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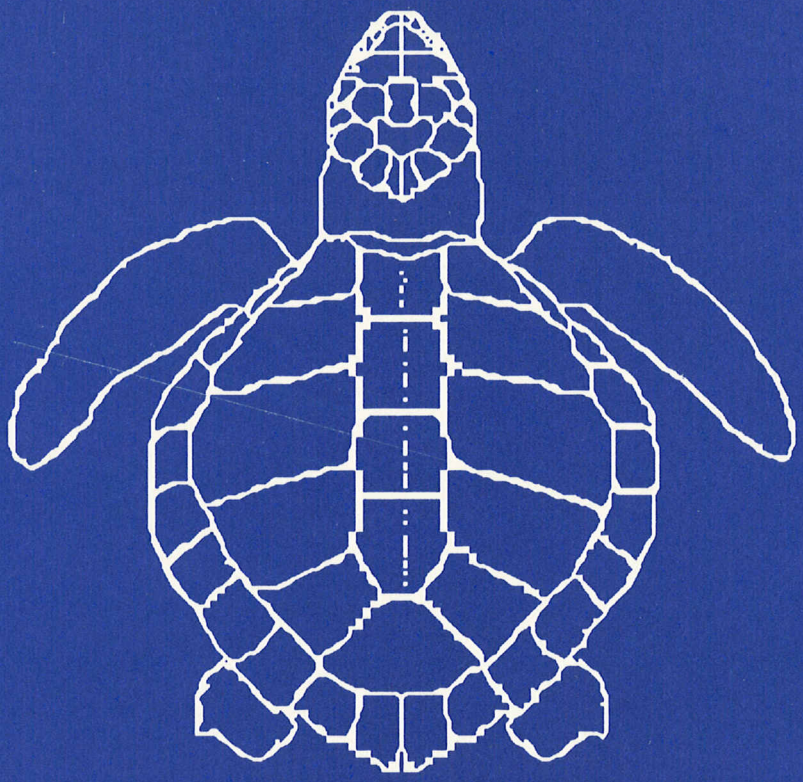
Kemp's Ridley Head Start Experiment and Other Sea Turtle Research at the Galveston Laboratory: Annual Report-Fiscal Year 1989



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Kemp's Ridley Head Start Experiment and Other Sea Turtle Research at the Galveston Laboratory: Annual Report-Fiscal Year 1989

BY

Clark T. Fontaine, Marcel J. Duronslet, Dickie B. Revera,
Theodore D. Williams, Jo A. Williams, Sharon A. Manzella,
Erich K. Stabenau, Andre M. Landry,Jr. and Charles W. Caillouet, Jr.

U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
John A. Knauss, Administrator

NATIONAL MARINE FISHERIES SERVICE
William W. Fox, Assistant Administrator for Fisheries

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EXECUTIVE SUMMARY

The National Marine Fisheries Service (NMFS), Galveston Laboratory completed its eleventh year of the head start experiment by releasing 808 tagged Kemp's ridley sea turtles (Lepidochelys kempi), of the 1988 year-class on 25 May 1989 offshore of Padre Island, Tx. One wild live-stranded and rehabilitated Kemp's ridley (found stranded as a hatchling) also was released with the 1988 head start year-class. Another 45 head started Kemp's ridleys of the 1986 year-class and 45 of the 1987 year-class were released offshore of Panama City, FL between 17-24 May 1989 during turtle excluder device (TED) certification trials conducted by the NMFS Mississippi Laboratories.

Currently, 19,657 Kemp's ridley hatchlings have been received for head starting of which 14,655 have been tagged and released (74.6%). Most hatchlings have been imprinted to Padre Island but some have been imprinted to Rancho Nuevo and Grand Cayman Island. Experiments on captive propagation of head started Kemp's ridleys was successfully completed by the Cayman Turtle Farm (1983) Ltd., Grand Cayman, B. W. I. but relocation of stunted, abnormal, incurably sick or permanently handicapped head started Kemp's ridleys to other organizations or agencies continued.

In July 1989, 2,012 hatchlings of the 1989 year-class were flown by U. S. Coast Guard helicopter to the head start facilities from the primary nesting beach at Rancho Nuevo, Tamaulipas, Mexico, where they had been incubated, hatched and "imprinted."

The Galveston Laboratory continued its participation in NMFS' Sea Turtle Stranding and Salvage Network (STSSN), documenting strandings of sea turtles along the coasts of Texas and southwest Louisiana on a two-week sampling interval. Stranding reports were prepared and submitted to STSSN state coordinators in Louisiana and Texas. Texas A&M University necropsied carcasses of dead-stranded sea turtles to determine sex, reproductive development, food habits and possible cause of death. Marine debris and sea turtle entanglement sampling surveys were continued once per month from West Matagorda Peninsula, TX to the Mermentau River, LA in conjunction with STSSN activities. Sixteen aerial surveys for sea turtles and Sargassum concentrations were conducted along the lower coast of Texas during the Fiscal year (1 October 1988 - 30 September 1989).

During fiscal year 1989, DNA analyses of blood samples from Kemp's ridley and green sea turtles was successfully used to determine sex and routine histological examination for sex determination of gonads and kidneys taken from ridleys that died during head starting continued. In addition, two and three year-old head started kemp's ridleys were used in stress physiology studies related to turtle excluder device (TED) certification trials in Florida. Preliminary results indicate that post-trawl

changes in blood variables are the results of a mixed acidosis containing metabolic and respiratory components.

A study was initiated in fiscal year 1989 to ascertain the level of genetic variation present in populations of Kemp's ridley and to investigate phylogenetic relationships of Kemp's to other sea turtles. There may be major implications to sea turtle conservation and management if the genetic relationship of Kemp's ridley to other sea turtles, especially the olive ridley, are clearly understood. Further, biochemical characterization of Rathke's gland exudate was completed on Kemp's ridley and loggerhead sea turtles and possible functions of the gland were indicated. Amino acid and amino sugar composition of high molecular weight fractions indicated similarities between the two species and the presence of lactic acid, a metabolite produced during anaerobic glycolysis, suggested a possible excretory function of this gland.

On 10-11 August 1989, a Blue Ribbon Panel comprised of Drs. Peter Pritchard, John Hendrickson, Nat Frazer, Mark Grassman and Thane Wibbels conducted a program review of the Kemp's Ridley Head Start Experiment and made recommendations to the NMFS Southeast Regional Office in St. Petersburg, FL concerning future work.

INTRODUCTION

Kemp's ridley sea turtle (Lepidochelys kempi) is the most endangered of the sea turtles. In June 1947, an estimated 40,000 turtles nested in a single day at the principal nesting beach near the village of Rancho Nuevo, Tamaulipas, Mexico, bordering the western Gulf of Mexico (Hildebrand, 1963). During the nesting season from 8 April to 16 August 1989, only 835 nests were found there (Richard Byles, U.S. Fish and Wildlife Service, Albuquerque, NM, personal communication, September 1989).

Head starting is an experiment and is part of an international recovery program aimed at restoring the Kemp's ridley sea turtle population (Klima and McVey, 1982; Woody, 1986). Phases of head starting include collecting, incubating and hatching the eggs, "imprinting" the hatchlings, rearing the hatchlings in captivity for 9-11 months, and tagging and releasing the turtles into the wild (Klima and McVey, 1982; Mrosovsky, 1983; Caillouet, 1984; Burchfield and Foley, 1989: Fontaine et al., 1985, 1989b). One goal of head starting has been to establish a new nesting colony in the United States at the National Park Service's (NPS) Padre Island National Seashore near Corpus Christi, TX.

One working hypothesis for head starting is that eggs and hatchlings become imprinted to their natal beach in such a way that the turtles return as adults to copulate and nest at the same location when mature (Owens, Grassman and Hendrickson, 1982; Klima and McVey, 1982; Caillouet, 1984; Fontaine and Caillouet, 1985; Fontaine et al., 1985, 1989b). This hypothesis remains unproven for any sea turtle species, but recent genetic research by Meylan, Bowen and Avise (1990) on green turtles (Chelonia mydas) supports it. The Kemp's ridley head start experiment is perhaps the largest field test of this hypothesis ever attempted. Another working hypothesis of head starting is that the head started turtles have at least as good a chance of survival after their release as their wild counterparts of the same age or size. Head starting clearly increases survival during the first year of life in captivity as compared to survival of hatchlings in the wild.

The ultimate success of head starting will depend upon documented evidence showing that head started Kemp's ridleys survive, mature and nest on beaches to which they were "imprinted." So far, this criterion of success has not been achieved. Reasons for the failure could include, but are not necessarily limited to:

(1) a longer time to sexual maturity than the current 12 year lifespan of the experiment;
(2) survival rates at sea that are too low to produce sufficient numbers of mature, head started animals for copulation and nesting;
(3) a lack of imprinting;
(4) imprinting to other than the natal beach; and

(5) habituation of turtles to conditions of captive-rearing and human contact that could not be overcome after release.

Of these, item 2 above seems the most likely, considering the wide array of causes of at-sea mortality in sea turtles (Henwood and Stuntz, 1987; Manzella, Caillouet and Fontaine, 1988; Klima, Gitschlag and Renaud, 1988; Fontaine et al., 1989a). However, this does not preclude other reasons.

International teams of biologists and volunteers have collected a small portion (< 5%) of the eggs laid during each nesting season at Rancho Nuevo since 1978. The Instituto Nacional de la Pesca (INP) of Mexico, the U.S. Fish and Wildlife Service (FWS) and its contractors and volunteers have been primarily involved in this phase. Most of the eggs were collected in plastic bags then placed in polystyrene foam boxes containing sand from the Padre Island beach (Burchfield and Foley, 1989). In this way, they were not allowed to touch the Rancho Nuevo sand. Boxes containing the eggs and sand were then transferred by aircraft to the U. S., either to Corpus Christi and thence by vehicle to the Padre Island National Seashore, or by direct flight to the National Seashore. There the eggs were incubated in a hatchery under the surveillance of NPS personnel. Beginning in 1985, incubation temperature was controlled to increase the proportion of female hatchlings (Shaver et al., 1988b). In some years (1978, 1979, 1980, 1983, and 1989) hatchlings also were obtained directly from Rancho Nuevo.

Upon emergence, hatchlings from eggs incubated at the National Seashore were taken by NPS personnel to the Padre Island beach and allowed to crawl into the surf where they were scooped up in dip nets and placed in boxes. After being weighed and measured, the "imprinted" hatchlings were transferred to the National Marine Fisheries Service's (NMFS) laboratory in Galveston, TX, where they were head started for 9-11 months. Most survivors in good health and condition were tagged and released into the Gulf of Mexico. Some were held longer than 1 yr by various cooperating organizations, oceanaria, agencies and universities as a potential brood stock (Caillouet 1984; Caillouet et al., 1986a) and to determine if a longer period of head starting increased survivability following release. Head started turtles kept at the Cayman Turtle Farm, Grand Cayman Island, B.W.I., have been successfully mated, and have produced viable F_1 generation hatchlings (Wood and Wood, 1984, 1989). When the Kemp's Ridley Working Group, comprised of representatives of INP, NMFS, FWS and NPS, held its annual meeting in Brownsville, TX in October 1988, it concluded that enough Kemp's ridleys had been "imprinted" at Padre Island to test the hypothesis of imprinting and to test feasibility of establishing a new nesting colony on Padre Island with head started animals. Thus, Kemp's ridley hatchlings of the 1989 year-class were imprinted at Rancho Nuevo. Since 1985, the NPS has increased its beach patrol intensity at the National

Seashore during the nesting season to search for head started nesters (Shaver et al., 1988a; Shaver, 1989).

ACCOMPLISHMENTS

There have been 19,657 Kemp's ridleys representing year-classes 1978-1989 received alive for head starting as of 30 September 1989 (Table 1). Of these, 14,655 (74.6%) had been head started, tagged and released into the Gulf of Mexico and adjacent estuaries (Table 2). Most (80%) of the hatchlings received alive had been "imprinted" to Padre Island, but some had been "imprinted" to Rancho Nuevo (19%) and Grand Cayman Island (1%).

Feeding, growth and survival of Kemp's ridleys during head starting have been reported by Klima and McVey (1982), Fontaine et al. (1985), Caillouet et al. (1986b) and Caillouet et al. (1989). Growth, migration and survival of the head started, tagged and released turtles have been determined from reports of their recapture or stranding (Manzella et al., 1988; Fontaine et al., 1989a). Diseases have been investigated by Clary and Leong (1984) and Leong et al. (1989).

Sporadic nestings of Kemp's ridleys and observations of a few hatchlings in the surf at Padre Island have been reported by the NPS since 1979, but to date there has been no evidence that such events are linked to head started Kemp's ridleys (Shaver, 1989).

A captive stock of head started Kemp's ridleys was established for experiments in captive propagation as a "safety net" for the species (Caillouet, 1984; Caillouet et al. 1986a). Successful captive propagation of Kemp's ridleys was achieved by Cayman Turtle Farm (1983) Ltd., Grand Cayman, B. W. I. with production of viable hatchlings in 1986, 1987 and 1988 (Wood and Wood, 1984,1989). Responsibility for the captive stock was transferred from NMFS to FWS following the meeting of the Kemp's Ridley Working Group in October 1988 at which time captive propagation was phased out of the recovery program. It was clear at that time that captive propagation was feasible and a proven success, and could be used in the future if all other recovery efforts failed.

Head started Kemp's ridleys that were stunted, otherwise abnormal, incurably sick, or permanently handicapped by injuries were transferred to other organizations, agencies or investigators to be used in research, or to be euthanized (Fontaine et al., 1985, 1989b).

Gonads and kidneys were routinely excised from Kemp's ridleys that died during head starting so that sex of these turtles could be determined histologically (Wibbels et al., 1985). This provided NPS with information necessary to determine the relationship between incubation temperature and sex ratio in Kemp's ridley (Shaver et al., 1988b; King, 1989). Recently, DNA analyses based

on blood samples from live individuals were used successfully to determine sex in Kemp's ridley and green turtles by the Division of Reproductive Genetics, Department of Obstetrics and Gynecology, University of Tennessee, Memphis, TN, in cooperation with the NMFS Galveston Laboratory (Duronslet et al., 1989b; Demas et al., 1990).

Two-year-old and three-year-old Kemp's ridleys reared at the Galveston Laboratory were submerged in trawls containing turtle excluder devices (TED) during TED certification trials off Panama City, FL on 17-24 May 1989. Blood samples were collected from the paired cervical sinuses, before and after 5 min of trawling, and were analyzed for pH, lactate, sodium, potassium, chloride, bicarbonate, total CO^2 and P_{co2}. Results indicated that post-trawl changes in blood variables were the result of a mixed acidosis containing metabolic and respiratory components (Stabenau and Heming, 1989; Stabenau, Heming and Mitchell, MS). This research is being conducted in cooperation with the University of Texas Medical Branch (UTMB), Department of Internal Medicine, Marine Biology Institute and Department of Physiology and Biophysics, as well as the NMFS Mississippi Laboratories and Panama City Laboratory.

A study is underway to ascertain the level of genetic variation present in populations of Kemp's ridley sea turtle and to investigate phylogenetic relationships of Kemp's ridley to other sea turtles, particularly the olive ridley (L. olivacea). Blood samples have been obtained from head started Kemp's ridleys representing three year-classes (1986, 1987, and 1988) and 17 clutches, none of which were laid by the same female. Knowledge of the level of intraspecific variation in the Rancho Nuevo population will aid in determining breeding structures and could lead to more effective management and conservation. This work is being conducted by the Department of Radiation Therapy, Biology Division, UTMB in cooperation with the Galveston Laboratory.

It is important to determine how Kemp's ridley sea turtle is related to other sea turtles especially the olive ridley. Clearly, these two closely related species have been shown to be taxonomically and morphologically distinct (Pritchard, 1989), but it would be useful to determine the degree to which they are genetically distinct or similar. For example, if Kemp's ridley and olive ridley sea turtles were shown to be genetically conspecific, though exhibiting morphological differences related to environmental variability over their ranges, this could have major implications to their conservation and management.

The Galveston Laboratory has participated in the STSSN and has conducted a systematic survey of sea turtle strandings on southwest Louisiana and Texas coasts resulting in documentation of 859 stranded sea turtles since 1985. These strandings are preliminary and do not include all strandings reported to STSSN Headquarters in Miami, FL. Total strandings from southwest Louisiana and Texas

are available from STSSN Headquarters and are shown in preliminary summaries in Tables 3-8 for the years 1984-1989, respectively (see also Schroeder 1988, 1989). Of 859 strandings documented by the Galveston Laboratory's survey, 79 were recovered alive of which 19 Kemp's ridleys were rehabilitated and released. Some rehabilitated wild caught or live-stranded turtles have been tagged with radio-tag, sonic-tag or satellite transmitters and tracked when released.

Sea turtle carcasses collected during STSSN surveys were necropsied by the Department of Biology and Marine Biology, Texas A&M University at College Station and Galveston, respectively, to record biological observations and measurements, and to attempt to determine cause of death (Heinly et al., 1988; Plotkin and Amos, 1988; Plotkin, 1989). Surveys of beached marine debris were conducted in the area from West Matagorda Peninsula, TX to the Mermentau River, LA, and provided an opportunity to document ingestion of marine debris by sea turtles and their entanglement in marine debris (Plotkin and Amos, 1988; Stanley, Stabenau and Landry, 1988).

A study of the biochemistry and possible functions of Rathke's gland secretions of head started Kemp's ridleys and loggerheads (Caretta caretta) has been conducted by Radhakrishna et al. (1989) and Weldon and Tannner (1990) of Texas A & M University in cooperation with the Galveston Laboratory. Rathke's gland secretions were found to contain 10 mg of protein per ml in Kemp's ridley and 24 mg per ml in loggerhead. Glucosamine and proline were major constituent amino acids. Amino acid and amino sugar composition of high molecular weight fractions indicated similarities between the two turtle species. It remains to be determined why these two species secrete such large volumes of soluble protein into the environment. Lactic acid, a metabolite produced during anaerobic glycolysis, is also present in the secretions, suggesting a possible excretory function of Rathke's glands (Weldon and Tanner, 1990).

HEAD START FACILITIES AND OPERATIONS

Head start facilities and operations have been described in detail by Fontaine et al. (1985, 1989b).

Hatchlings Received

During 13-20 July 1988, 925 Padre Island-"imprinted" Kemp's ridley hatchlings representing 10 clutches of the 1988 year-class were received from the NPS (Duronslet et al., 1989a, Tables 1 and 14). The incubating, hatching, "imprinting," packing and transporting operations were carried out by the staff at the National Seashore (Shaver et al., 1988a). All of the clutches came from eggs collected in the usual manner at the Rancho Nuevo beach.

Eggs of the 1988 year-class were incubated at the National

Seashore at 22.5-37.7°C (Shaver et al., 1988a). Sex in Kemp's ridley is influenced by incubation temperature, with the pivotal temperature (that producing a 1:1 F:M sex ratio) near 30°-31°C (Shaver et al., 1988b). Therefore, the sex ratio of the 1988 year-class should have been predominantly female. The sex ratio of hatchlings that died during the year was 2.8:1 (Donna Shaver, National Park Service, Padre Island National Seashore, Corpus Christi, TX, personal communication, March 1989).

The U. S. Coast Guard transported2,012 Rancho Nuevo-"imprinted" Kemp's ridley hatchlings of the 1989 year-class from the primary nesting beach at Rancho Nuevo to Galveston via helicopter (Table 1) on 9 July 1989. Two hatchlings were dead on arrival. Unlike years past, clutches of hatchlings from the 1989 year-class were mixed together, so the hatchlings were indistinguishable by clutch.

Distribution of Hatchlings Among the Raceways

In prior years (through the 1988 year-class), as the clutches of hatchlings were received, they were assigned more or less sequentially to the raceways arranged from east to west in the rearing facilities (Caillouet et al., 1986b; Caillouet et al., 1989; Duronslet et al., 1989a). However, in 1989 the clutches were not kept separated at Rancho Nuevo so the clutches were mixed and the hatchlings were placed in the raceways as they were received.

Schedule for Weighing and Measuring Turtles

All hatchlings of the 1988 year-class were weighed (Duronslet et al., 1989a, Table 17) and measured (carapace length and width) at the National Seashore by NPS personnel between 14 and 19 July 1988. Hatchlings of the 1989 year-class were weighed after arrival at the head start facilities (Table 9). Thereafter, at the Galveston Laboratory, a random sample of 5 turtles was selected from each of the 10 clutches of the 1988 year-class for weighing at weekly intervals, and these same five turtles in each clutch were tracked throughout the head start period (Table 10). If a turtle in any of these groups died, became ill or was mislocated, a substitution from the appropriate clutch was made. A random sample of 125 turtles of the 1989 year-class was selected for weighings at weekly intervals (Table 10). Prior to release, all surviving turtles were weighed and measured.

Growth curves of each year-class were fitted by regression of natural logarithms of weight on the square root of age (Table 11). The detransformed growth curves are shown in Figure 1.

Foods and Feeding

The foods and feeding methods used in head starting Kemp's ridleys were elaborated by Fontaine et al. (1985, 1989b) and

Caillouet et al. (1986, 1989b). The food used in head starting the 1988 and 1989 year-classes was a dry, floating, pelleted, diet manufactured by Purina, Richland, IN. It is the same diet used for rearing green sea turtles (Chelonia mydas) at the Cayman Turtle Farm (1983), Ltd. (James Wood, Cayman Turtle Farm, Personal Communication, August 1984).

The relationship between the average daily food ration (g) per turtle and average weight (g) per turtle in the 1988 year-class was linear (Figure 2). This relationship was used to determine daily rations for the 1989 year-class.

Health Care

Health care for the head started turtles consisted of prophylactic and therapeutic measures developed from previous research and experience (Clary and Leong, 1984; Fontaine et al., 1985; Leong et al., 1989). Maintaining clean seawater and warm temperature throughout head starting are among the most effective means of preventing diseases. The Texas Veterinary Medical Diagnostic Laboratory Systems, College Station, TX conducted necropsies on 4 of the 27 turtles that died during head starting of the 1988 year-class. Cause of death was not determined in these turtles due to advanced post-mortem change. Also during the year, a few turtles were provided medical treatment by Dr. Joseph Flanagan, DVM, Houston Zoo, Houston, TX. Overall, the 1988 year-class exhibited 97% survival to release.

Environmental Variables

Seawater temperature, salinity and pH were monitored (usually daily) in selected raceways beginning in July 1988 and ending in May 1989, during head starting of the 1988 year-class of Kemp's ridleys. These measurements served as general guides to environmental conditions in the raceways. The daily measurements of temperature, salinity and pH are summarized as monthly means in Table 12.

Average daily weight gain was determined for 50 turtles of the 1988 year-class weighed weekly throughout the head start period. The relationship between average daily weight gain (g) and average daily temperature and average daily salinity during head starting of the 1988 year-class is shown in Figure 3. Temperature (°C) and salinity (ppt) averages were grouped in intervals of 3°C or 3 ppt, respectively. As temperature increased and salinity decreased, weight gain increased during head starting. Weight gain also is a function of age and size.

The overall means and ranges in daily temperature, salinity and pH for the head start period were 27.6°C (24.8-29.5°C), 27.3 ppt (21.0-34.7 ppt) and 7.7 (7.4-7.8), respectively.

Seawater temperature was controlled through heating the air in the quonset huts with forced-air heaters and the incoming seawater with immersion heaters during winter. These measures stabilized the temperature in the raceways quite well.

Tags and Tagging

Tags were applied to all Kemp's ridleys of the 1988 year-class that were determined to be healthy (Table 13). Types of tags included: inconel flipper tags, living-tags, and internal, binary-coded magnetic tags (Fontaine et al., 1989b). Inconel flipper tags were applied to the trailing edge of the right front flipper. The flipper tag code series included QQA000-QQA974 for Padre Island-"imprinted" turtles and QQA975-QQA999 for Cayman Island-"imprinted" turtles. Living tags were applied to left costal scute 1 (Fontaine, Williams and Caillouet, 1988). Binary-coded, magnetic tags were inserted into the distal end of the left front flipper.

All head started turtles held longer than one year in captivity had been tagged with metal flipper tags before distribution to cooperating organizations, agencies and institutions (Duronslet et al., 1989a, Table 2). These turtles provided observations on flipper tag retention in captivity. In determining flipper tag loss rates, no data from turtles that died in captivity with the original tag intact were included. Retention time was measured in calendar years from the date of application of the tag. Three year-classes (1978, 1982 and 1984) provided the data.

The cumulative loss rate for monel flipper tags in head started Kemp's ridleys held in captivity beyond one year was calculated for each of the three year-classes using a logistic function (Prager, Recksiek and Saila, 1988):

$$P = 1 / \{ 1 + \exp (-K [T - T_{50}]) \}$$

where

K and T_{50} (the estimated number of years at which 50% of the tags had been lost) are empirical constants,
P = cumulative tag loss rate (= probability of tag loss), and
T = time (in years).

The estimates of K, T_{50} and r^2 are shown by year-class in Table 14, and graphs of fitted curves of cumulative tag loss are shown in Figure 4. The 1978 year-class had better tag retention than the other two year-classes. However, within five years of tagging, most tags had been shed. This retention is somewhat better than that for monel tags on loggerheads in the wild (Henwood, 1986). The cumulative recoveries of head started-tagged-released Kemp's ridleys (Figure 5) could reflect tag loss as well as mortality and detection/reporting rates of tagged animals. These three effects cannot be distinguished from one another in the recovery data.

Metal flipper tag shedding rates have been examined in loggerheads (Henwood, 1986) and green turtles (Balazs, 1982 and 1983). Henwood (1986) concluded that the monel flipper tag is not a permanent tag for loggerheads and gave three primary reasons:

(1) improper tag application,
(2) tissue necrosis and
(3) tag corrosion.

Balazs (1983) showed good success with inconel alloy flipper tags applied to Hawaiian green turtles. Apparently, flipper tag loss can be substantially reduced through use of inconel alloy tags and by improved application techniques.

The 1985 year-class of Kemp's ridleys was tagged with inconel alloy flipper tags, and results were similar to those of Balazs (1983). After 4 years, no inconel flipper tags have been shed from Kemp's ridleys of the 1985 year-class in captivity. However, the tissue of the flipper surrounding the tag has almost grown over the tag in some instances, and in others the tag is slowly being extruded from the tissue by the wound repair reaction. It appears that these tags will soon fall out, leaving a large crescent shaped tagging scar on the trailing edge of the flipper.

Anyone encountering a tagged or marked Kemp's ridley should contact the NMFS Miami Laboratory, 75 Virginia Beach Drive, Miami, FL 33149 (commercial telephone no. 305-361-4488, -4225, or -4487), or the NMFS Galveston Laboratory, 4700 Avenue U, Galveston, TX 77550 (commercial telephone no. 409-766-3500, -3507, -3523, -3516, -3525). The location and number of the tag or mark, and measurements (straight line) of the carapace length and width, weight of the turtle, location, date and method of recapture, sighting or stranding should be reported to NMFS.

Release

There were 808 multi-tagged survivors of the 1988 year-class of head started Kemp's ridleys packed into plastic boxes on 25 May 1989 and transported by truck to the University of Texas' Marine Science Institute at Port Aransas, TX. All turtles to be released were transferred to the University of Texas' research vessel LONGHORN and from there to the release site in the Gulf of Mexico about 12 nautical mi off Padre Island. All turtles were alive and appeared to be in good condition at the time of their release. As has been observed in previous offshore releases most of the turtles floated on the surface for a short time before diving.

A total of 100 multi-tagged turtles of the 1988 year-class was retained at the laboratory (Table 15). These are being held pending possible use in turtle excluder device (TED) certification trials in the Gulf of Mexico offshore of Panama City, FL during

spring 1990.

SUMMARY OF HEAD STARTED KEMP'S RIDLEY SEA TURTLE RELEASES AND RECOVERIES

Release data for head started Kemp's ridley year-classes 1978-1988 is summarized in Table 2. Of the 14,655 tagged Kemp's ridleys released, 621 had been recovered as of 30 September 1989 (Table 16). Of these, 159 from the 1982 year-class washed ashore at Padre Island shortly after the release. Many of these stranded turtles had ingested or become covered with oil after being released only 4 nautical miles from shore near Sargassum concentrations (Table 17). Also, many of the 117 recaptures of the 1985 year-class were caught within the bays in which they were released, or in adjacent bays, shortly after their release. The smallest number of recoveries (2) was from the 1988 year-class which had been at sea only 4 months as of 30 September 1989.

Most of the recoveries have occurred in Texas (Table 18) near the release site. Louisiana and Florida ranked second and third in number of recoveries, followed by North Carolina and South Carolina, respectively. Three turtles have been recovered as far away as France and Morocco (Manzella et al., 1988; Fontaine et al., 1989a).

The method of recovery was not reported (Table 19) in 16.4% of the cases. Of the reported methods of recovery, two dominated: stranded (43.6%) and shrimp trawl (22.7%). Of the stranded recoveries, 38.4% were found alive and 61.6% were found dead. Of the 141 shrimp trawl-caught recoveries, 51.8% were reported from Texas and 30.5% from Louisiana, for a combined percentage of 82.3% (Table 20). Table 21 shows the condition of the tagged sea turtles at the time of their recovery. More than half (57.3%) of the turtles were reported as being recovered alive and released back into the environment. More recoveries of head started turtles occurred in Spring (58.4%) and summer (25.9%) than in other seasons (Table 22).

Captive Propagation

The successful production of Kemp's ridley hatchlings by the captive breeding experiment conducted at Cayman Turtle Farm, Grand Cayman, B. W. I., and their export to the U.S. for head starting proved that captive propagation is feasible (Caillouet et al., 1986a). Therefore, the Kemp's Ridley Working Group decided that no more hatchlings would be produced at the turtle farm, and some of the breeders (Table 23) were exported to the U.S. and released in 1989. The 1988 year-class of hatchlings was the last to be produced at the turtle farm and head started at the Galveston Laboratory.

During fiscal year 1989, 121 Kemp's ridleys were conditioned

in outside, semi-natural enclosures preparatory to their release. The first group included 90 turtles (45 of the 1987 year-class and 45 of the 1986 year-class) used in TED certification trials offshore of Panama City, Florida. These turtles were conditioned in two earthen ponds at Sea-Arama Marineworld in Galveston for two weeks before transfer by NOAA aircraft to Florida on 17 May 1989.

Another 31 Kemp's ridleys were placed in Sydnor Bayou (part of the Galveston Bay System) for conditioning in August 1989 (Table 23). The entrance to the bayou was blocked off with a wire fence in August which was removed in October, thus releasing the turtles. The turtles placed in Sydnor Bayou included: 15 head started breeders returned from Cayman Turtle Farm (one was found dead of unknown causes three days after introduction into the bayou); 7 head started subadults of the 1984 year-class that had been maintained at Sea-Arama Marineworld; one subadult of the 1984 year-class that had been returned from Bass Pro Shops, Springfield, MO.; 5 1987 year-class and 2 1986 year-class that were part of the Kemp's ridleys held at Sea-Arama Marineworld; and 1 1984 year-class ridley that had been returned from Audubon Park and Zoological Gardens, New Orleans, LA. In addition, 1 loggerhead sea turtle (Caretta caretta) that had been received from the Florida Department of Natural Resources in 1987 was also released into Sydnor Bayou.

The twelve adult Kemp's ridleys of the 1978 and 1979 year-classes, previously held at Sea-Arama Marineworld, were transferred to Sea World of Texas in San Antonio during 1988, where Dr. David Owens continued his experiments on their reproductive physiology.

OTHER ACTIVITIES

By-Catch of Wild Sea Turtles

The wild sea turtle by-catch data file being maintained at the Galveston Laboratory includes turtles reported as by-catch by commercial and recreational fishermen. As of 30 September 1989, 82 by-caught turtles had been reported with shrimpers accounting for 86.6% of the total. Of the shrimp-caught turtles, 42.7% were caught in standard trawls (with no TED), off vessels participating in the Galveston Laboratory's TED evaluation program. One was caught by gill net and 7 by hook-and-line.

Of the 82 turtles recorded in the by-catch file, 41 were loggerheads, 21 Kemp's ridleys, 1 leatherback (Dermochelys coriacea), and 5 hawksbills (Eretmochelys imbricata), with no species identification reported for 14 specimens. Sixty-eight of the turtles were reported alive and 12 dead. For 2 of the turtles the condition upon capture was not reported. Turtles were reported from five states including: Florida (35), Texas (32), Louisiana (9), Georgia (4) and South Carolina (1).

Sea Turtle Sightings

The Galveston Laboratory maintains a sea turtle sighting data file. A sighting is an event in which a sea turtle is seen, usually swimming at the surface. Sea turtle strandings or turtles caught in trawls are excluded from this file. Some of the sightings were reported by divers belonging to dive clubs and some have been reported by oil companies cooperating with Galveston Laboratory observers on oil rig severance and salvage operations under Section 7 of the Endangered Species Act. Additional sightings were made by NMFS employees, boat operators, fishermen and the general public.

There were 152 sightings on file as of 30 September 1989. Four species were represented: 3 leatherbacks, 63 loggerheads, 14 Kemp's ridleys and 12 greens (Chelonia mydas). An additional 60 sightings were recorded, but no species identification was possible. Sightings were reported from Texas (65), Louisiana (63), Florida (17) and Alabama (5). For 2 of the turtles, no location was reported. One-hundred forty-four of the turtles were alive when sighted, 5 were dead, and 3 reports did not indicate whether the turtles were dead or alive. Of the 152 sightings, 122 were associated with some type of structure such as an oil platform, dock, or shrimp boat, etc.

In late June 1989, two "Sea Turtle Sighting Signs" were erected at the Fish Pass Jetties in Mustang Island State Park near Port Aransas, TX. These signs described the different species of sea turtle that inhabit the Gulf of Mexico and explained that numerous turtles had been sighted in the area. The signs requested that beachgoers, surfers and recreational fishermen report to NMFS any sea turtles seen around the jetties. Between 28 June 1989 and 30 September 1989, 67 sighting reports were received from the general public. Four species were reported including: 14 Kemp's ridleys, 13 hawksbills, 10 greens and 8 loggerheads. For 22 sightings no species identification was given. Such sighting information provides a valuable index of sea turtle occurrence near the north jetty at Port Aransas. When positive identifications of species were made by NMFS personnel, results showed that juvenile green sea turtles were the most common species near the jetty. Most turtles were seen during the hours of 10:00 a.m. and 6:00 p.m., probably the part of the day the jetties are most frequented by the public. Turtles were more frequently seen on the north side of the north jetty, as compared to either side of the south jetty. This was probably because the north side of the north jetty is most protected from the prevailing wind driven waves. Plans are to expand this project to other passes and jetties in Texas.

Radio and Sonic Tracking

Radio and sonic transmitters are attached when possible to

juvenile and sub-adult sea turtles that have been rehabilitated after being stranded or caught alive from the estuarine or bay environment. Such turtles are released into the same area where found or caught, and are tracked for about 30 days. Data are collected on submerged and surfaced times, movements, habitat and environmental conditions such as salinity and water and air temperatures. Such data will help determine what areas are important habitats for sea turtles and will provide a better understanding of their life cycles.

Two separate inshore tracking studies were completed during the year. The first, in Lake Calcasieu, LA, involved a 1985 year-class head started Kemp's ridley that was originally released on 6 May 1986 offshore of North Padre Island, TX. The turtle was caught in a fisherman's gill net in the West Cove area of Lake Calcasieu on 9 April 1988, 704 days after the original release date. After rehabilitation the turtle was re-released into West Cove on 23 September 1988, with radio and sonic transmitters attached, and tracked for 24 days.

The second tracking study involved a wild green turtle that was found cold stunned in the southern Laguna Madre near Port Isabel, TX in February 1989. After rehabilitation, the turtle was re-released on 24 August 1989, with radio and sonic transmitters attached, into the southern Laguna Madre and tracked for 26 days. Results of both studies are currently being analyzed.

Sea Turtle Stranding and Salvage Network (STSSN)

Sea turtle stranding surveys not only provide a means of quantifying the numbers, species, and sizes of stranded sea turtles, but also provide valuable information concerning life history and possible causes of sea turtle mortality at sea. The temporal-spatial distribution of sea turtles can be surmised from strandings in combination with information on ocean currents, stomach contents and sessile organisms (e.g., barnacles, etc.) growing on their shells.

The Galveston Laboratory continued its participation in the NMFS STSSN, with a focus on the coasts of Texas and southwest Louisiana. The STSSN area surveyed by the Galveston Laboratory covers the entire Texas coast from the Rio Grande River to the Sabine River (excluding the Padre Island National Seashore covered by NPS, and the Wynn Ranch covered by FWS on Matagorda Island) and the southwestern Louisiana coast from the Sabine River to the Mermentau River. Accessible beaches are surveyed using 4-wheel drive vehicles, 4-wheel all-terrain vehicles, or dirt bikes, depending upon their remoteness and conditions on the beach. In addition, reports from the public concerning strandings are responded to by Galveston Laboratory STSSN participants who collect the data and salvage the specimens. From 1 October 1988 through 30 September 1989, the STSSN documented 184 stranded sea turtles in

the survey area (Table 8). Nueces, Cameron and Galveston counties ranked highest in number of reported strandings.

A severe cold spell was responsible for 18 of the strandings reported from Cameron County, TX in February 1989. Seawater temperatures in the lower Laguna Madre, where the turtles were found, reached a low of 3°C (Don Hockaday, Pan American University, Personal Communication 1989). The cold-stunning event involved 16 green sea turtles, one loggerhead and one unidentified species. Thirteen of the green turtles were still alive when found. They were rehabilitated and released by either Sea Turtle, Inc. or Pan American University Marine Laboratory, South Padre Island, TX.

Sea turtle strandings in bays and estuaries can also yield valuable information about sea turtle biology. However, inshore beaches and marsh edges are generally inaccessible to vehicular traffic, and strandings are difficult to locate from boats. As a consequence, observations in inshore areas have been made through aerial surveys by Galveston Laboratory observers aboard U. S. Coast Guard helicopters.

A total of 25 aerial reconnaissance surveys for sea turtle strandings were conducted from 4 October 1988 through 26 September 1989. Surveys were made in conjunction with U. S. Coast Guard helicopter training flights within the Galveston, Matagorda, San Antonio and Corpus Christi bay systems. Only 1 stranded marine mammal (a bottlenose dolphin) was found on 8 August 1989, on the shoreline of upper Corpus Christi Bay near Portland, Texas. Although no stranded sea turtles were observed from the helicopter, 5 live sea turtles were sighted in the Matagorda (3 turtles) and Corpus Christi (2 turtles) bay complexes. These sightings, along with the 35 verified inshore strandings reported by volunteers, give further evidence that inshore areas are important sea turtle habitat.

Sea turtle carcasses have been collected for necropsy by Texas A&M University with the intent of obtaining biological information and determining cause of death. However, only in few specific cases can death be attributed to a specific cause based on necropsy (Plotkin, 1989). In most stranded animals, tissue decomposition is too advanced to definitely establish a cause of death. Necropsies also provide valuable biological data on sex, reproductive development and food habits. From 1 October 1988 through 30 September 1989 25 necropsies were performed. Stomach contents were removed from 21 animals and sexes were positively identified in 6 loggerheads (2 F, 4 M), 5 Kemp's ridleys (4 F, 1 M) 1 green (M) and 1 species unknown (M).

There is increasing evidence, however, for a number of possible causes of mortality in sea turtles at sea including (1) incidental capture in shrimp trawls (Henwood and Stuntz, 1987), (2) underwater explosions associated with petroleum platform

salvage operations (Klima et al., 1988), (3) hook-and-line fisherman, both commercial and recreational (Manzella et al., 1988), (4) ingestion of debris, especially plastics and tar-balls (Stanley et al., 1988; Plotkin, 1989), and (5) collision with boats/propellers and entanglement in plastic monofilament fishing lines and other plastic debris (Heinly et al., 1988; Plotkin and Amos, 1988).

Year around sampling of sea turtle strandings is essential as one means of evaluating conservation and management measures such as NMFS' implementation of mandatory use of TEDs, regulations concerning petroleum platform severance (through Section 7 Consultation under the Endangered Species Act), and Section 7 Consultations concerning the impacts of U. S. Army Corps of Engineers dredging projects. Longtime-series of data are especially important in this respect, and the STSSN's data base of strandings provides such a series, going back to 1980 (Schroeder, 1988, 1989).

Hatchling and Juvenile Sea Turtle Habitat

It has been postulated that Atlantic coast populations of sea turtles spend their first year of life in offshore convergence zones in association with accumulations of Sargassum (Carr, 1987). Large floating mats of this seaweed may provide both shelter and forage for the hatchlings. Cruises were conducted off the south Texas coast in April and July of 1989 to sample in offshore Sargassum mats in search of hatchling and juvenile sea turtles and forage organisms. The mats were first located by Galveston Laboratory observers aboard U. S. Coast Guard aircraft flying over the Gulf of Mexico. Flights were made on 10 Oct and 15 Nov 1988; 1 Feb, 24 and 30 March, 3, 7, 5, 11, and 28 April, 31 May, 7 and 29 June, 18 and 25 July and 29 August, 1989. Once Sargassum concentrations were located, their coordinates were radioed to sampling crews onboard the University of Texas' R/V LONGHORN.

Thirteen Sargassum mats were sampled by divers and surface trawls during 5 days in two offshore cruises. Divers failed to observe sea turtles from beneath the mats, and surface trawl hauls, producing 1.2 - 2.1 m diameter balls of the seaweed, also failed to capture sea turtles. Stomach contents of pelagic fish caught near the mats did not contain hatchling turtles or sea turtle parts. Pelagic fish included 22 dolphin (Coryphaena hippurus, 38.0 - 51.5 cm fork length), 7 king mackerel (Scomberomorus cavalla, 83.0 - 115.0 cm fork length), 2 bonita (Sarda sarda, 40.0 and 58.5 cm fork length), and 1 wahoo (Acanthocybium solandri, 115 cm fork length).

Marine Debris and Entanglement

Galveston Laboratory staff served on the Texas Coastal Cleanup Steering Committee sponsored by the Center for Marine Conservation

(CMC) and on the Texas General Land Office's "Adopt-a-Beach" Task Force. The Galveston Laboratory's SSTSN and marine debris-entanglement survey activities were coordinated with these two programs.

The marine debris and entanglement study was funded by NMFS' Northwest and Alaska Fisheries Center. Sampling for marine debris and entanglement was completed. Monthly samples were collected at five locations on the upper Texas coast and at one location in southwest Louisiana from June 1987 through September 1989. Characterization of the types and quantities of debris is being made. Stranded sea turtles found entangled or fouled in marine debris and those determined to have ingested such debris are being documented for the same time period.

Sea Turtle Rehabilitation

Live-stranded sea turtles and those captured alive by divers for future satellite tracking studies were held and rehabilitated (when necessary) and were either tagged and returned to their natural habitat or transferred to oceanaria. Those collected by divers were fitted with satellite transmitters and were released in the same general area offshore from which they were caught, while rehabilitated live-stranded turtles were tagged with radio and sonic tags and tracked in estuarine areas. Twelve live-stranded or live-captured sea turtles were held or rehabilitated in fiscal year 1989. Rehabilitation also gave sea turtle biologists and cooperating veterinarians further experience in medical treatment and rehabilitation of live-stranded sea turtles.

BLUE RIBBON PANEL REVIEW

The Kemp's ridley head start experiment was reviewed in August 1989 by a Blue Ribbon Panel of sea turtle experts including Drs. Peter Pritchard, John Hendrickson, Nat Frazer, Mark Grassman and Thane Wibbels. The Panel's summary conclusions are paraphrased below:

> There is worldwide interest in the question of whether or not head starting is an effective tool for conserving endangered sea turtle populations. The NMFS' Kemp's ridley head start experiment represents an unprecedented opportunity to address this question. If head starting works, this experiment has the potential of contributing significantly to population recovery of Kemp's ridley. Through the head start experiment, the Galveston Laboratory has refined first-year captive-rearing of sea turtles into an exact science. There is no better facility or staff in the world for this purpose.

Long-term tag return data indicate that head started turtles can adapt and grow in the wild, and breeding experiments have shown that head started turtles can successfully reproduce in captivity. However, based on tag return, stranding, by-catch, and nesting beach data collected by NMFS, U. S. Fish and Wildlife Service and Instituto Nacional de la Pesca, it is presently impossible to determine if head started ridleys are recruited into the natural breeding pool. Shrimp trawling-induced mortality of Kemp's ridleys (both wild and head started) is so high that few if any head started ridleys are expected to reach sexual maturity.

The head start experiment should be continued for a 10 year period following implementation of TED regulations in U. S. Gulf and Atlantic waters. This recommendation was based in part on current estimates of the time required by Kemp's ridleys to reach sexual maturity in the wild (8-10 years) and the apparently high rate of mortality all sea turtles are exposed to from various causes in the wild.

The Kemp's ridley head start experiment and HEART (Help Endangered Animals - Ridley Turtles) have greatly increased public awareness of the endangered status of sea turtles. Though enhanced public awareness is a worthwhile aspect of the work it should be made clear to the public that head starting is an experiment and it should not be viewed as the panacea of sea turtle conservation. There is a risk that head starting might be viewed by the public as the means of restoring the Kemp's ridley, thus detracting from the primary element of the Kemp's ridley recovery plan (i.e., protection of ridleys in their natural habitat). Thus, the survival of this species could be jeopardized by undue emphasis on head starting.

Public Outreach

The head start facility received approximately 5,900 visitors during the fiscal year. HEART held its annual open house on 11 February 1989, and about 1,000 people visited the head start facility on that day. Other community outreach activities included slide presentations at various schools, organizations and nature clubs. Numerous packets of information on sea turtles were sent out in response to requests.

CHANGES IN DIVISION STAFF

The current permanent staff of the Life Studies Division working on sea turtles includes:

Charles Caillouet, Marcel Duronslet, Clark Fontaine, Sharon Manzella, Dickie Revera and Theodore Williams.

Throughout fiscal year 1989 a number of temporary staff members resigned including George O'Donohoe, George Wyatt, Carolin Turner, Mervin Doucet, Alan Gielen and Kirsten Loop. The current temporary staff of the Life Studies Division working on sea turtles includes:

STSSN: Robert Barber, Jane Boslet, John Pitre, Hank Nieuwendaal, Robert Heinly, Gerilyn Jewett-Smith, Sherman Jones, Mark King, Will Vanoy, Pam Plotkin, Kerry Stanley and Anthony Williams.

Head Start: Gregg Sloat, Billy Ross, Steve Hollenbeck and Christy Giessinger.

Physiological Studies: Erich Stabenau

Tracking: Jo Anne Williams

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Table 1. Summary of "imprinted" Kemp's ridley sea turtle hatchlings received by the NMFS Galveston Laboratory as of 30 September 1989.

Year-Class	Inclusive Dates	Imprinting Location	Number Received Alive	Number Received Dead
1978	6 July - 3 August	Padre Island	1,854	1
	11 August	Rancho Nuevo	1,226	0
			3,080	1
1979	26 June - 23 July	Padre Island	1,656	2
		Rancho Nuevo	187	1
			1,843	3
1980	24 June - 14 July	Padre Island	1,608	4
	7 July	Rancho Nuevo	207	3
			1,815	7
1981	24 July - 22 August	Padre Island	1,864	1
1982	6 July - 16 August	Padre Island	1,524	0
1983	8 July - 12 August	Padre Island	230	0
	8 July	Rancho Nuevo	20	0
			250	0
1984	24 July - 27 July	Padre Island	1,441	106
1985	9 July - 7 August	Padre Island	1,684	8
1986	6 July - 26 July	Padre Island	1,759	0
1987	6 July - 23 July	Padre Island	1,278	4
	31 August	G.Cayman Isl.	159	1
			1,437	5
1988	13 July - 20 July	Padre Island	925	0
	14 July	G.Cayman Isl.	25	0
			950	0
1989	9 July	Rancho Nuevo	2,010	2

Table 1. (continued).

Year-Class	Inclusive Dates	Imprinting Location	Number Received Alive	Dead
1978 - 1988		Padre Island	15,823	126
1978 - 1980, 1983,1989		Rancho Nuevo	3,650	6
1987 - 1988		G.Cayman Isl.	184	1
Total			19,657	133

Table 2. Summary of head started Kemp's ridley sea turtle release sites, dates of releases, numbers of turtles released and flipper tag code series used, by year-class, as of 30 September 1989.

Year-class	Imprint location[a]	Release site	Release type[b]	Release date	Number released	Flipper[c] tag series
1978	PINS	Sandy Key, FL	O	22 Feb 1979	135	G----
	PINS	East Cape, FL	N	22 Feb 1979	52	G----
	PINS	East Cape, FL	O	28 Feb 1979	1	13582
	PINS	East Cape, FL	O	28 Feb 1979	166	G----
	PINS	Sandy Key, FL	O	5 Mar 1979	172	G----
	RN	Homosassa, FL	N	8 May 1979	751	G----, F----
	PINS	Homosassa, FL	O	8 May 1979	628	G----, F----
	PINS	Padre Island, TX	O	7 July 1979	112	G----, F----
	RN	Padre Island, TX	O	7 July 1979	1	G0985
	PINS	Homosassa, FL	O	3 June 1980	1	NNA260
					2,019	
1979	PINS	Homosassa, FL	O	3 June 1980	665	NNN---
	RN	Homosassa, FL	N	5 June 1980	66	NNA---
	PINS	Homosassa, FL[d]	N	5 June 1980	608	NNN---,
	Unknown	Key Largo, FL	B	9 July 1980	24	NNA---
	PINS	Padre Island, TX	O	2 June 1981	5	K----
	PINS	Galveston, TX	O	28 Sept 1981	1	J0096
					1,369	
1980	PINS	Padre Island, TX	O	2 June 1981	1,426	NNB---, K----
	PINS	Padre Island, TX	O	2 June 1981	100	8001 - 8100
	RN	Campeche, MX	O	3 Mar 1981	197	NNB---,
					1,723	K----
1981	PINS	Padre Island, TX	O	2 June 1982	1,521	NNG---, NNH---
	PINS	Sabine Pass, TX	O	14 July 1982	118	NNG---, NNH---
					1,639	

Table 2. (continued)

Year-class	Imprint location[a]	Release site	Release type[b]	Release date	Number released	Flipper[c] tag series
1982	PINS	Padre & Mustang Islands, TX	N	7 June 1983	1,159	NNL---, NNM---
	PINS	Nueces Bay, TX	I	7 June 1983	96	NNL---, NNM---
	PINS	Sabine Pass, TX	O	15 July 1983	69	NNL---, NNM---
	PINS	Mustang Island, TX	O	5 June 1984	1	NNM428
	PINS	Galveston, TX	O	19 Oct 1989	4	BBB---, NNZ---, AAK---
					1,329	
1983	PINS	Mustang Island, TX	O	5 June 1984	172	NNQ---
	RN	Mustang Island, TX	O	5 June 1984	18	NNQ---
					190	
1984	PINS	Padre & Mustang Islands, TX	O	21 May 1985	1,017	NNT---, NNV---
	PINS	Galveston, TX	I	19 Oct 1989	20	AAL---, BBB---, NNT---, NNZ---
					1,037	
1985	PINS	Copano Bay, TX	I	22 Apr 1986	448	NNX---, NNY---,
	PINS	Italian Bend, TX	I	22 Apr 1986	22	NNX---, NNY---,
	PINS	Port Bay, TX	I	22 Apr 1986	49	NNX---, NNY---,
	PINS	Padre Island, TX	O	6 May 1986	961	NNX---, NNY---,
	PINS	Galveston, TX	O	23 Sept 1986	54	NNX---,
					1,534	

Table 2. (continued)

Year-class	Imprint location[a]	Release site	Release type[b]	Release date	Number released	Flipper[c] tag series
1986	PINS	Mustang Island, TX	O	21 Apr 1987	1,630	PPK---, PPL---
	PINS	Padre Island, TX	O	17 May 1988	50	PPK---, PPL---
	PINS	Panama City, FL	O	17-24 May 1989	45	PPK---, PPL---
	PINS	Galveston, TX	I	19 Oct 1989	2	PPL---, BBB---
					1,727	
1987	PINS	Padre Island, TX	O	17 May 1988	1,100	PPR---, PPS---
	CAY	Padre Island, TX	O	17 May 1988	130	PPS---
	PINS	Panama City, FL	O	17-24 May 1989	45	PPR---, PPS---
	PINS	Galveston, TX	I	19 Oct 1989	5	PPR---, PPS---, BBB---
					1,280	
1988	PINS	Padre Island, TX	O	25 May 1989	794	QQA---
	CAY	Padre Island, TX	O	25 May 1989	14	QQA---
					808	
1978-1988	PINS	Padre Island, TX			13,454	
1978-1980, 1983, 1988	RN	Mustang Island, TX			1,033	

Table 2. (continued)

Year-class	Imprint location[a]	Release site	Release type[b]	Release date	Number released	Flipper[c] tag series
1986, 1988	CAY	Padre Island, TX			144	
1979	Unknown				24	
Total					14,655	

[a]PINS = Padre Island National Seashore
RN = Rancho Nuevo; and
CAY = Cayman Turtle Farm, Grand Cayman, B.W.I.

[b]I = bay or estuarine release;
N = release less than 3 nautical miles from shore;
O = release greater than 3 nautical miles from short;
B = released from beach.

[c]Monel tags, unless noted otherwise. For example, inconel tags were used on the 1985 and 1986 year-classes. Each dash represents a numerical digit from 0-9. Actual numerical series are not given because they were mixed. Details concerning the numerical series can be obtained from the NMFS SEFC Galveston Laboratory, 4700 Ave U, Galveston, TX 77550 (telephone: commercial 409-766-03507; FTS 527-6507) upon request.

[d]This release included turtles also tagged with radio-transmitters (see Klima and McVey, 1982; Wibbels, 1984).

Table 3. Numbers of sea turtles stranded during calendar year 1984 by species and county arranged in geographical order from north to south in southwestern Louisiana and Texas (Preliminary).[a]

County	State	Logger-head	Green	Leather-back	Hawks-bill	Kemp's ridley	Unknown	Total
Calcasieu	LA	0	0	0	0	0	0	0
Cameron	LA	0	0	0	0	3	0	3
Orange	TX	0	0	0	0	0	0	0
Jefferson	TX	4	0	2	0	40	3	49
Chambers	TX	0	0	0	0	2	1	3
Galveston	TX	7	0	0	1	2	10	20
Brazoria	TX	2	0	0	0	2	0	4
Matagorda	TX	0	0	0	0	0	0	0
Calhoun	TX	0	0	0	0	1	0	1
Aransas	TX	1	0	0	0	1	0	2
Nueces	TX	31	5	3	5	11	3	58
Kleberg	TX	26	2	1	1	2	11	43
Kenedy	TX	6	1	0	0	1	4	12
Willacy	TX	1	0	0	0	0	0	1
Cameron	TX	3	1	0	0	0	0	4
St. Patricio	TX	0	0	0	0	0	0	0
Refugio	TX	0	0	0	0	0	0	0
Unknown		1	1	0	1	0	0	3
Total		82	10	6	8	65	32	203

[a] Survey area extends from the Mermentau River, LA to Brownsville, TX. Adapted from STSSN data file, NMFS, Miami, FL.

Table 4. Numbers of sea turtles stranded during calendar year 1985 by species and county arranged in geographical order from north to south in southwestern Louisiana and Texas (Preliminary).[a]

County	State	Logger-head	Green	Leather-back	Hawks-bill	Kemp's ridley	Unknown	Total
Calcasieu	LA	0	0	0	0	0	0	0
Cameron	LA	0	0	0	0	0	0	0
Orange	TX	0	0	0	0	0	0	0
Jefferson	TX	4	0	1	0	24	6	35
Chambers	TX	0	0	0	0	0	0	0
Galveston	TX	12	2	0	1	10	4	29
Brazoria	TX	2	0	0	0	0	1	3
Matagorda	TX	0	0	0	0	0	0	0
Calhoun	TX	1	2	0	0	1	1	5
Aransas	TX	3	0	0	0	0	0	3
Nueces	TX	28	5	0	0	8	8	49
Kleberg	TX	20	1	0	1	2	7	31
Kenedy	TX	5	0	0	1	3	10	19
Willacy	TX	0	0	0	0	0	1	1
Cameron	TX	0	0	0	0	0	1	1
St. Patricio	TX	0	0	0	0	0	0	0
Refugio	TX	0	0	0	0	0	0	0
Unknown		0	1	0	0	0	0	1
Total		75	11	1	3	48	39	177

[a] Survey area extends from the Mermentau River, Louisiana to Brownsville, TX. Adapted from STSSN data file, NMFS, Miami, FL.

Table 5. Numbers of sea turtles stranded during calendar year 1986 by species and county arranged in geographical order from north to south in southwestern Louisiana and Texas (Preliminary).[a]

County	State	Logger-head	Green	Leather-back	Hawks-bill	Kemp's ridley	Unknown	Total
Calcasieu	LA	0	0	0	0	0	0	0
Cameron	LA	24	1	3	1	72	11	112
Orange	TX	0	0	0	0	0	0	0
Jefferson	TX	9	0	1	1	50	5	66
Chambers	TX	0	0	0	0	3	0	3
Galveston	TX	34	1	4	1	52	16	108
Brazoria	TX	2	0	0	0	1	3	6
Matagorda	TX	0	0	0	0	1	2	3
Calhoun	TX	2	0	0	2	4	4	12
Aransas	TX	6	0	0	4	67	5	82
Nueces	TX	42	2	0	18	19	7	88
Kleberg	TX	7	0	1	2	5	4	19
Kenedy	TX	15	0	1	0	3	2	21
Willacy	TX	3	0	0	0	1	0	4
Cameron	TX	11	1	0	0	2	1	15
St. Patricio	TX	1	0	0	0	1	0	2
Refugio	TX	0	0	0	0	4	0	4
Unknown		0	0	0	0	0	0	0
Total		156	5	10	29	285	60	545

[a] Survey area extends from the Mermentau River, LA to Brownsville, TX. Adapted from STSSN data file, NMFS, Miami, FL.

Table 6. Numbers of sea turtles stranded during calendar year 1987 by species and county arranged in geographical order from north to south in southwestern Louisiana (Preliminary).[a]

County	State	Logger-head	Green	Leather-back	Hawks-bill	Kemp's ridley	Unknown	Total
Calcasieu	LA	0	0	0	0	1	0	1
Cameron	LA	12	0	1	0	13	6	32
Orange	TX	0	0	0	0	0	1	1
Jefferson	TX	4	0	0	0	8	3	15
Chambers	TX	0	0	0	0	2	0	2
Galveston	TX	21	1	1	0	10	2	35
Brazoria	TX	2	1	0	0	2	1	6
Matagorda	TX	7	0	0	1	3	8	19
Calhoun	TX	13	0	0	0	9	12	34
Aransas	TX	1	0	0	0	14	5	20
Nueces	TX	35	8	0	7	17	3	70
Kleberg	TX	18	2	0	0	6	1	27
Kenedy	TX	9	0	0	1	1	7	18
Willacy	TX	0	0	0	0	0	3	3
Cameron	TX	17	2	0	0	0	8	27
St. Patricio	TX	0	0	0	0	0	0	0
Refugio	TX	0	0	0	0	1	0	1
Unknown		0	0	0	0	0	0	0
Total		139	14	2	9	87	60	311

[a] Survey area extends from the Mermentau River, LA to Brownsville, TX. Adapted from STSSN data file, NMFS, Miami, FL.

Table 7. Numbers of sea turtles stranded during calendar year 1988 by species and county arranged in geographical order from north to south in southwestern Louisiana and Texas (Preliminary).[a]

County	State	Logger-head	Green	Leather-back	Hawks-bill	Kemp's ridley	Unknown	Total
Calcasieu	LA	0	0	0	0	0	0	0
Cameron	LA	1	0	0	0	5	0	6
Orange	TX	0	0	0	0	1	0	1
Jefferson	TX	1	0	2	0	3	0	6
Chambers	TX	0	0	0	0	0	0	0
Galveston	TX	8	0	2	0	9	0	19
Brazoria	TX	1	0	2	0	2	0	5
Matagorda	TX	11	0	0	0	9	2	22
Calhoun	TX	9	0	0	0	5	1	15
Aransas	TX	1	0	0	0	6	1	8
Nueces	TX	32	5	1	4	15	6	63
Kleberg	TX	21	1	0	7	6	4	39
Kenedy	TX	14	1	0	0	2	2	19
Willacy	TX	3	0	0	0	1	0	4
Cameron	TX	10	0	0	1	1	1	13
St. Patricio	TX	0	0	0	0	0	0	0
Refugio	TX	0	0	0	0	0	0	0
Unknown		0	0	0	0	0	0	0
Total		112	7	7	12	65	17	220

[a] Survey area extends from the Mermentau River, LA to Brownsville, TX. Adapted from STSSN data file, NMFS, Miami, FL.

Table 8. Numbers of sea turtles stranded from 1 January 1989 to 30 September 1989 by species and county arranged in geographical order from north to south in southwestern Louisiana and Texas (Preliminary).[a]

County	State	Logger-head	Green	Leather-back	Hawks-bill	Kemp's ridley	Unknown	Total
Offshore						1		1
Calcasieu	LA	0	0	0	0	0	0	0
Cameron	LA	1	0	0	0	3	2	6
Orange	TX	0	0	0	0	0	0	0
Jefferson	TX	2	1	0	0	7	0	10
Chambers	TX	0	0	0	0	0	0	0
Galveston	TX	22	2	5	0	4	0	33
Brazoria	TX	5	1	2	0	3	0	11
Matagorda	TX	5	1	0	1	7	1	15
Calhoun	TX	5	2	0	0	3	0	10
Aransas	TX	5	0	0	0	3	1	9
Nueces	TX	16	3	2	7	11	1	40
Kleberg	TX	1	1	0	2	0	0	4
Kenedy	TX	0	0	0	0	0	0	0
Willacy	TX	1	0	0	0	0	1	2
Cameron	TX	13	19	0	1	4	2	39
St. Patricio	TX	1	0	0	0	0	0	1
Refugio	TX	0	0	0	0	0	0	0
Unknown		0	0	0	0	0	0	0
Total		77	30	9	11	46	8	181

[a] Survey area extends from the Mermentau River, LA to Brownsville, TX. Adapted from STSSN data file, NMFS, Miami, FL.

Table 9. Arithmetic mean weight (g) of Rancho Nuevo "imprinted" Kemp's ridley sea turtle hatchlings of the 1989 year-class[a].

Raceway Number	Rearing facility	Number weighed	Mean weight(g)
1	Old Quonset Hut	5	16.1
2	"	5	17.1
3	"	5	15.9
4	"	5	16.3
5	"	5	15.1
6	"	5	14.4
7	"	5	16.1
8	"	5	16.5
9	"	5	16.8
10	"	5	14.1
25	New Quonset Hut	5	16.8
26	"	5	16.9
27	"	5	16.6
Total		65	16.1

[a] All weights were taken on 10 July 1989. The clutches of hatchlings were not kept separated at Rancho Nuevo, Mexico.

Table 10. Dates for weighing of samples of head started Kemp's ridley sea turtles of the 1988 and 1989 year-classes.

1988 Year-class		1989 Year-class	
Date	Number	Date	Number
14-19 July 1988	925	6 Jan 1989	50
29	50	13	50
5 Aug	50	27	50
12	50	3 Feb	50
18	250	10	50
19	50	17	50
26	50	24	50
2 Sep	50	3 Mar	50
9	50	10	50
23	50	17	50
30	50	24	50
7 Oct	50	31	50
14	50	7 Apr	50
21	50	14	50
28	50	21	50
4 Nov	50	28	50
11	50	5 May	50
18	50	12	50
25	50	14-19	883
2 Dec	50		
9	50		
16	50		
23	50		
30	50		

Table 10. (continued).

1989 Year-class	
Date	Number
10 July 1989	65
14	125
21	125
28	125
4 Aug	125
11	125
18	125
1 Sept	125
8[a]	125
12 Oct.	125
9 Nov	125
8 Dec	125
5 Jan 1990	125
2 Feb	125
2 Mar	125
30	125
27 Apr	125
25 May	TBA

[a] After the 8 September 1989 weighing the schedule was changed from weekly to monthly.

Table 11. Statistics for the linear regressions of the natural logarithms of weight (g) on square root of age (years)[a]

Year-class	n	Slope, b	Intercept, a	s^2	r^2
1978	7379	5.084	-4.874	0.213	0.83
1979	6448	4.712	-4.389	0.104	0.87
1980	5084	4.916	-4.376	0.084	0.90
1981	7828	4.984	-5.062	0.060	0.94
1982	5832	5.109	-4.838	0.119	0.91
1983	647	3.653	-4.203	0.079	0.79
1984	5159	4.400	-4.572	0.098	0.86
1985	5515	6.566	-5.563	0.077	0.95
1986	4944	5.030	-4.272	0.061	0.93
1987	2815	6.273	-5.317	0.053	0.95
1988	1950	4.880	-4.773	0.013	0.98

[a] $Y=a+bX$,

where

$Y=\ln(W)$ for W=weight in g,

$X=T^{0.5}$ with T=age in years,

n=number of W and T pairs,

s^2=variance ofresiduals, and

r^2=coefficient of determination.

Table 12. Monthly mean temperature, salinity and pH during head starting of the 1988 year-class of Kemp's ridley sea turtles.

Month	Mean observations[a]	Mean temperature (C°)	Number of salinity (ppt)	pH
July 1988	43	27.2	32.6	7.8
August	81	28.1	34.7	7.9
September	82	26.1	31.5	7.8
October	78	28.0	27.1	7.4
November	73	28.1	29.0	[b]
December	94	27.2	27.2	_
January 1989	77	27.2	26.3	_
February	63	25.6	21.0	_
March	94	27.2	24.7	_
April	75	29.5	23.0	_
May	48	29.4	22.8	_

[a] Represents more than one raceway.

[b] No data

Table 13. Schedule of tagging the 1988 year-class of head started Kemp's ridley sea turtles.

Clutch	Dates of Tagging		
	Living Tag[a]	Internal Tag[b]	Flipper Tag[c]
2	4 Jan 1989	8-9 Mar 1989	18 May 1989
3	4,8	9	17-19
4	4,5,10	9,12	14,17,19
5	5,8,9	9,12	16,17,19
6	3,6,7,9	10,12	14,16,19
7	6,7,9	10,12	15,19
8	4,7,9	9,10,12	14,16,19
9	7,8	10	15
10	9,10	11,12	12,19
11	9,17,27	11,12	18,19
Cayman Island Farms[d]	none	18	23

a Applied to left costal scute 1.

[b] Binary-coded, magnetic metal tag inserted into the left foreflipper.

[c] Inconel tag inserted into the right foreflipper.

[d] Clutches were mixed at the Cayman Turtle Farm, Grand Cayman, B.W.I.

Table 14. Estimated parameters and statistics for the logistic functions[a] to cumulative proportion of tags lost vs age (years) among three head started Kemp's Ridley sea turtle year-classes held in long-term captivity.

Year-class	K	T_{50}	r^2
1978	0.666	2.188	0.723
1982	3.248	1.830	0.914
1984	1.437	2.567	0.979

[a] $P=1/\{1+\exp[-K(t-t_{50})]\}$,

where

P=tag loss probability,

K=empirical constant,

T=age in years,

T_{50}=estimated age at which 50% of the tags have been lost, and

r^2=coefficient of determination.

Table 15. Clutch identification numbers and inconel flipper tag codes for head started Kemp's ridley sea turtles of the 1988 year-class held for more than one year in captivity. All turtles received a living tag on left costal scute 1 and a magnetic wire-tag encoded D1:2; D2:81 in the left foreflipper.

Clutch Number	Tag Number	Clutch Number	Tag Number
8	QQA233	4	QQA775
8	QQA157	4	QQA922
8	QQA920	4	QQA726
8	QQA004	4	QQA701
8	QQA936	4	QQA860
8	QQA916	4	QQA869
8	QQA919	4	QQA863
8	QQA263	4	QQA911
8	QQA972	4	QQA457
8	QQA084	4	QQA960
8	QQA230	4	QQA909
8	QQA930	4	QQA931
8	QQA918	4	QQA965
8	QQA974	4	QQA121
8	QQA934	4	QQA437
8	QQA837	4	QQA941
8	QQA784	4	QQA532
8	QQA855	6	QQA086
8	QQA599	6	QQA184
8	QQA903	6	QQA927
8	QQA025	6	QQA957
8	QQA948	6	QQA002
8	QQA969	6	QQA237
8	QQA018	6	QQA942
8	QQA912	6	QQA973
8	QQA078	6	QQA850
8	QQA952	6	QQA921
8	QQA907	6	QQA087
8	QQA104	6	QQA264
8	QQA947	6	QQA273
8	QQA039	6	QQA915
8	QQA938	6	QQA615
8	QQA111	6	QQA945
8	QQA106	6	QQA706

Table 15. (Continued)

Clutch Number	Tag Number	Clutch Number	Tag Number
4	QQA056	6	QQA906
4	QQA226	6	QQA239
4	QQA496	6	QQA380
4	QQA434	6	QQA854
4	QQA038	6	QQA393
4	QQA033	6	QQA085
4	QQA608	6	QQA246
4	QQA092	6	QQA913
4	QQA063	6	QQA905
4	QQA006	6	QQA953
4	QQA027	6	QQA083
4	QQA959	6	QQA158
4	QQA098	6	QQA453
4	QQA954	6	QQA089
4	QQA956	6	QQA162
4	QQA722	6	QQA962

Table 16. Summary of recoveries of head started tagged and released Kemp's ridley sea turtles as of 30 September 1989. Release percentage is based on the number of hatchlings received alive and the recovery percentage is based on the number of turtles released.

Year-class	Imprinting Location	Released Number	Released Percent[a]	Recovered Number	Recovered Percent
1978	Padre Island	1,267	68.3	50	3.9
	Rancho Nuevo	752	61.3	25	3.3
		2,019	65.6	75	3.7
1979	Padre Island	1,279	77.2[b]	22	1.7
	Rancho Nuevo	66	35.3[b]	0	0.0
	Unknown	24		0	0.0
		1,369	74.3	22	1.6
1980	Padre Island	1,526	94.9	78	5.1
	Rancho Nuevo	197	95.2	5	2.5
		1,723	94.9	83	4.8
1981	Padre Island	1,639	87.9	50	3.1
1982	Padre Island	1,329	87.2	159	12.0
1983	Padre Island	172	74.8	11	6.4
	Rancho Nuevo	18	90.0	1	5.6
		190	76.0	12	6.3
1984	Padre Island	1,037	72.0	24	2.3
1985	Padre Island	1,534	91.1	117	7.6
1986	Padre Island	1,727	98.2	47	2.7
1987	Padre Island	1,150	90.0	26	2.3
	G. Cayman Isl.	130	81.8	4	3.1
		1,280	89.1	30	2.3
1988	Padre Island	794	85.8	1	0.1
	G. Cayman Isl.	14	56.0	1	7.1
		808	85.1	2	0.2

Table 16. (continued).

Year-class	Imprinting Location	Released Number	Released Percent[a]	Recovered Number	Recovered Percent
1989	Rancho Nuevo	(presently being head started)			
1978 - 1988	Padre Island	13,454	85.0[b]	585	4.3
1978 - 1980, 1983, 1989	Rancho Nuevo	1,033	28.3[b c]	31	3.0
1987 - 1988	G. Cayman Isl.	144	78.3	5	3.5
1979	Unknown	24	?	?	?
Total		14,655	74.6[c]	621	4.2

[a] Based upon number of hatchlings received alive by imprint group, or with imprint groups combined (see Table 1).

[b] Minimum estimated percentage, because some of the recoveries; in the unknown imprint group of the 1979 year-class could have added to this group.

[c] Based on all year-classes except the 1989 year-class which had not been released (see Table 1).

Table 17. Percent of total recoveries of head started flipper-tagged and released Kemp's ridley sea turtles by year-class[a].

Year-class	Recoveries	
	Number	Percent
1978	7	12.1
1979	22	3.5
1980	83	13.4
1981	50	8.0
1982	159	25.6
1983	12	1.9
1984	24	3.9
1985	117	18.8
1986	47	7.6
1987	30	4.8
1988	2	0.3
Total	621	100.0

[a] As of 30 September 1989.

Table 18. Recoveries of head started, flipper-tagged and released Kemp's ridley sea turtles of the 1978-1988 year-classes, by country, state and recovery zone (oceanside vs bayside), as of 30 September 1989.

Country	State	Oceanside	Bayside	Not reported	Total
U. S. A.					
	Texas	176	164	54	394
	Louisiana	46	27	8	81
	Mississippi	1	5	0	6
	Alabama	2	1	1	4
	Florida	25	19	9	53
	Atlantic	9	9	4	22
	Georgia	6	0	3	9
	S. Carolina	2	4	6	12
	N. Carolina	1	16	3	20
	Virginia	0	1	1	2
	Maryland	0	0	2	2
	New Jersey	1	1	0	2
	New York	0	1	1	2
Mexico		7	1	1	9
France		2	0	0	2
Morocco		0	1	0	1
Total		278	250	93	621
Percent		44.8	40.3	15.0	100.0

Table 19. Recoveries of head started, flipper-tagged and released Kemp's ridley sea turtles of the 1978-1988 year-classes, by method of recovery, as of 30 September 1989.

Recovery method	Number	Percent
Method not reported	102	16.4
Stranded		
Dead	167	26.9
Alive	104	16.7
Shrimp trawl		
Dead	27	4.3
Alive	101	16.3
Not reported	13	2.1
Hook and line	36	5.8
Gill net	19	3.1
Swimming	35	5.6
Dip net	7	1.1
Cast net	2	0.3
Butterfly net[a]	2	0.3
Flounder net	2	0.3
Beach seine	1	0.2
Pound net	1	0.2
Crab pot	1	0.2
Oyster dredge	1	0.2
Total	621	100.0

[a] Wingnet used to catch shrimp.

Table 20. Shrimp trawl by-catch of head started, flipper-tagged and released Kemp's ridley sea turtles of the 1978-1988 year-classes, by country and state, as of 30 September 1989.

Country	State	Number	Percent
Mexico		5	3.6
USA			
	Texas	73	51.8
	Louisiana	43	30.5
	Mississippi	1	0.7
	Alabama	1	0.7
	Florida		
	Gulf	3	2.1
	Atlantic	3	2.1
	Georgia	5	3.6
	South Carolina	4	2.8
	North Carolina	2	1.4
	Virginia	1	0.7
Total		141	100.0

Table 21. Condition of head started, flipper-tagged and released Kemp's ridley sea turtles when recovered, by year-class, as of 30 September 1989.

Year-class	Alive	Dead	Not reported	Total
1978	62	8	5	75
1979	14	3	5	22
1980	45	16	22	83
1981	26	19	5	50
1982	95	54	10	159
1983	9	3	0	12
1984	13	11	0	24
1985	45	71	1	117
1986	26	18	3	47
1987	20	10	0	30
1988	1	1	0	2
Total	356	214	51	621
Percent	57.3	34.5	8.2	100.0

Table 22. Recoveries of head started, flipper-tagged and released Kemp's ridley sea turtles of the 1978-1988 year-classes, by season, as of 30 September 1989.

Season	Number	Percent
Spring (April-June)	363	58.4
Summer (July-September)	161	26.0
Autumn (October-December)	55	8.9
Winter (January-March)	41	6.6
Not reported	1	0.2
Total	621	100.0

Table 23. Head started captive stock of Kemp's ridley sea turtles released into Sydnor Bayou in August 1989.

Year-class	Left fore-flipper	Right fore-flipper	PIT tag	Living Tag	Carapace length, cm	Carapace width, cm	Weight kg	Source[a]
1982	BBB921	NNZ604	7F7FOC236E	None	60.1	56.3	0	CAY
1982	BBB927	NNZ607	7F7FO81030	None	58.2	55.4	0	CAY
1982	None	BBB926	7F7FOC222A	None	55.9	54.3	0	CAY
1982	BBB924	NNZ606	7F7FO90E33	None	62.5	59.5	0	CAY
1984	BBB904	NNZ755	7F7FO9123A	LC5	48.5	48.4	0	SA
1984	BBB906	None	7F7FOC1A18	LC5	50.3	48.5	0	SA
1984	BBB907	NNZ754	7F7FO91514	LC5	55.1	51.3	0	SA
1984	BBB909	NNZ758	7F7FOC1D13	LC5	53.3	50.9	0	SA
1984	BBB910	NNZ759	7F7FOF0511	LC5	49.3	49.8	0	SA
1984	BBB908	NNZ757	7F7FOF0025[b]	LC5	50.0	49.6	0	SA
1984	BBB912	None	7F7FO90A3F	LC5	52.9	49.3	0	CAY
1984	BBB917	None	7F7FO91411	LC5	50.1	46.2	21.6	CAY
1984	BBB918	NNZ602	7F7FOE7A5E	LC5	48.1	45.7	0	CAY
1984	BBB916	NNZ601	7F7FOC2119	LC5	50.7	47.4	0	CAY
1984	None	BBB992	7F7FOC2763	LC5	48.0	46.2	17.2	AZ
1984	BBB925	None	7F7FO90D6F	LC5	50.7	46.4	0	CAY
1984	BBB904	NNZ756	7F7E124B66[c]	LC5	51.0	50.1	0	SA
1984	BBB914	None	7F7FOE7A18	LC5	52.2	48.6	21.1	CAY
1984	BBB928	NNZ608	7F7FOC2061	LC5	49.3	46.5	0	CAY
1984	None	BBB902	7F7FOF0049	LC5	61.5	64.1	30.9	BPS
1984	BBB913	None	7F7FOE7B45	LC5	53.2	47.7	20.9	CAY
1984	BBB919	NNZ603	7F7FOC2E2E	LC5	53.4	47.4	26.8	CAY
1984	BBB923	NNZ605	7F7FOC2263	LC5	52.4	47.6	0	CAY
1984	BBB922	None	7F7FOC2020	LC5	55.6	50.2	0	CAY
1986	PPL718	BBB994	7F7E1B452C	N4	48.7	46.6	22.1	NMFS
1986	None	BBB993	7F7E1B372D	N4	51.5	48.5	18.2	NMFS
1987	None	PPR885	7F7FOC1D68	RC1	37.0	36.5	7.7	NMFS
1987	None	PPR818	7F7FOC2544	RC1	34.5	34.3	6.2	NMFS
1987	None	PPR847	7F7FO8752B	RC1	34.7	33.2	5.9	NMFS
1987	None	BBB911	7F7FOE7E32	RC1	32.7	30.7	4.5	NMFS
1987	None	PPS254	7F7FOC2B30	RC1	37.6	37.2	8.4	NMFS

[a]CAY = Cayman Turtle Farm, Grand Cayman, B.W.I.; SA = Sea-Arama Marineworld, Galveston, TX; AZ = Audubon Park and Zoological Gardens, New Orleans, LA.; BPS = Bass Pro Shops, Springfield, MO.

[b]Turtle has second PIT tag 7F7E1B420E.

[c]Turtle has second PIT tag 7F7FOC2945.

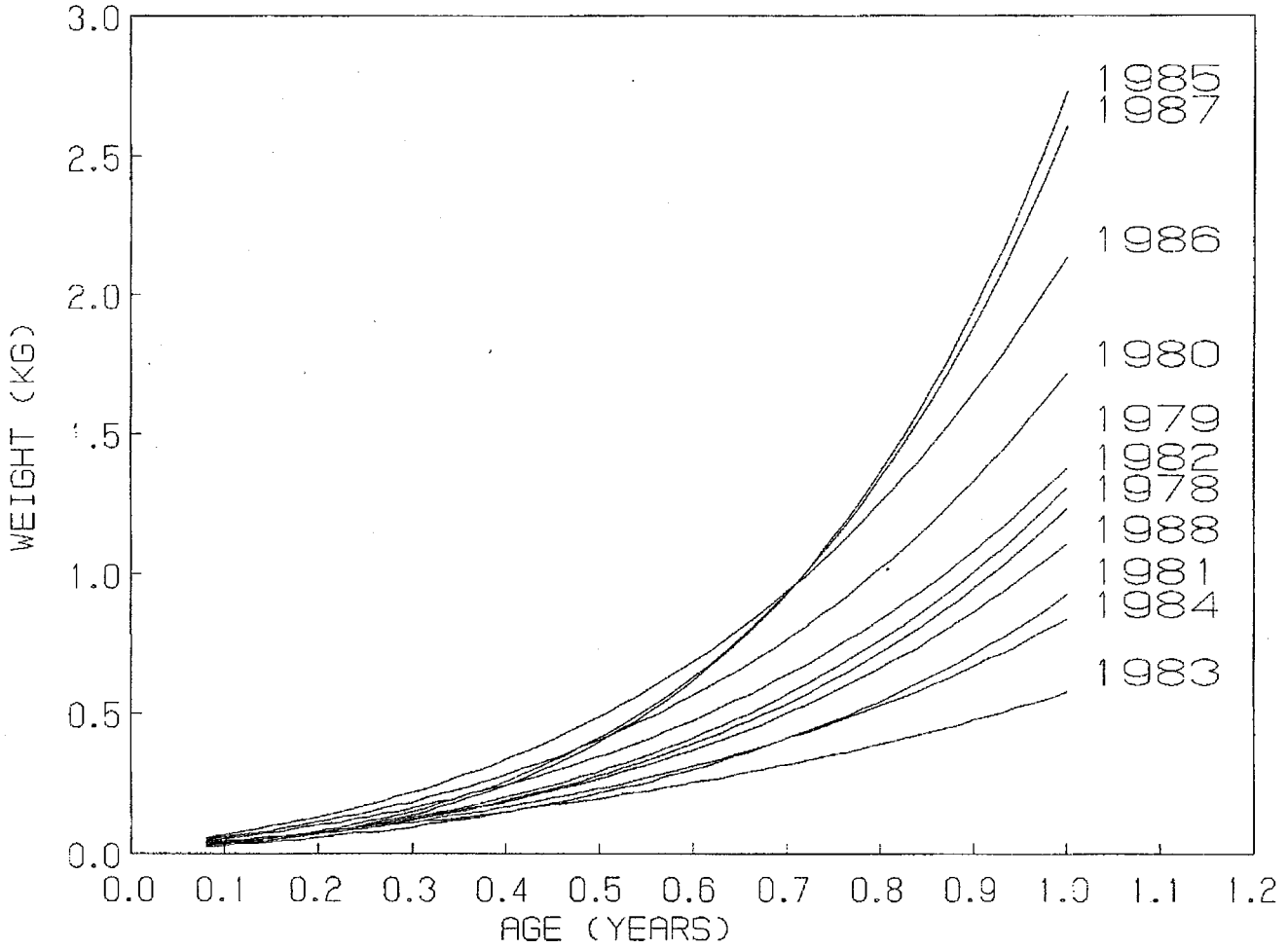

Figure 1. Fitted growth curves for head started Kemp's ridley sea turtles year-classes 1978-1988. Curves were fitted by linear regression of ln(W) on $T^{0.5}$, where W is weight (kg) and t is age (years). The figure represents detransformed results (see also Caillouet et al. 1986a).

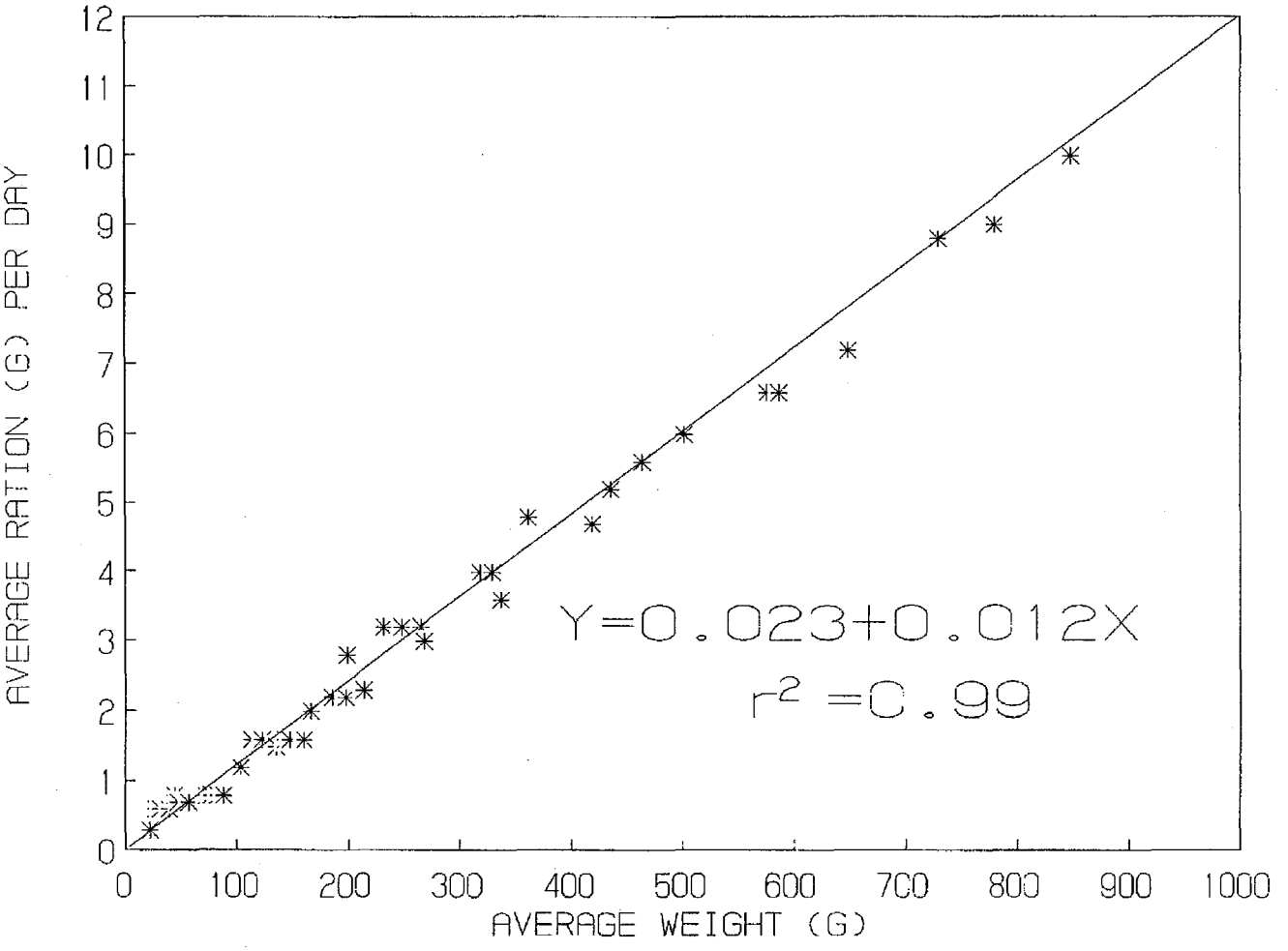

Figure 2. Fitted linear relationship between Y=weekly average food ratio (g) per turtle per day and X=weekly average weight (g) per turtle during head starting of the 1988 year-class of Kemp's ridleys. This relationship was used to set feeding rates of the 198 year-class.

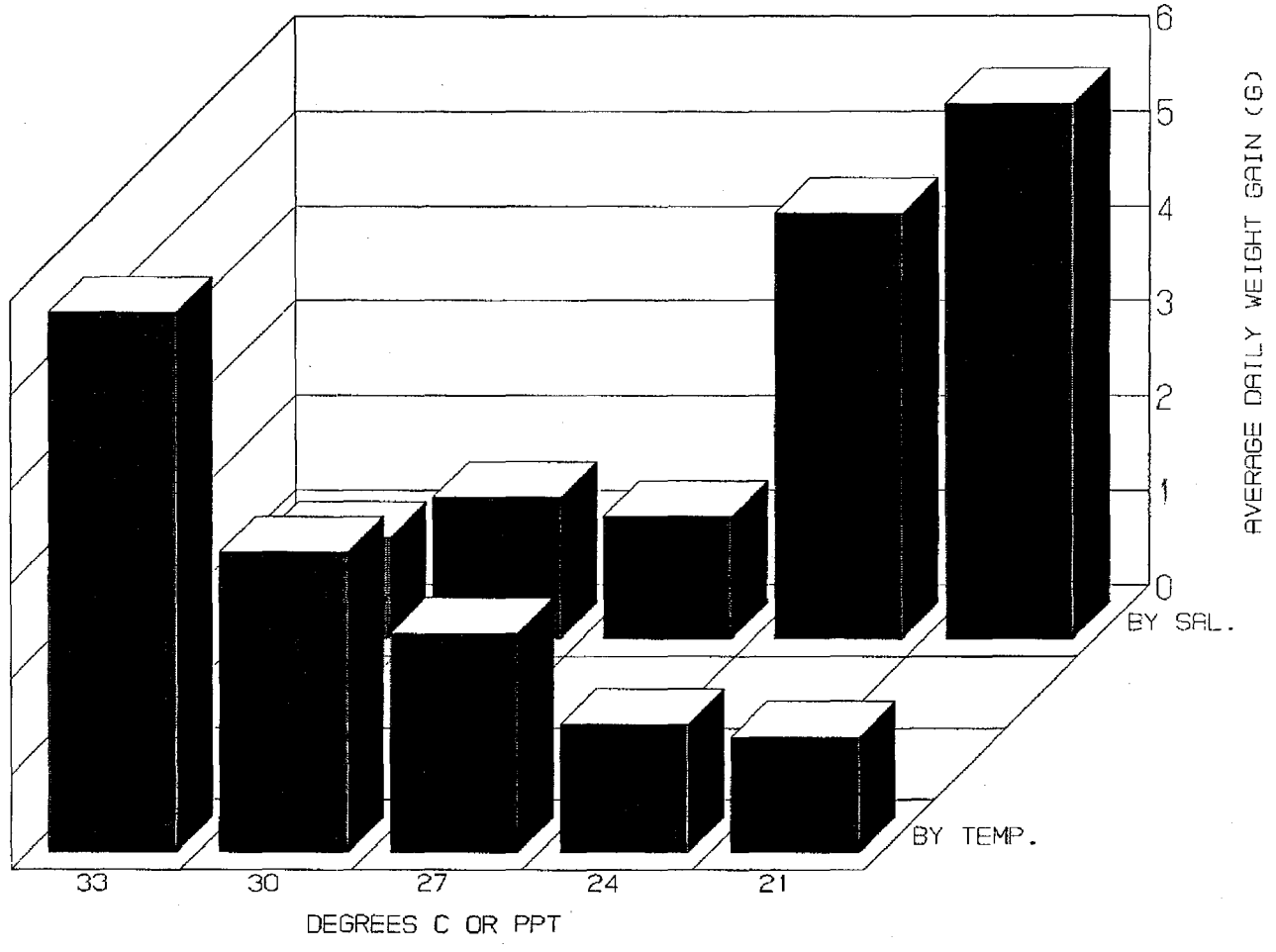

Figure 3. Relationship between weekly average weight gain per turtle per day for 50 Kemp's ridleys of the 1988 year-class and weekly averages of temperature (°C) and salinity (ppt) grouped into 3° or 3 ppt intervals, respectively.

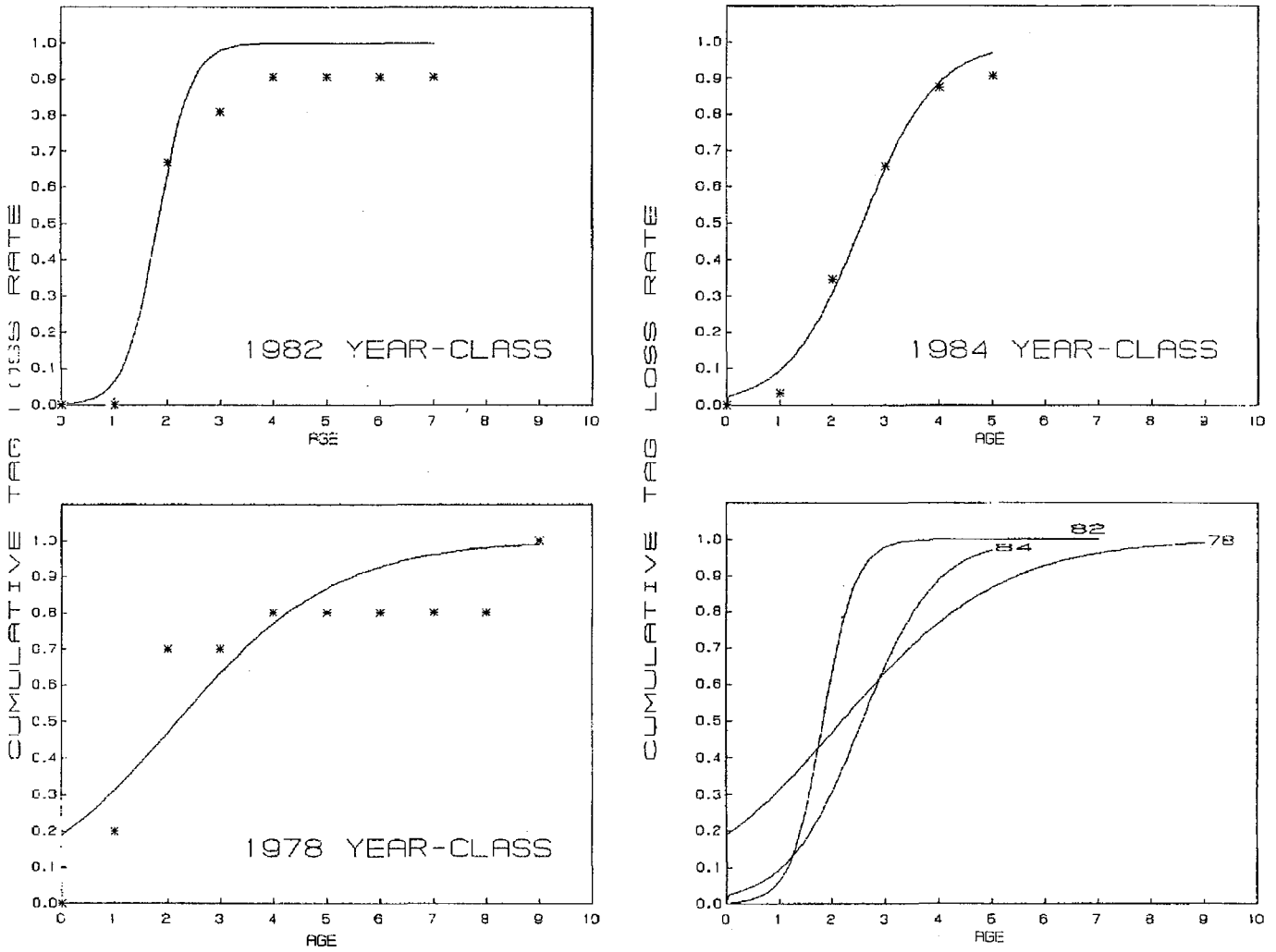

Figure 4. Cumulative tag loss rate with age (years) for three head started Kemp's ridley sea turtle year-classes (1978, 1982, 1984) held in long-term captivity. All tags were Hasco style 681 made of monel alloy.

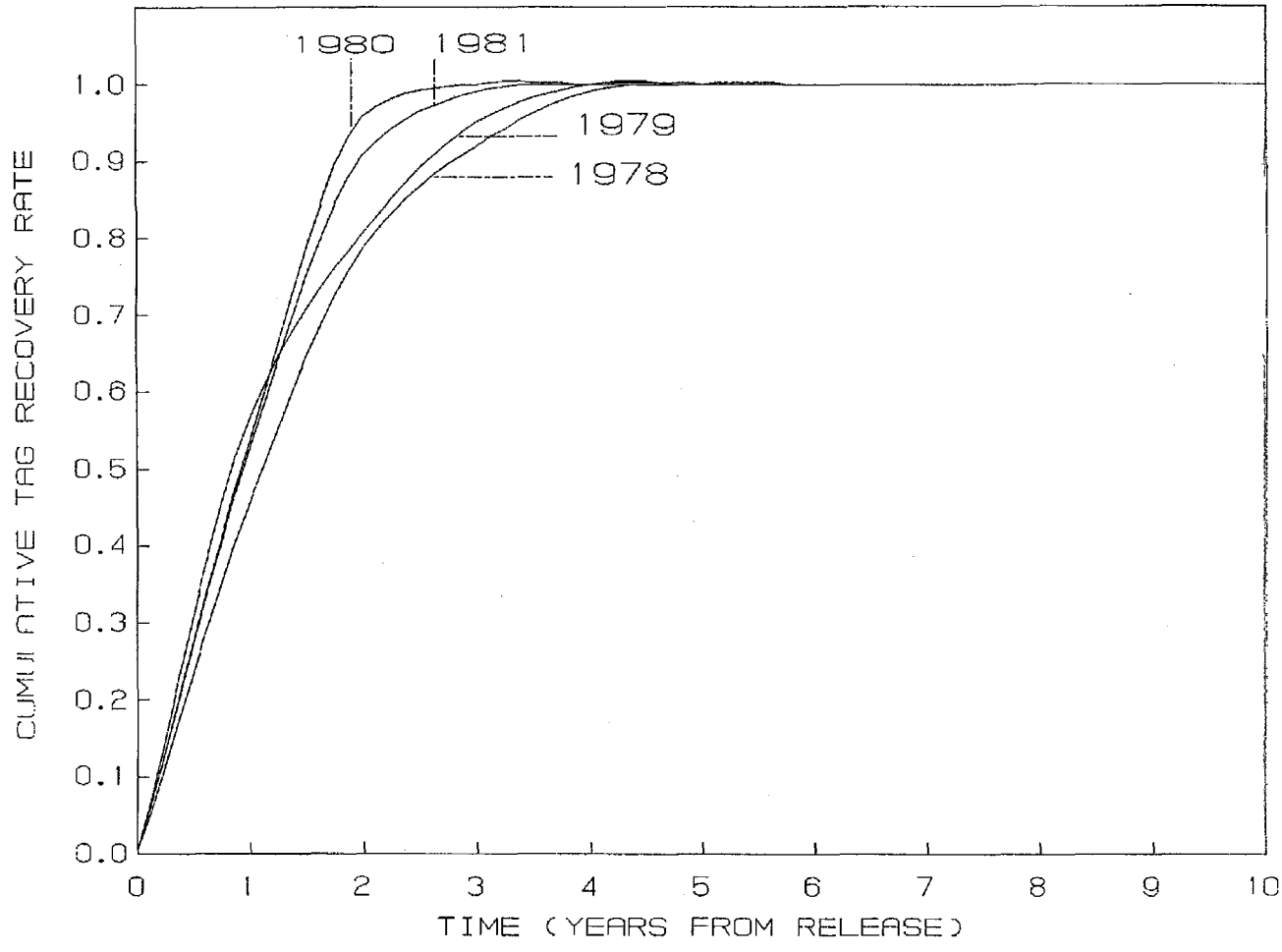

Figure 5. Cumulative tag recovery rate with time (years from release) for head started, tagged and released Kemp's ridley sea turtles of the 1978-1981 year-classes released offshore of Mustang and Padre Islands, Texas.