

**PADRE ISLAND NATIONAL SEASHORE
KEMP'S RIDLEY SEA TURTLE PROJECT
1991 REPORT**

BY:

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ABSTRACT

Patrols for nesting sea turtles and related public education efforts continued at Padre Island National Seashore (PAIS) during 1991. From mid-April through August, PAIS employees, volunteers, and U.S. Marine Corps personnel spent 2,355 hours patrolling 13,703.1 km of beach. A Kemp's ridley sea turtle (*Lepidochelys kempii*) nest was laid approximately 1.6 km south of the Malaquite Pavilion, Padre Island National Seashore, on 29 April 1991. It was the only confirmed sea turtle nest laid on PAIS beaches (and the entire Texas coast) during 1991. The 107 eggs were packed into a styrofoam box and incubated at the park facility. One hundred of the 107 eggs hatched, for an overall hatching rate of 93.8%. All hatchlings were released on the beach on 21 June and successfully entered the surf. One clutch of Kemp's ridley sea turtle eggs laid in captivity was transferred to PAIS for incubation. However, none of the eggs hatched and all appeared to be infertile. Seven Kemp's ridley hatchlings were found stranded along Padre and Mustang Islands during June and July. Some of these hatchlings may have emerged from nests laid on south Texas beaches. Two of the four live Kemp's ridley hatchlings were brought to the PAIS hatchling sea turtle rehabilitation facility for stabilization and care. Both survived and were released into the Gulf of Mexico.

BACKGROUND

During each summer, from 1978 to 1988, approximately 2,000 Kemp's ridley sea turtle 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. Overall, approximately 12,000 yearlings were released into the Gulf of Mexico after 9 to 12 months of head starting. To date, no Padre Island imprinted turtles have been confirmed to have returned and nested at PAIS. 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. Public education programs, beach patrols, and protection and monitoring of nesting sea turtles and nests will be continued at the park for the foreseeable future. This report summarizes these efforts during 1991.

BEACH PATROLS

Seasonal beach patrols for nesting sea turtles, tracks, nests, and hatchlings began at PAIS in 1986 and continued through 1991. From mid-April through August 1991, two patrols were usually conducted daily, one heading north from the Ranger Station and one heading south. Twenty of the southern patrols were from the Ranger Station to the Mansfield Channel and back, approximately 193 km. Included in the 20 were 10 patrols that involved overnight camping at the Mansfield Channel. Camping trips increased the number of days that park personnel could be present on the beach, increased patrol efficiency, and reduced mechanical wear of patrol vehicles. One hundred southern patrols of shorter duration and distance were also conducted. Seventy-one patrols were conducted north of the Ranger Station. Most of these northern patrols covered the entire area from the Ranger Station to the Nueces/Kleberg County line. Since 28 patrols encompassed areas both north and south of the Ranger Station, it is

impossible to quantify the exact number of kilometers patrolled in either direction. However, the majority of the 13,703.1 km patrolled during 1991 were south of the Ranger Station.

Complete coverage of the entire patrol area on all days of the patrol season (mid-April through August) was not possible because of shortages in personnel and vehicles. It was necessary to concentrate efforts in areas, and at times, when they would be most effective. 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 (Tables 1 & 2). Most stranded hatchlings were found on North Padre Island, north of the PAIS 27 km marker, and Mustang Island, from July through August. During August, patrols to the Mansfield Channel for nesting turtles were terminated and more effort was concentrated on patrolling north of the 27 km marker for stranded hatchlings. Additionally, after 1 July, all weekend patrols were discontinued due to the high likelihood that beach visitors would detect and report turtle sightings.

Patrol speed and vehicle type also varied during the season. Patrols exclusively for nesting turtles, tracks, and nests (mid-April through June) were conducted at speeds of 16-26 km/hr whereas patrols exclusively for stranded hatchlings (August) were conducted at speeds of 8 km/hr or less. Five different vehicle types were used. Four-wheel drive trucks were the main patrol vehicles (8,268.6 km) (Fig. 1). They were used primarily to search for nesting turtles and tracks. However, trucks were sometimes also used for hatchling patrols, with one person operating the vehicle and one walking to search for hatchlings. A 4-wheel drive ambulance, obtained by PAIS from surplus military property, was used to patrol 2,145.2 km. "Hummers" (all-terrain military vehicles) were provided by the U.S. Marine Corps and used on five occasions (766.0 km). The ambulance and hummers

were used only for patrols for nesting turtles and tracks, since hatchlings could not be seen from these vehicles. Three of the 20 patrols to the Mansfield Channel were conducted using a hummer, five using the ambulance, and 12 using 4-wheel drive trucks. "Mules", small all-terrain vehicles also obtained from military surplus property, were utilized for 2,388.2 km of patrolling and were the primary vehicles used to detect stranded hatchlings. They had an open field of view, could operate at slow speeds, and were designed to operate in rough field conditions. An all-terrain, 4-wheel cycle was used during a few patrols for nesting turtles, tracks, and hatchlings (135.2 km).

Patrols for nesting turtles, tracks, nests, and hatchlings were usually conducted by two individuals; one motor vehicle operator and one observer. Park staff, volunteers, and U.S. Marine Corps personnel participated in patrols (Fig. 2). At least one of the individuals conducting each patrol was intensively trained in patrol protocol and data collection methodology. Park employees patrolled a total of 957 hours. All members of the Resources Management Division were trained to conduct nesting sea turtle patrols and to detect and respond to turtle sightings. This year, resources managers patrolled a total of 943.25 hours and Maintenance Division employees a total of 13.75 hours. A few other staff members participated in patrols during their off-duty hours and their contributions are grouped with those for volunteers.

Volunteers and U.S. Marine Corps personnel participated in patrols again this year. Prior to conducting a patrol, each untrained volunteer or marine was shown an introductory slide presentation to instruct them on procedures to be used to search for nesting turtles, tracks, nests, and hatchlings. Collectively, volunteers spent more hours patrolling than did park employees. Fifty-four volunteers donated a total of 1,349 hours during patrols. Four were intensively trained, allowed to conduct patrols without park staff members, and contributed 60%

of the total volunteer hours. Of the remaining volunteers, 17 were EXXON Corporation employees and/or their relatives (120.50 hours) and 33 were local citizens (428.25 hours). U.S. Marine Corps personnel donated a total of 49 hours during patrols utilizing hummers.

STAFF AND VISITOR EDUCATION

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 of the potential for nesting Kemp's ridleys and urging them to look for nesting turtles and tracks.

All park employees were shown photographs of nesting sea turtles and tracks and instructed to report all sightings. All were trained to collect pertinent information from visitors so that their sightings could be located and investigated further.

A variety of methods were used to educate park visitors about the possibility of nesting turtles. 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 developed and 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 continuous playing video tape about the Kemp's ridley project were available at the PAIS Visitor Center. Magnetic signs, stating that vehicles were conducting turtle patrols and that all live sea turtle sightings should be reported, were affixed to patrol vehicles.

MATING

A pair of mating sea turtles was observed and photographed in the

Mansfield Channel, approximately 230 m E of marker 22, on 3 June 1991. Mr. Walt Kittleberger, a fishing guide from Port Mansfield, Texas, first observed the pair at 1200 h, in the center of the channel. The pair later drifted northward out of the channel and into Laguna Madre waters approximately 0.6 m deep. They were still coupled when last seen at 1315 h. Mr. Kittleberger promptly forwarded photographs of the pair to the park. The turtles were identified as Kemp's ridley based upon color, shape of the carapace, and size (Shaver, in prep.). It was impossible to determine whether they possessed tags, tag scars, or living tags, and hence whether they were wild or head started individuals. Patrols to the southern end of PAIS were intensified in an attempt to detect nesting by the female. However, no sea turtle nests were found anywhere along the Texas coast subsequent to the mating.

Occasionally Kemp's ridley sea turtles nest along the Texas coast. Mating in the wild has not been documented in the literature. This is the first confirmed observation of Kemp's ridley sea turtles mating in Texas waters. This is also the first documentation of this species in the lower Laguna Madre and the first observation of mating in inshore waters. The observation is also noteworthy because of the date of occurrence. It is thought that mating occurs before or during the beginning of the nesting season, approximately 1 April (Byles, pers. comm.). However, the mating pair was observed on 3 June, during the middle of the Kemp's ridley nesting season.

NESTING OBSERVATIONS

Nesting Female - No sea turtle tracks, nesting females, or nests were located or investigated during beach patrols in 1991. However, a nesting Kemp's ridley sea turtle was found by three PAIS visitors (Gerry Muhl, Sally Muhl, Mary Wey) on 29 April 1991. Two of the visitors remained with the turtle while one notified park staff. Resources managers arrived at the nest site as the female began to deposit eggs. This nesting was the only

confirmed observation of sea turtle tracks, nesting females, or nests at the park (or elsewhere along the Texas coast) this year. It was also the first confirmed nesting by a Kemp's ridley on the Texas coast since 1988 and the first at PAIS since 1985 (Table 1).

The Kemp's ridley was first seen emerging from the surf at 1015 h, on 29 April 1991. It crawled up the beach, approximately 1.6 km south of the Malaquite Pavilion, and excavated a nest cavity at the base of the fore-dunes. Due to extremely high tides, the nest site was only about 40 m from the water's edge. Strong north winds (approximately 32 km/hr) quickly obliterated the tracks. Park staff members examined, measured, and photographed the nesting female. No living or metal flipper tags were present. Metal tag QQC026 was applied to the left front flipper. The curved carapace length of the female was 71.0 cm and curved carapace width was 74.0 cm. The 107 eggs laid were retrieved and placed into a styrofoam box containing moist sand from the nest.

Egg Incubation - The clutch of eggs was promptly transported to the Padre Island National Seashore sea turtle egg incubation facility. The smaller styrofoam box, containing the clutch of 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., 1988). 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 (Morreale et al., 1982; Mrosovsky, 1982; Dutton et al., 1985). The incubation facility and practices were once again modified to increase 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., 1989). These alterations also helped prevent incubation temperatures from becoming too cold or fluctuating excessively, both of which could stress the developing embryos and reduce their viability (Shaver et al., 1987). The clutch was placed on the upper shelf, where incubation temperatures are typically the warmest (Shaver et al., 1988). Plastic sheeting and bamboo shades were placed over the shed walls to trap heat. A floor heater was run continuously during the first two weeks of May and during other periods of cool temperatures. The heater was also autocycled daily from 2300 to 0700 h, from 15-31 May, to moderate excessive fluctuations in nocturnal temperatures.

Clutch 1 incubation temperatures were monitored particularly closely during the last third of incubation. During this time, metabolic heat and high ambient temperatures can cause incubation temperatures to exceed the lethal limit of 38.0 C (Shaver et al., 1987; Shaver and Chaney, 1989). Several means were used to ensure that incubation temperatures never exceeded 38.0 C. Usage of the floor heater was discontinued during approximately the last 3 weeks of incubation. The clutch was moved to the cooler, lower shelf on 3 June, when incubation temperatures reached 34.8 C. Styrofoam box lids were removed to reduce incubation temperatures after they exceeded 35.5 C. Generally, lids were removed between 2200 and 0600 h and replaced by 0900 h. This pattern of lid removal decreased temperatures in accordance with thermal cycles of natural nests at mean mid-nest depth (30 cm) (Shaver et al., 1988; Shaver et al., 1989). Lids were removed 15 times from 4-18 June, for a total of 91.5 h.

Clutch 1 incubation temperatures ranged from 25.0-37.5 C (mean=31.5 C, SD=3.2 C) (Fig. 3). First third of incubation period temperatures ranged from 25.0-31.7 (mean=28.3 C, SD=1.8 C), middle third from 27.5-34.8 (mean=31.1 C, SD=1.6 C), and last third from 33.0-37.5 C, SD=1.0 C). Mean ambient and control box

temperatures were calculated for the clutch 1 incubation period (29 April-19 June). Mean ambient shed temperatures recorded from the top (mean=30.0 C, SD=3.0 C), middle (mean=29.6, SD=2.7 C) and bottom (mean=29.0 C, SD=2.3 C) shelves in 1991 were significantly different from one another (ANOVA, $F=40.41846$, $P<0.01$). Mean temperatures of control boxes located on top (mean=29.7 C, SD=1.5 C), middle (mean=29.5 C, SD=1.5 C), and bottom (mean=28.7 C, SD=1.4) shelves in 1991 were significantly different from one another (ANOVA, $F=165.5577$, $P<0.01$).

Styrofoam incubation boxes were opened approximately once a week 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. Distilled water was added in small amounts to the top sand layer of the clutch on approximately six occasions.

Clutch 1 was first detected hatching on 19 June. The incubation period (from egg laying to pipping) for this clutch was 52 days. One hundred of the 107 eggs hatched and emerged from their egg shells. This 93.5% hatch is well above the overall hatching rate of 77.1% achieved from 1978-1988 (Shaver, 1989b). All emerged hatchlings were transferred to another double styrofoam incubation box containing Padre Island sand on 20 June. They were held in the transfer box for 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.

Hatchling Release - Hatchlings were taken to the approximate nest site for release on 21 June. Most were lethargic when first placed on the beach at 0700 h, but all became active within 60 minutes. The hatchlings were guarded from beach predators and the last one entered the water 2 hours after it was placed on the beach. About 40 staff members, media representatives, invited

guests, and passing visitors attended the release.

Hatchling Measurements - All hatchlings were measured and weighed at the PAIS laboratory just prior to their release on 21 June (Figs. 4 & 5). The mean straight-line carapace length (SLCL) (mean=42.2 mm, SD=0.8 mm, range=40.0-43.9 mm, N=100) and mean weight (mean=16.6 g, SD=0.7 g, range=15.1-18.8 g, N=100) of the hatchlings was significantly smaller than the mean SLCL (mean=44.4 mm, SD=0.9 mm, range=42.1-46.4, N=95) and weight (mean=17.8 g, SD=0.7 g, range=15.1-19.1, N=95) of the 1988 clutch of Kemp's ridley eggs laid on Mustang Island, Texas and incubated at PAIS. However, the mean SLCL for 1991 clutch 1 was neither the smallest nor the largest for any year class hatched at PAIS since 1978 (Shaver et al., 1988) and the mean weight was greater than for any previous year class.

Unhatched Eggs - The seven unhatched Kemp's ridley eggs from clutch 1 were preserved after full-term clutch incubation. They were injected with, and stored in, F.A.A. solution. Eggs were examined and embryos classified according to procedures and guidelines used at PAIS since 1982 (Shaver et al., 1988; Shaver and Chaney, 1989). All unhatched eggs were found to be fertile. Two eggs contained embryos; one stage 11 and one stage 12 (Cratz, 1982). Neither of the embryos were large enough to remove gonads for histological sex determination. The five remaining eggs were fertile but contained no identifiable embryos.

Projected Sex Ratios - A direct estimate of clutch sex ratio could not be made based upon examination of specimens. No dead hatchlings or late-staged embryos were available from this clutch for sex determination. Clutch sex ratio estimates were 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., 1988; Shaver, 1989b). Clutch 1 values for the mean middle third of incubation period temperature (31.1 C) and incubation period (52 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., 1988)], it was estimated that 93.3% of the clutch was female. However, it was estimated that only 10.1% of the clutch was female when the equation correlating percent female with the incubation period [$Y = 772.343 - 14.643X$ (Shaver, 1989b)] was used. It is likely that the incubation period for this clutch was extended because of relatively cool temperatures during the first few weeks of incubation. Hence, the estimate of sex ratio that was based upon the mean middle third of the incubation period temperature, rather than the incubation period, is probably more reliable.

EGGS LAID IN CAPTIVITY

One clutch of Kemp's ridley eggs was laid in captivity at Sea World, San Antonio, Texas on 21 June. The female that had laid the clutch had been observed mating about one month prior to egg deposition. The 85 eggs were packed into a styrofoam box containing PAIS sand and were brought to the park for incubation on 24 June. Incubation practices and procedures were the same as those described above and used during the last five years at PAIS (Shaver et al., 1988). No metabolic heat was detected in the clutch and no eggs hatched. After 47 days of incubation, all eggs were orange and severely indented. They were examined for embryological development and all appeared to be infertile (Shaver and Chaney, 1989). Similarly, all Kemp's ridley eggs laid in captivity and transferred to PAIS for incubation during 1988 and 1990 were found to be infertile (Shaver et al., 1988; Shaver, 1990).

HATCHLING STRANDINGS

Because of the high number of hatchlings that were found stranded on North Padre and Mustang Islands in 1990 (Shaver, 1990), PAIS expended considerable effort to detect stranded hatchlings in 1991. Seven hatchling Kemp's ridley sea turtles were found

stranded along Mustang and North Padre Islands during June and July, 1991 (Fig. 6). However, as during 1990, most of the hatchlings were located by pedestrians in heavily visited beach areas (Shaver, 1990). 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 3).

Four of the hatchlings were found alive and transported to two local rehabilitation facilities. Two of the turtles were taken to the new facility at PAIS; both survived and were ultimately released into the Gulf of Mexico (see Hatchling Rehabilitation Facility). The other two live hatchlings were brought to the University of Texas Marine Sciences Institute (UTMSI), Port Aransas, Texas for rehabilitation. One hatchling died almost immediately and was brought to PAIS for necropsy. All of the four dead hatchlings were necropsied to examine yolk reserves, retrieve gut contents, and remove gonads for histological sex determination (Table 3).

The first two stranded hatchlings found in 1991 probably originated from a clutch that was laid on PAIS and released at the 1.6 km marker on 21 June. Both were of the size of the newly released hatchlings, possessed large quantities of internal yolk, possessed an egg tooth, and had no epizoots (Table 3). The first was found just 1.6 km N of the release site, about 4 hours after the release. The second was found the following day, approximately 51 km N of the release location. The prevailing nearshore currents were northward and could have carried the second hatchling to the stranding location during the intervening time between the release and stranding (Amos, pers. comm.).

The origin of the five remaining stranded Kemp's ridley hatchlings is more difficult to ascertain since these turtles were of varying sizes, stranded over a period of 30 days, and

stranded along a distance of over 53 km (Table 3). Straight-line carapace lengths of the stranded *L. kemp*i ranged from 44 to 57 mm (Fig. 7) and weights from 16 to 30 g (Fig. 8). All had obviously been in the water for several days since they possessed epizoans. However, a few were the size of newly emerged hatchlings (Shaver et al., 1986; Shaver et al., 1988), contained internal yolk, possessed an obvious umbilical scar, and/or still had an egg tooth. It is possible that at least some of these stranded Kemp's ridley turtles emerged from nests laid on Texas shores.

HATCHLING SEA TURTLE REHABILITATION FACILITY

More hatchlings stranded during the summer of 1990 than during any summer from 1980-1989 (Texas Sea Turtle Stranding and Salvage Network data). Forty of the 53 hatchlings found in 1990 were alive. Most were injured and in need of immediate care and stabilization. Unfortunately, there was no suitable local facility available where the hatchlings could be taken for rehabilitation.

It was feared that similarly high numbers of hatchlings might strand during successive summers. The park staff and Kemp's Ridley Sea Turtle Working Group concluded that improved, local rehabilitation efforts must be undertaken in the future to ensure the survival of these stranded hatchlings. In May, 1991, EXXON Corporation, USA donated \$30,000 to PAIS for the construction of a hatchling rehabilitation facility at the park. Specific plans for the facility were formulated after consultation with individuals from the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Texas State Aquarium, and National Park Service Southwest Regional Office who had expertise in the care, maintenance, and rehabilitation of sea turtles. The rehabilitation facility was designed to hold up to 70 hatchlings, each in an individual 20-gallon aquarium, in sterilized water. Although the building was not constructed in time for the 1991 stranding season, it should be completed prior to the initiation of the 1992 season.

During 1991, a temporary rehabilitation facility was established at the park. Holding conditions, practices, and techniques were similar to those that will be utilized during future years. Ten of the 20 gallon aquariums were placed into the temporary facility. Each 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. The majority of water within each tank was replaced biweekly.

Two live hatchlings were placed into the facility in July, 1991. Each was fed shrimp, squid, and a small amount of pelleted "turtle chow". SLCL, SLCW, CCL, CCW, and weight were measured weekly and hatchling health was closely monitored. Veterinary care was provided by Dr. Martin Frey and Dr. Mike Hughes, both of whom have previous experience in treating sea turtles. After two months of care, both hatchlings had grown considerably (Figs. 9 & 10) and were deemed healthy enough for release. On 18 September 1991, the two hatchlings were released approximately 10 km offshore from Port Aransas, Texas. Deep Sea Headquarters (Port Aransas, Texas) donated use of a vessel to take the turtles offshore. A variety of media personnel, park staff members, and EXXON Corporation representatives attended the release.

FUTURE PLANS

Public education programs, beach patrols, and protection and monitoring of nesting sea turtles and nests will be continued at the park during 1992. Attempts will be made to continue volunteer and U.S. Marine Corps participation in this project. By the beginning of the hatchling stranding season, construction of the sea turtle hatchling rehabilitation facility should be completed and the facility should be operational.

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Gratitude must be extended to Tony Amos (UTMSI) and to a number of beach visitors who assisted with detection, protection, and documentation of the stranded hatchlings. EXXON Corporation must be gratefully acknowledged for their very generous donation in support of a sea turtle hatchling rehabilitation facility at PAIS. Numerous PAIS employees assisted with the construction and operation of the rehabilitation facility. Dr. Martin Frey and Dr. Mike Hughes provided veterinary care to the hatchlings held at the PAIS rehabilitation facility and Carole Allen (HEART) donated turtle chow for the stranded hatchlings. Bob Tyler, Deep Sea Headquarters, must be thanked for donating use of a vessel to release the rehabilitated hatchlings.

LITERATURE CITED

Cratz, F. 1982. Embryological stages of the marine turtle *Lepidochelys olivacea* (Escholtz). Rev. Biol. Trop. 30(2):113-120.

Dutton, P.H., C.P. Whitmore, and N. Mrosovsky. 1985. Masculinisation of leatherback turtle *Dermochelys coriacea* hatchlings from eggs incubated in styrofoam boxes. Biol. Conserv. 31:249-264.

Morreale, S.J., G.J. Ruiz, J.R. Spotila, and E.A. Standora. 1982. Temperature dependent sex determination: Current practices threaten conservation of sea turtles. Science 216:1245-1247.

Mrosovsky, N. 1982. Sex ratio bias in hatchling sea turtles from artificially incubated eggs. Biol. Conserv. 23:309-314.

Shaver, D.J. N.d. Kemp's ridley sea turtle reproduction. Herp Review. (in prep.).

_____. 1990. Padre Island National Seashore Kemp's Ridley Sea Turtle Project 1990 report. National Park Service, Department of the Interior. 19 pp.

_____. 1989a. Padre Island National Seashore Kemp's Ridley Sea Turtle Project 1989 report. National Park Service, Dept. of the Interior. 4 pp.

_____. 1989b. Results From eleven years of incubating Kemp's ridley sea turtle eggs at Padre Island National Seashore. In: Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology, February 7-11, Jekyll Island, Georgia, p. 163-165. S.A. Eckert, K.L. Eckert and T.H. Richardson (eds.). NOAA Technical Memorandum NMFS-SEFC-232.

_____, and A.F. Amos. 1988. Sea turtle nesting on Texas beaches in 1987. Marine Turtle Newsletter 42:7-9.

_____, and A.H. Chaney. 1989. An analysis of unhatched Kemp's ridley sea turtle eggs. In: Proceedings from the First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management, Oct. 1-4, 1985, Galveston, Texas, p. 82-89. C.W. Caillouet, Jr. and A.M. Landry, Jr. (eds.). Texas Sea Grant Publication TAMU-SG-89-105.

_____, E. Cheeseman, K. Brennan, N. Karraker, and J. Bjork. 1987. Padre Island National Seashore 1988 Report: Kemp's Ridley Sea Turtle Restoration and Enhancement Project, Incubation and Imprinting Phase. National Park Service, Department of the Interior. 142 pp.

_____, _____, S. Chacon, and J. Bjork. 1988. Padre Island National Seashore 1988 Report: Kemp's Ridley Sea Turtle Restoration and Enhancement Project, Incubation and Imprinting Phase. National Park Service, Department of the Interior. 51 pp.

_____, D.W. Owens, A.H. Chaney, C.W. Caillouet Jr., P.M. Burchfield, and R. Marquez M. 1989. Styrofoam box and beach temperatures in relation to incubation and sex ratios of Kemp's Ridley Sea Turtles. In: Extended Abstracts from the Eighth Annual Workshop on Sea Turtle Conservation and Biology, February 24-26, 1988, Fort Fisher, North Carolina, p. 103-108. B. Schroeder (ed.). NOAA Technical Memorandum NMFS-SEFC-214.

_____, P. Plotkin, A. Neville, and K. Brennan. 1986. Padre Island National Seashore 1986 report: Kemp's Ridley Sea Turtle Restoration and Enhancement Project, Incubation and Imprinting Phase. National Park Service, Department of the Interior. 135 pp.

Table 1. Documented sea turtle nestings on Texas beaches from 1979 through 1991.
 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

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.

Table 2. Sea turtle tracks, nests, and nesting females sighted along the South Texas coast, 1985-1991. km = kilometer marker along Padre Island National Seashore.

Species	Date	Location	Type Sighted	Investigator	Number Eggs	Incubated PAIS ?
Kemp's ridley	13 June 85	40.6 km	female	NPS	97	yes ¹
Kemp's ridley	11 June 86	71.6 km	female	NPS	0	N/A ²
Kemp's ridley	17 June 86	72.3 km	tracks	NPS	0	N/A ³
Kemp's ridley	6 July 86	27.4 km	female	visitor	?	N/A ⁴
Kemp's ridley	13 Apr. 88	64-72 km	tracks	visitor	?	N/A ⁵
Kemp's ridley	27 Apr. 88	Mustang	female	UTMSI	103	yes ⁶
Kemp's ridley	10 July 88	42.5 km	female	NPS	0	N/A ⁷
Kemp's ridley	11 July 88	50.7 km	tracks	NPS	0	N/A ⁸
Kemp's ridley	3 June 89	86.1 km	tracks	NPS	0	N/A ⁹
Kemp's ridley	29 Apr. 91	1.6 km	female	NPS	107	yes ¹⁰
Green	13 July 87	68.2 km	tracks	NPS	2	yes ¹¹
Green	12 July 89	68.7 km	tracks	NPS	0	N/A ¹²
Green	11 July 90	41.8 km	tracks	NPS	0	N/A ¹³
Loggerhead	5 June 88	48.9 km	tracks	visitor	?	N/A ¹⁴
Loggerhead	25 June 88	Mustang	female	UTMSI	114	yes ¹⁵
Loggerhead	10 June 90	53.1 km	tracks	NPS	0	N/A ¹⁶
Loggerhead	11 June 90	7.1 km	female	NPS	0	N/A ¹⁷
Loggerhead	11 June 90	3.2 km	nest	NPS	83	N/A ¹⁸

- ¹ Nesting turtle observed by visitor and reported to NPS
- ² Female observed by NPS patroller on Rolligon; frightened back into water prior to nesting
- ³ Tracks observed by NPS patrollers; no eggs found
- ⁴ Female observed by visitor and reported to NPS one week later; visitor observed nest excavation but did not get close enough to observe eggs
- ⁵ Tracks observed by credible visitor and reported to NPS one week later
- ⁶ Female observed by visitor about 6.5 km south of Access Rd. #1 on Mustang Island; reported to UTMSI; eggs transferred to PAIS for incubation
- ⁷ Female observed by visitors and NPS patrollers; failed to nest
- ⁸ Tracks observed by NPS patrollers; no eggs found
- ⁹ Tracks observed by NPS patrollers; no eggs found
- ¹⁰ Female observed by visitors and reported to NPS; eggs incubated in PAIS facility
- ¹¹ Tracks observed by visitor and reported to NPS; only 2 eggs found in nest
- ¹² Tracks observed by NPS patrollers; no eggs found
- ¹³ Tracks observed by NPS patrollers; no eggs found
- ¹⁴ Tracks observed by visitor and reported (by photo) to NPS four months later
- ¹⁵ Female observed by visitor about 6.5 km south of Access Rd. #1 on Mustang Island; reported to UTMSI; investigated by UTMSI and NPS; eggs transferred to PAIS for incubation
- ¹⁶ Tracks observed by visitor and reported to NPS; no eggs found
- ¹⁷ Female observed by visitor and reported to NPS; frightened back into water by passing vehicle prior to nesting
- ¹⁸ Hatched nest observed by visitor and reported to NPS; 83 pipped eggs shells and 10 dead hatchlings found; lay date projected assuming a 60 day incubation period and nest detection two weeks after hatchling

Table 3. Sea turtle hatchlings stranded on Padre and Mustang Islands from 21 June - 29 July 1991.

I.D. #	Species	SLCL (cm)	SLCW (cm)	CCL (cm)	CCW (cm)	Weight (g)	Stranding location	Stranding date	Comments ¹
LK-01	Lk	4.3	3.4	4.5	4.5	15	PAIS, Malaquite Beach	21 June	dead, y, et, us, U, o
LK-02	Lk	4.1	3.3	4.4	4.2	15	MI, Sandcastle Condo	22 June	live (UTRF), died, y, et, us, U, o
LK-03	Lk	4.5	4.2	4.9	5.1	19	PAIS, 3 km marker	1 July	dead, ep, y, et, us, M
LK-04	Lk	4.4	4.0	4.7	4.5	16	PAIS, 18 km marker	1 July	live (PAISRF), ep, us
LK-05	Lk	4.8	4.4	5.2	5.2	21	MI, access rd. 2	5 July	live (UTRF), ep
LK-06	Lk	5.7	5.3	6.0	6.0	30	PI, 2.8 km S. of Bob Hall Pier	13 July	dead, ep, F
LK-07	Lk	4.7	4.3	5.0	5.0	20	PAIS, 10 km marker	29 July	live (PAISRF), ep, et, us

¹ y = internal yolk, et = egg tooth, us = umbilical scar, F = female, M = male, U = unknown sex, ep = epizoan, o = probably originated from a clutch of hatchlings released at the PAIS 1.6 km marker on 21 June, UTRF = University of Texas Marine Sciences Institute rehabilitation facility, PAISRF = Padre Island National Seashore rehabilitation facility.

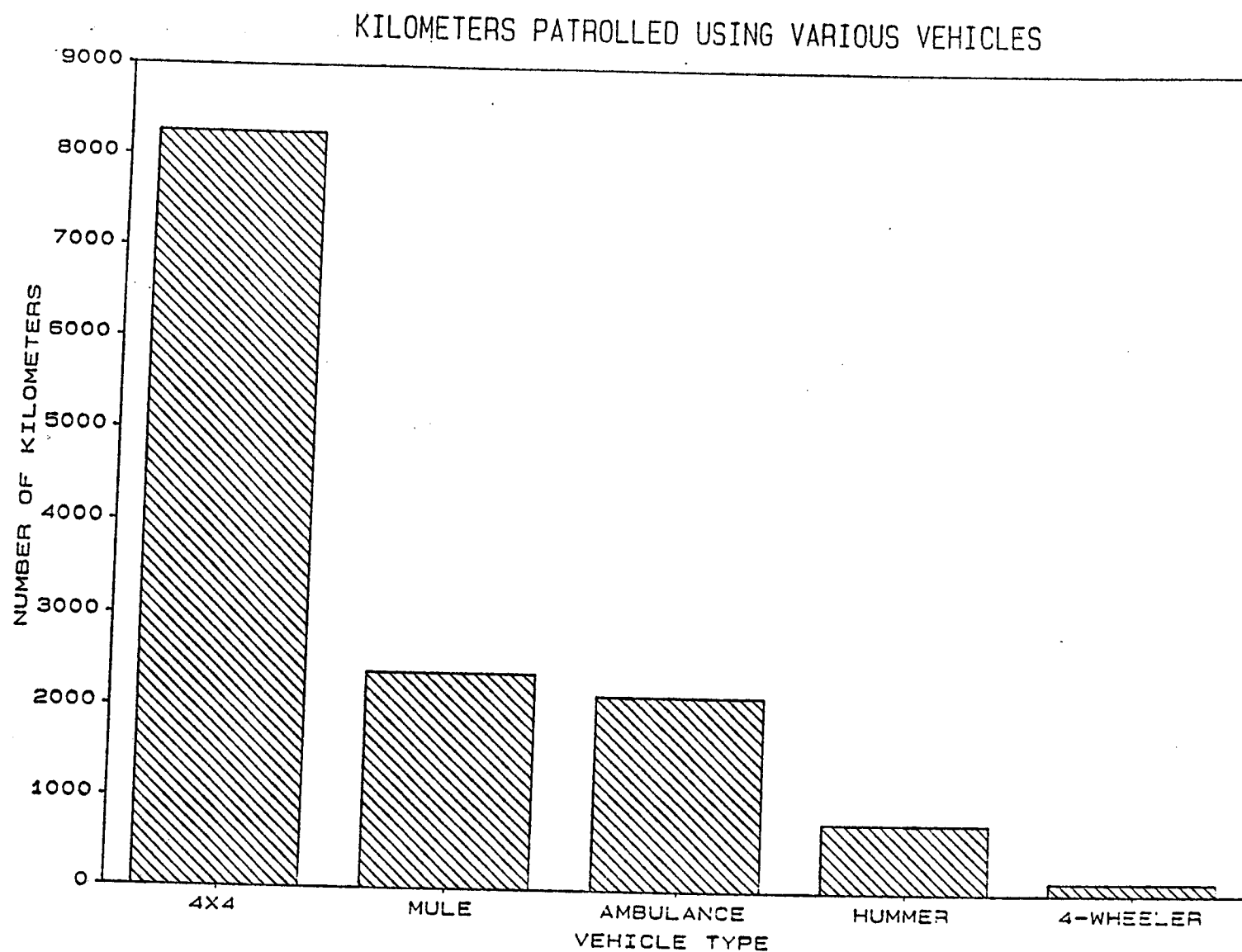


Fig. 1. Number of kilometers patrolled using various types of vehicles from mid-April through August, 1991.

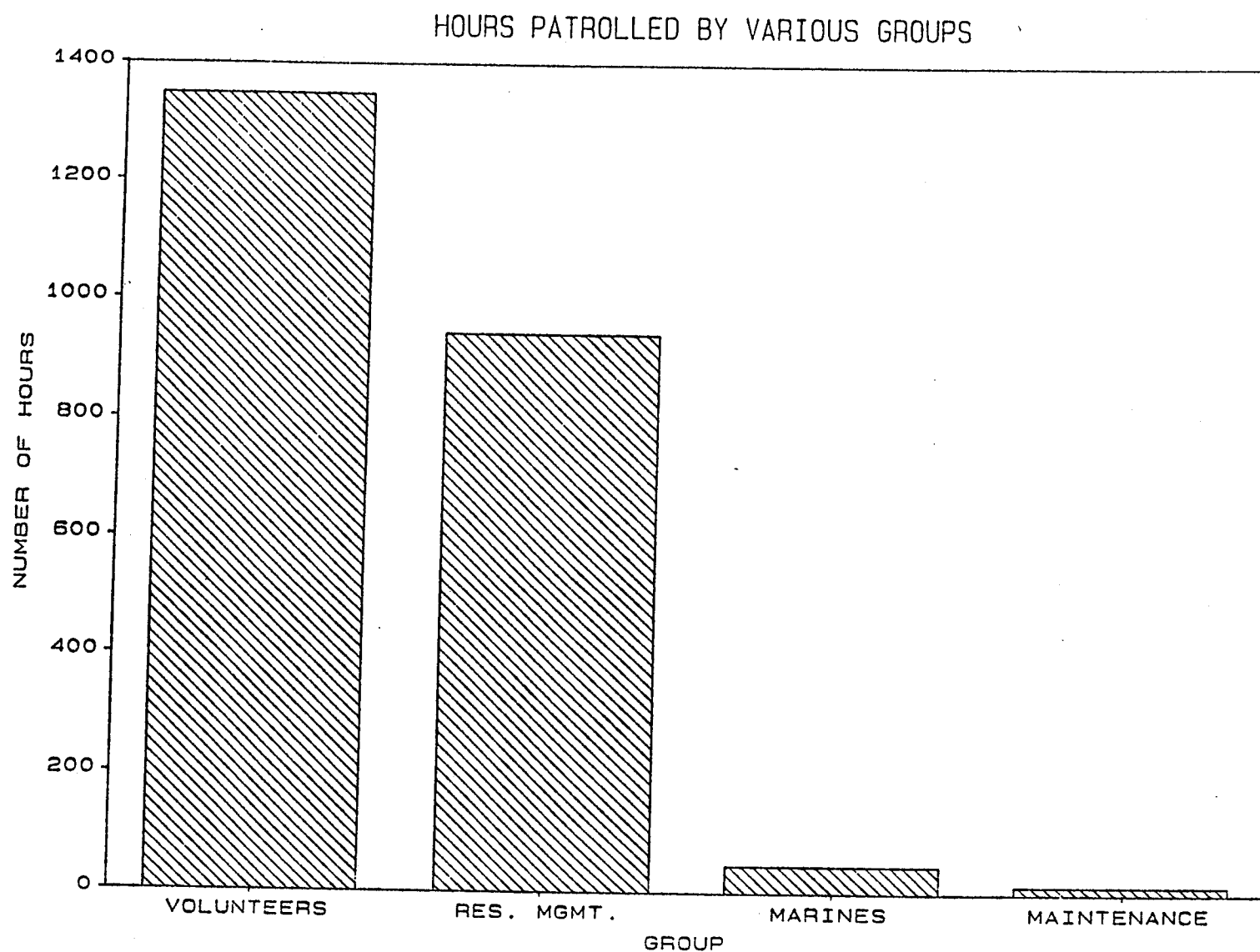
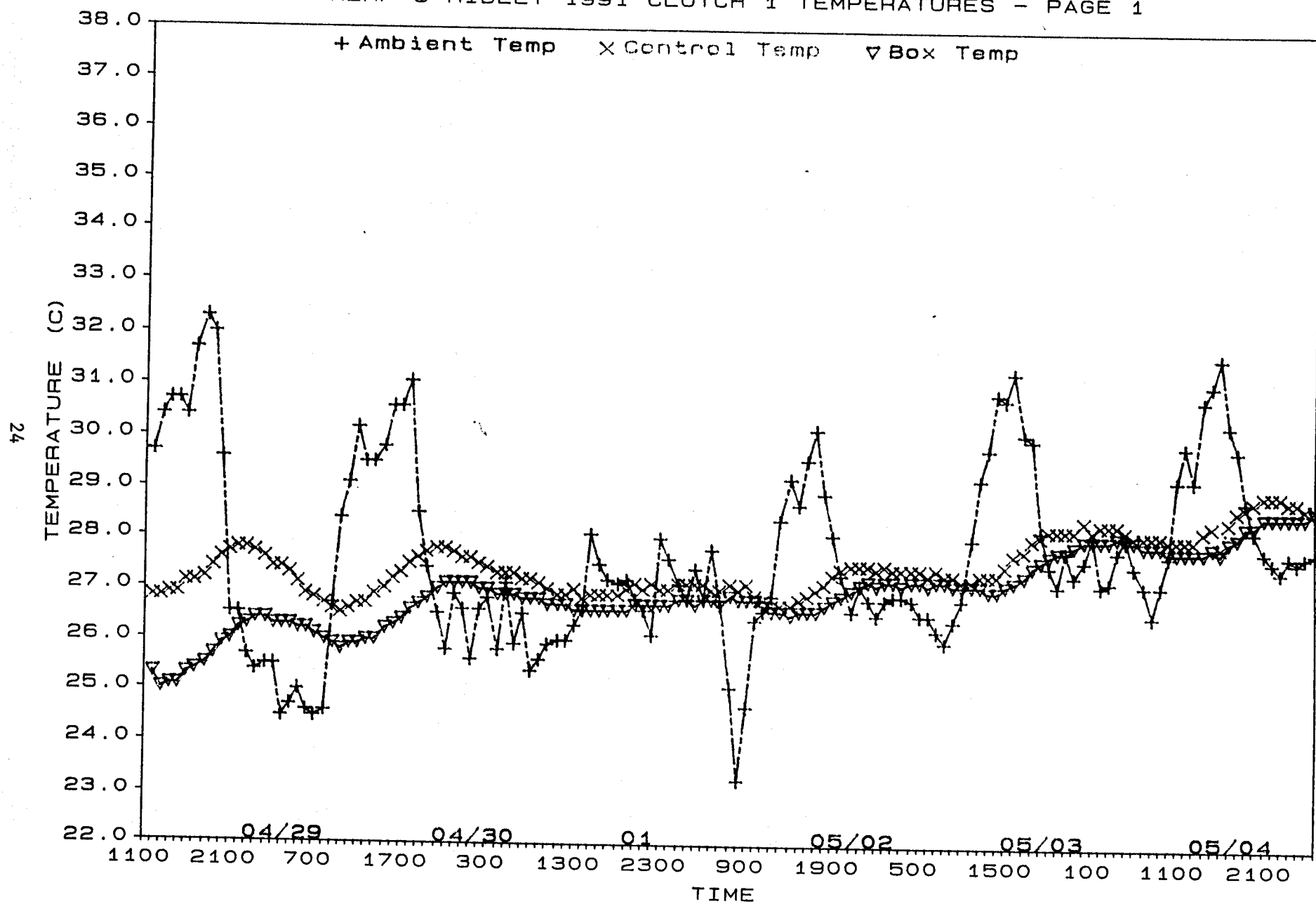


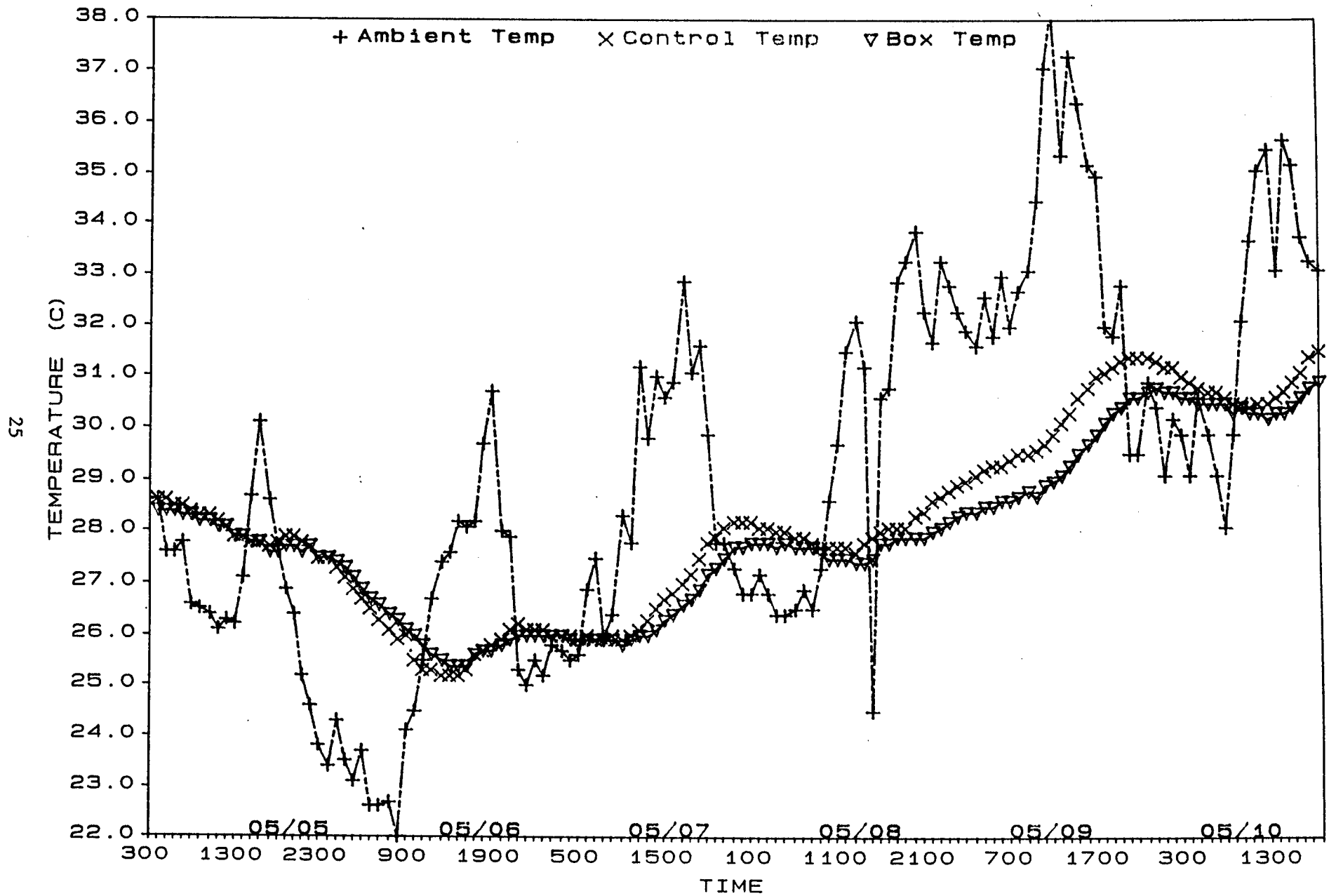
Fig. 2. Number of hours that various groups spent conducting patrols from mid-April through August, 1991.

Fig. 3. Clutch 1 incubation temperatures from 29 April - 19 June, 1991
(9 pages).

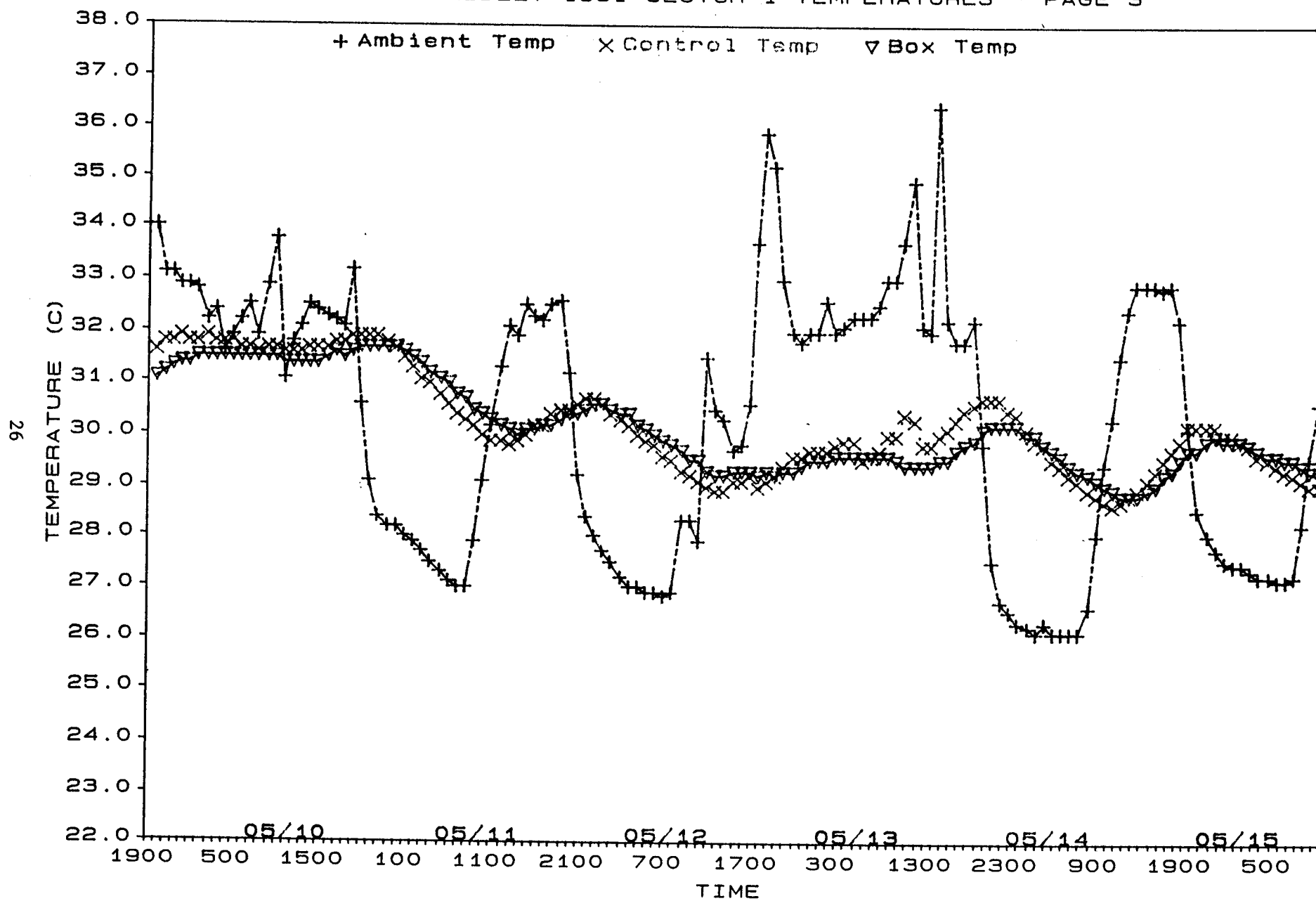
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 1



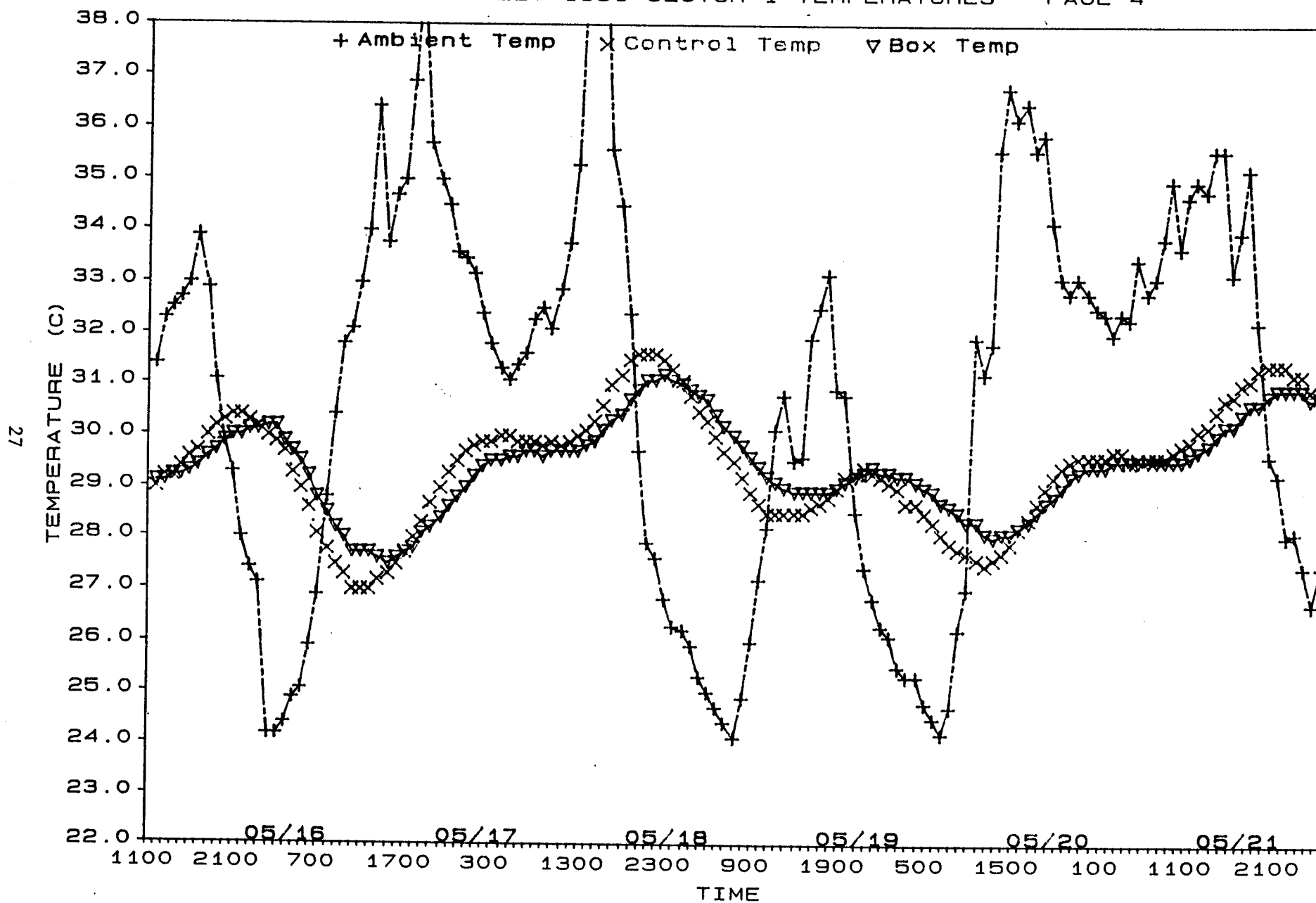
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 2



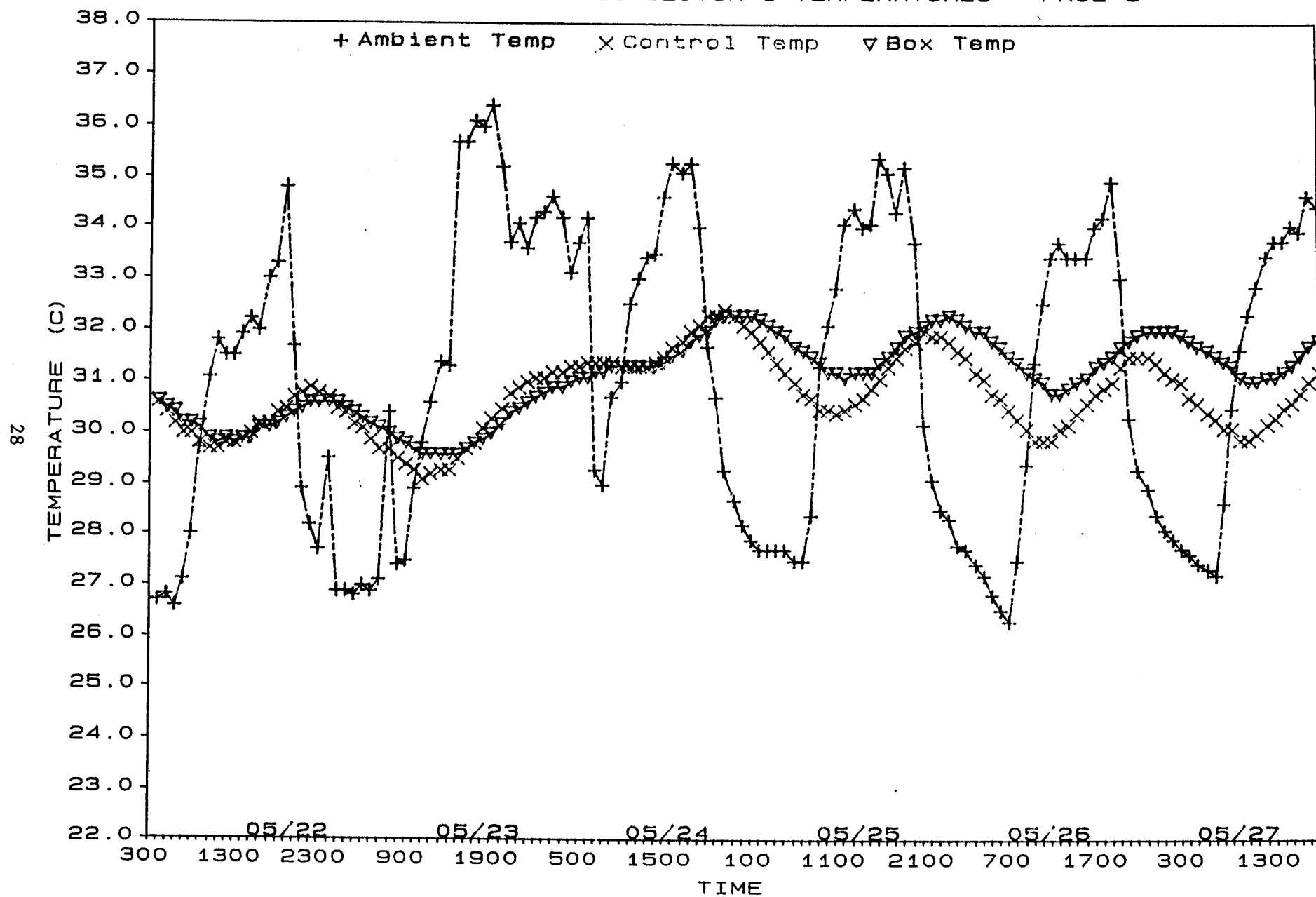
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 3



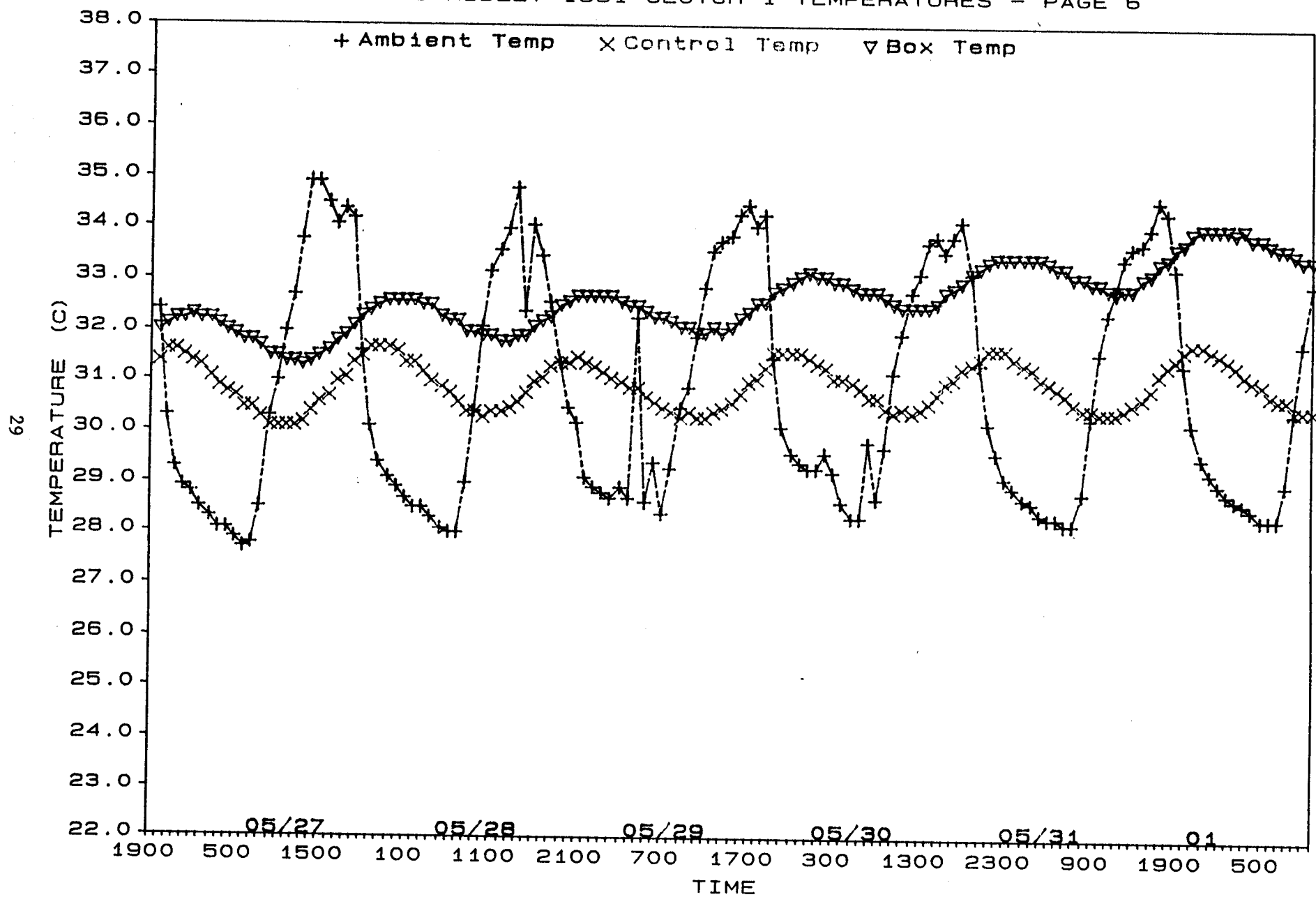
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 4



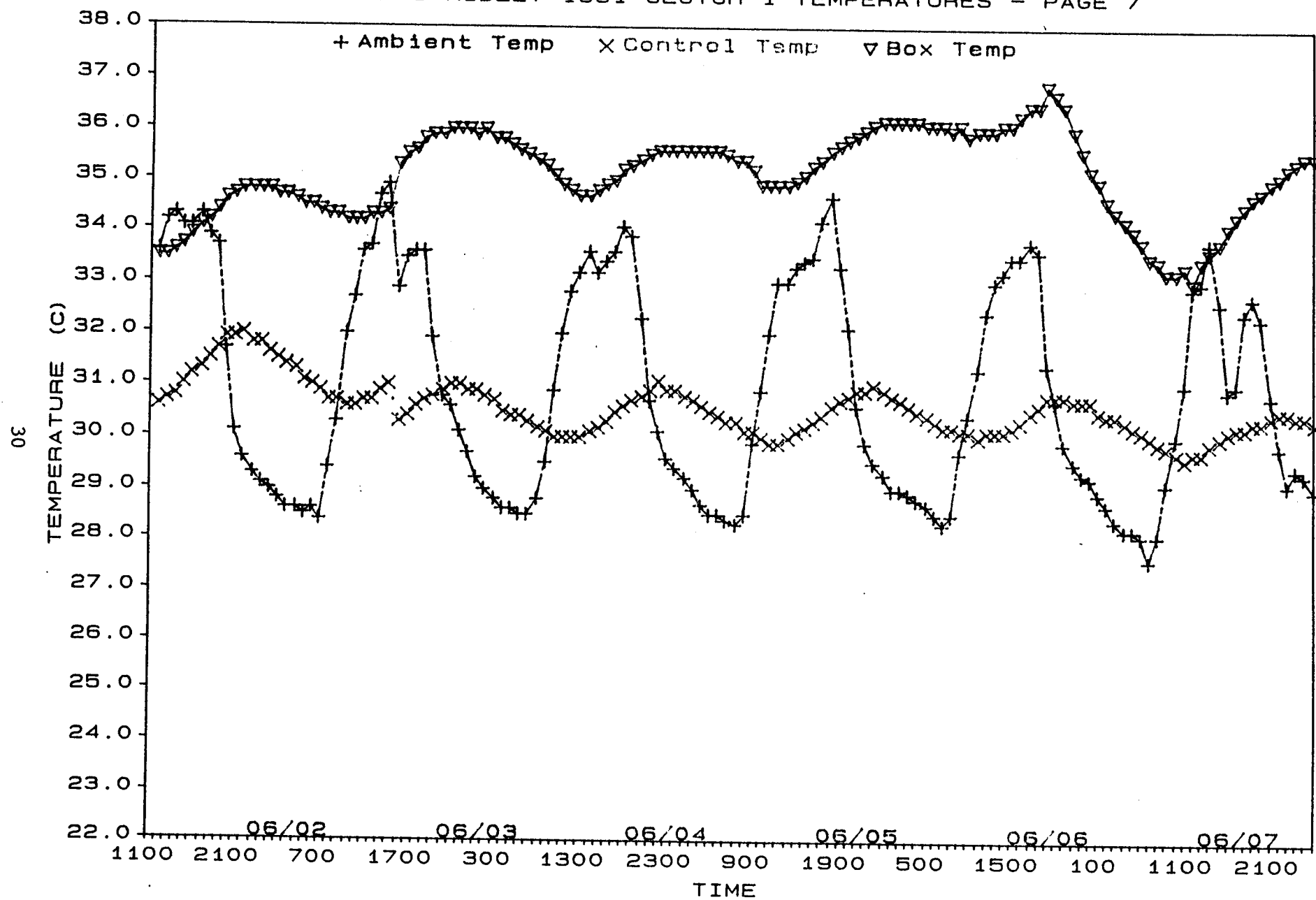
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 5



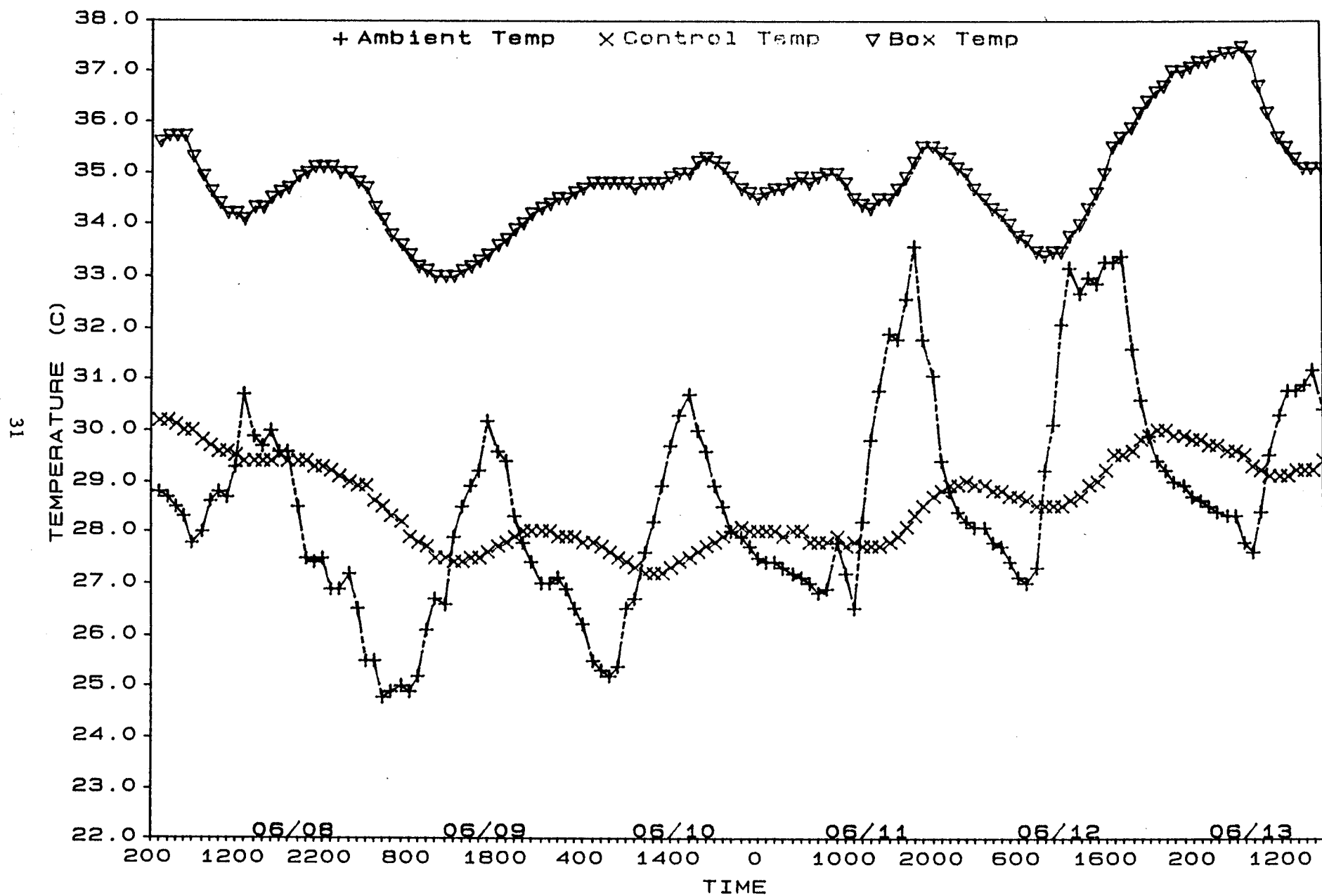
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 6



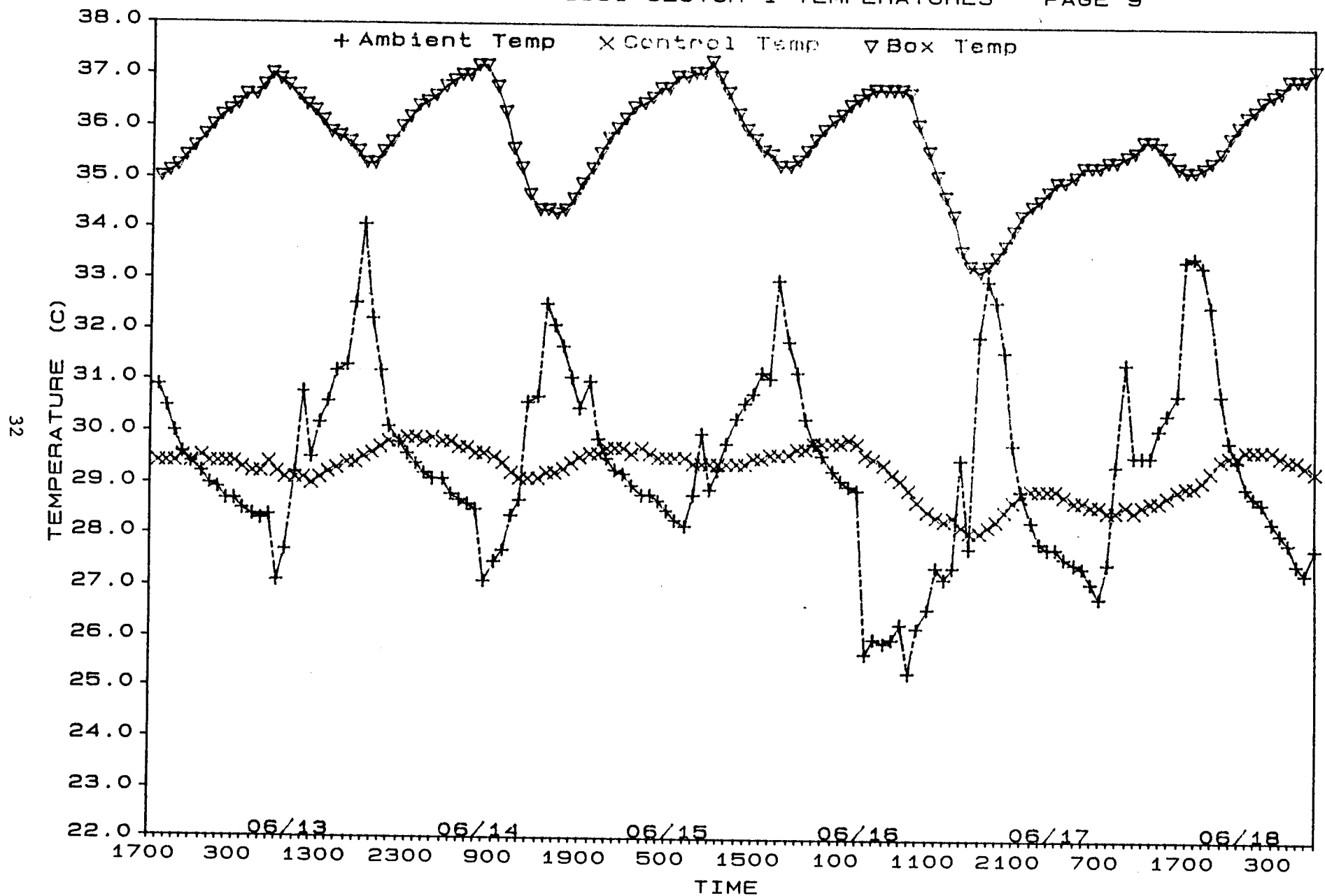
KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 7



KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 8



KEMP'S RIDLEY 1991 CLUTCH 1 TEMPERATURES - PAGE 9



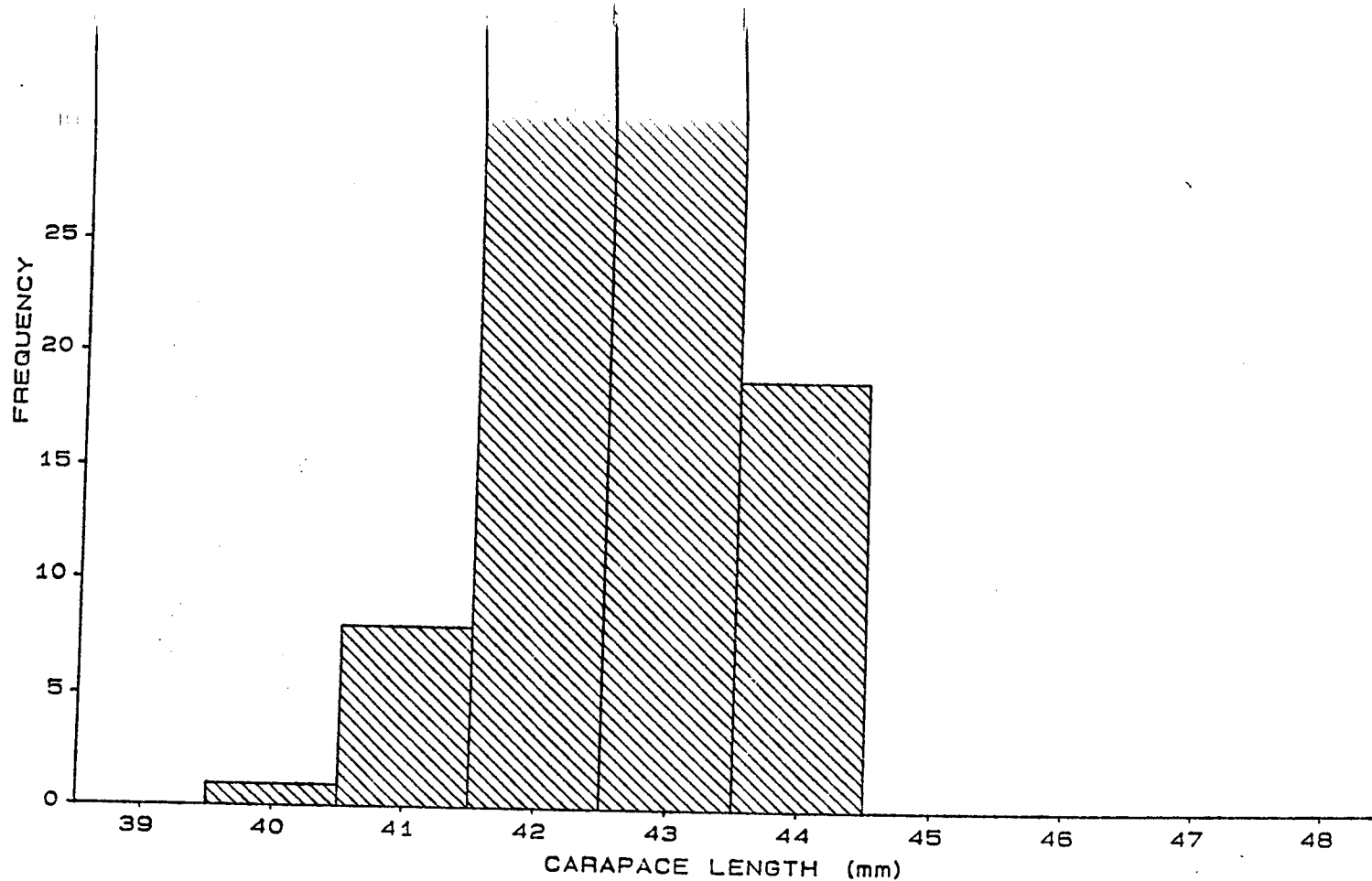


Fig. 4. Straight-line carapace lengths of 1991 clutch 1 Kemp's ridley sea turtle hatchlings.



Fig. 5. Weights of 1991 clutch 1 Kemp's ridley sea turtle hatchlings.

STRANDINGS - N. PADRE AND MUSTANG ISLANDS (80-91)

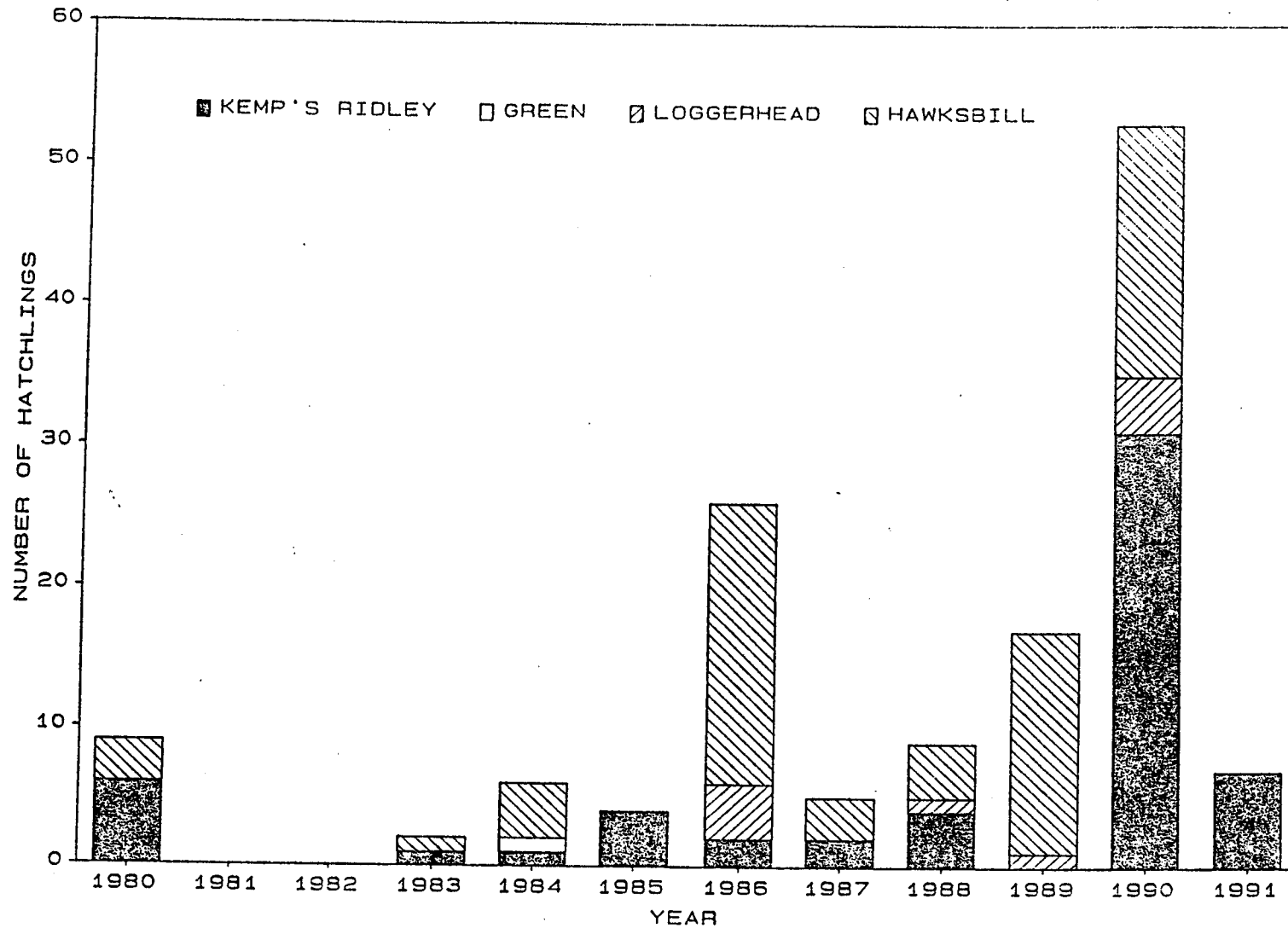


Fig. 6. Sea turtle hatchlings and post-hatchlings stranded on North Padre and Mustang Islands from 1980-1991.

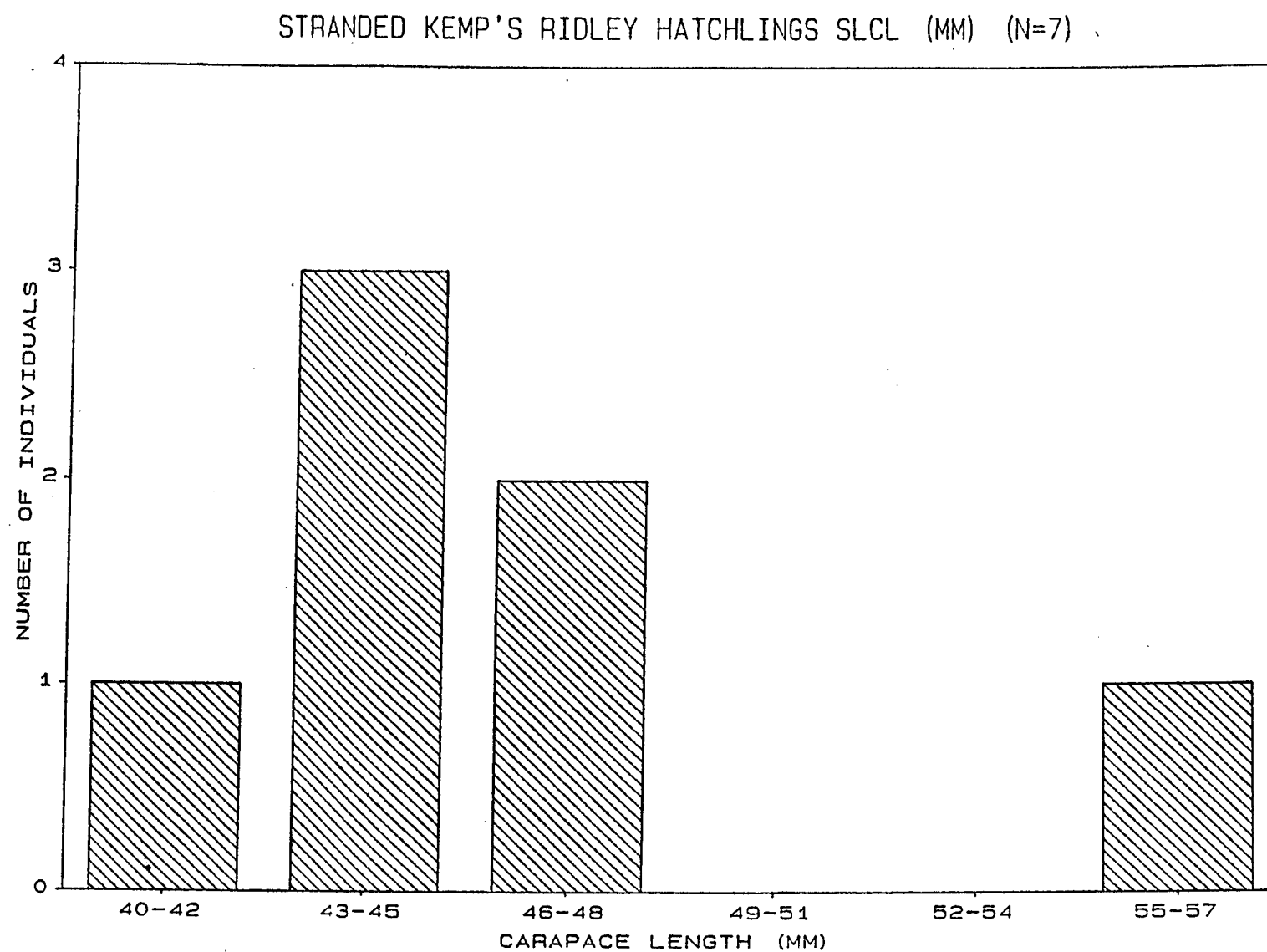


Fig. 7. Straight-line carapace lengths of Kemp's ridley sea turtle hatchlings that stranded during June and July, 1991.

STRANDED KEMP'S RIDLEY HATCHLINGS WT (G) (N=7)

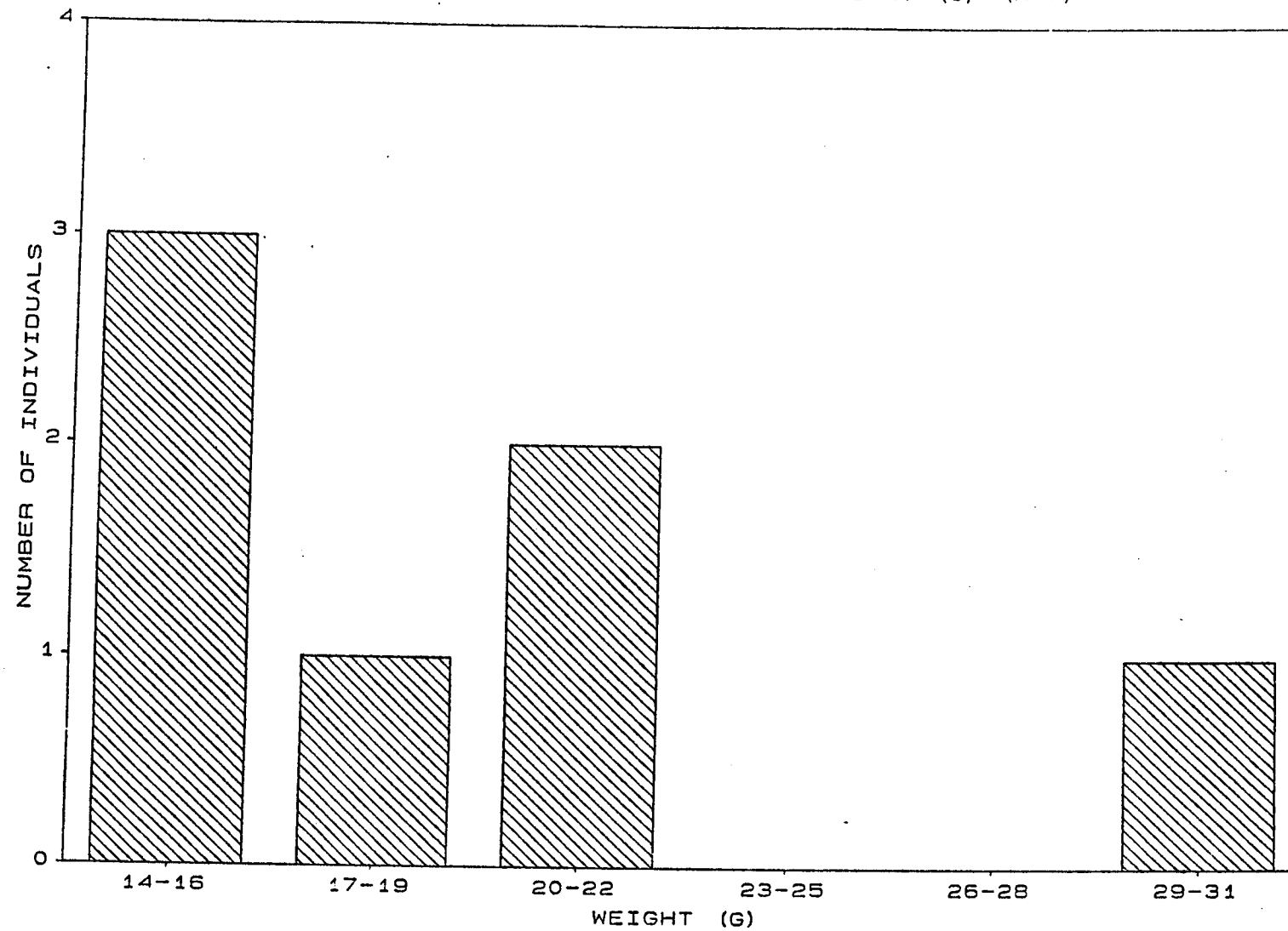


Fig. 8. Weights of Kemp's ridley sea turtle hatchlings that stranded during June and July, 1991.

SLCL OF L. KEMPI REHABILITATED AT PAIS

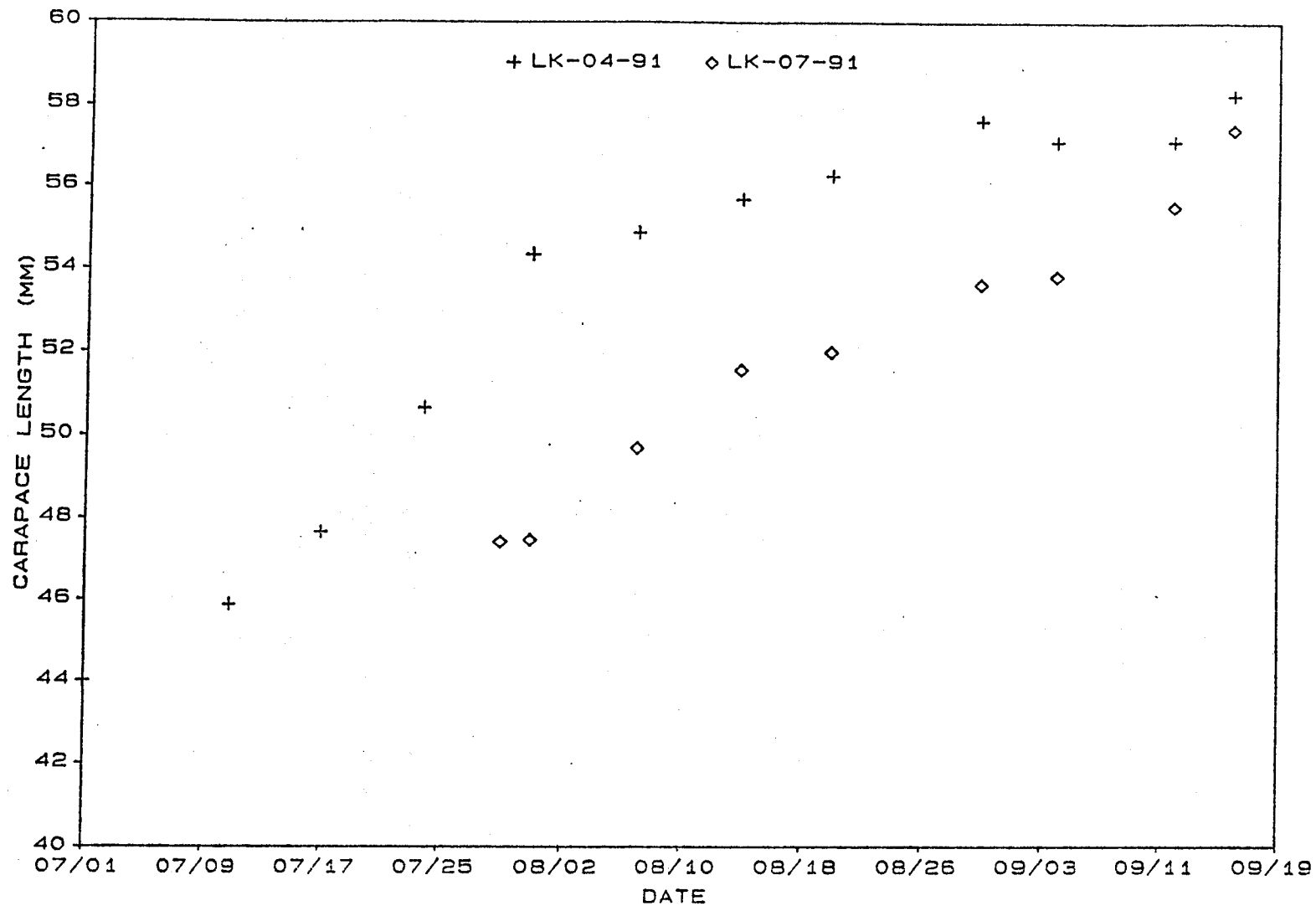


Fig. 9. Straight-line carapace lengths of Kemp's ridley sea turtle hatchlings held at the Padre Island National Seashore rehabilitation facility.

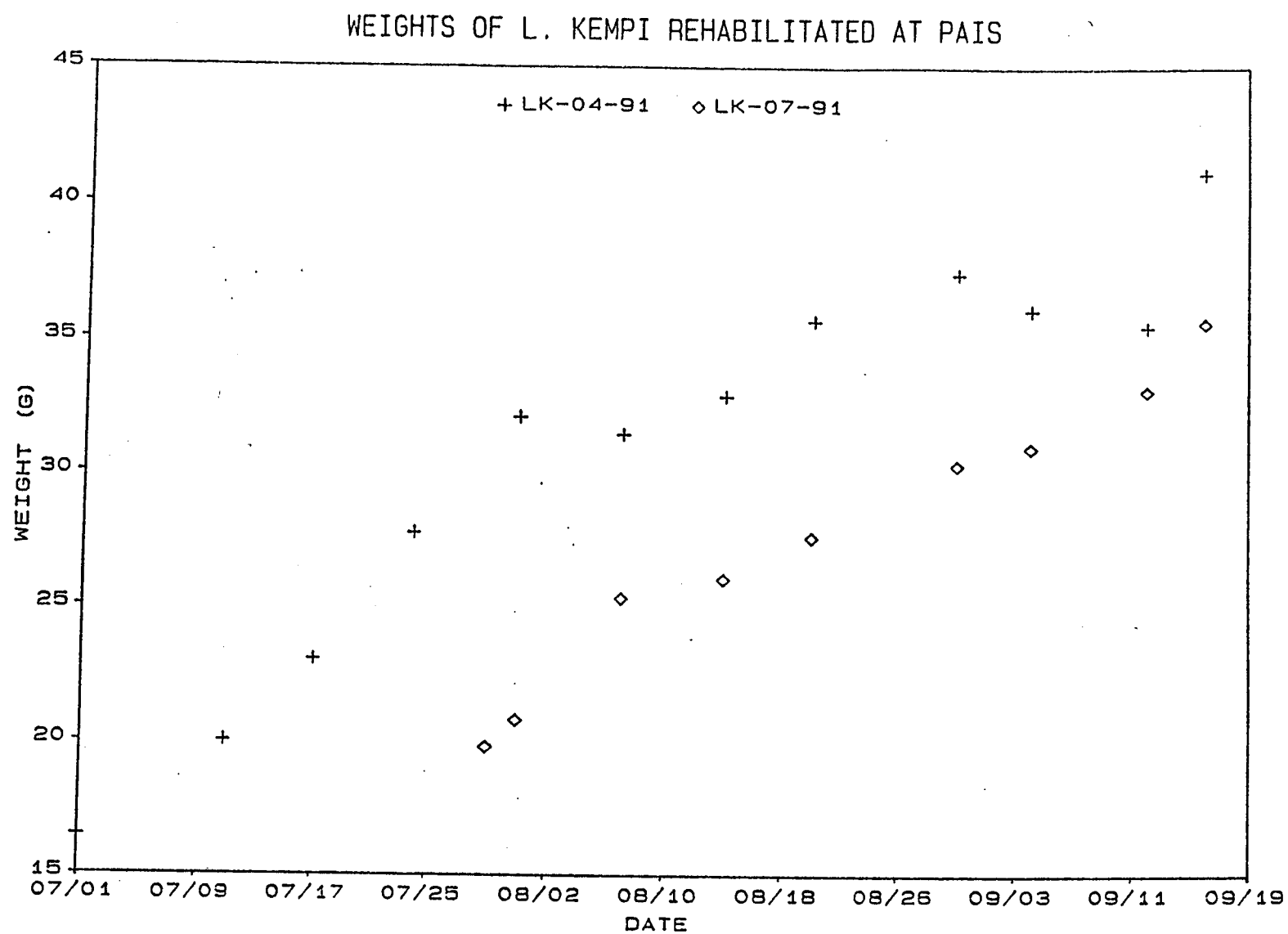


Fig. 10. Weights of Kemp's ridley sea turtle hatchlings held at the Padre Island National Seashore rehabilitation facility.