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Headstarting the Kemp's Ridley Turtle, *Lepidochelys kempi*

ABSTRACT

A summary of the international program to restore and preserve the Kemp's ridley turtle is provided. The program can be divided into 3 main parts: 1) enhancement of nesting success and survival at Rancho Nuevo, Tamaulipas, Mexico; 2) establishment of a second breeding population at Padre Island National Seashore in Texas, and 3) an experimental study to evaluate the concept of headstarting.

In 1978 the Galveston headstart turtle program obtained a 68 percent survival rate and released approximately 2,000 juvenile turtles. The Kemp's ridley turtle is best reared in individual containers to avoid aggressive behavior. Immediate treatment of damaged or ill turtles with antibiotics provided a 95 percent recovery rate. The turtles were released at 3 locations in the Gulf of Mexico. All turtles received flipper tags, and selected turtles released at Everglades National Park and Homosassa, Florida, were equipped with radio transmitters to allow radio-tracking by plane and boat. The yearling turtles did not remain in the areas where released and exhibited pelagic behavior rather than benthic orientation. One animal recovered at Jekyll Island, Georgia, 8 months after release showed an increase of 2,700–4,000 g in weight and provides evidence that 1 of the project objectives, to demonstrate survival after release, may have been met.

Introduction

The Kemp's ridley turtle, *Lepidochelys kempi,* is an endangered species that nests primarily on a single beach in the western hemisphere—Rancho Nuevo, in the state of Tamaulipas, Mexico. In 1947, over 40,000 nesting females used this isolated beach; however, the nesting population in recent years has ranged between only 200 to 500 females a year. Unless positive steps are taken to protect the nesting beach and improve recruitment, the species is threatened with extinction.

Representatives of the U.S. Fish and Wildlife Serv-

Table 1. Summary of nesting and hatching success of Kemp's ridley turtle

Year	Number of nests collected	Estimated number of nesting females	Total number of eggs	Number of eggs in corral	Number of eggs in styrofoam containers (Mexico)	Number of eggs in styrofoam containers (Padre Island)	Hatching rate in corral (percentage)	Hatching rate in styrofoam containers (Mexico) (percentage)	Hatching rate in styrofoam containers (Padre Island) (percentage)
1978	711	450	85,000	65,000	18,000	2,000	57	64	88.1
1979	950	500	97,600	89,000	6,500	2,100	68	80	85.6

Source: U.S. Fish and Wildlife Service.

ice and the National Park Service presented an action plan for the restoration and enhancement of the Kemp's ridley turtle to representatives from the Texas Parks and Wildlife, National Marine Fisheries Service and the Instituto Nacional de Pesca who met in January 1977 in Austin, Texas. This group of state and federal scientists agreed to the proposed plan, which provides for: 1) enhancement of nesting success and survival at Rancho Nuevo, Tamaulipas, Mexico; 2) establishment of a second breeding population at Padre Island National Seashore, Texas[1]; and 3) an experimental study to evaluate the concept of headstarting.

An international program to implement the plan was begun in 1978, and this paper discusses the initial results of the cooperative effort to save the Kemp's ridley from extinction with special emphasis on the headstarting aspects of the program being conducted at the National Marine Fisheries Service, Southeast Fisheries Center's Galveston Laboratory.

Enhancement of Nesting Success and Survival, Rancho Nuevo, Mexico

The Instituto Nacional de Pesca and the Fish and Wildlife Service joined forces on the beach at Rancho Nuevo to protect the eggs and nesting adults and to document the present nesting intensity. Mexican marines patrol the beach to keep predators and poachers away, and Mexican and U.S. biologists record the number of turtles, nests and eggs. Nests are marked at the time of nesting, and the eggs removed and placed in man-made nests within a fenced corral to minimize predation by man and wildlife. A small number of eggs are placed in styrofoam hatching chests for protection and for movement to the United States as part of the establishment of a second breeding population and the headstarting program. In 1978 over 85,000 eggs were collected and protected and in 1979 almost 100,000 eggs were incubated (Table 1). The program is considered successful because more hatchlings have gone to sea than in the years immediately preceding the cooperative international program. We are unaware of the hatching rate before the collection and protected incubation program was initiated in 1978, but we assume because of reduced predation by wildlife and man that the present hatching success is significantly greater now than before.

Establishment of a Second Breeding Population at Padre Island

Not until 1961 was Rancho Nuevo identified as the prime nesting area for Kemp's ridley turtles (Carr 1963; Hildebrand 1963). Small numbers of Kemp's ridley turtles have nested periodically along the lower Texas coast during recent years. The National Park Service requested the Fish and Wildlife Service to conduct a study of the feasibility of establishing a second Kemp's ridley nesting population at Padre Island National Seashore as part of the restoration plan. The study showed that nests laid on Padre Island had been fertile, and that the beach slope and profile and sand grain size at Padre Island were similar to those at Rancho Nuevo. Some differences were noted between air and water temperatures but these were considered insignificant, especially during the nesting season.

The cooperating agencies agreed to attempt the establishment of a second nesting population at Padre Island National Seashore. The mechanical and biological problems associated with transplanting sea turtle eggs have been resolved over many years of effort, and the process is now routine for experienced personnel. However, the mechanisms of imprinting hatchling sea turtles to a given beach are not understood. Factors complicating evaluation of transplanting programs are the enormous mortality of hatchlings in their first year of life and the lack of suitable tagging methods for new hatchlings.

The agencies identified the following factors as the minimum necessary for the potential success of a transplant program to establish a second nesting colony.

1. A natural orientation exposure for hatchlings on the proposed natal beach and near shore waters. Incubation should occur in the sand from the proposed natal beach to ensure proper chemical imprinting dur-

1. 1978-ABC-IV-0751, No. 27611-8786- (Mexican Permit); 1979-ABC-IV1258, Exp. 4287- (Mexican Permit).

ing the incubation period.

2. A captive rearing program of 6 months to 1 year to bring the hatchlings up to a size where, presumably, predator mortality will be reduced and the turtles can be tagged.

3. An adequate technique for marking juvenile turtles to allow recognition as adults.

4. A release program that places the young in the proper area and habitat so they enter the environment at an appropriate place and time in association with naturally occurring young of the same year class.

There was also concern that the low populations remaining in Mexico could not support any removal of eggs for such a program. It was decided, however, to limit the removal of eggs for a transplant program to a small number (less than 5 percent) and that the number of yearling turtles supplied by the headstart program would outweigh any losses of eggs because of the natural high mortality rate during the first year.

In 1978 and again in 1979, approximately 2,000 eggs were obtained from egg laying females at Rancho Nuevo. The eggs were not allowed to touch Rancho Nuevo sand, but were caught and placed in styrofoam containers containing Padre Island sand and then flown to Padre Island for incubation and imprinting. The hatchling turtles were allowed to walk down the beach, from what biologists considered the probable nesting area, to the water where they were allowed to swim a few minutes before being collected and transported to Galveston. Our educated guess is that imprinting on natal beaches occurs during incubation and during the walk down the beach into the water and the swim away from the beach. The study's experimental design provides the hatchlings with this imprinting potential.

Experimental Headstart Program

The culture and later release of turtles in the sea as a means of increasing turtle populations, headstarting, is an unproven management concept. The technique, though practiced by commercial turtle farmers and some government conservation agencies, has never been scientifically tested to determine the degree of reliability as an acceptable management technique. The headstarting program will provide answers to questions raised by researchers concerning the fate of cultured turtles in the sea, such as: 1) Do they survive after release? 2) Do they breed and do they breed where released or on natal beaches? 3) What is the optimum marine habitat to release post hatchlings or juvenile turtles?

Headstarting Kemp's ridley turtles was identified as a major component of the overall recovery plan for this species because: 1) the population has seriously declined to a level that might prevent natural recovery unless recruitment is improved by assisting hatchlings through the first year; 2) in order to verify the establishment of a second nesting beach at Padre Island a headstarting program is required to produce turtles which can be tagged to provide later identification; 3) the project lends itself to scientific evaluation of the headstart technique for turtle management; 4) the headstart period can be used to provide valuable information on the life history of the species; and 5) maintaining hatchlings in captivity provides a possible brood stock should the species face immediate extinction because of an environmental disaster.

The decision to involve the Galveston Laboratory in the Kemp's ridley turtle experiment headstarting program was unanimously approved by U.S. Fish and Wildlife, Texas Parks and Wildlife, U.S. National Parks Service, Instituto Nacional de Pesca, and the National Marine Fisheries Service in the multiagency action plan of January 1978. The rationale for the decision was that the Galveston Laboratory had the necessary physical plant to support the program. The laboratory is the one closest to the natural nesting population and has extensive expertise in aquaculture and has had experience rearing loggerhead turtles, *Caretta caretta*.

Turtle Culture

The Galveston Laboratory has reared turtles for the past 2 years utilizing commercial feeds, semiclosed raceways, and individual containers. Growth and survival rates are carefully recorded and techniques have been developed to control disease and to minimize aggressive behavior between turtles. The ultimate objective is to develop optimal culture techniques and to obtain information on early life history of marine turtles. During July and August 1978, 3,081 Kemp's ridley turtle hatchlings were brought to Galveston and placed in a facility designed to provide optimum water quality and disease control. These turtles had come from 2 incubation and imprinting sites: 1,226 were hatchlings from Rancho Nuevo, Mexico; 1,855 had been incubated and allowed to go to sea at Padre Island National Seashore in the hope of imprinting them to a new beach so that a second nesting population could be established (Table 2).

Continuous modifications of the holding systems and disease treatments have led to increased survival and disease control. The survival until 9 May 1979, the time of the final release, was 68 percent. Several individuals had reached 1,200 g, but the average size at both release times was about 600 g.

The present holding system contains 15 raceways each with 106 buckets with perforated bottoms, 9 tanks 2-m in diameter also containing perforated buckets and 210 individual basins. Four 24,000-liter insulated reservoir tanks are equipped with immersion heaters to

Table 2. Headstarted Kemp's ridley hatchlings received and released in 1978 and 1979

Site of imprinting	*Arrival date*	*Number*	*Average weight (g)*	*Number released*	*Survival released (percentage)*
Padre Island	3–8 August 1978	1,855	17	1,321	71
Rancho Nuevo	11 August 1978	1,266	17	749	61
Padre Island	7–24 July 1979	1,658	14.5	—	—
Rancho Nuevo	26 June 1979	188	14.5	—	—

warm the water in winter. This system allows for the individual maintenance of 2,000 turtles. Two 40,000-liter waste treatment tanks process turtle wastewater before the effluent is released from the facility.

Results of experiments to determine optimum foods and feeding rates disclosed no significant differences between combinations of fresh foods and turtle pellets, and turtle pellets alone. No difference in growth rates was observed between single or multiple daily feedings. Pelleted turtle feed was chosen for its convenience and good growth results, but we do feel that feeding live shrimps, crabs and fish before release helps prepare young captive turtles to feed in the wild. The turtles did not hesitate to feed on natural foods when presented with live foods. Figure 1 shows no difference in the average growth rate between Rancho Nuevo and Padre Island imprinted turtles fed pelleted food. Turtles reached an average size of 153 g, 336 g, and 587 g in 3, 6, and 8 months, respectively (Wheeler, NMFS, personal communication).

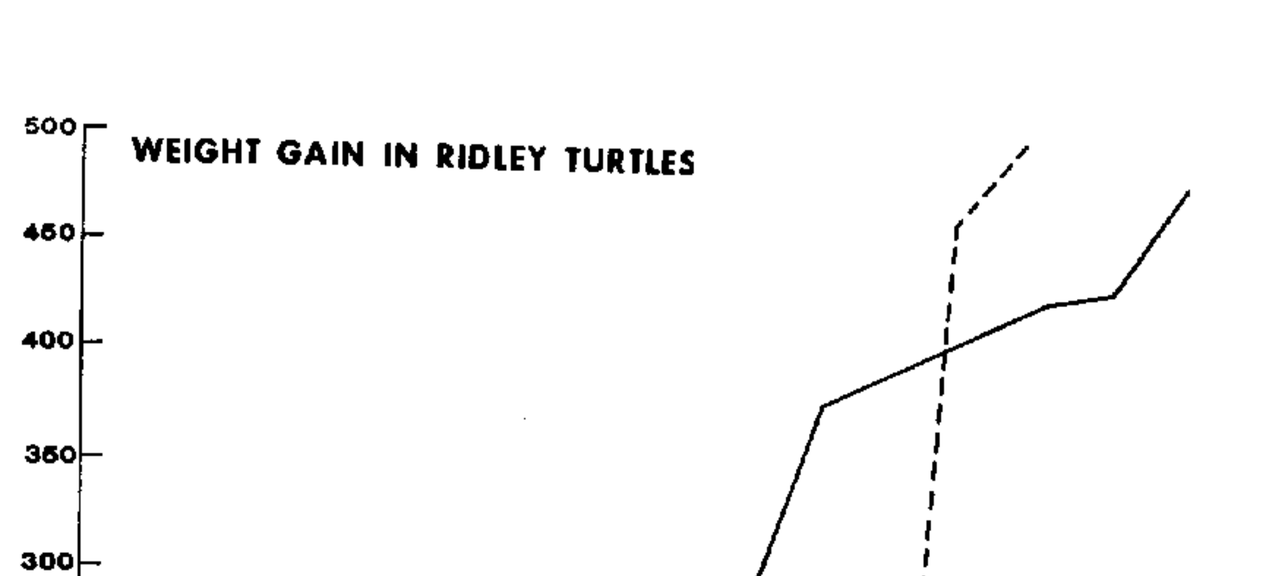

Figure 1. Average growth-in-weight curves for cultured Kemp's ridley sea turtles hatched at Rancho Nuevo, Mexico, and Padre Island, Texas.

Disease Control and Behavior

Aggressive behavior between turtles was the greatest problem in holding Kemp's ridley turtles. The physical damage caused by biting opened the way for secondary infections, which would cause death if not treated in time. Early detection of damage and immediate treatment with ampicillin and other antibiotics resulted in recovery of 95 percent of the damaged turtles. Healing was facilitated by isolating damaged turtles in individual buckets within a raceway. This was adopted as the best way of preventing the damage that leads to infection and mortality. Also, labor was reduced once turtles were placed in buckets within the raceway.

Behavioral experiments to determine methods of controlling aggressive behavior have been started and preliminary results show there is a hierarchy within groups of turtles; certain turtles are more aggressive than others regardless of hierarchy; and high temperature and corresponding higher activity lead to more aggression (Howe, University of Houston, personal communication). This work is continuing, and we will use the information obtained to design better holding facilities for turtles, in the hope of enabling us to culture the majority in groups for easier maintenance.

Disease is a major problem in the mass culture of Kemp's ridley turtles. At least 16 kinds of disease conditions have been observed in the headstarting program, and some have been significant causes of mortality (Leong, NMFS, personal communication): eyelid infection, emaciation syndrome, fungal infection of the lung, peritonitis, and intestinal obstruction. These diseases are particularly noticeable in group-held turtles, which are under more stress than individually held turtles. Techniques to improve diagnostic capabilities, i.e., X-ray and hemotological analyses, are being developed.

Release of Cultured Turtles

The release and later nesting of cultured turtles is the aim of the program. The release location of cultured turtles is extremely important in that Drs. Carr, Hildebrand, Márquez, and Pritchard, and our staff, have agreed to select sites that place young turtles in the habitat they would normally encounter in the wild.

Unfortunately, there is little information available concerning distribution of juvenile ridley turtles. After searching the literature and reviewing unpublished data, we have concluded that south Florida and Homosassa, Florida, are suitable habitats for releasing cultured juvenile turtles. In 1979, we planned to release 400 g cultured turtles as soon as enough of the 1978 year class achieved this size. By February, several hundred turtles were ready for release. South Florida was selected as the best location for the mid-winter release because of the warmer water temperatures and the natural occurrence of the species in the area. A total of 525 Padre Island imprinted turtles were released between 22 February and 5 March 1979 at Everglades National Park. A second site was selected for a spring release off Homosassa, which appears to provide an ideal habitat for green turtle populations. Ridley turtles had historically made some use of this area. A total of 1,368 turtles, of both Rancho Nuevo and Padre Island imprinted turtles were released off Homossassa on 8

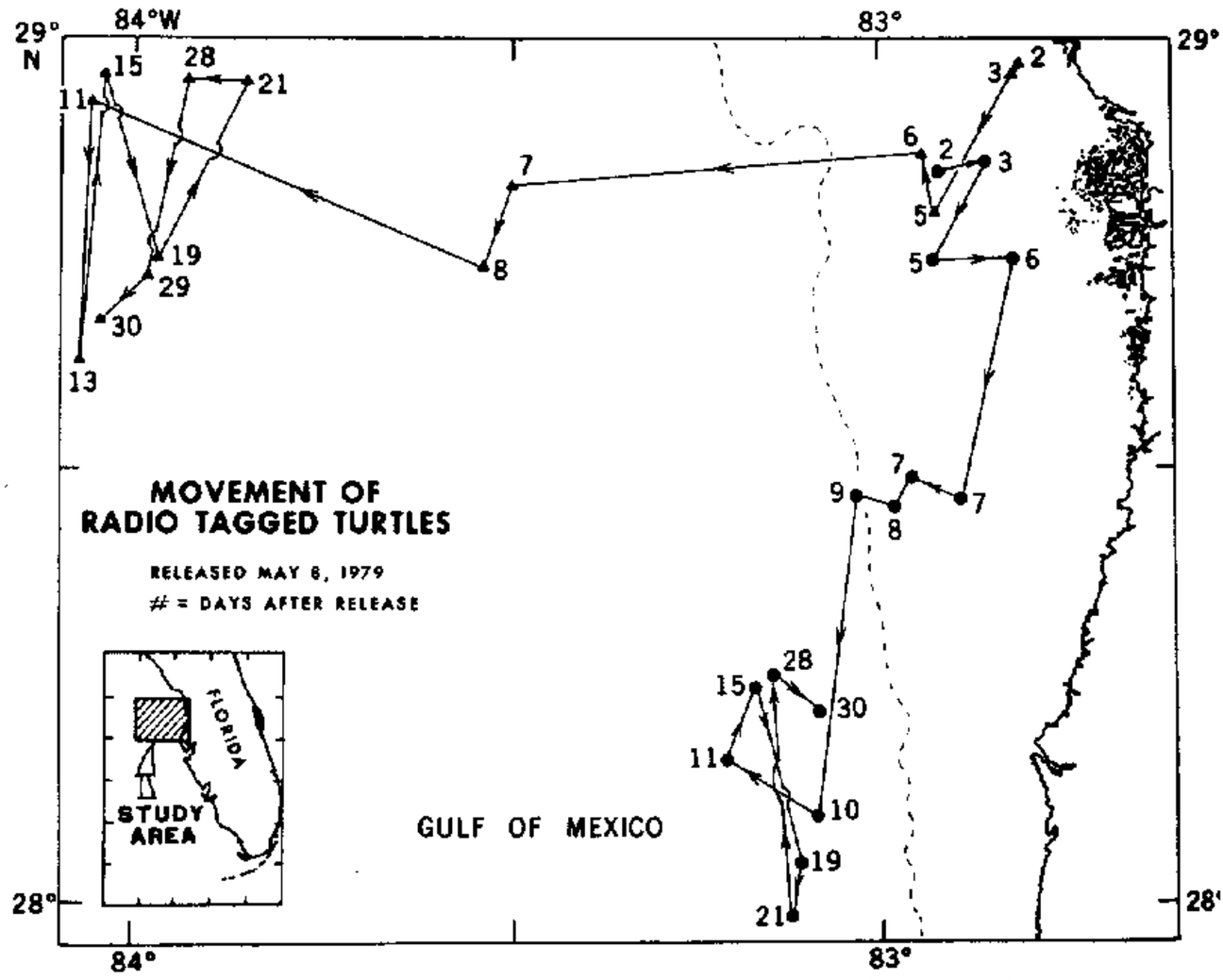

Figure 2. Chart of tagged radio tracked Kemp's ridley turtles released 8 May 1979 off Homosassa, Florida.

Table 3. Recovery of Kemp's headstarted turtles

Released	*Recovered*	*Days out*	*Condition*	*Rereleased*
1. Cape Sable	Florida Keys	49	Healthy[1]	Yes
2. Cape Sable	Del Ray Beach, Fla	21	Injured[1]	Yes
3. Cape Sable	Florida Keys	14	Healthy	Yes
4. Cape Sable	Florida Keys	25	Healthy	Yes
5. Cape Sable	Florida Keys	32	Healthy	Yes
6. Cape Sable	Miami, Fla.	47	Weak	Yes
7. Cape Sable	Pompano, Fla.	66	Healthy	Yes
8. Cape Sable	Key Biscayne	26	Thin[2]	Yes
9. Cape Sable	Florida Keys	32	Healthy[1]	Yes
10. Cape Sable	Florida Keys	40	Feeding	Yes
11. Cape Sable	Florida Keys	31	Slow	Yes
12. Cape Sable	Miami, Fla.	54	Tar	Yes
13. Cape Sable	Florida Keys	55	Healthy	Yes
14. Cape Sable	Florida Keys	17	Healthy[1]	Yes
15. Cape Sable	Florida Keys	28	Dead	No
16. Cape Sable	Florida Keys	31	Poor	Died
17. Cape Sable	Jekyll Island, Ga.	234	Excellent[3]	Yes
18. Homosassa, Fla.	Mississippi Sound	51	Healthy[4]	Yes
19. Homosassa, Fla.	Port Everglades	120	Healthy	Yes
20. Homosassa, Fla.	Homosassa, Fla.	1[5]	Healthy	Yes
21. Homosassa, Fla.	Homosassa, Fla.	1[5]	Healthy[1]	Yes
22. Homosassa, Fla.	Clearwater, Fla.	19	Healthy	Yes
23. Homosassa, Fla.	Homosassa, Fla.	1[5]	Healthy	Yes
24. Homosassa, Fla.	Weeki-Wachee Springs	48	Healthy[1]	Yes
25. Homosassa, Fla.	Port Richie, Fla.	42	Healthy	Yes
26. Homosassa, Fla.	Homosassa, Fla.	1[5]	Healthy[1]	Yes

1. Flipper injured or gone.
2. Found in parking lot.
3. Gained 2,700–4,000 g.
4. Increase of 394 g in weight.
5. Easy to catch.

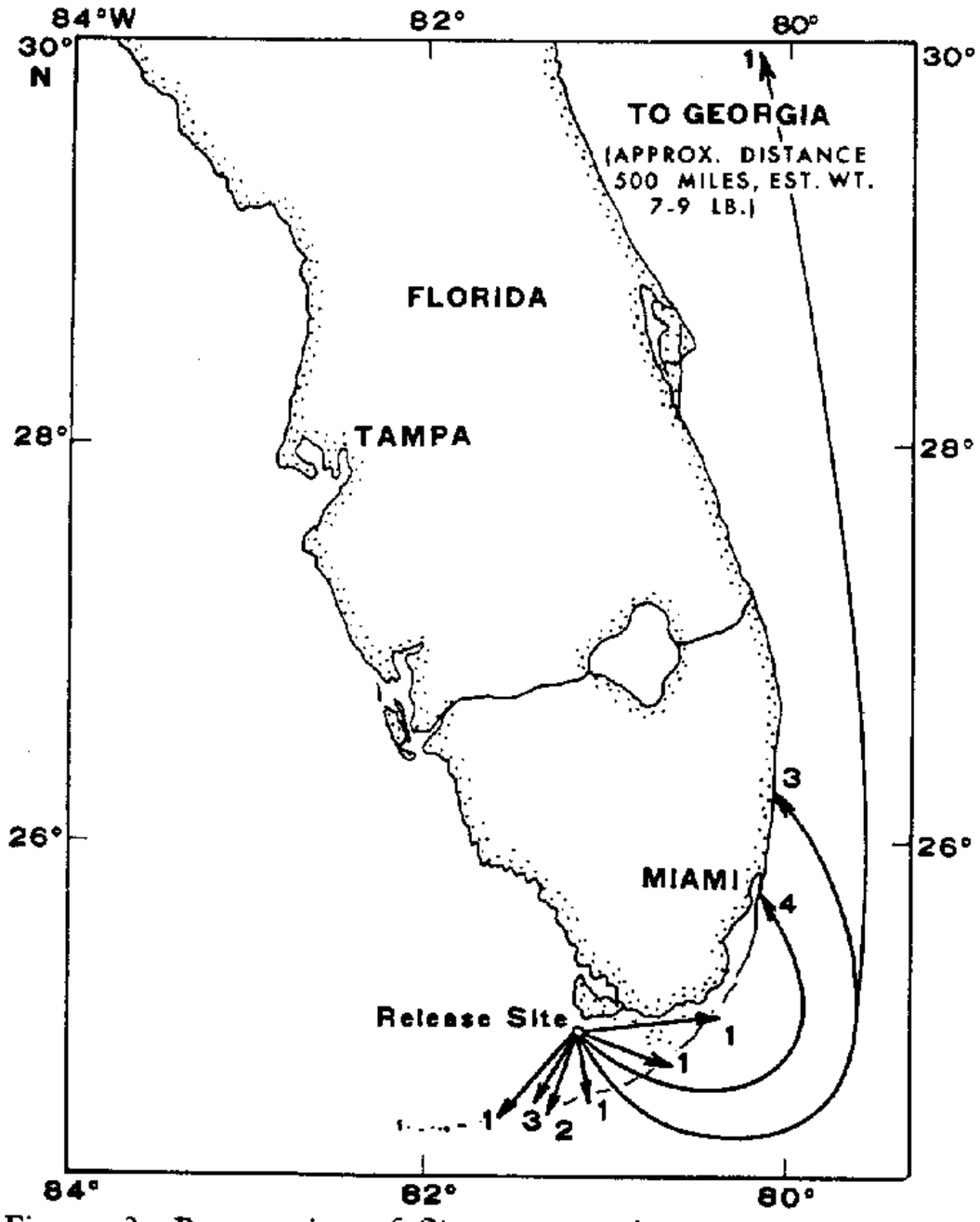

Figure 3. Recoveries of flipper tagged turtles released 22 February 1979 to 5 March 1979 at Everglades National Park.

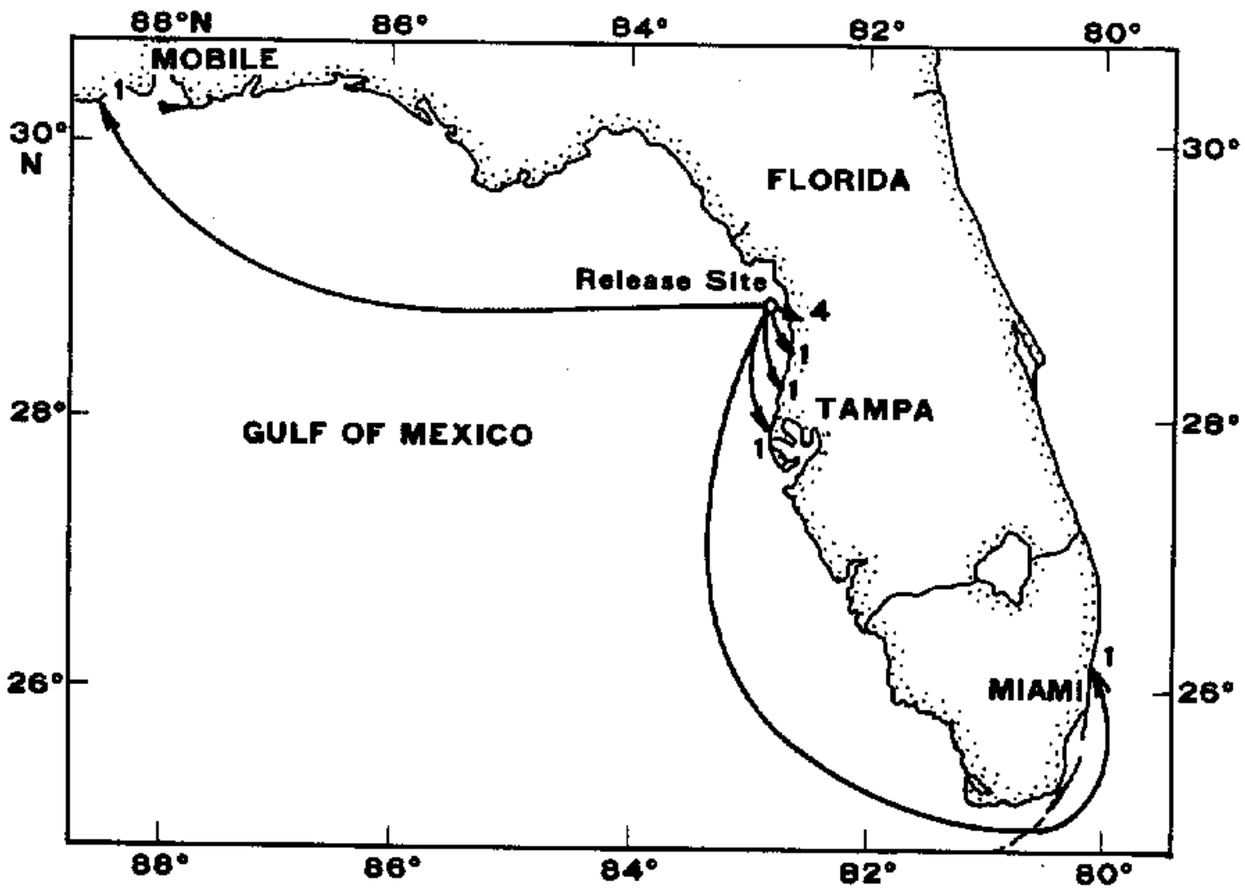

Figure 4. Recoveries of flipper tagged turtles released 9 May 1979 at Homosassa, Florida.

and 9 May 1979. A third area was Padre Island's National Seashore Park, because of the attempt to establish a second nesting beach at that location, at which 98 turtles were released in July.

An integral part of this year's program was to determine the movement and survival of the young Kemp's ridley turtle after release. All released turtles were tagged with monel flipper tags, and 10 to 12 turtles in the first 2 releases were equipped with small radio-transmitters and were followed by plane and boat. Some turtles were tracked for as long as 30 days; diving behavior and movement were observed.

Preliminary analysis shows that the transmitters were essential in determining probable movement of the released group. Many of the radio-tracked turtles were observed diving and behaving normally during the 30-day tracking period. Several transmitters became detached during tracking, indicating that a better means of attachment is necessary. Because of possible detachment of transmitters we visually verified attachment of the transmitters to the turtles by locating the transmitters from planes and directing a boat to the site for location using a hand-held receiver and visual verification. Using this method we were able to find several transmitters that had broken away. We were also able to verify the attachment of a transmitter to a turtle after one week thus validating all earlier plane observations. The movements of 2 turtles after the Homosassa release are plotted in Figure 2. These turtles were representative of 2 trends of movement observed in the 10 turtles with radio-transmitters. One group of radio-tagged turtles tended to move offshore (west) and another group moved along shore (south). They remained in the immediate area of the release for 5 to 6 days and then a significant movement of 80 to 160 km occurred, either west or south. The turtles stayed in the same general area until the completion of the 30-day tracking period. We are now trying to relate the movement observed to wind and wave conditions recorded during the tracking period.

The recovery of flipper-tagged turtles through September 1979 has been surprising; thus far, 27 headstarted tagged turtles have been recovered—17 from the South Florida release, 9 from the Homosassa release (Table 3). Twenty-five recovered turtles were captured alive and released; most appeared active and in good health. The turtles recovered from the Everglades Park release were found in the Florida Keys, Biscayne Bay and up the east coast to Delray Beach, Florida. Eight months after release, the weight of 1 turtle recaptured off Jekyll Island, Georgia, had increased 2,700 to 4,000 g. The turtles recovered from the Homosassa release were found south of the release point to Tampa, but there were recoveries from Biloxi, Mississippi, and Fort Lauderdale, Florida (Figures 3 and 4). Several recoveries have occurred after 6–8 weeks.

Many of the recoveries occurred within estuary systems or inside of barrier islands, indicating a possible orientation to brackish-water conditions. We feel, however, that it is still too soon to make any conclusions regarding yearling turtle habitat preference.

These results tend to confirm that headstarted Kemp's ridley turtles survive in the wild and that a major question concerning the effectiveness of the program can be answered in the affirmative.

Future Plans for Kemp's Ridley Headstart Program

In July 1979, 1,846 hatchling Kemp's ridley turtles were received in Galveston. This year the turtle research program will emphasize studies of the early life history requirements of marine turtles. Behavioral studies to help in the modification of aggressive behavior and to determine orientation to chemical and physical parameters will be conducted. Further work will be done on developing systems for holding the turtles in groups and on the development of semiclosed systems, which will reduce the need to heat large volumes of water during the cold winter months. Special attention will be given to improving disease diagnosis and control. We also hope to consolidate the information gained thus far into a manual on turtle diseases and cures.

If labor and space permit, other species of turtles will be maintained so that early life history requirements between species can be compared. Tagging and release studies will be continued to obtain additional information on survival and movement after release.

The final evaluation of the program will take many years as we must wait for the effects of our work to appear on nesting beaches, either at Rancho Nuevo, Padre Island, or elsewhere. The actual age to sexual maturity is not known, but estimates range from 5 to 10 years and older.

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