INTRODUCTION

The Kemp's ridley sea turtle, Lepidochelys kempi, is the most endangered of the sea turtles. Since 1978, the National Marine Fisheries Service (NMFS) has been participating in an international recovery program to save the Kemp's ridley from extinction. Cooperating in the Kemp's ridley recovery program are the Instituto Nacional de la Pesca (INP) and Secretaria de Desarollo Urbano y Ecologia (SEDUE) of Mexico, the U.S. Fish and Wildlife Service (FWS), the U.S. National Park Service (NPS) and the NMFS. Also assisting are the Texas Parks and Wildlife Department (TPWD), the Gladys Porter Zoo, the Florida Department of Natural Resources (FDNR), the U.S. Coast Guard, the U.S. Navy, and Texas A&M University. The goal of the program is to increase the population of Kemp's ridleys through protection of the only known nesting aggregation near the village of Rancho Nuevo, Tamaulipas State, Mexico, and through establishment of a new nesting colony at Padre Island, near Corpus Christi, Texas. The program, initially planned for ten years, is now in its seventh year.

Kemp's ridleys are head started at the Galveston Laboratory as part of the NMFS Southeast Fisheries Center's (SEFC) Protected Species Program. Head starting involves rearing the animals in captivity during their first year of life. Eggs collected by the FWS from the nesting beach near Rancho Nuevo are incubated by NPS personnel at the Padre Island National Seashore near Corpus Christi, Texas, and the hatchlings are "imprinted" by exposure to the Padre Island sand and surf. After "imprinting," the hatchlings are transferred to the NMFS Galveston Laboratory, usually by U.S. Navy aircraft. The hatchlings are reared in captivity for 10-12 months, then survivors in good health and condition are tagged and released into the Gulf of Mexico, usually from a U.S. Coast Guard cutter, and their recoveries are monitored by NMFS. A limited number of head started Kemp's ridleys are transferred to marine aquaria and a turtle farm for extended head starting and captive breeding. In addition, head starting provides opportunities for the study of survival, growth, reproduction, behavior, physiology, and pathology of Kemp's ridleys in captivity.

OBJECTIVES

The goal of the Sea Turtle Head Start Research Project at the Galveston Laboratory is to test feasibility of increasing the population of Kemp's ridleys through head starting. The primary objectives of the project are:

(1) to provide care, maintenance, and husbandry to each year-class of head started Kemp's ridley sea turtles so as to increase their survival and optimize their growth during the critical first year of life;

(2) to tag healthy survivors of head started Kemp's ridleys and release them into their natural environment;

(3) to monitor survival, growth, maturation, and reproduction of head started/tagged/released Kemp's ridleys based on reported recoveries of tagged animals; and

(4) to carry out extended head starting so as to provide larger, older Kemp's ridleys for tagging and release.

A secondary objective is to expand the captive stock of Kemp's ridleys to provide potential breeders as a "safety net" for the species.

Criteria for measuring success of the project are:

(1) increased survival and optimized growth during head starting of Kemp's ridleys;

(2) survival, growth, migration and tag retention of head started/tagged/released Kemp's ridleys in the wild;

(3) return of head started/tagged/released Kemp's ridleys to lay eggs on any beach;

(4) return of head started/tagged/released Kemp's ridleys to lay eggs on beaches where hatchlings were "imprinted;" and

(5) reproduction of head started Kemp's ridleys in captivity.

HEAD STARTING METHODS

The sea turtle head start research facilities[1/] at the Galveston Laboratory are comprised of (1) two quonset huts (each 36 x 96 ft) constructed of tubular, aluminum framing covered with double layers (inflated) of polyethylene sheathing which allow penetration of sunlight; (2) 15 830-gal, fiberglass, rectangular raceways used for rearing sea turtles; (3) 210 6-gal, fiberglass, hemispherical basins, some of which are used for rearing sea turtles, and others for isolation and treatment of their diseases and injuries; (4) six fiberglass reservoirs for seawater (combined capacity of 50,000 gal), (5) two fiberglass, wastewater digestion tanks (combined capacity of 20,000 gal) and associated equipment, (6) a house-trailer providing office and laboratory space, and (7) miscellaneous equipment, supplies and storage facilities.

Within each raceway, 108 plastic buckets, each with 12 1-in holes in their bottoms, are suspended in seawater. Because Kemp's ridleys are aggressive, they are reared in isolation by placing them in separate buckets to prevent them from attacking and injuring one another.

1/Fontaine, C. T., K. T. Marvin, T. D. Williams, W. J. Browning, R. M. Harris, K. L. W. Indelicato, G. A. Shattuck and R. A. Sadler. The husbandry of hatchling to yearling Kemp's ridley sea turtles (*Lepidochelys kempi*). Manuscript in preparation, NMFS SEFC Galveston Laboratory, Galveston, Texas.

Seawater for the operation, pumped from the Gulf of Mexico near the Galveston beachfront south of the facilities, is filtered by suction through well-points buried in sand under water[1/]. Suspended particulates are allowed to settle before the seawater is transferred to the six reservoirs adjacent to the quonset huts. The quonset huts are ventilated by exhaust fans during the summer, and heated by forced-air heaters in winter. The seawater in four of the reservoirs is heated by immersion heaters during the winter.

The seawater in raceways containing turtles is replaced completely with clean seawater three times a week[1/]. The raceways are scrubbed once each week to remove turtle excrement, algae, and unconsumed food. Wastewater from the raceways is transferred to the two digestion tanks where it is aerated. After aeration, the suspended solids are allowed to settle for 4-6 hr, then the effluent is drained from the digestion tanks and discharged into the municipal sewerage system.

Head started turtles are fed a dry, floating, pelleted diet (modified trout chow) manufactured for sea turtles by PURINA[2/]. As hatchlings, they initially are fed a daily amount near 5.0% of their body weight[1/]. This daily ration of pelleted food is adjusted gradually during the head starting period until it approaches 1.5% of the body weight for yearlings. The daily ration is based on the average body weight of randomly drawn samples of animals weighed at monthly intervals. This ration is divided into two equal portions, one fed in the morning and the other in the afternoon. Water temperature, salinity, pH, and general welfare of the turtles are monitored. Selected data are entered, validated, edited, and stored in computer-compatible media for access and statistical analysis.

[2/]Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Diseased or injured turtles are isolated for treatment by being transferred to the sick bay located in one of the quonset huts[1/]. Samples of those that die are necropsied. In cases of epizootics, Dr. Jorge Leong and his staff have investigated the causes of death, provided advice, and participated in remedial treatments[3/].

Surviving yearlings in good health and condition are tagged with coded, monel tags (supplied by the SEFC's Protected Species Program) affixed to the trailing edge of the right front flipper (some turtles also are tagged on the left front flipper)[1/]. Other marking methods are being tested. These include the "living-tags" (transplants of plastron tissue to the carapace), internal, binary-coded, magnetic metal tags, and radio-transmitter tags. Needed is a mark or tag that can be applied to all sizes of turtles, that will remain on a turtle throughout its life, and that can be easily recognized when the turtle is recaptured, found stranded, or when it returns to a nesting beach.

[3/]Leong, J. K., D. L. Smith, D. B. Revera, J. C. Clary III, D. H. Lewis, J. L. Scott and R. A. DiNuzzo. Health care and diseases of captive hatchlings of the loggerhead and Kemp's ridley sea turtles. Manuscript in preparation, NMFS SEFC Galveston Laboratory, Galveston, Texas.

HURRICANE DAMAGE

Hurricane Alicia crossed Galveston island on August 18, 1983. This hurricane virtually destroyed the original quonset hut, adjacent storage sheds and the wastewater treatment facilities[1/]. While repairs were in progress, major modifications were made for more efficient operation and management of the facilities. The original quonset hut was divided into two separate quonset huts, one housing 10 raceways and the other housing five raceways and the hemispherical basins.

EXTENDED HEAD STARTING AND CAPTIVE BREEDING

A group of 25 head started/tagged Kemp's ridleys from the 1982 year-class was distributed among five marine aquaria to add to those already maintained at three other locations (Table 1). These may be released into the natural environment as older animals or retained in the captive stock of potential breeders. They, as well as other Kemp's ridleys held in captivity, also provide opportunities for extended observations of survival, growth, behavior, reproduction and retention and recognition of tags. One of the 25 turtles died during the fiscal year at Gulfarium; the remaining 24 are in good condition. Of the 24 survivors, 12 (50%) lost at least one monel flipper tag. Nine of the survivors had been doubled-tagged with monel flipper tags; five (56%) of these lost one of the tags and one (11%) lost both. Steps were taken to replace the tags that were lost. Electrolysis may be one cause of tag deterioration and loss in captivity (Larry Ogren, NMFS Laboratory, Panama City, Florida, personal communication).

In 1980, 100 head started Kemp's ridleys of the 1979 year-class were returned to Mexico (Table 1), and 96 of these were transferred to the Cayman Turtle Farm [1983] Ltd., Grand Cayman, BWI. In August 1984, there were more than 30 survivors (averaging 44 lbs) at the farm. Two of these nested on the farm's artificial beach late in May 1984 (James Wood and Fern Wood, Marine Turtle Newsletter No. 30, p. 12, 1984). According to Wood and

Wood (ibid.), the eggs showed signs of embryonic development and 3 of them hatched. Unfortunately, the three hatchlings died; they were small and had unabsorbed yolk-sacs (James Wood, personal communication, August 1984).

As a consequence of this break-through in the project, Charles Caillouet visited the farm in August 1984 to examine the facilities and methods used in rearing the Kemp's ridleys. He also visited Turtle Kraals and Key West Municipal Aquarium in Key West, Florida, Fort Jefferson National Monument in the Dry Tortugas Islands, and the Miami Seaquarium, Miami, Florida, to evaluate facilities and capabilities with a view toward expansion of the stock of Kemp's ridleys in captivity.

A Kemp's ridley weighing 1,120 g was found stranded on West Beach of Galveston Island on August 5, 1984. It was covered with and had ingested petroleum. After it was cleaned with mineral oil by personnel at Sea-Arama Marineworld, Galveston, Texas, it was transferred on August 6 to the head start facilities. It recovered fully and is growing on a diet of pellets and shrimp. It was nicknamed "Oiliver" by the head start staff. On October 5, it was tagged with monel tag no. NNP930, and will be kept in captivity pending further disposition.

1983 YEAR-CLASS

All but two survivors of the 1983 year-class were tagged with monel flipper tags in May 1984, and were released on June 5, 1984, 20 nautical miles off Mustang Island (near Corpus Christi, Texas) in cooperation with the U.S. Coast Guard, Port Aransas, Texas. Of the 190 tagged yearlings released, 172 had been "imprinted" at the Padre Island National Seashore and 18 at Rancho Nuevo, Mexico. The latter 18 had been used in experiments on imprinting by Dr. David Owens and his graduate students at Texas A&M University, College Station, Texas. Six of the tagged/released turtles were found stranded on the Mustang Island beaches within 2 weeks following their release. Four were covered with petroleum and suffered from ingestion of tar balls. Of these, two were alive and two were dead (tags no. NNQ651 and NNQ655) when found. The two additional live ones were not

oiled. One of these (tag no. NNQ680) was in good enough condition to be released near the same location and on the same day it was found. The other three live ones (tags no. NNQ518, NNQ569 and NNQ507) recovered and were released on July 7, 1984, by Dr. Anthony Amos of the University of Texas Institute of Marine Science, off Hospital Rock, approximately 38 mi offshore from Port Aransas at 27°32.19'N, 69°27.94'W.

The two head started turtles of the 1983 year-class that were not released were stunted. They are being maintained in the head start facility and are being used in a test of internal, binary-coded, magnetic metal tags.

1984 YEAR-CLASS

Hatchlings of the 1984 year-class were received from the NPS between July 24 and 27, 1984. Of the hatchlings received, 40% had been "living-tagged" by Dr. and Mrs. John Hendrickson (University of Arizona, Tucson, Arizona) at Padre Island prior to shipment. Of the 1,547 received, 1,441 were alive. Within 10 days of their receipt, an additional 247 hatchlings died. As of October 11, there were 1,179 survivors.

As of October 11, 1984, the surviving hatchlings of the 1984 year-class had an average weight, by raceway, ranging from 72.2 to 111.9 g. In general, the overall health of the year-class appeared to be good. Only two hatchlings of the 1984 year-class were recognized as abnormal when received: one with a cross-beak and another with no eyes.

The pelleted food used to head start the six previous year-classes (1978-1983) of Kemp's ridleys did not float as required for the surface-feeding hatchlings. The usual ration had to be doubled in order to obtain enough floaters for adequate feeding. A substitute supplier (PURINA[2/]) was selected to provide the remaining food needed to rear the 1984 year-class. HEART (Help Endangered Animals-Ridley Turtles), a private organization based in Houston, Texas, purchased all the food for the 1984 year-class.

All the 1984 year-class turtles will be tagged with "living-tags" and internal, binary-coded, magnetic metal tags, as well as with monel flipper

tags, after they reach the proper size for such tagging.

On September 21, 1984, 12 olive ridley, L. olivacea, hatchlings were received from Ross Witham, FDNR, Jensen Beach, Florida. These also are being head started. Currently, there are six survivors, but they have exhibited much slower growth than the Kemp's ridleys.

SUMMARY BY YEAR-CLASS

As shown in the summary of results (Table 2), 8,241 Kemp's ridleys representing six year-classes (1978-1983) have been tagged and released, and 378 (4.6%) of these have been recovered (Table 3). For each year-class the actual percentage survival over the head starting period was slightly higher than the percentage released because abnormal turtles were not released, and some turtles were retained in captivity for extended head starting and captive breeding (Tables 1 and 2). Growth and survival of the 1978-1983 year-classes have been described by Caillouet et al.[4/]

FUTURE RESEARCH

Head starting of the 1984 year-class of Kemp's ridleys will continue, with release tentatively scheduled for June 1985. It is expected that not more than 50 animals from this year-class will be distributed among various organizations and agencies to increase the captive stock for extended head starting and captive breeding. Hatchlings of hawksbill sea turtles, Eretmochelys imbricata, and black sea turtles, Chelonia agassizi, may be made available by the FWS for head starting at the Galveston Laboratory in the future.

Experiments on the 1984 year-class of Kemps ridleys are underway to evaluate the effects of feeding level, feeding frequency, clutch,

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[4/] Caillouet et al. Early growth and survival of Kemp's ridley sea turtles, Lepidochelys kempi, in captivity. Manuscript submitted to the editor of Fishery Bulletin.

and raceway. Dr. Andre Landry and his students at Texas A&M University at Galveston are conducting a morphometric examination of growth in 100 animals of the year-class, in an attempt to develop a non-harmful method of distinguishing the sexes at early ages in live specimens. We are hopeful that this study can be extended in the future to larger, older animals held in captivity and nesters at Rancho Nuevo, to develop morphometric methods of distinguishing new recruits from older nesters on the nesting beach. Dr. David Aldrich of Texas A&M University at Galveston conducted preliminary experiments on temperature and salinity preferences in hatchlings of the 1984 year-class, but the hatchlings showed only passive behavior when exposed to environmental gradients. Dr. David Owens is continuing research on imprinting, reproductive physiology, and reproductive behavior in Kemp's ridleys in close cooperation with the Galveston Laboratory.

Future plans include testing of small radio-transmitter tags on hatchlings, both in the laboratory and at Rancho Nuevo, as funding and resources permit. In addition, adults at Rancho Nuevo may be tagged with radio-transmitters, some tracked with radio receivers and others with satellites.

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Carole Allen, Chairperson of HEART (Help Endangered Animals - Ridley Turtles), Houston, Texas, and the members of HEART have helped to increase public awareness of the Kemp's ridley head start research project as well as the need for sea turtle conservation in general. For their efforts, we are especially grateful.

Bea Richardson typed the manuscript through its many revisions.

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Fontaine, Clark T. (edited by Charles W. Caillouet, Jr.). 1984. Cruise report on release of the 1983 year-class of head-started and tagged Kemp's ridley sea turtles (Lepidochelys kempi) on June 5, 1984. 7 p. plus one figure.

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Table 1. Tag numbers and other information for head started Kemp's ridley sea turtles distributed to Cayman Turtle Farm [1983] Ltd. and seven marine aquaria.

Recipient	Year-Class	Clutch No.[a]	Date Shipped	"Living-Tagged"[b]	Internal Tag[c] Code	Flipper Tag Code[d]
Miami Seaquarium Miami, FL	1978	-[e]	11-?-78	Yes/No[f]	None	G series
Sea-Arama Marineworld Galveston, TX	1978	-	11-?-79	No	None	G series
Cayman Turtle Farm [1983] Ltd. Grand Cayman Island	1979	-	7-4-80[g]	No	None	NNA Serie
Marine Life Park, Inc., Gulfport, MS	1982	5	2-6-84	No	(D_1-2;D_2-1)	NNL 665/666
		18	"	Yes	(D_1-2;D_2-10)	NNM 872
		17	"	No	(D_1-2;D_2-16)	NNM 835
		16	"	No	(D_1-2;D_2-17)	NNM 790
		15	"	Yes	(D_1-2;D_2-18)	NNM 703
Gulfarium Ft. Walton Beach, FL	1982	4	1-26-84	No	(D_1-2;D_2-2)	NNL 485/486
		3	"	Yes	(D_1-2;D_2-5)	NNL 437/438 (Died 5/29/84)
		3	"	No	(D_1-2;D_2-8)	NNL 297/298
		4	"	No	(D_1-2;D_2-4)	NNL 475/476
		20	"	No	(D_1-2;D_2-9)	NNM 994 (tag lost 9/?/84)
Clearwater Marine Science Center Clearwater, FL	1982	9	11-9-83	No	(D_1-2;D_2-20)	NNM 106/107
		9	"	No	(D_1-2;D_2-21)	NNM 154/155
		12	"	No	(D_1-2;D_2-32)	NNM 193
		12	"	No	(D_1-2;D_2-33)	NNM 251/252
		10	"	Yes	(D_1-2;D_2-34)	NNM 330
Key West Municipal Aquarium Key West, FL	1982	6	11-9-83	No	(D_1-2;D_2-68)	NNL 902/903
		7	"	Yes	(D_1-2;D_2-64)	NNM 026
		8	"	No	(D_1-2;D_2-40)	NNM 406
		11	"	No	(D_1-2;D_2-41)	NNM 448
		19	"	No	(D_1-2;D_2-42)	NNM 576
Turtle Kraals Key West, FL	1982	10	11-9-83	Yes	(D_1-2;D_2-36)	NNM 353
		7	"	No	(D_1-2;D_2-65)	NNM 023/024
		6	"	No	(D_1-2;D_2-66)	NNL 917
		8	"	Yes	(D_1-2;D_2-37)	NNM 375
		5	"	No	(D_1-2;D_2-69)	NNL 682/683

[a] Used by the NPS at the Padre Island National Seashore and by NMFS at the Galveston Laboratory.

[b] "Living tags" were placed on costal skutes.

[c] Manufactured by Northwest Marine Technology Inc., Shaw Island, Washington. Mention of trade names or commercial products does not constitute endorsement or recommendation of use. The tag was inserted underneath the skin of the right front flipper near the distal end of the humerus.

[d] Monel tags. A single number indicates a tag on the right front flipper. Two numbers separated by a slash indicate double-tags on left and right front flippers, respectively.

[e] No data.

[f] Twenty-three Kemp's ridleys at Miami Seaquarium were "living-tagged" to identify individual animals (Report on "living-tag" marking of Atlantic ridley sea turtles at Miami Seaquarium, by L. P. Hendrickson and J. R. Hendrickson, June 1981, NMFS SEFC, Miami, FLorida). Three were not "living-tagged."

[g] Shipped to Cancun, Mexico. Later transferred to Cayman Turtle Farm.

Table 2. Kemp's ridley sea turtle head start research project data summary by year-classes 1978-1984.

Year-class	Hatchlings received: Inclusive dates[a]	Average wgt. (g)	No. alive	No. dead	Total	Tagged turtles released: Number	Percent[b]	Tagged Turtles Recovered[c]: Number	Percent[d]
1978	7-6-78 8-11-78	16.9	3,080	1	3,081	2,019	65.6	75	3.7
1979	6-26-79 7-23-79	18.1	1,843	3	1,846	1,345	73.0	18	1.3
1980	6-24-80 7-14-80	16.2	1,815	7	1,822	1,723	94.9	84	4.9
1981	7-12-81 8-22-81	20.6	1,864	1	1,865	1,639	87.9	46	2.8
1982	7-6-82 8-16-82	19.2	1,524	0	1,524	1,325	86.9	149	11.2
1983	7-8-83 8-12-83	15.0	250	0	250	190	76.0	6	3.2
1984	7-24-84 7-27-84	16.4	1,441	106	1,547				
Year-classes Combined			11,817	118	11,935	8,241		378	4.6

[a] Month/day/year.

[b] Based on number received alive.

[c] As of February 1, 1985.

[d] Based on number released.

Table 3. Recoveries of head started/tagged/released Kemp's ridley sea turtles.

Year-Class	Numbers Recovered*			Total
	Alive**	Dead	Unknown	
1978	63	8	4	75 (20%)
1979	14	3	1	18 (5%)
1980	46	17	21	84 (22%)
1981	24	17	5	46 (12%)
1982	94	48	7	149 (39%)
1983	5	1	0	6 (2%)
Total	246 (65%)	94 (25%)	38 (10%)	378

*As of February 1, 1985.

**Returned to the environment.