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The Biology and Ecology of Juvenile Sea Turtles: Kemp's Ridley (Lepidochelys kempi) in the Gulf of Mexico and western North Atlantic

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Introduction

The early life history stages of Kemp's ridley (Lepidochelys kempi) have not received as much attention by biologists as have studies of the older, reproductively active adults. This was probably due to their small size, reduced numbers, and cryptic habits in the extensive marine environment of the Gulf of Mexico and North Atlantic, and was compounded by their being frequently misidentified (Brongersma 1982). However, the adults, as well as juveniles, were relatively common years ago and well known to the trawlermen of the Gulf of Mexico (Liner 1954; Carr 1977). After the sole nesting beach at Rancho Nuevo, Mexico, was discovered by scientists in 1961 (Hildebrand 1982), ridleys became highly visible and relatively accessible to biologists at that rookery. That was the situation until their numbers declined to the low levels reported today (R. Byles, USFWS, pers. comm.; Frazer 1986). Before their numbers decreased to the present levels, tagging studies conducted by Mexican biologists at Rancho Nuevo revealed that the females returned to the crab-rich foraging grounds either south of the rookery in the Tabasco-Campeche Bay region or north, primarily off the Louisiana coast, after the nesting season (Chavez 1969; Pritchard and Marquez 1973; Marquez

1984). It was also determined that the majority of tag returns came from shrimp fishermen trawling in those two areas (NMFS 1987).

Nothing is known about the distribution, or even the occurrence, of hatchlings in the pelagic stage in the Gulf of Mexico. A few are sometimes observed swimming in the surf zone off Padre Island, Texas, and some have been tossed up on the beaches of Mustang Island, Texas, during storms (A. Amos, Univ. Texas, and Padre Island National Seashore personnel, pers. comm.). In either case, the littoral zone, with its attendent predators is clearly not the appropriate habitat of these young turtles. Paradoxically, the smallest post-hatchlings recorded are specimens found in the Atlantic (Schmidt and Dunn 1917; Deraniyagala 1939). One is from the Azores and the other from an unknown locality identified only as "United States".

The juvenile life history stage, not including the hatchlings or the post-hatchling pelagic stage (Carr 1986), is best described as the postpelagic or coastal benthic stage where they feed primarily on crustaceans such as portunid crabs, bivalves, and a variety of other invertebrates (Dobie, Ogren and Fitzpatrick 1961). This developmental stage is widely distributed throughout the Gulf of Mexico and northward along the Atlantic coast from Florida to New England. Kemp's ridley has also been recorded from Bermuda

(Mowbray and Caldwell 1958), but nowhere else in the western North Atlantic, and that includes the Bahamas and Antilles (Carr 1980).

In the eastern Atlantic, ridleys include a wide range of size classes, from small post-hatchlings to large subadults (20 cm to 57 cm carapace length). Only one adult size individual (66 cm) has been recorded from the Atlantic (Henwood and Ogren, 1987). With the discovery of the rookery at Rancho Nuevo, a postulated old world origin for these individuals was laid to rest (Brongersma 1972). However, the fate of these turtles in the North Atlantic remains undetermined. Some obviously die from exposure to low temperatures if they venture too far north (Lazell 1980; Meylan and Sadove 1986). But whether all are lost to the breeding population, or return to the Gulf of Mexico to mature and breed is not known.

Historical records from the turn of the century characterize the juvenile ridley as a common inhabitant of North Carolina bays and sounds (Coker 1906). Kemp's ridley was the second most abundant sea turtle caught in the Cedar Key, Florida, turtle fishery (Carr and Caldwell 1956). However, this might not reflect the natural conditions concerning species dominance because of the fishermen's bias for the green turtle (Chelonia mydas). Elsewhere in the United States, unusual numbers of small ridleys were found cold-stunned in Vineyard Sound, Massachusetts,

and were reported to be a common inhabitant of New York harbor (Babcock 1930; Carr 1980).

The nesting population of Kemp's ridley at Rancho Nuevo was first observed by biologists in the early 1960s when it was determined that a single "arribada" of the 1940s had been reduced by over 92% (Marquez 1984). A corresponding decrease in the number of hatchlings produced would be expected, and the number that survived the pelagic stage and entered the coastal benthic population as juveniles would also be very low. The decline was the result of a systematic and intensive egg harvest over a period of many years (Hildebrand 1982), in addition to other natural causes and continuing incidental catch primarily by shrimp trawlers elsewhere in the species range. However, during the last two decades, with increasing beach protection provided by the Mexican government, and a very successful hatchery program operated by Mexican and American biologists, an average of 20,000 hatchlings were produced annually the first decade after discovery of the rookery, and 50,000 thereafter (Marquez 1984). This can be expected to have resulted in a major demographic change in the Gulf of Mexico, and possibly the western Atlantic region, for the Kemp's ridley. The adult population has continued to decline steadily during 1978-1985 (Frazer 1986) with only about six hundred females nesting annually in 1986 (NMFS 1987). Observations or incidental captures of adult ridleys at sea

have become rare events. Conversely, juveniles in the postpelagic benthic stage are now commonly found at various localities in coastal waters from Texas to New England, possibly as a result of the protection afforded the nests. The following account will present some observational data and tagging results obtained in recent years that provide support for the summary and overview on the early life history of Kemp's ridley.

Results

At-sea captures of sea turtles continue to be the most important and productive research activity conducted at this laboratory to ascertain the distribution and abundance of sea turtles in coastal waters. This is especially true if a turtle biologist or a similarly trained person is directly involved in collecting or handling the turtles and recording the species identification and morphometrics. For the summary presented in this report, references dealing with significant numbers of juvenile turtles and meristic data were selected to complement our limited data (Tables 1 and 2).

In general, most of the capture effort in the southeast region of the United States is either by active fishing gear, trawls and strike gill nets, or more passive methods such as turtle tangle nets. The primary objective of the project is to tag and release turtles. In certain areas along the Gulf and Atlantic coast, turtles are sometimes captured by pound nets,

hook and line, and fortuitously when they are immobilized by cold temperatures (Ogren and McVea 1987; Ehrhart 1983). Some stranding records are included in the size distribution examples discussed, but the majority of captures were made by shrimp trawls.

Juvenile Kemp's ridleys are not the only species collected during the course of these studies. Adult and subadult loggerheads (Caretta caretta) dominate the catch on the Atlantic coast, and juvenile green turtles (Chelonia mydas) although less abundant in our catches than are loggerheads and Kemp's ridleys, are found in both areas in the Gulf of Mexico and Atlantic. Other areas along the Gulf coast of Florida south of Cedar Key are reported to have significant numbers of juvenile green turtles, but they are not being sampled at the present time. An expansion of the netting project at Cedar Key is being planned to include a sampling station in the Homosassa area.

To summarize, most of the capture and tagging effort takes place along the northwest, and east-central coasts of Florida, with considerable seasonal (summer) effort in South Carolina in Winyah Bay. The most productive method of capture has been with shrimp trawls, but "run around" gill nets and, more recently, turtle tangle nets have accounted for an increasing number of captures on the west coast of Florida. Over six hundred turtles have been captured, tagged and released since the implementation

of this phase of the project. Of this total, 376 loggerheads, 146 Kemp's ridley, and 22 green turtles were captured on the Atlantic coast. During 1978-1984, on the Atlantic coast, approximately 60 juvenile Kemp's ridley and 20 green turtles had been tagged and released (Henwood and Ogren 1987) and represent a significant number of juvenile and subadult turtles from the coastal waters of the United States offshore the Indian River estuarine system of east central Florida as reported by Ehrhart (1983).

On the west coast of Florida, capture efforts have resulted in the tagging of over 100 juvenile sea turtles, primarily Kemp's ridleys. The species composition is 110 Kemp's ridleys, 10 green turtles and 7 loggerheads. The capture methods included gill and tangle nets, as well as shrimp trawls. Recent and significant recaptures of ridleys in the Gulf were reported. One was at large at Cedar Key, Florida from July 1986 until May 1987, and another migrated to the east from Biloxi, Mississippi, to Dauphin Island, Alabama; two other ridleys were recaptured in Louisiana, a considerable distance west of their original capture sites at Panama City, Florida and Biloxi, Mississippi, respectively (Table 4).

These tagging studies are part of a long-term research effort to establish migratory patterns, seasonal occurrence, distribution and growth of foraging populations of juvenile sea

turtles in coastal waters. Data from recent recaptures of tagged ridleys are presented in Tables 3 and 4. New netting methods are being developed for the Cedar Key study in order to increase the efficacy of the project. Also, netting effort is being extended to include areas that appear to be more favorable to the capture of subadult green turtles at the Waccasassa reefs and Homosassa to the south.

Discussion

Juvenile Kemp's ridley sea turtles are widely distributed throughout U.S. coastal waters from Maine to Texas. The smallest individuals, ranging in carapace length from 20 to 25 cm, are probably postpelagic stage individuals entering shallow coastal zone of bays, sounds and estuaries (Figure 1). Here in these developmental habitats, their ecologic niche changes to that of a benthic carnivore. This size class is apparently most numerous in the Gulf of Mexico, giving credence to speculation that the entire life cycle occurs entirely within the Gulf of Mexico for some unknown part of the population. Historically, the smallest post-hatchling ridleys were reported only from the New England states and the eastern North Atlantic (Brongersma 1972; Carr 1980). However, the ridleys found in the North Atlantic states that have a carapace length greater than 25 cm are still relatively small individuals whose movements are most likely mediated by ocean currents. They may take a little longer to

complete their pelagic developmental stage in the Gulf of Mexico and the Atlantic than their Gulf of Mexico cohorts, and thus enter the coastal zone at a larger size.

Examination of the other size class groupings of Kemp's ridleys along the Atlantic east coast, for which we have more than just a few records, reinforces earlier comments on the possibility of a north-south gradient (Table 1), similar to that of the green sea turtle (Carr 1952). The average size increases southward along the coast, giving support to the idea that the smallest ridleys transported out of the Gulf of Mexico are carried by currents north to New England and then shoreward across the continental shelf via Gulf stream gyres (Carr 1980, 1986). Carr and others (Lazell 1980; Meylan 1986) have proposed this and the data presented in this report would appear to agree with such an explanation. Some of these Gulf of Mexico expatriates do not leave the Gulf Stream at this downstream point, but obviously continue their journey to northern Europe and points south in the eastern North Atlantic (Brongersma 1972, 1982; Carr 1980).

There has been considerable debate as to whether these Atlantic expatriates can survive in the North Atlantic and live long enough to return to the Gulf of Mexico to breed. Or, are they all doomed "waifs", destined either to become cold-stunned in the winter or permanently isolated in the Atlantic (Carr

1980)? Historical records and scientific data strongly suggest that some mortality does occur when young ridleys are carried into northern latitudes on either side of the Atlantic and are exposed to the lethal effects of winter temperatures (Lazell 1980; Meylan and Sadove 1986). However, some individuals apparently manage to survive either by being carried farther downstream to warmer latitudes in the eastern Atlantic and/or by some unknown migratory route southward along the coast of the United States to Florida.

In the above case of Atlantic expatriates, our data support the possibility of a seasonal migration south from northern latitudes in the fall, and a subsequent return to northern foraging grounds with the warming of the waters in the spring (Henwood and Ogren 1987). Other workers studying sea turtle populations along the Atlantic coast have also postulated a seasonal migration between the New York Bight and Chesapeake Bay and Florida (Lutcavage and Musick 1985). A similar migratory pattern has been suggested for the loggerhead, as well. Otherwise, it is hard to explain the regular occurrence of significant numbers of viable and healthy turtles in northern waters in the warmer months. The few tag returns we have from ridleys either tagged in Florida and recaptured as far north as Chesapeake Bay, and vice versa, could be indicative of what some members of the population are doing in order to exploit the

crustacean/mollusc-rich foraging grounds north of Florida and avoid being exposed to the low temperatures that occur for part of the year (Figure 2 and Table 3) (Henwood and Ogren in press). Seasonal migrations by other marine poikilotherms are not unusual.

Size distribution for Kemp's ridley along the northern Gulf of Mexico is more or less unremarkable as compared to that of the Atlantic (Table 2). However, some attention should be given to two areas - - western Louisiana and eastern Texas, and Wakulla and Franklin counties, in northwest Florida. The smallest ridleys occur in these areas and are of the appropriate size (20-25 cm CL), that would approximate the growth increment that occurred during the time the hatchling first enters the pelagic stage offshore of the natal beach and the time it enters the coastal benthic stage. However, the precise age of these individuals is not known. Although we have no documented records of ridleys from the pelagic stage, conversations with tuna long-line fishermen indicate that baby turtles do occur in the Gulf. In either case, favorable onshore currents exist that may bring them ashore at these two points east and west of the Mississippi delta. Wind-driven surface currents west of the Mississippi River, and a deeper and more permanent, but variable current in the eastern Gulf--the Loop Current--may be the hydrographic features that are involved. In any event, this small size class

of ridleys, present in the shallow coastal waters of Texas and inshore waters of Louisiana and Florida, has been recorded during our investigation and does support the belief that some percentage of the ridley population spends its entire life cycle within the Gulf of Mexico (Table 2, Figure 1).

Other physical and biological factors, such as temperature, depth, and food items studied during the course of this project could be mentioned, but the data are scanty and much more will have to be collected if we are to discuss relationships with any degree of certainty. For this report, however, a brief summary will identify some of the more interesting correlations that require further study

- Distribution of ridleys along the coastal United States is frequently correlated with areas abundant in portunid crabs , the primary prey species for Kemp's ridley (Dobie et al 1961; Hildebrand 1982). These areas include blue crab nursery grounds, i.e., shallow seagrass beds, and shallow mud bottom bays of coastal marshes, two distinct types of marine habitats.

- Localities where unusual numbers of juvenile ridleys were captured incidental to trawling efforts have been reported since the mid-1970s. They are: (1) Sabine River offing--Sea Rim State Park, Texas; (2) Caillou

Bay, Terrebonne Parish, Louisiana; and (3) Big Gulley, east of the Mobile Bay offing, Alabama.

These events, or "jubilees" in the vernacular of coastal Alabamians, may have been unusual in that they are thought to be correlated with a high density or abundance of blue crabs resulting in a concentration of foraging ridleys. The displacement of deeper hypoxic water landward by offshore winds and a subsequent shoreward migration of demersal prey species is the most logical explanation for this phenomenon. These physical events are not necessarily regular occurrences but appear to be episodic in nature (May 1973; Renaud 1986).

- The shallow coastal waters of the Gulf of Mexico serve as the foraging habitat for Kemp's ridleys throughout the year. A seasonal offshore movement in response to low water temperatures is indicated. Three juvenile ridleys, 20-47.5 cm CL, were captured by trawling at depths ranging from 70-95 feet during late winter and early spring (Jan-Apr) off Apalachicola Bay, Florida. Data on this offshore movement for to deeper and warmer water for northern Gulf ridleys are scanty, however.

On the Atlantic coast, coastal habitats as far north as Massachusetts are utilized by ridleys during the summer months. The New England ridleys frequently succumb to cold temperatures in November-December; others occurring south of Cape Cod may survive and some may migrate south to Florida to overwinter (Ogren and McVea 1982; Henwood and Ogren 1987).

- The preliminary findings, albeit qualitative, suggest that in the United States the Gulf coast from Port Aransas, Texas to Cedar Key, Florida, is the foraging habitat for subadult ridleys in the northern Gulf. Historically, Florida Bay, in the southeastern Gulf, should also be identified but recent information is lacking. On the east coast of the U.S., ridleys are apparently common, but less abundant than in the Gulf, from Cape Canaveral north to Chesapeake Bay. They are found inshore only during spring-summer-fall north of about latitude 29 N. During the winter months they apparently migrate either south or offshore to warmer waters.

- Size and depth relationships were observed for a large sample (n=79) of juvenile Kemp's ridleys from northwest

Florida. The majority (91%) of turtles were captured in depths 20 feet or less, but all of the ridleys less than 25 cm CL, except one, were collected from depths three feet or less.

- A variety of substrates and bottom types were associated with ridley captures and included mud, sand, oyster shell, and turtle grass (Thalassia). No preference was indicated.

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Table 1. Size distribution of Kemp's ridley from the Atlantic coast (order of notation under carapace length: mean, range, number)

Carapace length straight line/cm	Locality	Date	Source
30,27-33(7)	Cape Cod Bay, MA	Nov 1978	Lazell (1980)
35.6, 26.5-43(7)	Sandy Hook Bay/ New York Bight	Jun-Nov 1973-75	Azarovitz (Unpub. data)
41, 27-62(21)*	Chesapeake Bay, VA	May-Nov 1979-81	Lutcavage and Musick (1985)
34.8, 20.3-57.2(21)	Coastal zone, SC and GA	Jun-Nov 1978-83	Henwood and Ogren (1987)
38.6, 24.1-66(40)	Cape Canaveral, FL	Dec-Mar 1978-84	Henwood and Ogren (1987)

* Curved carapace length (approx. 2 cm>straight line measurement)

Table 2. Size distribution of Kemp's ridley from the northern Gulf of Mexico (order of notation under carapace length: mean, range, number)

Carapace length straight line/cm	Locality	Date	Source
53.5, 38-64(72)	Cedar Key, FL	Apr-Nov 1955	Carr & Caldwell (1956)
45.9, 33.5-57(36)	Cedar Key, FL	May-Nov 1984-7	NMFS data
35.5, 20.3-55.9(30)	Apalachicola-Apalachee Bays, FL	Mar-Jan 1970-85	Rudloe/ NMFS data
37.4, 20.3-53(53)	Apalachicola-Apalachee Bays, FL	Jan-Dec 1985-87	Rudlow/ NMFS data
31, 25.8-39(7)	Mississippi Sound and coastal zone, AL	Feb-Oct 1966-83	Carr (1980)/ NMFS data
23.7, 21.6-26.3(5)	Terrebonne and Caillou Bays, LA	June 1984	NMFS data
32.3, 20.3-45.7(61)	Sea Rim State Park, TX	Apr-Nov 1983-85	Texas Parks and Wildlife/STSSN
31, 24.1-39.8(6)	Coastal zone, LA and eastern TX	Mar-Nov 1978	NMFS data

Table 3. Recent recaptures of Kemp's ridleys along the Atlantic coast

Tag number(s)	Date tagged	Locality	Gear	Date recaptured	Locality	Gear
PPF 541-542	11/29/85	Port Canaveral, FL	Shrimp trawl	12/13/86 and 3/23/87	Port Canaveral, FL	Shrimp trawl
PPF 542-54	2/25/87	Port Canaveral, FL	Shrimp trawl	7/28/87	Glynn County, GA	Shrimp trawl

Table 4. Kemp's ridley recaptures, Gulf of Mexico

Tag number(s)	Date tagged	Locality	Gear	Date recaptured	Locality	Gear
NNJ 253	11/7/84	Mississippi Sound, Biloxi, MS	Shrimp trawl	9/16/85	Sabine Pass Jetties, State Line TX-LA	Shrimp trawl
NNZ 674-907	7/6/85	Fidlers Point, Wakulla County, FL	Gill Net	7/9/85	Fidlers Point, Wakulla County, FL	Seine net
NNW 701-702	11/18/85	1 mile offshore Shell Island, Bay County, FL	Shrimp trawl	4/86	3 miles offshore Marsh Island, Iberia Parish, LA	Shrimp trawl
NNZ 219-220	5/31/86	Mud Cove, Franklin County, FL	Shrimp trawl	6/26/86	Mud Cove, Franklin County, FL	Shrimp trawl
NNJ 266	7/15/86	Captured in Mississippi Sound, Released 25 miles offshore Horn Island, MS	Shrimp trawl	8/4/86	E. Deer Island Mississippi Sound, MS	Shrimp trawl
NNJ 267	7/15/86	Horn Island, Mississippi Sound, MS	Shrimp trawl	10/23/86	Dauphin Island, Mississippi Sound, AL	Shrimp trawl
NNW 729-730	7/30/86	Corrigan Reef, Levy County, FL	Turtle net	5/21/87	Corrigan Reef, Levy County, FL	Turtle net
NNZ 231-232	12/7/86	St. George Island, Franklin County, FL	Shrimp trawl	4/3/87	Alligator Point, Franklin County, FL	Shrimp trawl
NNZ 252-253	4/13/87	Shell Point, Wakulla County, FL	Shrimp trawl	4/16/87	Shell Point, Wakulla County, FL	Shrimp trawl

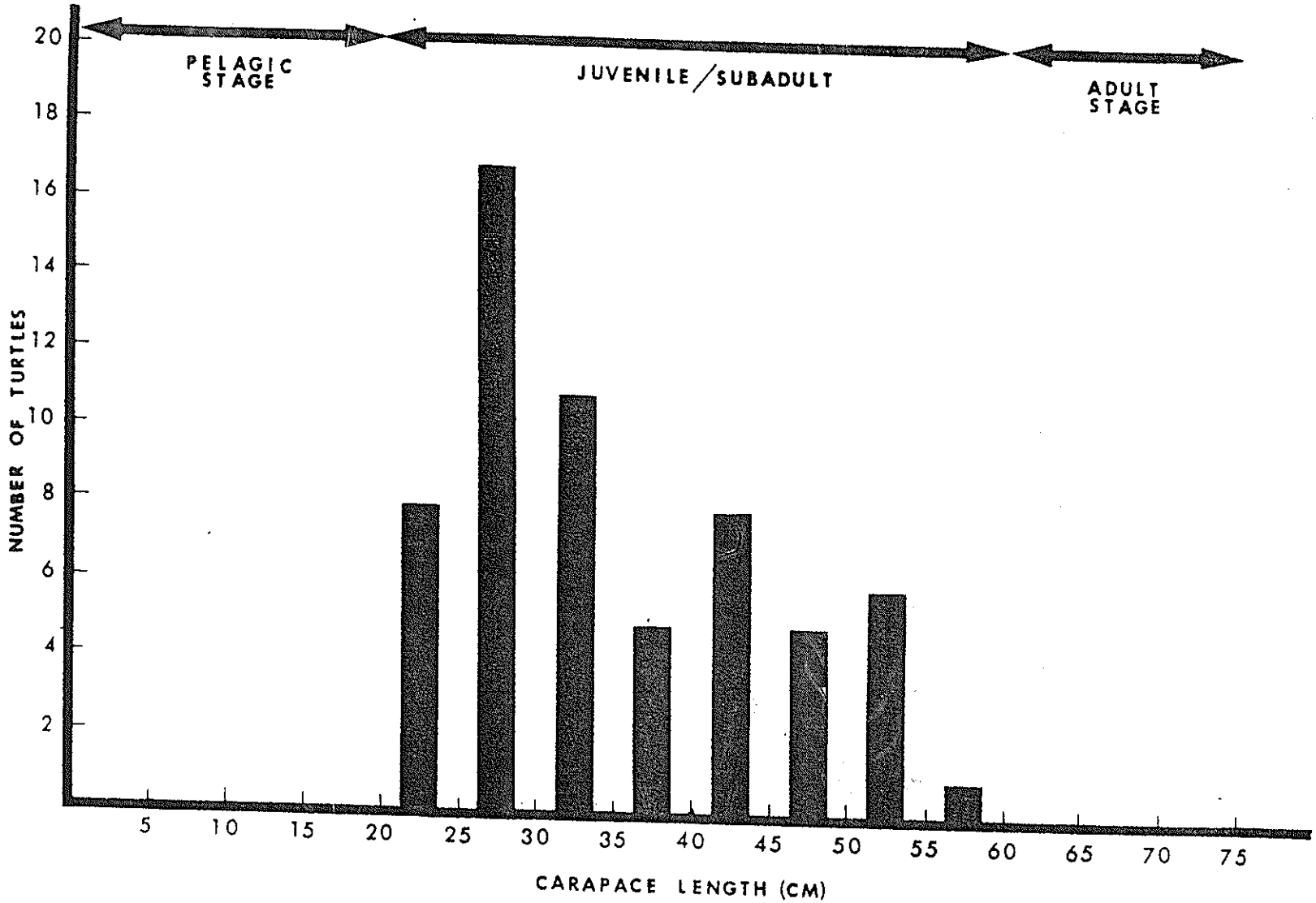

Figure 1. Length frequency data for Kemp's ridley sea turtles captured by shrimp trawls in the NE Gulf of Mexico, 1984-86.

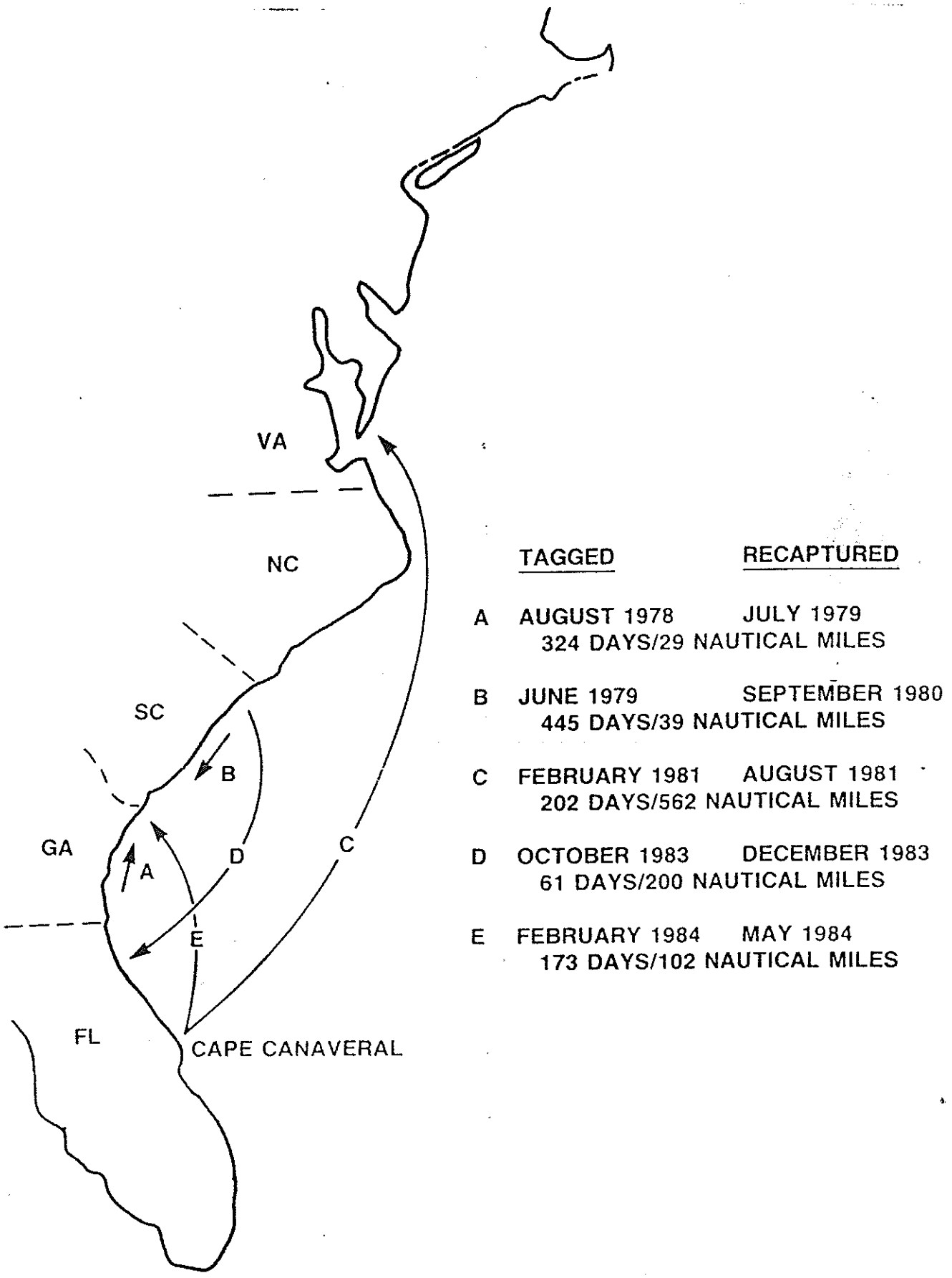

Figure 2. Juvenile Kemp's ridley coastal migrations from Henwood and Ogren (in press).