

PADRE ISLAND NATIONAL SEASHORE
KEMP'S RIDLEY SEA TURTLE PROJECT
1994 REPORT

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ABSTRACT

Patrols for nesting sea turtles and related public education efforts continued at Padre Island National Seashore (PAIS) during 1994. From April through mid-September, PAIS employees and volunteers spent 1,347 hours patrolling a total of 23,470 km of beachfront.

All confirmed sea turtle nesting emergences and tracks for the Texas coast during 1994 occurred on Padre Island. A wild Kemp's ridley turtle (*Lepidochelys kempi*) laid 111 eggs at the PAIS 52.2 mile marker on 7 June 1994. The nesting was the first documented for Kemp's ridley along the Texas coast since 1991. The eggs from the nest were packed into a styrofoam box and incubated at the PAIS incubation facility. Ninety percent of the eggs hatched and all 100 hatchlings from the clutch were released on the beach at PAIS and set free into the Gulf of Mexico. Of the 10 large embryos removed from the 11 unhatched eggs, four were male and six were female.

Two documented Kemp's ridley tracks (unknown wild or head-started) and three documented loggerhead (*Caretta caretta*) tracks were observed at PAIS but were deemed to have been false crawls. Three recently released, adult, head-started turtles were confirmed to have emerged onto the beach at PAIS. One of the three was observed on the beach three times during the same day. Three additional unsubstantiated reports, including two daytime nesting turtles and one set of tracks, were made for North Padre Island this year.

Ten sea turtle hatchlings were found stranded along North Padre and Mustang Islands from 18 June through 30 September, including one Kemp's ridley, two loggerhead, six hawksbill (*Eretmochelys imbricata*), and one unknown species turtles. The two loggerhead hatchlings may have emerged from South Texas nests. Three of the hatchlings, including one hawksbill and two loggerheads, were dead when located. The Kemp's ridley, unknown species turtle, and other five hawksbills were found alive.

Three injured, live hatchlings (including one *L. kemp*i and two *E. imbricata*) were brought to the PAIS sea turtle hatchling rehabilitation facility for stabilization and care. All three hatchlings survived and were released into the Gulf of Mexico after two to three weeks of rehabilitation at PAIS. Three live hawksbill hatchlings were transported to the University of Texas Marine Sciences Institute (UTMSI) for rehabilitation. All three *E. imbricata* are still being held at UTMSI for rehabilitation (as of 30 September 1994).

BACKGROUND

During each summer, from 1978 to 1988, approximately 2,000 Kemp's ridley turtle (*Lepidochelys kempi*) eggs were shipped to Padre Island National Seashore (PAIS) from Rancho Nuevo, Mexico in an experimental attempt to establish a secondary breeding colony of this species through imprinting. Of the 22,507 eggs received, 17,358 (77.1%) hatched and 15,875 hatchlings were shipped to the National Marine Fisheries Service Laboratory for head-starting (Shaver, 1989b; 1992a). Overall, 13,454 yearlings were released into the Gulf of Mexico after 9 to 11 months of head-starting. To date, no turtles experimentally imprinted to Padre Island have been confirmed nesting at PAIS or any other nesting beach. However, it is unknown how many have survived after release and none may have attained adulthood yet.

Transfer of Kemp's ridley eggs to PAIS from Rancho Nuevo, Mexico was terminated after the 1988 incubation season. Now the primary objective of the PAIS Kemp's ridley project is to identify whether Kemp's ridleys return to nest at PAIS (Shaver, 1989a). Also significant in our efforts is the location and protection of all sea turtle nests and stranded hatchlings from local beaches. Public education programs, beach patrols, and protection and monitoring of nesting sea turtles, nests, and stranded hatchlings will be continued at the park for the foreseeable future. This report summarizes these efforts during 1994.

BEACH PATROLS

Management of the Padre Island National Seashore nesting beach, including beach patrols of the area, is listed as a priority 2 recovery task item in the Kemp's Ridley Sea Turtle Recovery Plan (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1992). As a result, seasonal beach patrols for nesting sea turtles, tracks, nests, and hatchlings began at PAIS in 1986 and have continued through 1994.

From 4 April through 9 September 1994, one patrol was conducted each Tuesday,

Wednesday, Thursday, and Friday. Virtually all of the patrols were made south of the Ranger Station. However, a few patrols of the northern section of North Padre Island were also conducted. Northern patrols usually covered the area from the Ranger Station to the Nueces/Kleberg County line and back. The majority of this northern patrol route was north of the PAIS northern boundary. The southern patrol route encompassed the area from the Ranger Station to the Mansfield Channel and back, approximately 193 km.

Complete coverage of the entire patrol area on all days of the patrol season (April through mid-September) was not possible due to vehicle speed and personnel time limitations. Because of these limitations, typically only the northernmost 80 km of the southern area were patrolled and no patrols involving camping were conducted during 1994. It was also necessary to concentrate efforts in areas, and at times, when they would be most effective. Weekend patrols were not conducted due to the high likelihood that beach visitors would detect and report turtle sightings. Additionally, areas and dates of coverage were based upon historical trends of nesting and hatchling stranding dates and locations. Most sea turtle tracks and nests found along the Texas coast during the last 10 years were located between the 27 and 72 km markers on PAIS, from mid-April and mid-July (Table 1). However, Kemp's ridley turtles have been documented nesting in Rancho Nuevo, Mexico from April through August. Most stranded hatchlings were found on North Padre Island, north of the PAIS 27 km marker, and Mustang Island, from July through mid-September. Hence, during late August and early September 1994, patrol efforts were concentrated north of the 27 km marker, in an attempt to locate stranded hatchlings rather than nesting turtles.

Resources Management Division staff continued to conduct an intensive study of marine debris at PAIS during 1994. Division employees studied debris washed ashore along a linear distance of 25.6 km. Due to limited beach access, the area was traversed twice each day to accomplish the study. The study area extended 6.4 km south from the northern PAIS boundary and 19.2 km south from the

Malaquite Beach/South Beach barricade. Employees were observant for sea turtle sightings during their travel to and from the Marine Debris Survey sites.

Additionally, a Resources Management employee travelling to monitor oil and gas activities at the park, was observant for turtle sightings. The time and distance of travel for oil and gas monitoring activities and the Marine Debris Survey were included in summary statistics for 1994 beach patrol efforts.

For the 1994 patrol season, a total of 761 km of beachfront was traversed during north patrols, 14,511 km during south patrols, 8,079 km during marine debris surveys, and 119 km during oil and gas monitoring activities (Fig. 1). Although the distance covered in conjunction with southern patrols was slightly less than during previous years, the distance covered in the northern patrols was only one-tenth of that covered during 1993 (Shaver, 1993). Marine Debris Survey distance was slightly greater than during 1993.

Four types of vehicles were used for patrolling during 1994 (Fig. 2). As during 1993, all-terrain 4-wheel cycles (ATVs) were the primary patrol vehicle during 1994. ATVs were used to patrol 20,978 km of beachfront and logged more patrol distance than any other vehicle type during 1994. Contrastingly, only 5,643 km were patrolled via ATVs during 1992. ATVs were considered the preferred vehicles for patrols because they: 1) have excellent vantage for sighting sea turtle hatchlings, tracks, and nesting turtles; 2) can be operated by one individual; and, 3) can be operated at varying speeds and for varying distances, depending upon conditions.

During patrol seasons from 1986-1992, four-wheel drive trucks (4X4) were used more than any other type of patrol vehicle. However, the suitability of these vehicles for patrols is limited because they: 1) have a reduced field of observation and are ineffective for sighting small turtles and faint sea turtle tracks; 2) are subject to relatively high levels of mechanical failure; and, 3) require two people to be present in order to conduct patrols (one driver and one observer). During 1994,

1,889 km of beachfront was patrolled using 4x4 vehicles, in sharp contrast to the 12,141 km logged using these vehicles in 1992. During 1994, 4X4 trucks were used primarily for: 1) marine debris surveys; 2) oil and gas monitoring activities; and, 3) patrols conducted while retrieving large stranded sea turtles or investigating nesting emergencies.

"Mules", small all-terrain vehicles obtained from military surplus property, were utilized for 64 km of patrolling during 1994, as compared to 6,025 km of patrolling during 1993 and 2,326 km during 1992. Although these vehicles provided excellent vantage for observations, they were limited to slower speeds and shorter distances. Mules were used primarily by volunteers, within the relatively short northern patrol route. A military surplus munitions jeep was used to patrol 539 km of beachfront, primarily during debris surveys and investigations of reported turtles.

Similar amounts of time were spent patrolling during 1991 (2,355 hours) (Shaver, 1991), 1992 (2,243 hours) (Shaver, 1992b), and 1993 (2,527 hours) (Shaver, 1993). However, the amount of time spent conducting patrols, 1,347 hours, was greatly reduced during 1994, despite distance coverage being intermediate between levels accomplished during 1992 and 1993. The expanded use of ATVs and virtual elimination of the northern patrol route (previously conducted on mules) were probably the most significant factors leading to increased efficiency during 1994. Two people were needed to conduct all patrols using four-wheel drive vehicles and most patrols using mules, with one individual operating the motor vehicle and the other scanning the beach for pertinent sightings. However, ATV patrols were conducted by one person and hence were less labor-intensive. Also, ATVs and mules were used to locate stranded hatchlings during 1992, 1993, and 1994, replacing slow walking patrols used for this purpose during 1990 and 1991.

A large contingent of individuals were needed to conduct patrols because of the extensive area (125 km linear distance) and lengthy season (5 months) (Fig. 3). Because of the extremely rigorous beach conditions, each individual was limited to

no more than two patrol days/week. All of the individuals conducting patrols were intensively trained in patrol protocol and data collection methodology.

Volunteers conducted virtually all patrols exclusively made for the detection of sea turtles. Five volunteers donated a total of 722 hours during this effort. In comparison, volunteers donated 899 hours during 1992 beach patrols and 1,222 hours during 1993 beach patrols.

Due to limitations in funding, park staff members were unavailable to conduct regularly scheduled patrols during 1994. However, they did assist with investigation of reports and contributed to the patrol effort by remaining alert for sightings while conducting their other duties (oil and gas monitoring and marine debris surveys). Park employees contributed a total of 625 hours to the overall patrol effort during 1994, as compared to 1,344 hours during 1992 and 1,306 hours during 1993.

Although Maintenance Division and Ranger Division employees traversed long distances of beachfront during the course of their duties, their vehicle types (large sedans and four-wheel drive trucks) and high speeds (typically in excess of 40 km/hr) prohibited them from being able to observe nesting sea turtles or tracks. Thus, no beach driving conducted by Ranger Division and Maintenance Division employees qualified for inclusion in PAIS 1994 beach patrol efforts.

STAFF AND VISITOR EDUCATION

The Kemp's Ridley Sea Turtle Recovery Plan lists addressing education/awareness and long-term education needs as a priority 2 recovery task item, with the National Park Service being one of the responsible agencies (U.S. Fish and Wildlife Service and National Marine Fisheries Service, 1992). Accordingly, efforts to educate the park staff and public about the Kemp's ridley project continued this year. Since PAIS is 105 km long and extensive areas are often devoid of park personnel, it is imperative that park employees and visitors assist with detection and reporting of

turtle sightings. Therefore, great emphasis was placed on alerting them about the potential for nesting Kemp's ridleys and urging them to look for nesting turtles, tracks, and stranded hatchlings.

A variety of methods were used to educate park visitors about the possibility of sighting nesting turtles and stranded hatchlings. Posters, detailing the need to report sea turtle nestings and tracks, were displayed at PAIS and other local parks and establishments. Additional posters, alerting visitors about the possibility of encountering stranded hatchlings, were distributed at a number of locations within the park. Beach signs, alerting visitors to report live sea turtle sightings immediately, were posted at the park. A display and video tape about the Kemp's ridley project were available at the PAIS Visitor Center.

RELEASE OF AND RECOVERY OF ADULT KEMP'S RIDLEY TURTLES

On 20 May 1994, 13 adult Kemp's ridley turtles were released in the surf at Closed Beach, PAIS. These 13 turtles had been experimentally imprinted to PAIS between 1978 and 1982, head-started, and held in captivity throughout their lives. All turtles possessed one metal tag on a front flipper and one metal tag on a rear flipper. Many were light in coloration and possessed large, white numbers painted on their carapace. One individual was missing a front flipper. Included in the 13 were seven males and six females. The males possessed tails that extended beyond their carapace. Two of the females were outfitted with back-pack satellite transmitters. Tracking of these turtles was conducted by the National Marine Fisheries Service (NMFS). Beginning the day after the release, some of the 13 turtles were sighted by beach patrollers and visitors. Most of the sightings were made on PAIS beaches (see Sea Turtle Tracks and Nests). Strandings and aquatic sightings of the released turtles are documented in this section.

At 1430 h on 22 May 1994, visitors reported seeing an approximately 76 cm long turtle with a transmitter on its carapace, swimming 4.6 m from shore at the PAIS 42.3 km marker. A volunteer patroller received information from visitors who

stated that they saw a turtle with a transmitter attempting to emerge from the surf at the 40 and 45 km markers and that the turtle was frightened back into the water before crawling up the beach. It is likely that this was one of the two outfitted with transmitters and released at PAIS two days previously. Specifically, it was probably AAV 589, QQC 133 that was sighted the previous day at the 24.5, 28.5, and 29.8 km markers (see Sea Turtle Tracks and Nests).

One of the 13 released turtles was located stranded at the Corpus Christi Bay marina on 5 June 1994, documented by a PAIS volunteer patroller, and brought to PAIS for necropsy. Tags AAV 541 and QQC 143 were found on the dead female turtle. Additionally, PIT tag 1FOA5D7604 was found. The turtle possessed a possible boat propeller injury and was too injured and decomposed to remove gut contents for analysis.

Tags from one of the released male turtles (AAV 594, QQC 135) were reported from the beach on the northern side of the south jetty at the Mansfield Channel. The cinched tags were found by a NMFS employee on 17 June 1994, returned to NMFS, and reported to PAIS. The NMFS employee found no signs of the turtle on the beach.

SEA TURTLE TRACKS AND NESTS

All confirmed sea turtle nesting emergences and tracks for the Texas coast during 1994 occurred between 21 May and 6 July on Padre Island. A wild Kemp's ridley sea turtle was observed nesting at the PAIS 84.0 km marker on 7 June 1994; the first documented nesting for this species along the Texas coast since 1991 (Table 1). Two documented Kemp's ridley tracks (unknown wild or head-started) and three documented loggerhead tracks were observed at PAIS but were deemed to have been false crawls. Three recently released, adult, head-started turtles were confirmed to have emerged on the beach at PAIS. One of the three was observed three times during the same day. Additionally, two unsubstantiated reports of daytime nesting turtles and one unconfirmed report of sea turtle tracks were made

for North Padre Island this year.

A Kemp's ridley turtle and its tracks were seen at the PAIS 22.1 km marker at 1000 h on 21 May 1994. The track pattern was V-shaped, with a disturbed area of sand at the apex, approximately half way to the coppice dunes. The turtle was observed by visitors and a volunteer patroller as it was reentering the water. Unfortunately, insufficient time was available for them to observe whether the turtle had a metal flipper tag. However, photographs showed that the turtle was light in coloration and that it had all four flippers present, a tag scar on the right front flipper, faint traces of a painted number on its carapace, and no transmitter. Also, the turtle appeared to have had a short tail. It is likely that this was one of the 13 adult Kemp's ridley turtles that had been released the previously day, based upon these characteristics and the temporal/spatial proximity to the release. It is unlikely that the turtle had nested. No eggs were found when the disturbed area of sand at the apex of the tracks was excavated to a diameter of 152 cm and a depth of 45.7-55.9 cm.

Kemp's ridley AAV 589, QQC 133 (with a transmitter) was sighted on the beach at PAIS on three occasions on 21 May 1994. Based upon the tag numbers, this was one of the 13 turtles released at PAIS the previous day and was a female. The first sighting was at the 24.5 km marker at 1015 h. The tracks from this emergence meandered up the beach, to the base of the coppice dunes. Along the length of the tracks there were three disturbed areas of sand where the turtle was observed attempting to nest. However, the turtle was apparently disturbed by visitors. Visitors read the tag number almost as soon as the turtle crawled onto the beach and six individuals surrounded the turtle when it was first seen by NPS employees. Although NPS employees moved the visitors away from the turtle, she failed to nest before reentering the water. AAV589, QQC 133 was next sighted on the beach at the 28.5 km marker at 1600 h. Unfortunately, visitors that reported sighting the turtle stated that they placed it back into the water and that it had not nested. The third sighting was made by a patrol volunteer at 1740 h at

the 29.8 km marker. At that time the turtle was seen reentering the water. The volunteer found it impossible to determine where the turtle had been on the beach and whether it had nested.

Kemp's ridley AAV 596, QQC 134 was sighted on the beach at the PAIS 12.1 km marker at 1030 h on 22 May 1994. This turtle was seen by beach visitors, NPS employees, and a volunteer patroller. The turtle was readily identifiable as being one of the 13 released because of the tag numbers and the number six painted on its carapace. The turtle crawled 28 m directly westward towards the dunes, excavated a cavity, turned, crawled 34 m northeastward back to the water, and reentered the surf. The NPS employee observed that the turtle did not lay eggs and did not cover the cavity. Based upon records and photographs, this long tailed turtle was a male.

The first unsubstantiated report was of a turtle seen on the beach at the PAIS 32.2 km marker at 1145 h on 24 May 1994. Visitors relayed information to a volunteer patroller that they saw the turtle "moving sand with its flippers" and put it back into the water because they thought that it was "stuck in the sand". However, the volunteer patroller was unable to locate the site of the emergence to investigate and obtain corroborating evidence. If the report is credible, it is likely that the turtle was an adult ridley, based upon the size described by the visitors, photo identification made by the visitors, and daytime emergence of the animal. Since the visitors stated that they did not see any transmitters, tags, missing flippers, or numbers on the carapace of the turtle, it is unknown whether this would have been a wild or head-started turtle.

A set of sea turtle tracks was detected by a volunteer patroller at the PAIS 22.9 km marker at 1045 h on 25 May 1994. The tracks were very prominent and were 58 cm wide, with alternating flipper impressions. They extended approximately 36.6 m westward and terminated in a disturbed area of sand about 122 cm in diameter. Within the disturbed area there was a 32 cm deep uncovered cavity.

Despite excavation of the disturbed area, no eggs were found and it is likely that none were laid. Based upon the track width and impression pattern, it is likely that the tracks were made by a Kemp's ridley. However, it is impossible to determine whether the turtle was a wild or head-started individual.

The only confirmed sea turtle nest for the Texas resulted from the emergence of Kemp's ridley turtle at the PAIS 84.0 km marker at 1130 h on 7 June 1994. This untagged turtle had no signs of a tag scar and no numbers painted on its carapace and hence was not one of the 13 released on PAIS. Additionally, the turtle did not have a living tag. However, it was not checked for the presence of a PIT tag. The turtle measured 68.0 cm curved carapace length (CCL) and 70.0 cm curved carapace width (CCW). The turtle was oriented directly westward when it deposited 111 eggs in a nest cavity located 28 m from the water. The uppermost eggs were located at 30 cm depth and the bottom of the nest cavity was at 45 cm depth. The eggs were carefully packed into a styrofoam box containing sand from the nest and transported to the PAIS incubation facility. Beach driving conditions were extremely favorable and, after 3 h of smooth transport, the eggs arrived at the facility at 1930 h. Incubation, hatching, and release information for this clutch is presented below (see Sea Turtle Egg Incubation Techniques and Sea Turtle Egg Incubation Results).

Another set of sea turtle tracks was located by a volunteer patroller at the 54.7 km marker at 1116 h on 17 June 1994. The tracks extended 35 m from the surf. One uncovered cavity was located along the tracks and no other disturbed areas of sand or eggs were located. The tracks measured 69 wide, with alternate flipper impressions. Based upon this pattern it is likely that the tracks were from a Kemp's ridley. However, it is impossible to determine whether they were from a wild or head-started individual.

The second unsubstantiated report was of a set of sea turtle tracks on Closed Beach, 0.4 km north of the road behind the Ranger Station. A visitor stated that

they saw prominent tracks with alternating flipper impressions at 1700 h on 29 June 1994. The visitor reported that the V-shaped tracks extended to mid-beach and terminated in a disturbed area. However, the report was not filed with a volunteer patroller until 2 July 1994. The volunteer and the visitor immediately searched the area but were unable to locate the tracks. Based upon the sketchy information and lack of corroboration, it is impossible to determine whether the report was credible and, if so, whether the tracks were from a loggerhead, wild Kemp's ridley, or head-started Kemp's ridley.

The third unsubstantiated report was of an approximately 90 cm long x 90 cm wide turtle, 23 m from the water, "half buried in the sand". A visitor reported to a lifeguard that they saw the turtle 1.6 km north of Bob Hall Pier on North Padre Island, at approximately 1100 h on 30 June 1994. However, upon investigation, the lifeguard did not see the turtle. An NPS Resources Management Division employee investigated the area at 1330 and also found no signs of the turtle or tracks. However, the NPS employee stated that numerous vehicle tracks in the area and windy conditions would have obscured turtle tracks. The NPS employee located a depression in the area that was 60 cm in diameter that was possibly a body pit and a 35 cm deep uncovered cavity. However, numerous human foot prints surrounded the depression and it appeared that people had dug into the hole. Due to the disturbance and lack of other evidence, this report could not be corroborated.

Two visitors reported seeing a large sea turtle on the beach at PAIS, 0.8 km south of the end of the paved road, at 2245 h on 4 July 94. The visitors rushed to alert NPS personnel at the Ranger Station and the author immediately travelled to the site to investigate the report. Unfortunately, upon my arrival at 2300 h, the turtle was no longer present on the beach but its tracks were extremely prominent. The tracks were 85 cm wide, with alternating flipper impressions. Because of the track pattern, description of the turtle, and nighttime emergence, the turtle was deemed to have been a loggerhead. The tracks meandered considerably on the beach. A

disturbed area of sand (65 cm x 65 cm) was found at the most landward extent of the tracks, approximately half way between the surf line and the primary dunes. NPS staff excavated the disturbed area to a depth of 20.3 cm. However, no nest cavities or other disturbed areas of sand were found. The visitors that sighted and reported the turtle stated that they "followed the turtle with their car and perhaps frightened it". Because of the details obtained from the prompt site investigation and interviews with the visitors, it is certain that this emergence was a false crawl.

A Resources Management Division employee conducting a Marine Debris Survey observed a set of prominent sea turtle tracks at 0930 h on 5 July 1994. The tracks were located on Malaquite Beach, half way between the pavilion and the Malaquite Beach/South Beach barricade. The tracks measured 65-75 cm wide, with alternating flipper impressions, and were absent from the intertidal area. Because of the pattern, it is likely that the tracks were made by a loggerhead turtle. The V-shaped tracks extended nearly to the base of the primary dunes. Two disturbed areas of sand (90 cm x 90 cm) were observed near the apex of the tracks. NPS personnel excavated both areas to a depth of 40 cm. However, no nest cavities or eggs were found and the emergence was deemed a false crawl. The site of this emergence was about 1.2 km north of the location where the loggerhead emerged the previous evening. It is likely that the same turtle produced these tracks and the set described above, due to the temporal and spacial proximity of both.

A volunteer patroller detected a set of sea turtle tracks at the PAIS 51.7 km marker at 1230 h on 6 July 1994. The prominent tracks were 89 cm wide, showed alternating flipper impressions, and were absent in the 6 m wide intertidal area. This track pattern was indicative of a loggerhead turtle. The apex of the V-shaped tracks was approximately 40 m from the tide line. A disturbed area of sand, 150 cm x 160 cm, was located at the apex. The entire disturbed area was excavated to a depth of 40 cm. However, no nest cavities or eggs were found and the emergence was deemed a false crawl.

SEA TURTLE EGG INCUBATION TECHNIQUES

The following protocol was utilized to care for sea turtle eggs within the PAIS incubation facility. Sea turtle eggs were transported to the park incubation facility as soon as possible after collection. Each of the smaller styrofoam boxes, containing the eggs, was placed into a larger styrofoam box. Styrofoam box dimensions and incubation procedures were the same as those used since 1986 (Shaver et al., 1986; Shaver et al., 1988a). Ambient and control box temperatures were monitored at the three shelf heights. Incubation, ambient, and control box temperatures were recorded at hourly intervals and transferred directly into a computerized database using a Data Acquisition System.

Attempts were made to elevate incubation temperatures in order to avoid the potentially masculinizing effect of incubating sea turtle eggs in styrofoam boxes (Mrosovsky, 1982; Dutton et al., 1985). The incubation facility and practices were once again modified to produce mean middle third of incubation period temperatures that slightly exceeded pivotal temperatures. Such modifications proved successful in producing primarily female Kemp's ridley sea turtles at Padre Island National Seashore from 1985-1988 (Shaver et al., 1988b; Shaver, 1989b).

Attempts were also made to prevent incubation temperatures from becoming too hot, too cold, or too unstable, all of which could stress the developing embryos and reduce their viability (Shaver et al., 1987; 1988b; Shaver, 1989b; Shaver and Chaney, 1989). Plastic sheeting and bamboo shades were placed over the shed walls to trap heat and reduce temperature fluctuations.

Eggs incubated in the facility during June, July, August, and early-September 1994. During that time there were no prolonged episodes of cold temperatures that threatened to make incubation temperatures become too low. However, during July, last third of incubation period temperatures for the clutch of 111 Kemp's ridley eggs could have exceeded lethal limits due to metabolic heat and high ambient temperatures (Shaver et al., 1987; 1988a; Shaver, 1989b; Shaver

and Chaney, 1989).

Several means were utilized to reduce incubation temperatures of the clutch of 111 eggs during the latter portion of the incubation period. A portable air conditioner was utilized during periods of hot diurnal temperatures. On the 19th day of incubation, the clutch was moved to a cooler, lower shelf. Incubation box lids were removed to reduce incubation temperatures after they exceeded 34-35 C. Generally, lids were removed between 2200 and 0800 h and replaced by 1000 h. This pattern of lid removal decreased temperatures in accordance with thermal cycles of natural nests at mid-nest depth (30 cm) (Shaver et al., 1988a; 1988b). Because of these precautions, incubation temperatures of this clutch never exceeded 37.0 C.

Styrofoam incubation boxes were opened approximately once every two weeks throughout incubation to check for fungal infections, insects, and sand moisture. No fungal infected eggs or insects were found in any of the clutches. Moisture content of the sand above the eggs was monitored by the "pie-crust" pinch technique. Decreased sand moisture was detected in only the Kemp's ridley clutch containing 111 eggs. A small amount of distilled water was added to the top sand layer on a few occasions near the termination of the incubation period.

Incubation boxes were checked for hatching twice daily beginning on the 45th day of incubation. All emerged hatchlings were transferred to other double styrofoam boxes containing moist Padre Island sand. They were held in transfer boxes for approximately 24 hours to allow them to gain strength and enter their infantile frenzy. Activity levels of the hatchlings were monitored to determine the appropriate release time. The hatchlings were released on Closed Beach, PAIS during early morning hours.

Unhatched eggs were allowed to incubate for up to 5 days after the remainder of the clutch had hatched. After that time, all unhatched eggs were preserved for

later analysis. The Kemp's ridley clutch containing 39 eggs had not hatched by 56 days of incubation. It was then unearthed to determine whether any of the eggs were viable and all non-viable eggs were preserved. Unhatched eggs from both clutches were injected with, and stored in, F.A.A. solution. Large embryos were injected with 10% buffered formalin to preserve internal tissues. Eggs were examined and embryos classified according to procedures and guidelines used at PAIS since 1982 (Shaver et al., 1988a; Shaver and Chaney, 1989). Cratz (1982) and Miller (1985) were used as to classify Kemp's ridley embryos.

INCUBATION OF EGGS LAID ON SOUTH TEXAS BEACHES

Incubation facility temperatures - Comparisons were made between ambient and control box temperatures recorded from the three shelf heights during the middle third of the incubation period for the clutch of 111 eggs (23 June-7 July). Since temperatures were not normally distributed, non-parametric procedures were used to make comparisons. Median ambient shed temperatures recorded from the top (median = 29.5, mean = 30.1, SE = 0.2, range = 24.8-38.3 C, N = 360), middle (median = 29.3, mean = 30.1, SE = 0.2, range = 25.1-38.6 C, N = 360), and bottom (median = 29.1, mean = 29.7, SE = 0.1, range = 25.3-36.4 C, N = 360) shelves in 1994 were not significantly different from one another (Kruskal-Wallis, $P = 0.289$). In contrast, median temperatures of control boxes located on top (median = 30.4, mean = 30.4, SE = 0.0, range = 28.2-31.9 C, N = 360), middle (median = 30.2, mean = 30.2, SE = 0.0, range = 28.1-31.7 C, N = 360), and bottom (median = 29.4, mean = 29.4, SE = 0.0, range = 27.7-30.5 C, N = 360) shelves in 1994 were all significantly different from one another (Kruskal-Wallis, $P < 0.001$; Student-Newman-Keuls, $P < 0.05$).

Incubation temperatures and hatching results - Incubation temperatures of the Kemp's ridley clutch containing 111 eggs ranged from 26.7-36.9 C. Temperatures exceeded 36.0 C on 11 h, eight of which occurred within 24 h of hatching. Attempts were made to maintain middle third of the incubation period temperatures slightly above the pivotal temperature for this species, 30.2 C

(Shaver et al., 1988b). These manipulations were apparently successful since the mean middle third of incubation period temperature was 31.6 C (S.E. = 0.0, median = 31.5, range = 29.5-33.5 C, N = 360). During the middle third of the incubation period, the median incubation temperature of this box was significantly higher than the median temperature of the bottom shelf control box (Mann-Whitney Rank Sum Test, $P < 0.001$).

The incubation period (from egg laying to pipping) for this clutch was 47 days. One hundred of the 111 eggs hatched (90.1%) and emerged from their egg shells. Eighty-six of the hatchlings were released on Closed Beach at 0710 h on 25 July. All were active and entered the surf within 2 h. The hatchlings were guarded from beach predators by staff members, invited guests, and media who attended the release. One late hatching individual from this clutch was released at 0820 h on 26 July. Although one late hatching turtle was also released at 0820 on 27 July, 12 other individuals released at that time were unable to swim through the very rough surf and were recaptured. Those 12 individuals were immediately taken approximately 8 km offshore from Port Aransas, Texas and released into the Gulf of Mexico. The 12 turtles swam vigorously during the offshore release.

Straight-line carapace lengths (SLCLs) and weights of hatchlings from this clutch were compared with those from the Kemp's ridley clutches laid on south Texas beaches and incubated at PAIS during 1991 and 1988. Since the SLCLs and weights were not normally distributed, non-parametric comparisons were performed. The median SLCL (median = 41.10, mean = 40.88, SE = 0.15, range = 36.00-46.80 mm, N = 100) of hatchlings from the 1994 clutch was significantly smaller than the median SLCL (median = 42.20, mean = 42.17, SE = 0.09, range = 40.00-43.85 mm, N = 100) of hatchlings from the 1991 clutch and the median SLCL (median = 44.50, mean = 44.42, SE = 0.10, range = 42.10-46.35 mm, N = 95) of hatchlings from the 1988 clutch (Kruskal-Wallis $P < 0.001$, Dunn's Test $P < 0.05$). Additionally, the median weight (median = 14.80, mean = 14.63, SE = 0.13, range = 10.41-17.23 g, N = 100) of hatchlings from the

1994 clutch was significantly smaller than the median weight (median = 16.70, mean = 16.64, SE = 0.07, range = 15.10-18.80 g, N = 100) of hatchlings from the 1991 clutch and the median weight (median = 17.97, mean = 17.84, SE = 0.08, range = 15.11-19.14 g, N = 95) of hatchlings from 1988 clutch (Kruskal-Wallis $P < 0.001$, Dunn's Test $P < 0.05$). The mean SLCL and weight of the 1994 hatchlings were similar to those from the 1987 year class of Kemp's ridley turtles incubated at PAIS (Shaver et al., 1987). Individuals from the 1987 year class were smaller than individuals from any of the other year classes from 1983-1988 (Shaver et al., 1987). The relatively small size of hatchlings from the 1994 Kemp's ridley clutch may have been related to the relatively large number of eggs in the clutch and/or the relatively warm incubation temperatures during the last trimester of incubation.

The 11 unhatched eggs from this clutch were preserved after full-term clutch incubation. One was infertile and 10 contained well-developed embryos. According to embryological stages of development described by Cratz (1982) and Shaver and Chaney (1989), nine of the embryos were stage 30 (50 days of development [dd]) and one was stage 30-31 (50-55 dd). According to embryological stages of development described by Miller (1985), one of the embryos was stage 29 (39-41 dd) and nine were stage 30 (44-46 dd).

None of the 10 embryos possessed deformities and gonads were removed from each for histological sex determination. Of the 10 embryos analyzed for gender, six were females and four were males, yielding a sex ratio of 1M:1.5F. Clutch sex ratio estimates were also made based upon the mean middle third of incubation period temperature and incubation period, both of which have been found to be correlated with clutch sex ratio (Shaver et al., 1988b; Shaver, 1989b). Values for the mean middle third of incubation period temperature (31.6 C) and incubation period (47 days) were inserted into equations previously derived correlating these variables with percent females. Using the equation correlating percent female with the mean middle third of incubation period temperature [$Y = -$

$1297.8747 + 44.7152X$ (Shaver et al, 1988b)], it was estimated that 100% of the clutch was female. It was estimated that 84.1% of the clutch was female when the equation correlating percent female with the incubation period [$Y = 772.343 - 14.643X$ (Shaver, 1989b)] was used. Thus, using results from the histological sex determination and both equations, it is estimated that a preponderance of females was produced in this clutch.

INCUBATION OF EGGS REMOVED FROM DEAD KEMP'S RIDLEY

Thirty-nine eggs were removed from a Kemp's ridley sea turtle that was found washed ashore on Mustang Island on 21 July 1994. Upon detection, the turtle was immediately transferred to PAIS for necropsy. Eggs found within the turtle were placed into a styrofoam box in the PAIS incubation facility. However, no metabolic heat was detected in this clutch and none of the eggs hatched. On 15 September 1994, after 56 days of incubation, all eggs were orange and severely indented and all were preserved. The contents of each egg were examined but no identifiable embryos were found. However, the eggs were too decomposed to determine whether they were fertile or infertile. Although such investigations were successfully conducted in the past (Shaver and Chaney, 1989), decomposition of these 39 eggs was probably accelerated. The female turtle that contained the eggs was decomposed when detected and necropsied.

HATCHLING STRANDINGS

Relatively large numbers of hatchlings and post-hatchlings (hereafter referred to as hatchlings) were found stranded on North Padre and Mustang Islands in 1990 (Shaver, 1990). Since that time PAIS has expended considerable effort to detect these small stranded turtles. Ten hatchlings were found stranded along Mustang and North Padre Islands from 18 June through 30 September 1994. Among the 10 were one Kemp's ridley, two loggerhead, six hawksbill, and one unknown species hatchlings (Fig. 4). The number of hatchlings found stranded on south Texas beaches since 1980 has varied greatly between years (Fig. 4). As during 1990, 1992, and 1993, most of the hatchlings were located by pedestrians in

heavily visited beach areas (Shaver, 1990, 1992b, 1993).

Stranding locations and dates were noted for each hatchling and all were measured for straight-line carapace length (SLCL), straight-line carapace width (SLCW), curved carapace length (CCL), curved carapace width (CCW), and weight (Table 2). To access possible age and origin of the hatchlings, each was examined for the presence of an umbilical scar, egg tooth, internal yolk and gut contents (if dead), wounds, and epizoans (Table 2). Additionally, hatchlings that were found dead or died during rehabilitation were necropsied in an attempt to determine cause of death and remove gonads for histological sex determination. Gonads were shipped to Dr. Robinson (Texas A&M University, Veterinary Diagnostic Laboratory), who determined gender of the dead hatchlings (Table 2).

All three of the hatchlings that were dead when located were necropsied at PAIS (Table 2). It was impossible to retrieve gut contents or remove gonads for histological sex determination from CC-94-02, due to advanced decomposition. However, gut contents and gonads were removed from the EI-94-01 and CC-94-01.

Six of the seven hatchlings that were found alive were transported to two local rehabilitation facilities (Table 2). Unfortunately, one hatchling (unknown species) was located and reported by a beach visitor on Mustang Island but never transported to a rehabilitation facility. Three of the turtles (including one *L. kempi*, and two *E. imbricata*) were taken to the facility at PAIS. All three survived and were released into the Gulf of Mexico after 2-3 weeks of rehabilitation. The other three live *E. imbricata* were brought to the University of Texas Marine Sciences Institute (UTMSI), Port Aransas, Texas for rehabilitation. All are currently being held for rehabilitation.

The two loggerhead hatchlings may have emerged from South Texas nests. Both individuals were the size of newly hatched turtles (Shaver, 1992b). CC-94-01

possessed a prominent umbilical scar and egg tooth (Table 5). Although CC-94-02 possessed an egg tooth, it was too decomposed to examine for an umbilical scar, internal yolk, or digestive tract contents. However, both may have been in the water for several days prior to stranding since they possessed epizoans and wounds. Additionally, CC-94-01 contained materials that indicated offshore feeding. The origin of the other stranded hatchlings is more difficult to ascertain since these turtles were larger than newly emerged hatchlings.

PAIS HATCHLING SEA TURTLE REHABILITATION FACILITY

Each of the three stranded hatchlings rehabilitated at PAIS was held in an individual 75.6 liter aquarium, in sterilized water. Holding conditions, practices, and techniques were similar to those utilized during 1991, 1992, and 1993 (Shaver, 1991, 1992b, 1993). Each holding container was filled with Gulf of Mexico water that had been pumped through a series of filters and an ultraviolet sterilizer to remove inert elements, particles, bacteria, protozoa, and fungi. Each aquarium had an individual, external, biological filter and an under-gravel filter. Water quality was monitored at least once a week.

LK-94-01 and EI-94-03 were fed small pieces of shrimp and squid that were held in front of them within soft forceps. As recommended for hatchling Kemp's ridley sea turtles (Fontaine et al., 1989), each hatchling held at the PAIS facility was fed approximately 5% of their body weight each day. EI-94-02 refused to eat shrimp and squid and was fed glucose and vegetable baby food. SLCL, SLCW, CCL, CCW, and weight were measured weekly. All size and weight measurements were made by the author to avoid individual differences in measurement technique, a major source of error in growth data (Bjorndal and Bolten, 1988; Boulon and Frazer, 1990). Hatchling health was closely monitored. Veterinary care was provided by Dr. Mike Hughes, who has previous experience in treating sea turtles.

All of the hatchlings that were placed into the PAIS rehabilitation facility were extremely active but were missing pieces of their flippers. Wounds on LK-94-01

and EI-94-02 were recent, whereas wounds on EI-94-03 had already healed when the turtle was found. The two turtles with recent wounds were prescribed a series of amikacin (anti-biotic) injections by Dr. Hughes. Additionally, wounds on the Kemp's ridley were treated with iodine. After two weeks of care the flipper wounds on EI-94-02 healed and after three weeks most of the flipper wounds on LK-94-01 healed.

To avoid habituation to humans, the hatchlings were released as soon as they were judged to be healthy. During release, all three hatchlings swam vigorously. On 30 August 1994, a vessel donated by Deep Sea Headquarters, Port Aransas, Texas, was used to take EI-94-02 approximately 8 km offshore from Port Aransas, Texas and release it into the Gulf of Mexico. SLCL, SLCW, CCL, and CCW remained constant for the turtle during the 12 days of rehabilitation, although weight decreased by 3 g during that time.

On 22 September 1994, LK-94-01 and EI-94-03 were taken approximately 8 km offshore from Port Aransas, Texas and released into the Gulf of Mexico using a PAIS vessel. Despite a current that was heading from north to south, both hatchlings swam westward after release. After 21 days of rehabilitation, LK-94-01 increased SLCL by 1.0 cm, SLCW by 1.1 cm, CCL by 1.2 cm, CCW by 1.2 cm, and weight by 48 g and EI-94-03 increased SLCL by 1.1 cm, SLCW by 0.6 cm, CCL by 1.6 cm, CCW by 1.1 cm, and weight by 67 g.

FUTURE PLANS

Public education programs, beach patrols, and protection and monitoring of nesting sea turtles and nests will be continued at the park during 1995. Attempts will be made to continue volunteer participation in this project. ATVs will continue to be the preferred patrol vehicle. Operation of the PAIS sea turtle egg incubation and hatchling rehabilitation facilities will be continued.

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Table 1. Documented sea turtle nestings on Texas beaches from 1979 through 1994.
PAIS = Padre Island National Seashore, Padre Island, PBP = Padre Balli Park,
Padre Island, SPI = South Padre Island, and MI = Mustang Island.

Species	Number of eggs	Lay date	Nesting location	Incubation location and method	Percent hatch
Loggerhead	84	15 June 1979	SPI	SPI, nest site	1
Kemp's ridley	67	17 June 1979	PAIS	PAIS, styrofoam box	97
Kemp's ridley	113	30 April 1980	PBP	PAIS, styrofoam box	55
Kemp's ridley	115	22 May 1980	PAIS	PAIS, nest site	2
Kemp's ridley	97	13 June 1985	PAIS	PAIS, styrofoam box	72
Green	2	13 July 1987	PAIS	PAIS, styrofoam box	50
Kemp's ridley	104	27 April 1988	MI	PAIS, styrofoam box	91
Loggerhead	113	26 June 1988	MI	PAIS, styrofoam box	69
Loggerhead	83	11 June 1990	PAIS	PAIS, nest site	100 ¹
Kemp's ridley	107	29 April 1991	PAIS	PAIS, styrofoam box	94
Loggerhead	91	25 June 1992	PAIS	PAIS, styrofoam box	93 ²
Loggerhead	130	6 July 1992	PAIS	PAIS, styrofoam box	45
Kemp's ridley	111	7 June 1994	PAIS	PAIS, styrofoam box	90

¹ Nest not detected until after hatching; lay date projected based upon a 60 day incubation period and nest detection two weeks after hatching; number of eggs and hatching rate estimated from examination of egg shells.

² Totals based upon 91 eggs recovered for styrofoam box incubation and do not include 5-7 broken eggs found at the top of the nest

Table 2. Sea turtle hatchlings stranded on North Padre and Mustang Islands from 18 June - 30 September 1994¹.

I.D. #	Species	SLCL (cm)	SLCW (cm)	CCL (cm)	CCW (cm)	Weight (g)	Stranding location ²	Stranding date	Condition Facility ³	Fate ⁴	Sex ⁵	Comments ⁶
EI-01	Ei	8.7	5.6	8.5	8.2	94	MI, Port Aransas Dunes Condominium	18 June	dead	-	M	ep, wf
EI-02	Ei	8.5	6.8	8.8	8.3	77	PI, PAIS, N. Beach/ Closed Beach barr.	19 Aug.	live PAISRF	R 30 Aug.	U	ep, wf
LK-01	Lk	7.9	7.1	8.3	8.9	69	MI, unknown loc. near Port Aransas	2 Sept.	live PAISRF	R 22 Sept.	U	ep, wf
EI-03	Ei	9.7	7.5	10.0	9.2	116	MI, unknown loc. near Port Aransas	2 Sept.	live PAISRF	R 22 Sept.	U	ep, wh
UN-01	Unknown	-	-	-	-	-	MI, unknown loc. near Port Aransas	2 Sept.	live	unknown	U	t
EI-04	Ei	5.6	4.2	7.0	6.5	40	MI, Mustang Island State Park	3 Sept.	live UTRF	H	U	wh
EI-05	Ei	9.7	7.6	9.9	9.3	114	MI, Mustang Island State Park	4 Sept.	live UTRF	H	U	wh
EI-06	Ei	7.5	5.9	7.8	6.8	59	MI, Newport Pass	6 Sept.	live UTRF	H	U	ep, wf
CC-01	Cc	5.2	4.5	5.6	5.3	18	MI, Port Aransas Dunes Condominium	17 Sept.	dead	-	U	ep, wh, et, us
CC-02	Cc	5.5	4.4	6.2	5.8	-	PI, PAIS 4-wheel Drive Sign	19 Sept.	dead	-	U	ep, w, et

¹ Also stranded during this time period was one dead EI hatchling found on South Padre Island, 4.2 km north of Brazos Santiago Pass, on 2 Sept. 94. Turtle measured 6.0 cm CCL and 5.5 cm CCW. Tips of all four flippers missing.

² PI = Padre Island, PAIS = Padre Island National Seashore, MI = Mustang Island

³ PAISRF = Padre Island National Seashore rehabilitation facility,
UTRF = University of Texas Marine Sciences Institute rehabilitation facility

⁴ R = released 8 km offshore from Port Aransas, Texas, H = still being held for rehabilitation as of 6 December 1993

⁵ M = male, F = female, U = unknown

⁶ y = internal yolk, et = egg tooth, us = umbilical scar, ep = epizoon, wf = fresh external wounds, wh = healed external wounds, w = wounds (undetermined whether fresh or healed), t = taken by visitor and never brought to a rehabilitation facility

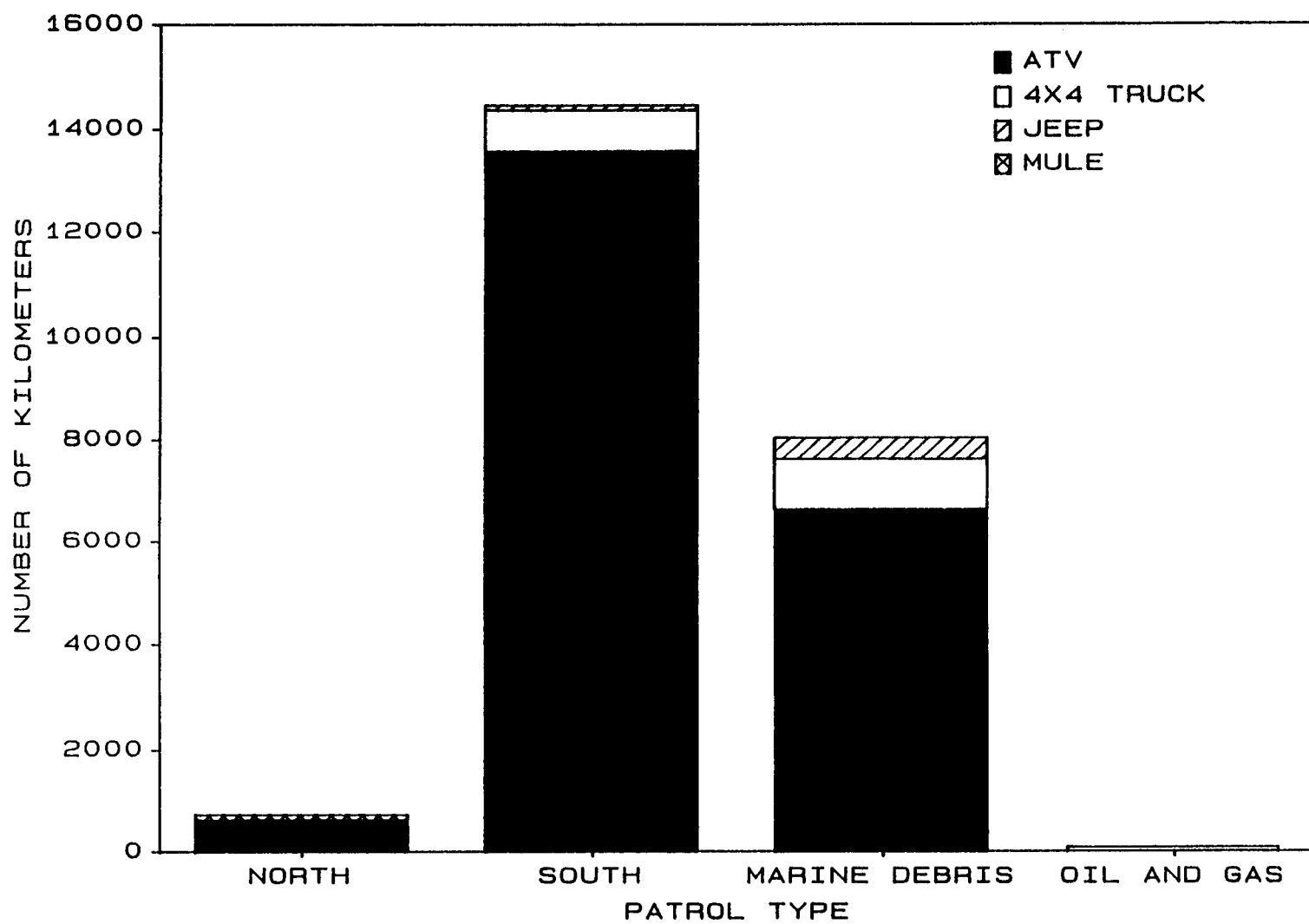


Fig. 1. Number of kilometers patrolled during various types of patrols conducted from April through mid-September, 1994.

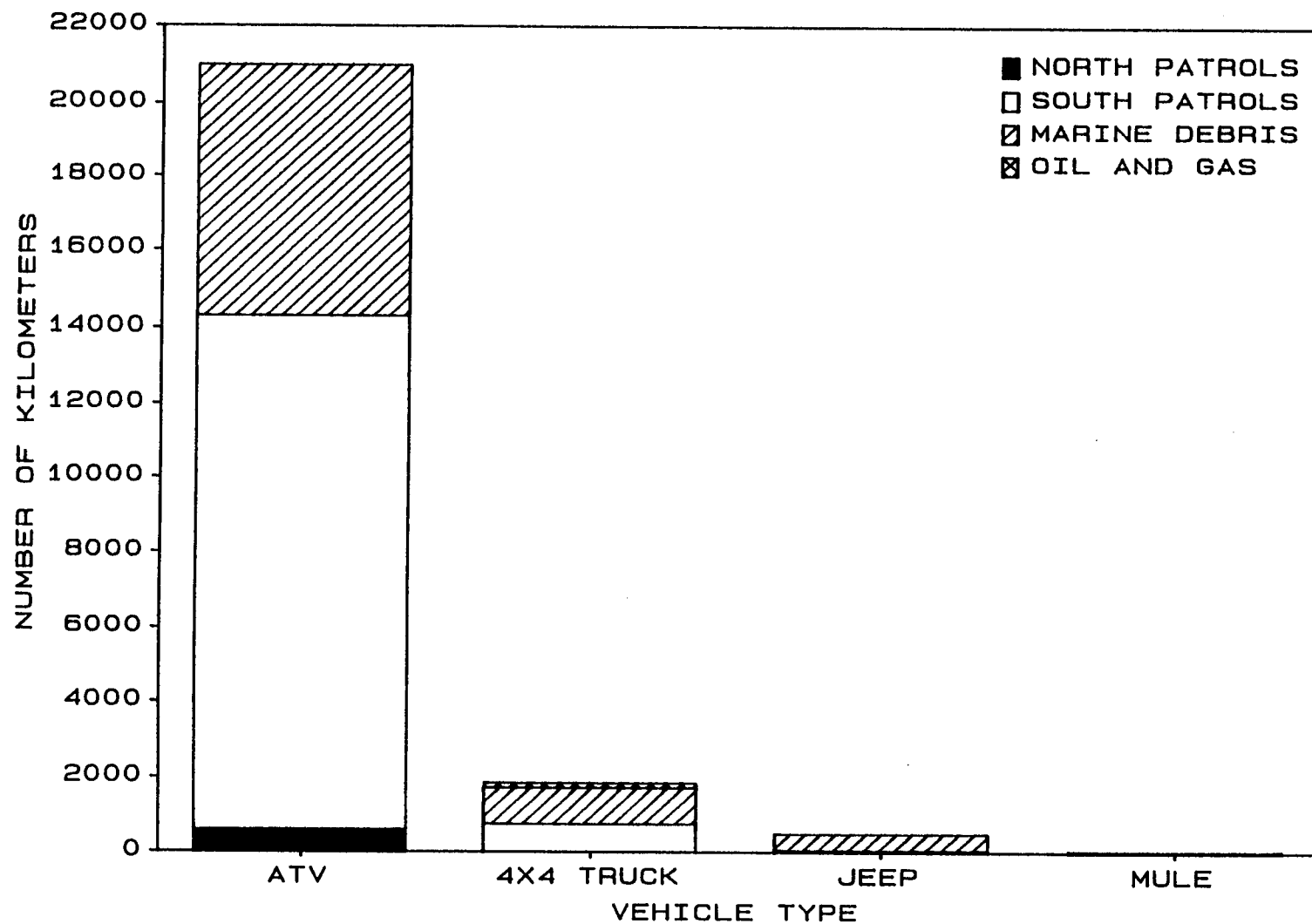


Fig. 2. Number of kilometers patrolled using various types of vehicles from April through mid-September, 1994.

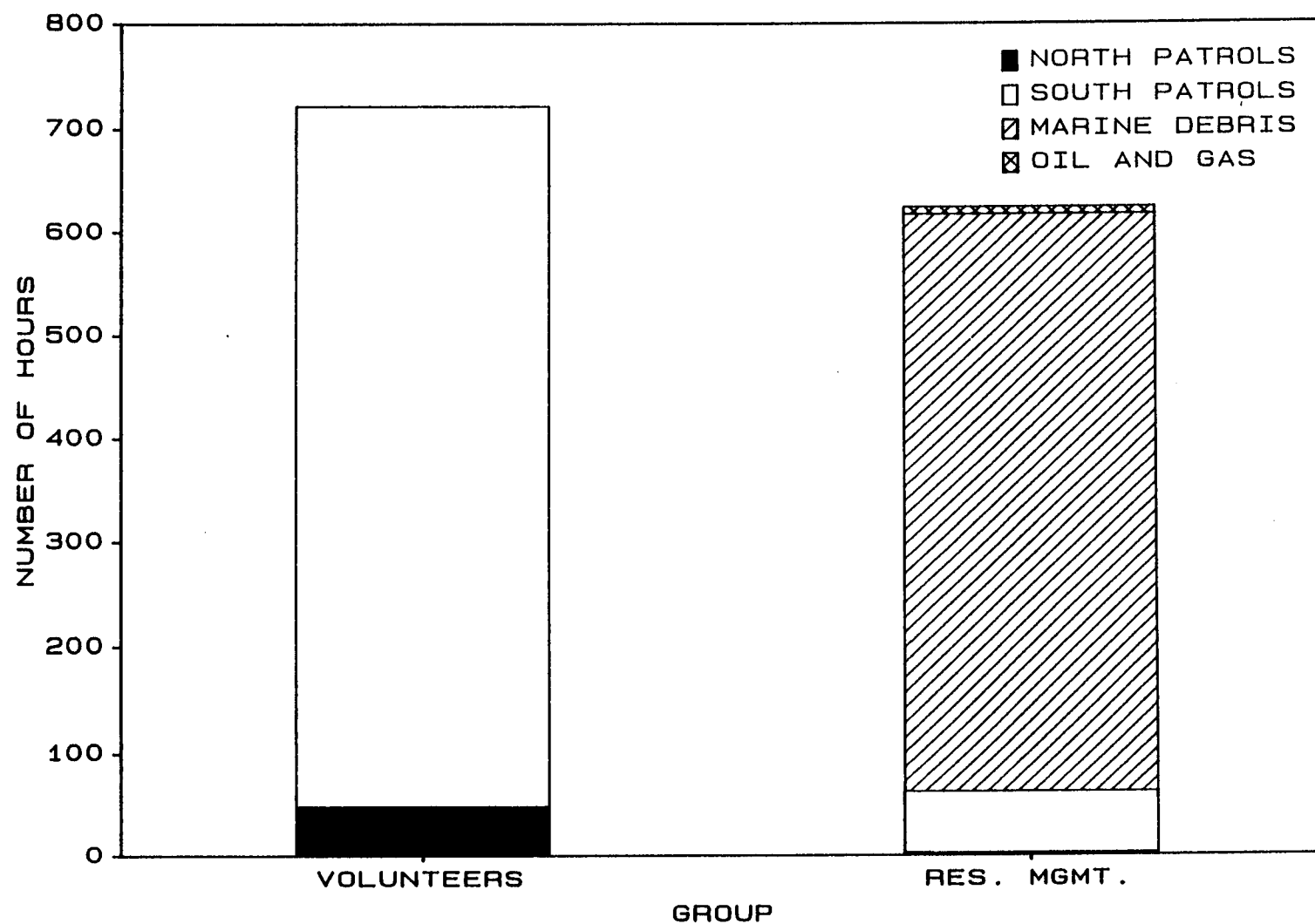


Fig. 3. Number of hours that various groups spent conducting patrols from April through mid-September, 1994.

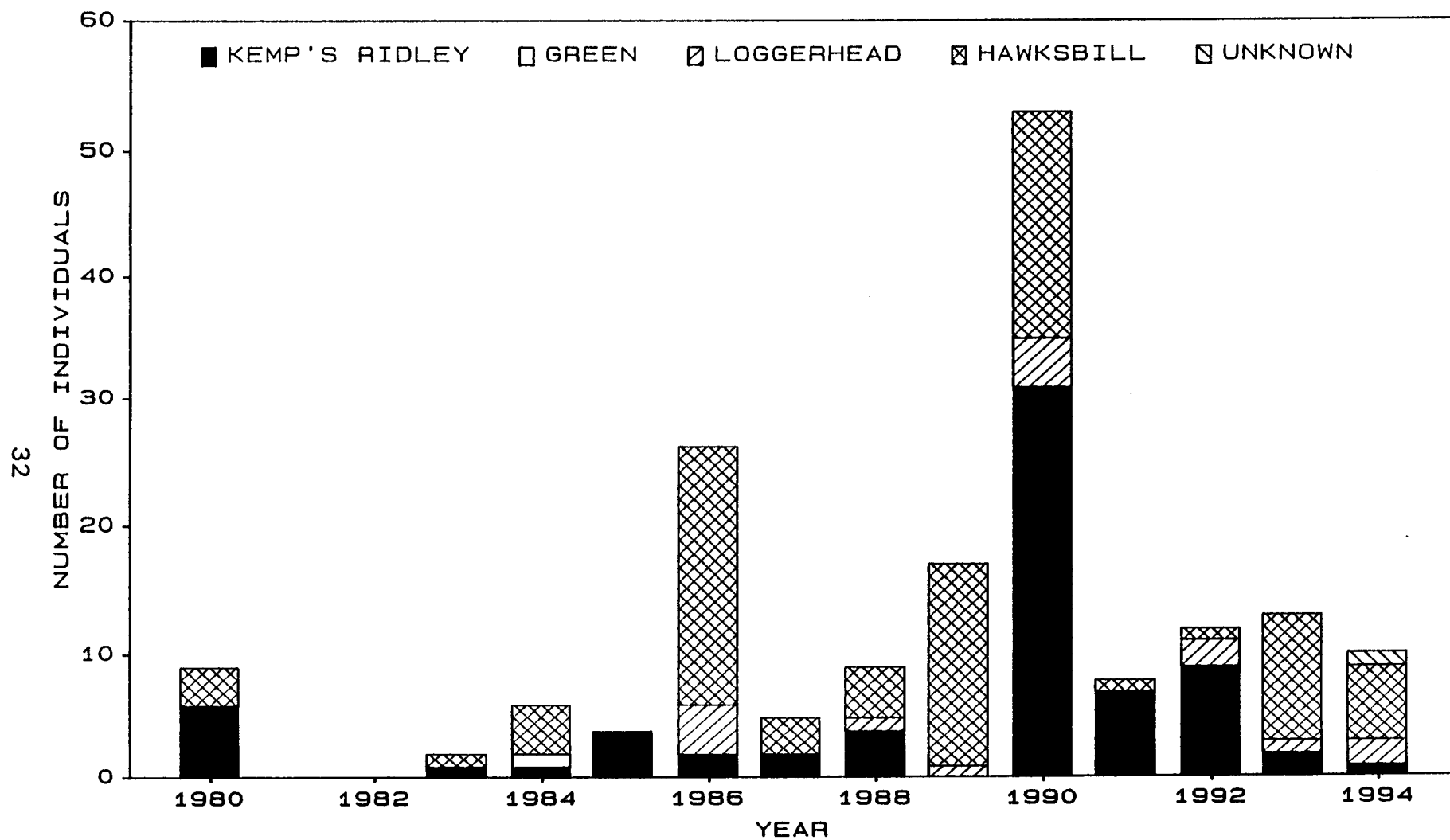


Fig. 4. Sea turtle hatchlings and post-hatchlings stranded on North Padre and Mustang Islands from 1980-1994.