNOWLEDGMENTS

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LITERATURE CITED

Carr, A.F. 1952. Handbook of turtles. Ithaca, New York: Cornell University Press.

_____ 1956. The windward road. New York, Alfred Knopf, Inc.

_____ 1957. Notes on the zoogeography of the Atlantic sea turtles of the genus *Lepidochelys.* Rev. Biol. Trop. 6(2): 245-262.

_____ 1980. Some problems of sea turtle ecology. Amer. Zool. 20(3): 489-497.

_____ and D.K. Caldwell. 1956. The ecology and migrations of sea turtles. 1. Results of field work in Florida, 1955. Am. Mus. Nov., (1793): 23 p.

_____ and D.K. Caldwell. 1958. The problem of the Atlantic ridley turtle in 1958. Rev. Biol. Trop. 6(2): 245-262.

Chavez, H., M.G. Contreras and T.P.E. Hernandez. 1967. Aspectos biologicos y proteccion de la tortuga lora, *Lepidochelys kempi* (Garman), en la costa de Tamaulipas, Mexico. Inst. Nac. Invest. Biol. Pesqueras (17): 1-19.

Ehrhart, L.M. 1983. Marine turtles of the Indian River lagoon system. Florida Sci. 46(3/4):313-336.

Henwood, T.A. 1987. Movements and seasonal changes in loggerhead turtle, *Caretta caretta,* aggregations in the vicinity of Cape Canaveral, Florida (1978-84). Biol. Conserv. 40: 191-202.

Lazell, J.D. 1980. New England waters: critical habitat for marine turtles. Copeia 1980(2): 290-295.

Lutcavage, M. and J.A. Musick. 1985. Aspects of the biology of sea turtles in Virginia. Copeia 1985(2): 449-456.

Marquez, R. 1972. Resultados preliminares sobre edad y crecimiento de la tortuga lora, *Lepidochelys kempi* (Garman). Mem. IV Congd. Nac. Ocean. (Mexico): 419-427.

Mendonca, M.T. and L.M. Ehrhart. 1982. Activity, population size and structure of immature *Chelonia mydas* and *Caretta caretta* in Mosquito Lagoon, Florida. Copeia (1982)1: 161-167.

Ogren, L.H. and C. McVea, Jr. 1982. Apparent hibernation by sea turtles in North American waters. p. 127-132. *In*: K.A. Bjorndal (Ed.) Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Wash. D.C.

Pritchard, P.C.H. and R. Marquez. 1973. Kemp's ridley turtle or Atlantic ridley. I.U.C.N. Monograph No. 2, Morges, Switzerland.

Wilcox, W.A. 1896. Commercial fisheries of Indian River, Florida. Rpt. U.S. Comm. Fish and Fish. 22: 249-262.

Tyrrell A. Henwood, *NMFS 9450 Koger Blvd., St. Petersburg, FL 33702 and* Larry H. Ogren, *NMFS 3500 Delwood Beach Dr., Panama City, FL 32401.*