

1983 REPORT: Kemp's Ridley Sea Turtle  
Restoration and Enhancement Project  
Incubation and Imprinting Phase  
1983

by: Robert King, et. al.

1983 REPORT  
KEMP'S RIDLEY SEA TURTLE  
RESTORATION AND ENHANCEMENT PROJECT  
INCUBATION AND IMPRINTING PHASE

Report Prepared By:

Robert King  
Biologist  
Padre Island National Seashore

Anne Anderson  
Park Ranger  
Padre Island National Seashore

Donna Shaver  
Park Technician (seasonal)  
Padre Island National Seashore

Pamela Plotkin  
Student Conservation Association Volunteer

# TABLE OF CONTENTS

	page
Summary.....	1
General.....	1
Personnel.....	2
Incubation Observations.....	2
Disposition of Eggs and Hatchlings.....	6
Incubation Box Moisture Content.....	6
Hatchling Length and Weight.....	7
Egg Movement Induced Mortality.....	7
Incubation Temperatures.....	8
Conclusion.....	9
Literature Cited.....	9
Table 1. A summary of hatching success in each clutch, the number hatched, the percent hatched, the number lost during imprint, and the number transferred to Galveston.....	10
Table 2. This table shows the locations of the probes which were planted within the clutches at Rancho Nuevo, and denotes those which were attached to the CR-5 for monitoring.....	11
Table 3. Summary table showing clutch lay date, middle third of incubation period, hatch date, and incubation period in days.....	12
Table 4. Summary of hatching information showing date and time hatching began, date last egg hatched, duration of hatching, and presence of late hatching individuals.....	13
Table 5. Summary of pre-release hatchling information including date and time of hatchling transfer, number transferred, activity level in transfer box on release morning, number of clutches hatching, and total time in transfer box before release.....	14

	page
Table 6. Summary of hatchling release information showing date and time lapse, activity level of turtles during release, and disorientation exhibited.....	16
Table 7. Summary of the mean and standard deviations of carapace length and weight for all hatchlings.....	17
Table 8. An analysis of 1983 unhatched eggs showing total number of unhatched eggs examined and relative percentages of each embryonic class; infertile, fertile and possibly containing an early-stage embryo, incubated for 10-18 days, and incubated for over 18 days, and relative percent of eggs infested with fungal growth.....	18
Table 9. An analysis of 1980, 1982, and 1983 unhatched eggs showing total number of eggs examined and relative percentages of each embryonic class; infertile fertile and possibly containing an early-stage embryo, incubated for 10-18 days, and incubated for over 18 days.....	19
Table 10. Results of sand moisture analysis conducted on clutches 521 through 792, including date and incubation day of sand sample collection, and absolute moisture content (percent by weight).....	20
Table 11. Summary of the disposition of the unhatched eggs and the method by which they were preserved.....	21
Table 12. This table shows the disposition of the 1983 Kemp's Ridley sea turtle hatchlings.....	22
Table 13. This table shows the number of hatchlings which died in each clutch, the date of death, and general comments surrounding the death.....	23
Table 14. This table shows the number of deformed hatchlings in each clutch and their type of deformity.....	24
Table 15. Descriptive statistics for 1980, 1981, 1982, and 1983 Kemp's Ridley hatchlings.....	25
Figure 1. 1980 Kemp's Ridley curved carapace length.....	26
Figure 2. 1981 Kemp's Ridley curved carapace length.....	27
Figure 3. 1982 Kemp's Ridley curved carapace length.....	28

	page
Figure 4. 1983 Kemp's Ridley straight line carapace length .....	29
Figure 5. 1983 Kemp's Ridley weight.....	30
Graph 1. Individual clutch success vs. number of incubation days before plane transport from Rancho Nuevo, Mexico to Padre Island National Seashore for years 1978, 1979, and 1980.....	31
Graph 2. Individual clutch success vs. number of incubation days before plane transport from Rancho Nuevo, Mexico to Padre Island National Seashore for years 1981, 1982, and 1983.....	32

## SUMMARY

A total of 2006 Kemp's Ridley sea turtle eggs were received at Padre Island National Seashore on June 28, 1983. Incubation of these eggs resulted in an overall hatching success of 12.06% (See Table 1). Seven died prior to imprinting, two escaped into the surf during imprinting, three died after imprinting, and the remaining 230 were transported to the National Marine Fisheries Laboratory, Galveston, to participate in the Head-Start program. Unhatched eggs were preserved for future study. In addition the length and weight of each hatchling was recorded and compared to similar data from 1980, 1981, and 1982. The 1983 program was completed on August 12.

## GENERAL

At 1500 hours on June 28, 1983 Padre Island National Seashore received eighteen styrofoam boxes (2006 eggs) of Kemp's Ridley (Lepidochelys kempii) sea turtle eggs from Playa de Rancho Nuevo, Tamaulipas, Mexico, via U.S. Fish and Wildlife Service. Each styrofoam box contained a single clutch of eggs. The styrofoam boxes then were transported to the National Seashore Biological Field Station and each box was opened and examined. The top layer of eggs was covered with plastic window screen and a final layer of Padre Island beach sand. The thermocouples, which were planted within the styrofoam boxes of Rancho Nuevo at the beginning of incubation, were connected to a CR-5 multi-channel digital recorder. Most styrofoam boxes contained more than one thermocouple. Thermocouples had been placed in the bottom, middle, and top layer of eggs in most boxes (Table 2). The CR-5 provided 24 hour monitoring of clutch temperatures at one hour intervals (observations began at 2300 hours June 28, 1983). Clutch moisture was closely monitored via the "pie-crust" pinch technique with distilled water used to maintain "proper" sand moisture. The eggs were left to incubate. The clutches were checked for hatching periodically around the projected end of incubation (Table 3). When hatching was detected, the thermocouples along with the plastic screen and surface sand were removed. Hatching was then allowed to proceed uninterrupted (Table 4). If no hatching was evident by incubation day fifty-nine, the boxes were opened and the eggs preserved. To alleviate overcrowding during the hatching process active hatchlings were transferred to holding boxes to await imprinting (Table 5). The turtles were imprinted to the Padre Island beach consistent with previous years, ie. once active in the holding boxes, they were placed on the beach and allowed to crawl approximately fifty meters to the surf where they were allowed to swim briefly before being collected (Table 6). Once imprinted the turtles were weighed, measured (Table 7), and placed in tubs of Gulf sea water to await transport to the National Marine Fisheries Laboratory in Galveston. Transport flights were conducted by Training Air Wing Four, Training Squadron VT 28 and VT 31, Corpus Christi Naval Air Station. On August 12, 1983 the last

hatchlings were transported to Galveston completing the Service's involvement in the sixth year of this ten year restoration project.

#### PERSONNEL

Park Biologist Robert King was responsible for the National Park Service - Padre Island National Seashore portion of this project. Park Technicians Donna Shaver (fourth year with the project) and Anne Anderson (second year) collected all data and coordinated the imprinting process. Student Conservation Association Intern Pamela Plotkin (second year) assisted in all portions of the project. These persons were also involved in the second year of an extensive beach temperature and moisture profile study which was conducted simultaneously with the turtle project.

#### INCUBATION OBSERVATIONS

The following is a detailed account of observations and events which occurred during the 1983 season and a comparison with those of past years. These observations together with those of the other researchers involved in this project may aid in determining why such a low percentage of eggs hatched and may aid in preventing such a reoccurrence in the future.

On March 30, 1983 twenty large plastic garbage bags were filled with Padre Island beach sand. The bags were twisted closed and each placed in a five-gallon bucket and sealed with a lid. This beach sand was collected from the embryonic dune area of the Closed Beach adjacent to Gulf Island Ranger Station, Padre Island National Seashore, from a depth of not more than six inches. These twenty buckets were transported to Gladys Porter Zoo, Brownsville, Texas on April 1, 1983 to await shipment to the Ridley nesting beach at Playa de Rancho Nuevo, Mexico.

Upon arrival the eighteen styrofoam boxes (each containing one clutch of eggs) were opened and examined. At this time, at least some of the uppermost eggs in approximately one-half of the boxes were visible. Although the eggs from clutches 348 and 349 appeared to be viable, many top layer eggs in other clutches were severely dimpled and orange in color. A large number of ants were found and removed from box 579. The sand in all boxes appeared to be very moist and Gray Bower, the USF&WS pilot who flew the eggs to Padre Island National Seashore from Rancho Nuevo, commented that the sand seemed much wetter than in previous years.

A plastic-coated screen and a final layer of Padre Island sand were applied over the eggs in each box. Eggs were left to incubate, but were checked periodically for moisture content by the "pie-crust" pinch technique. Much less water was added to the boxes during incubation this year than during the previous years.

The hatching success of clutches 348 and 349 was 94.3% and 74.2% respectively. Small flies and fly pupae were found in box 349 as the last few eggs hatched. This did not seem unusual since the same type of fly and pupae were found in a number of boxes in previous years.

All unhatched eggs from clutches 348 and 349 were injected with and preserved in F.A.A. solution, then transported to Texas A & I University for embryological analysis. During this preservation process no red liquid exuded from, nor was any internal fungal growth observed in any eggs.

Clutches 518, 520, and 521 (hatching success 22.4, 10.7, and 0.8% respectively) incubated for forty-nine to fifty-one days before hatching. As the eggs began to hatch a number of apparently non-viable eggs appeared to obstruct the path of emerging hatchlings, thereby forming a barrier to individuals emerging from the lower layers of eggs. These eggs were carefully examined and those considered non-viable were removed from the clutch and preserved before most of the hatchlings had emerged. In previous years large numbers of eggs were never removed from incubation boxes while hatching was in its early to mid-stages. The low hatching percentages of these three clutches did not seem cause for alarm since a few low hatching clutches have been present each year. Flies like those found in incubation box 349 were also found in box 518 as it was hatching. All unhatched eggs from these clutches were injected with and preserved in F.A.A., then transported to Texas A & I University. As these eggs were being preserved, many were found to contain a red-colored growth on the inner egg-shell surface and they exuded a red liquid when injected with the F.A.A. solution.

Preliminary embryological examination was conducted at Texas A & I University and consisted of; opening each egg, removing and preserving each embryo, and examining each yolk sac for signs of digestion and the presence of embryonic membranes. This examination was conducted on 341 unhatched eggs from clutches 348, 349, 518, 520, and 521 (Table 8). On the basis of this examination embryonic development was classified into one of the following:

Eggs with no embryo

1. Infertile; Eggs in which no embryo was located and which showed no signs of yolk digestion, no change in yolk texture, and which possessed a round yolk shape and no embryonic membranes.
2. Fertile; Eggs which contained embryonic membranes and which showed a change in yolk texture and signs of yolk digestion.

Eggs with embryo

1. 10-18 day development
2. 18 day plus development



The classes 10-18 day and 18 day plus were based on Yntema's (1968) deliniation of embryological stages of development of Chelydra serpentina. However, eggs containing embryos which died very early in incubation may have been misclassified as infertile because of decomposition of embryonic membranes during the incubation period. These embryos together with embryos from the remaining thirteen clutches will undergo further examination. This detailed embryological study is in progress and should yield results by January 1984.

Examination of the unhatched eggs from these five clutches (348, 349, 518, 520, and 521) produced some interesting results. Although some eggs from clutches 348 and 349 contained maggots (not unusual) there were no signs of fungal infection, ie. pink, red, or purple coloration of the yolk or the membranes of the inner shell surface. All eggs from clutches 518, 520, and 521 showed signs of fungal growth. Many of these eggs were so severely infested that their yolks and inner shell surfaces were almost completely pink. Clutches 348, 349, and 518 contained embryos in many different stages of development, whereas relatively few embryos were isolated from clutches 520 and 521. In addition, the majority of the embryos found in clutches 348 and 349 had survived for at least eighteen days. Clutch 518 produced relatively equal percentages in the 10-18 day and 18 day plus classes, whereas clutches 520 and 521 produced very few embryos in these advanced stages.

This same embryological classification was applied to unhatched eggs from 1980 and 1982 year classes. All three year classes are presented for comparsion (Table 9).

Clutch 519, which was laid and collected on the same day as clutches 518, 520, and 521, was allowed to incubate for sixty-one days. This clutch produced no turtles. The eggs were carefully examined and all appeared to be non-viable. Eighty-one eggs from this clutch were removed and transported unpreserved to the National Marine Fisheries Service (NMFS) Laboratory at Galveston for culturing. Twenty additional unpreserved eggs from clutch 597 were also sent to Galveston for culturing. At this time thirty-five unhatched eggs from clutch 519 were injected with and preserved in 10% buffered formalin and transported to the NMFS laboratory for histological analysis.

After the sand and all eggs were removed from incubation box 519, it was removed from the incubation shed. The surface of the shelf beneath the box was wet and blackened with what appeared to be fungal growth. In previous years this condition was present only under those boxes containing recently hatched turtles. The source of this excessive moisture was apparently fluid from ruptured eggs associated with hatching. Due to the large quantity of moisture found beneath box 519, slats were placed beneath all remaining clutches to facilitate drainage.

With the increased concern over the low hatching success, sand samples

from incubation boxes 572 through 792 were taken and frozen for future heavy metal and pesticide analysis. Sand samples for determining absolute sand moisture were collected from these boxes during egg removal.

Some non-viable eggs were removed from the top layers of eggs in incubation boxes 577 and 597 as these clutches began to hatch. These two clutches produced five hatchlings. All unhatched eggs from clutch 577 and fifty-seven unhatched eggs from clutch 597 were injected with and preserved in F.A.A. for future embryological examination. Of the remaining eggs in clutch 597, twenty unpreserved eggs were sent to Galveston for culturing and the remaining fifty-two were injected with and preserved in 10% buffered formalin for histological examination.

Clutch 571 produced only three hatchlings, two which were normal, and one which had no eyes and non-occluding jaws. The deformed hatchling died prior to shipment to Galveston. Unlike other boxes which hatched, no surface eggs were removed to allow the hatchlings free access to the surface. Twenty eggs from clutch 571 were frozen in preparation for heavy metal and pesticide analysis. Approximately two-thirds of the remaining eggs were injected with and preserved in 10% buffered formalin and one-third were injected with and preserved in F.A.A.

Flies of the same type as those found in incubation boxes 349 and 518 were found in boxes 579 and 578 soon after their arrival from Mexico. These flies were present in boxes 579 and 578 throughout incubation, despite repeated removal of pupae and adults. One egg was removed from box 579 before full incubation because it contained a large number of maggots.

After fifty-nine to sixty days of incubation it became apparent that no turtles would hatch from clutches 572, 575, 579, 578, 596, 622, and 623. All eggs were removed; twenty eggs from each clutch were frozen, approximately two-thirds of the remaining eggs were injected with and preserved in 10% buffered formalin, and one third were injected with and preserved in F.A.A.

Clutch 791 hatched after fifty-two days of incubation. Many non-viable eggs were removed from the upper layers as soon as hatching was detected. Clutch 792 was allowed to incubate for fifty-five days at which time twenty eggs were removed for culturing. These eggs and twenty unpreserved eggs removed from clutch 791 were sent to Galveston. Sand samples taken from each of these incubation boxes at this time and kept at room temperature were also sent to Galveston for culturing. After allowing the remaining eggs in clutch 791 to incubate an additional two days, the remaining eggs were removed. Twenty eggs from clutches 572, 575, 578, 579, 596, 622, 623, 791, and 792, were frozen for heavy metal and pesticide analysis. In addition, ten eggs each from clutches 791 and 792 were freeze-dried for heavy metal and pesticide analysis. Approximately two thirds of all the remaining eggs were injected with and preserved in 10% buffered formalin and one-third were

injected with and preserved in F.A.A.

Unhatched eggs from clutches 572 through 792 were not opened, but were superficially examined for embryonic development and fungal growth before they were preserved. Few large embryos were felt within the eggs and large amounts of what appeared to be red fungal growth were seen on the inner shell surfaces of many of the eggs as they were injected. Sand moisture samples were taken from clutches 571 through 792 as the unhatched eggs were removed. Moisture ranged from 10% to 17% in these clutches (Table 10). Wet and blackened areas similar to those left under box 519 were found in the areas beneath boxes 518 through 792.

#### DISPOSITION OF EGGS AND HATCHLINGS

All but 101 of the unhatched eggs from all clutches were preserved for future study (Table 11). The methods of egg preservation are indicated in the previous section and are dependent upon the intended type of study in which the eggs will be used. The 101 unpreserved eggs were transported directly to NMFS Galveston Laboratory for culture studies. These eggs presently form the basis of a cooperative study between the National Park Service and the National Marine Fisheries Service concerning the isolation and identification of both fungal and bacterial species observed to be present in the unhatched eggs. As mentioned previously Texas A & I University is presently conducting an embryological study on the 829 unhatched eggs which were preserved in F.A.A. solution. The remainder of the eggs (574) which were preserved in 10% buffered formalin will await histological examination by the National Marine Fisheries Service.

A total of 242 hatchlings were produced from all eighteen clutches (Tables 12, 13, 14). Of these ten hatchlings died prior to transport to Galveston. The kidneys of these dead hatchlings were removed and preserved in 10% buffered formalin for sex determination at a later time. Two of the hatchlings escaped during imprinting and the remaining 230 were transported to NMFS Galveston without incident.

#### INCUBATION BOX MOISTURE CONTENT

Absolute moisture content was determined for the sand in each incubation box 521 through 792 (Table 10). An approximate 200 gram sample of sand was collected from various egg layers in each clutch at the end of the incubation period. These samples were weighed, dried, and reweighed. Moisture content was then calculated and is expressed as percent water (gram) by weight.

The moisture values ranged from 9.8 to 17.2% water/weight. These values are consistent with those reported from the corrals at Rancho Nuevo for the 1982 year class.

Clutches 521, 577, 571, 597, and 791 had moisture contents of 17.2, 12.0, 15.0, 15.0, and 13.1% respectively and all produced turtles. Other clutches with moisture contents below these produced no turtles.

Though these incubation moisture contents of the 1983 class appear high, especially when compared to those of other species of sea turtles, they are in line with those reported from both the hatchling corrals and beaches of Rancho Nuevo.

#### HATCHLING LENGTH AND WEIGHT

In an attempt to distribute some of the data that has been collected in the past three years, curved carapace length (mm) of a sample of hatchlings from 1980, 1981, and 1982 are presented in Figures 1, 2, and 3 respectively. Figures 4 and 5 represent the straight line carapace length (mm), and the weight (gram) of all the hatchlings from the 1983 year class. Preliminary investigations indicate that the Ridley hatchlings curved carapace length and straight line carapace length differ by approximately .5 mm, the straight line length being the smaller.

From these five histograms it appears that both hatchling length and weight are normally distributed. The weight data, as is common with population weight statistics, is skewed to the right.

Descriptive statistics for each year class are presented in Table 15. Analysis of variance of the carapace length data for years 1980, 1981, and 1982 shows a highly significant difference ( $P \leq .0001$ ) between the year classes.

There does not appear to be any increasing or decreasing trend in hatchling carapace length, even after taking into account the .5 mm correction factor for the 1983 class, among the 1980-1983 year classes examined.

#### EGG MOVEMENT INDUCED MORTALITY

Graphs 1 and 2 illustrate the effect of egg movement on hatching success in relation to the transport of Ridley clutches from Playa Del Rancho Nuevo, Mexico to Padre Island National Seashore. These two graphs represent the entire six years (1978-1983) of this project and reflect only the effects of egg movement associated with the plane transport to Padre Island. In both graphs the hatching success of each clutch from each of the six year classes is plotted against the number of days of incubation prior to plane transport, ie. the number of days from lay date to plane flight, of each year class to Padre Island.

In general there does not appear to be any clear relationship between hatching success and the number of days of incubation prior to egg

movement during shipment to Padre Island. It is clear, however, the during the past six years eggs have been transported to Padre Island throughout the incubation cycle without severely affecting hatching success. In this respect the poor hatching success of the 1983 class does not appear to be the result of egg movement induced mortality in so far as the plane transport is concerned.

These graphs do indicate that excessive fluxuation in hatching sucess is associated with those days in which a large number of clutches were collected at Rancho Nuevo; eg. forty-one days prior to shipment in 1978, thirty and thirty-three days in 1979, twenty-five days in 1980, thirty-five days in 1981 and twelve days in 1982. These fluxuations may be the result of egg movement induced mortality at the time of collection. In contrast, hatching success was usually high for those clutches which were among only four or five collected in a single day.

In short, and given that egg handling was similar to that of previous years, it does not appear that the egg movement associated with the plane transport of clutches to Padre Island was responsible for the hatching failure of the 1983 year class.

#### INCUBATION TEMPERATURES

Three thermocouples (top, middle, and bottom layer of eggs) were installed in most of the clutches during egg loading of the styrofoam boxes in Mexico (Table 2). This procedure represented a deviation from the one thermocouple per box of previous years and was designed to illustrate any differential heating or cooling caused by either egg location within the styrofoam box or metabolic heating during incubation. Needless to say, successful clutches are needed to fully define the influence of these two factors. However, one important fact about styrofoam boxes is evident from the failure of this 1983 year class. Analysis of variance examination of the temperature readings recorded from the three probes in every box showed that there was no significant difference between the probes. This implies that egg location within the styrofoam box itself has no effect upon temperature flow through the eggs. In other words temperature flow through the styrofoam box is uniform. This is important for the early stages of incubation. We might, however, expect metabolic heat generated by successful clutches in the later period of incubation to modify this relationship.

The installation of three thermocouples per styrofoam box should be repeated in the 1984 season. The failure of the 1983 year class does little to define the relationship between metabolic heat and egg location within the incubation box.

## CONCLUSION

This report leaves many questions unanswered concerning the failure of the 1983 year class. Currently embryological, histological, and fungal and bacterial studies are underway on this years unhatched eggs. These studies may lead to a probable cause for this years hatching failing and may form the basis for the procedures to be adopted for the 1984 season.

## LITERATURE CITED

Yntema, C. L. 1968. A series of stages in the embryonic development of Chelydra serpentina. J. Morphol. 125:219-251.



**Table 1.** A summary of hatching success in each clutch, the number hatched, the percent hatched, the number lost during imprint, and the number transferred to Galveston.

Clutch Number	Number Eggs In Clutch Padre Island	Number Eggs In Clutch Rancho Nuevo	Number Eggs Hatched	Percent Eggs Hatched	Total Number Turtles Lost During Imprint	Number to Galveston
348	105	105	99	94.3	2	97
349	124	124	92	74.2	0	87
518	107	107	24	22.4	0	22
519	116	115	0	0.0	0	0
520	112	112	12	10.7	0	10
521	134	127	1	0.8	0	1
572	101	101	0	0.0	0	0
575	102	103	0	0.0	0	0
577	111	112	2	1.8	0	2
579	90	110	0	0.0	0	0
578	111	113	0	0.0	0	0
571	123	123	3	2.4	0	2
596	107	101	0	0.0	0	0
597	132	133	3	2.3	0	3
622	115	115	0	0.0	0	0
623	107	107	0	0.0	0	0
791	104	104	6	5.8	0	6
792	105	105	0	0.0	0	0
Total	2006	2017	242	12.06	2	230

**Table 2.** This table shows the locations of the probes which were planted within the clutches at Rancho Nuevo, and denotes those which were attached to the CR-5 for monitoring.

BOX-PROBE LOCATIONS			
Clutch Number	Bottom	Middle	Top
348	@	*	@
349	@	*	@
518	*	*	*
519	*	*	*
520		*	*
521	*	*	*
572	*	*	*
575	*	*	*
577	*	*	*
579	*	*	*
578	*	*	*
571	*	*	
596	*	*	*
597	*	*	*
622	*	*	@
623	*	#	
791	@	*	*
792	*	*	@

\* Probes which were attached to the CR-5

@ Probes which were planted in Rancho Nuevo but not attached to CR-5

# Probe attached to CR-5, and broke on incubation day 53



**Table 3.** Summary table showing clutch lay date, middle third of incubation period, hatch date, and incubation period in days.

Box number	Lay date	Middle third of incubation period	Hatch date	Incubation period (days)
348	15 May 83	1 June 83-18 June 83	4 July 83	51
349	15 May 83	31 May 83-16 June 83	2 July 83	49
518	29 May 83	15 June 83-2 July 83	17 July 83	50
519	29 May 83	-	-	61 *
520	29 May 83	15 June 83-2 July 83	19 July 83	51
521	29 May 83	16 June 83-4 July 83	21 July 83	53
572	2 June 83	-	-	59 *
575	2 June 83	-	-	60 *
577	2 June 83	20 June 83-8 July 83	26 July 83	55
579	2 June 83	-	-	60 *
578	2 June 83	-	-	60 *
571	2 June 83	20 June 83-8 July 83	26 July 83	55
596	4 June 83	-	-	59 *
597	4 June 83	21 June 83-8 July 83	24 July 83	50
622	5 June 83	-	-	59 *
623	5 June 83	-	-	59 *
791	17 June 83	4 July 83-21 July 83	8 Aug 83	52
792	17 June 83	-	-	55 *

\* Indicates incubation day on which unhatched eggs were removed for preservation.

**Table 4.** Summary of hatching information showing date and time hatching began, date last egg hatched, duration of hatching, and presence of late hatching individuals.

Clutch Number	Date of Hatching	Time of Hatching	Date Last Egg Hatched	Duration of Hatching	Late Hatching Individuals
348	4 July 83	0700	6 July 83	3 days	yes
349	2 July 83	1530	5 July 83	4 days	yes
518	17 July 83	0700	21 July 83	5 days	yes
519	-	-	-	-	-
520	19 July 83	2200	20 July 83	2 days	no
521	20 July 83	2100	21 July 83	1 day	no
572	-	-	-	-	-
575	-	-	-	-	-
577	26 July 83	1700	26 July 83	1 days	no
579	-	-	-	-	-
578	-	-	-	-	-
571	26 July 83	1900	28 July 83	3 days	no
596	-	-	-	-	-
597	24 July 83	0700	27 July 83	4 days	yes
622	-	-	-	-	-
623	-	-	-	-	-
791	8 Aug 83	0700	9 Aug 83	2 days	no
792	-	-	-	-	-

Table 5. continued

Clutch Number	Date Transferred	Time Transferred	Number Transferred	Activity Level in Transfer Box on Release Morning	Number of Clutches in Shed Hatching	Total Time In Transfer Box Before Release
575	-	-	-	-	-	-
577	27 July 83	0730	2	active	3	25 hours 10 min
579	-	-	-	-	-	-
578	-	-	-	-	-	-
571	27 July 83	0730	1	active	3	25 hours 10 min
	28 July 83	1330	* 1	inactive		43 hours
	29 July 83	0750	* 1			24 hours 40 min
596	-	-	-	-	-	-
597	26 July 83	0800	2	active	3	48 hours 15 min
	29 July 83	0750	1	inactive		24 hours 40 min
622	-	-	-	-	-	-
623	-	-	-	-	-	-
791	9 Aug 83	1100	≠ 1	active	1	45 hours 25 min
	10 Aug 83	0700	≠ 5			25 hours 25 min
792	-	-	-	-	-	-

\* released together

@ released together

# released together

& died, never released

\$ 2 released 23 July 83, 2 released 24 July 83

\* released together

≠ released together

**Table 5.** Summary of pre-release hatchling information including date and time of hatchling transfer, number transferred, activity level in transfer box on release morning, number of clutches hatching, and total time in transfer box before release.

Clutch Number	Date Transferred	Time Transferred	Number Transferred	Activity Level in Transfer Box on Release Morning	Number of Clutches in Shed Hatching	Total Time In Transfer Box Before Release
348	5 July 83	0930	* 5	active	2	70 hours 30 min
	6 July 83	0715	* 70			48 hours 45 min
	7 July 83	0830	* 18			23 hours 30 min
	8 July 83	0630	3			1 hour 30 min
	9 July 83	0730	3			24 hours 30 min
349	4 July 83	0700	@ 2	semi-active	2	49 hours
	4 July 83	1400	@ 5			42 hours
	5 July 83	0930	@ 38			22 hours 30 min
	6 July 83	0930	# 35			47 hours 45 min
	7 July 83	0830	# 8			24 hours 45 min
518	9 July 83	0730	1	& very active	3	& 25 hours 40 min
	20 July 83	0700	8			23 hours
	21 July 83	0930	11			\$ 22 hours 30 min
	22 July 83	1000	4			\$ 45 hours 30 min
519	-	-	-	-	-	-
520	20 July 83	0730	10	very active	2	24 hours 45 min
	21 July 83	0930	1	inactive		23 hours
521	22 July 83	1000	1	very active	2	22 hours 30 min
572	-	-	-	-	-	-

continued

**Table 6.** Summary of hatchling release information showing date and time of release, release time lapse, activity level of turtles during release, and disorientation exhibited.

Clutch Number	Date of Release	Time of Release	Release Time Lapse	Activity Level During Imprint	Disorientation Exhibited
348	8 July 83	0800	1 hr 30 min	active	no
	10 July 83	0745	45 min	active	no
349	6 July 83	0800	1 hr 5 min	semi-active	no
	8 July 83	0915	1 hr 30 min	semi-active	yes
518	21 July 83	0840	35 min	active	no
	22 July 83	0830	1 hr	active	no
	23 July 83	0830	50 min	active	yes
	24 July 83	0730	45 min	active	no
519	-	-	-	-	-
520	21 July 83	0815	30 min	active	no
	22 July 83	0845	45 min	semi-active	no
521	23 July 83	0830	40 min	active	no
527	-	-	-	-	-
575	-	-	-	-	-
577	28 July 83	0850	25 min	active	no
579	-	-	-	-	-
578	-	-	-	-	-
571	28 July 83	0840	20 min	active	no
	30 July 83	0830	1 hr	semi-active	yes
596	-	-	-	-	-
597	28 July 83	0815	45 min	inactive	no
	30 July 83	0830	1 hr 10 min	inactive	no
622	-	-	-	-	-
623	-	-	-	-	-
791	11 Aug 83	0825	30 min	active	no
792	-	-	-	-	-

**Table 7.** Summary of the mean and standard deviations of carapace length and weight for all hatchlings.

Clutch number	Number of turtles	<u>CARAPACE LENGTH (mm)</u>		<u>WEIGHT (gram)</u>	
		Mean	Standard deviation	Mean	Standard deviation
348	97	41.34	1.03	14.83	0.74
349	87	41.01	1.57	15.22	0.87
518	23	42.70	2.38	17.10	1.29
519	0	-	-	-	-
520	11	44.12	1.44	16.42	1.18
521*	1	-	-	-	-
572	0	-	-	-	-
575	0	-	-	-	-
577*	2	-	-	-	-
579	0	-	-	-	-
578	0	-	-	-	-
571*	3	-	-	-	-
596	0	-	-	-	-
597*	3	-	-	-	-
622	0	-	-	-	-
623	0	-	-	-	-
791*	15	43.14	1.80	15.43	1.55
792	0	-	-	-	-
TOTAL	233	41.59	1.71	15.31	1.16

\* Combined data from boxes 521, 577, 571, 597, and 791 due to low number of turtles

**Table 8.** An analysis of 1983 unhatched eggs showing total number of unhatched eggs examined and relative percentages of each embryonic class; infertile, fertile and possibly containing an early-stage embryo, incubated for 10-18 days, and incubated for over 18 days, and relative percent of eggs infested with fungal growth.

Clutch #	Total # Of Eggs Examined	EGGS WITH EMBRYOS		EGGS WITHOUT EMBRYOS		FUNGAL EGGS
		Relative Percent Infertile	Relative Percent Fertile With Early-Stage Embryo	Relative Percent Incubated 10-18 Days	Relative Percent Incubated Over 18 Days	Relative Percent Eggs Obviously Infested With Fungal Growth
348	6	0	16.0%	16.0%	66.0%	0
349	32	15.6%	31.2%	3.2%	50.0%	0
518	83	0	12.2%	39.7%	48.1%	100%
520	100	19.0%	60.0%	11.0%	10.0%	100%
521	93	1.0%	91.4%	5.4%	2.2%	100%
Total	314	17.9%	53.0%	16.2%	22.9%	87.8%

**Table 9.** An analysis of 1980, 1982, and 1983 unhatched eggs showing total number of eggs examined and relative percentages of each embryonic class; infertile, fertile and possibly containing an early-stage embryo, incubated for 10 to 18 days, and incubated for over 18 days.

CLASSIFICATION OF UNHATCHED EGGS, YEARS 1980, 1982, AND 1983

Year	Total # Of eggs Examined	Relative Percent Infertile	Relative Percent Fertile With Early-Stage Embryo	Relative Percent Incubated 10-18 Days	Relative Percent Incubated Over 18 Days
1980	447	*	*	6.0%	3.1%
1982	135	28.8%	23.7%	16.3%	31.2%
1983	314	17.9%	52.8%	16.2%	22.9%

\* Many of the unhatched eggs from 1980 were in poor condition at the time of examination and hence the distinction could not be made between infertile and fertile eggs possibly containing very early-stage embryos.



**Table 10.** Results of sand moisture analysis conducted on clutches 521 through 792, including date and incubation day of sand sample collection, and absolute moisture content (percent by weight).

Clutch number	Date of sample collection	Incubation day of sample collection	% Moisture
521	24 July 83	56	17.2
572	1 Aug 83	60	12.0
575	2 Aug 83	61	12.0
577	1 Aug 83	60	12.0
579	2 Aug 83	61	10.0
578	2 Aug 83	61	13.0
571	1 Aug 83	60	15.0
596	3 Aug 83	60	11.0
597	29 July 83	55	15.0
622	4 Aug 83	60	15.0
623	4 Aug 83	60	14.8
791	13 Aug 83	57	13.1
792	13 Aug 83	57	9.8

Table 11. Summary of the disposition of the unhatched eggs and the method by which they were preserved.

DISPOSTION OF UNHATCHED EGGS

Clutch number	Total eggs	Total unhatched	Unpreserved and shipped to Galveston for culturing	Refrigerated and shipped to Galveston for culturing	Freeze-dried for heavy metal and pesticide analysis	Frozen for heavy metal and pesticide analysis	Injected with 10% buffered formalin for histological analysis	Injected with F.A.A. solution for embryological analysis
348	105	6	0	0	0	0	0	6
349	124	32	0	0	0	0	0	32
518	107	83	0	0	0	0	0	83
519	116	116	61	20	0	0	35	0
520	112	100	0	0	0	0	0	100
521	134	133	0	0	0	0	0	133
572	101	101	0	0	0	20	50	31
575	102	102	0	0	0	20	55	27
577	111	109	0	0	0	0	0	109
579	90	90	0	0	0	20	40	30
578	111	111	0	0	0	20	61	30
571	123	120	0	0	0	20	60	40
596	107	107	0	0	0	20	54	33
597	132	129	0	20	0	0	52	57
622	115	115	0	0	0	20	55	40
623	107	107	0	0	0	20	50	37
791	104	98	20	0	10	20	27	21
792	105	105	20	0	10	20	35	20
Total	2006	1764	101	40	20	200	574	829

**Table 12.** This table shows the disposition of 1983 Kemp's Ridley sea turtle hatchlings.

**DISPOSITION OF HATCHLINGS**

Clutch Number	Number Hatched	Died in Box	Escaped During Imprint	Died in Tub After Being Measured	Transferred to Galveston
348	99	0	2	0	97
349	92	5	0	0	87
518	24	1	0	1	22
519	0	0	0	0	0
520	12	1	0	1	10
521	1	0	0	0	1
572	0	0	0	0	0
575	0	0	0	0	0
577	2	0	0	0	2
579	0	0	0	0	0
578	0	0	0	0	0
571	3	0	0	1	2
596	0	0	0	0	0
597	3	0	0	0	3
622	0	0	0	0	0
623	0	0	0	0	0
791	6	0	0	0	6
792	0	0	0	0	0
<b>Total</b>	<b>242</b>	<b>7</b>	<b>2</b>	<b>3</b>	<b>230</b>

**Table 13.** This table shows the number of hatchlings which died in each clutch, the date of death, and general comments surrounding the death.

DEAD HATCHLINGS

Clutch number	Number dead	Date died	Comments
348	0		
349	2	6 July 83	
	2	8 July 83	all 5 were runts with large egg sacs
	1	9 July 83	
518	1	22 July 83	runt with large egg sac
	1	23 July 83	deformed hatchling
519	0		
520	1	20 July 83	large egg sac
	1	24 July 83	no obvious deformity
521	0		
572	0		
575	0		
577	0		
579	0		
578	0		
571	1	6 Aug 83	deformed hatchling
596	0		
597	0		
622	0		
623	0		
791	0		
792	0		
TOTAL	10		

**Table 14.** This table shows the number of deformed hatchlings in each clutch and their type of deformity.

DEFORMED HATCHLINGS

Clutch number	Number of deformed hatchlings	Type of deformity
348	0	
349	0	
518	2	both had high domed and lop-sided carapaces
519	0	
520	0	
521	0	
572	0	
575	0	
577	0	
579	0	
578	0	
571	1	no eyes, offset jaw, only one lung
596	0	
597	0	
622	0	
623	0	
791	0	
792	0	
Total	3	

**Table 15.** Descriptive statistics for 1980, 1981, 1982, and 1983  
Kemp's Ridley Hatchlings

Year	Curved Carapace Length (mm)			Weight (gram)	
	n	$\bar{x}$	s	$\bar{x}$	s
1980	317	43.62	2.04	-	-
1981	230	42.14	1.85	-	-
1982	199	44.71	1.66	-	-
1983*	233	41.59	1.71	15.31	1.16

\*1983 straight line carapace length

FIGURE 1. 1980 CURVED CARAPACE LENGTH - KEMP'S RIDLEY N=317

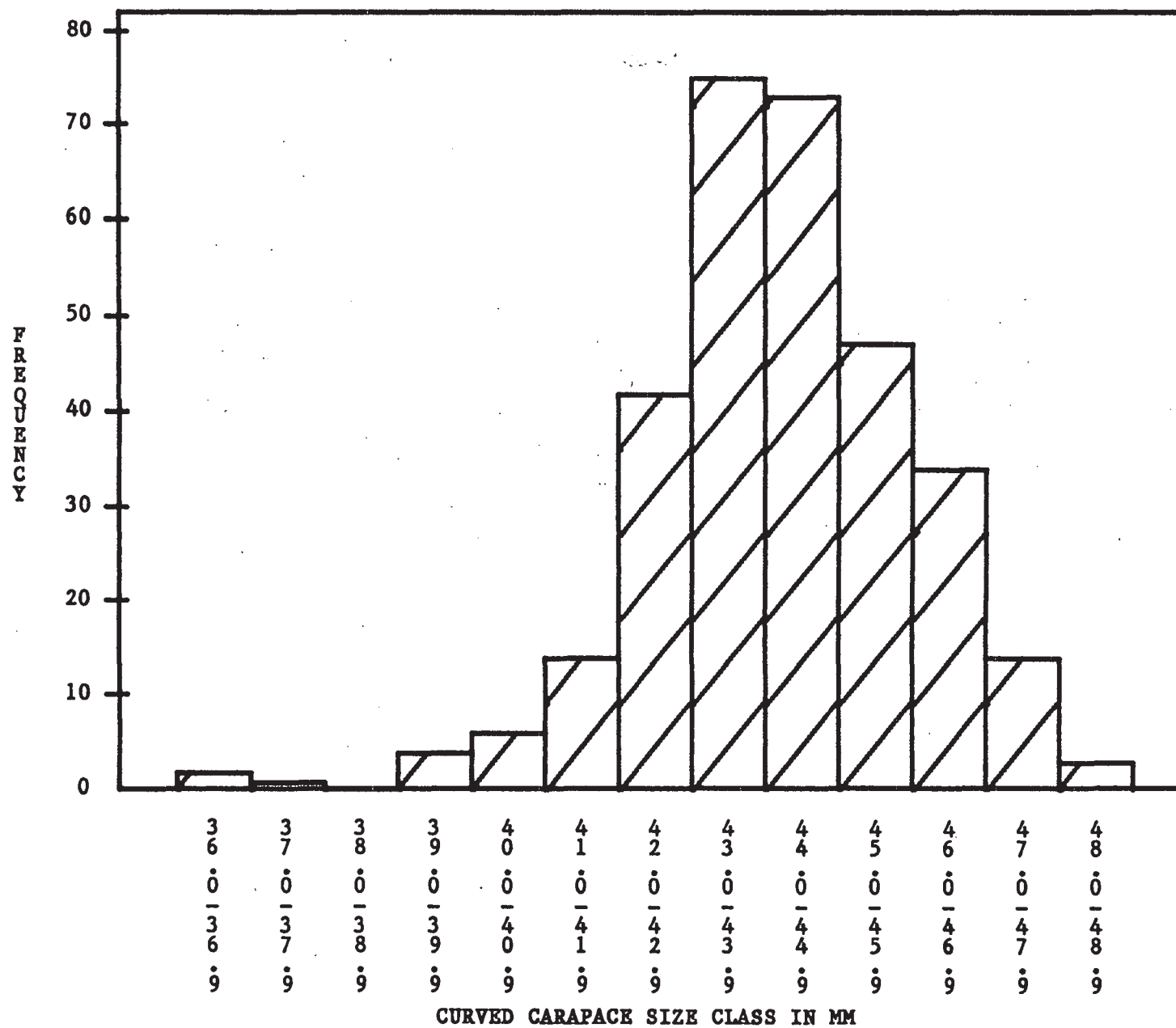


FIGURE 2. 1981 CURVED CARAPACE LENGTH - KEMP'S RIDLEY N=230

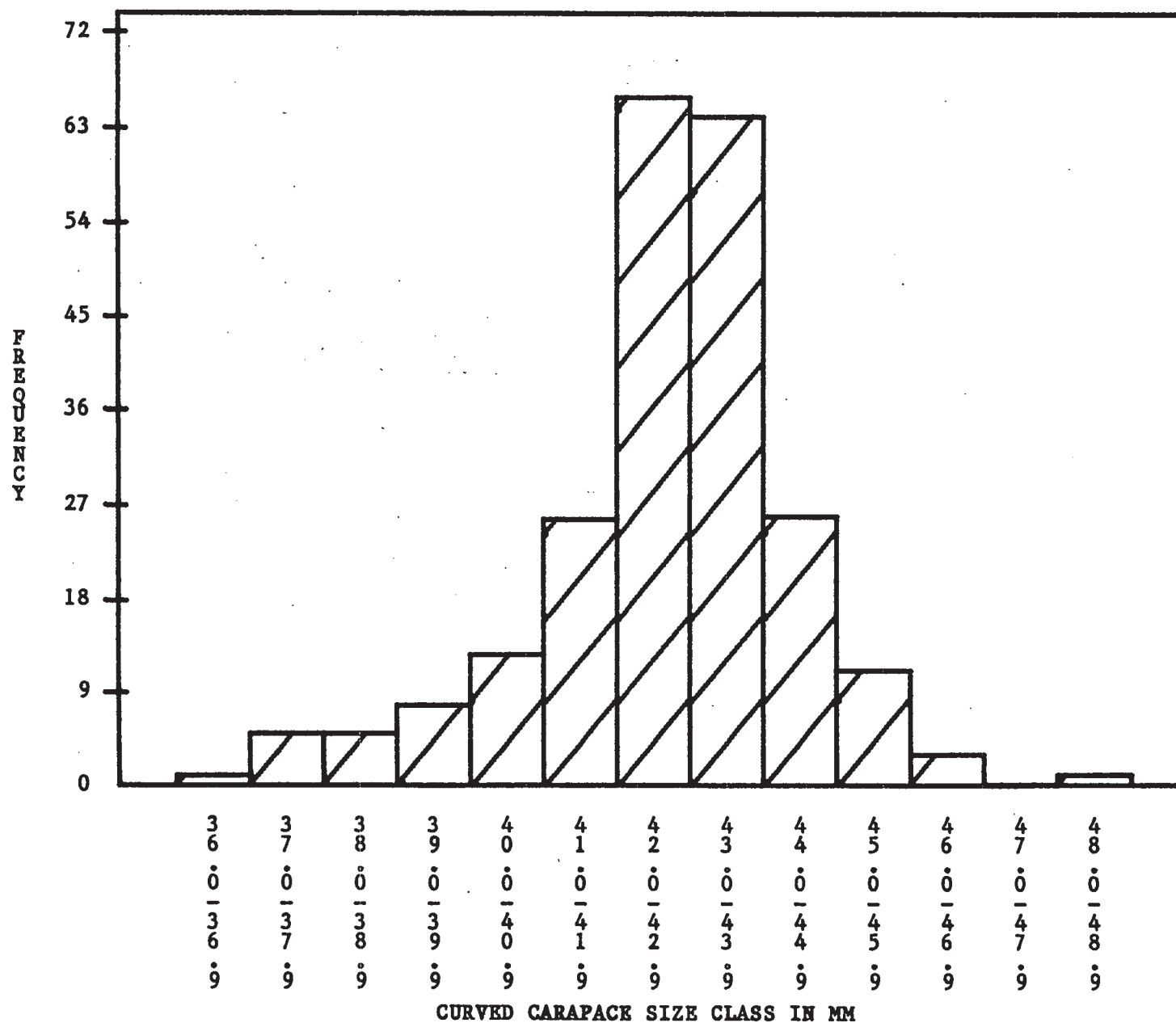




FIGURE 3. 1982 CURVED CARAPACE LENGTH - KEMP'S RIDLEY N=199

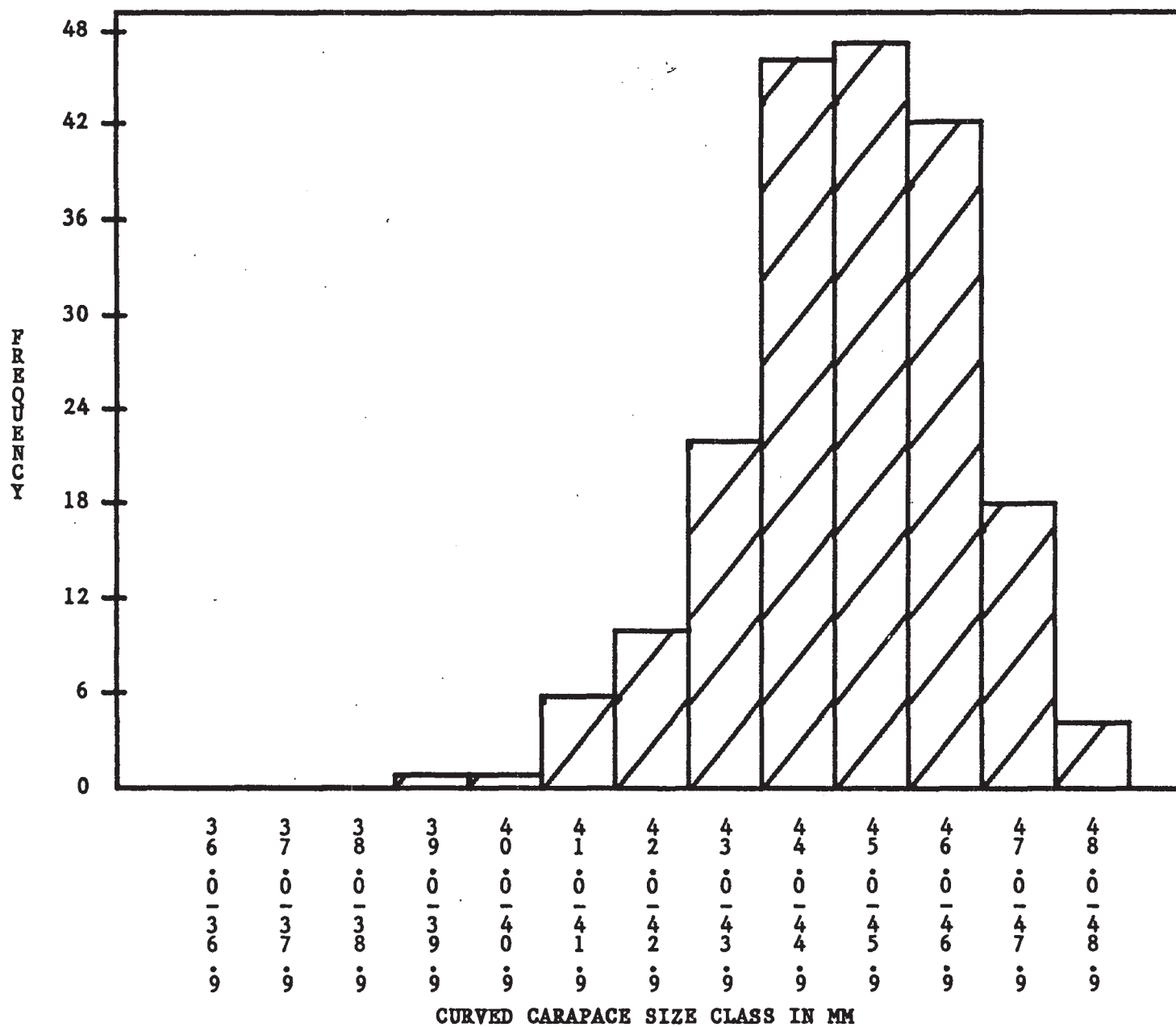


FIGURE 4. 1983 KEMP'S RIDLEY HATCHLING CARAPACE LENGTH HISTOGRAM N=233

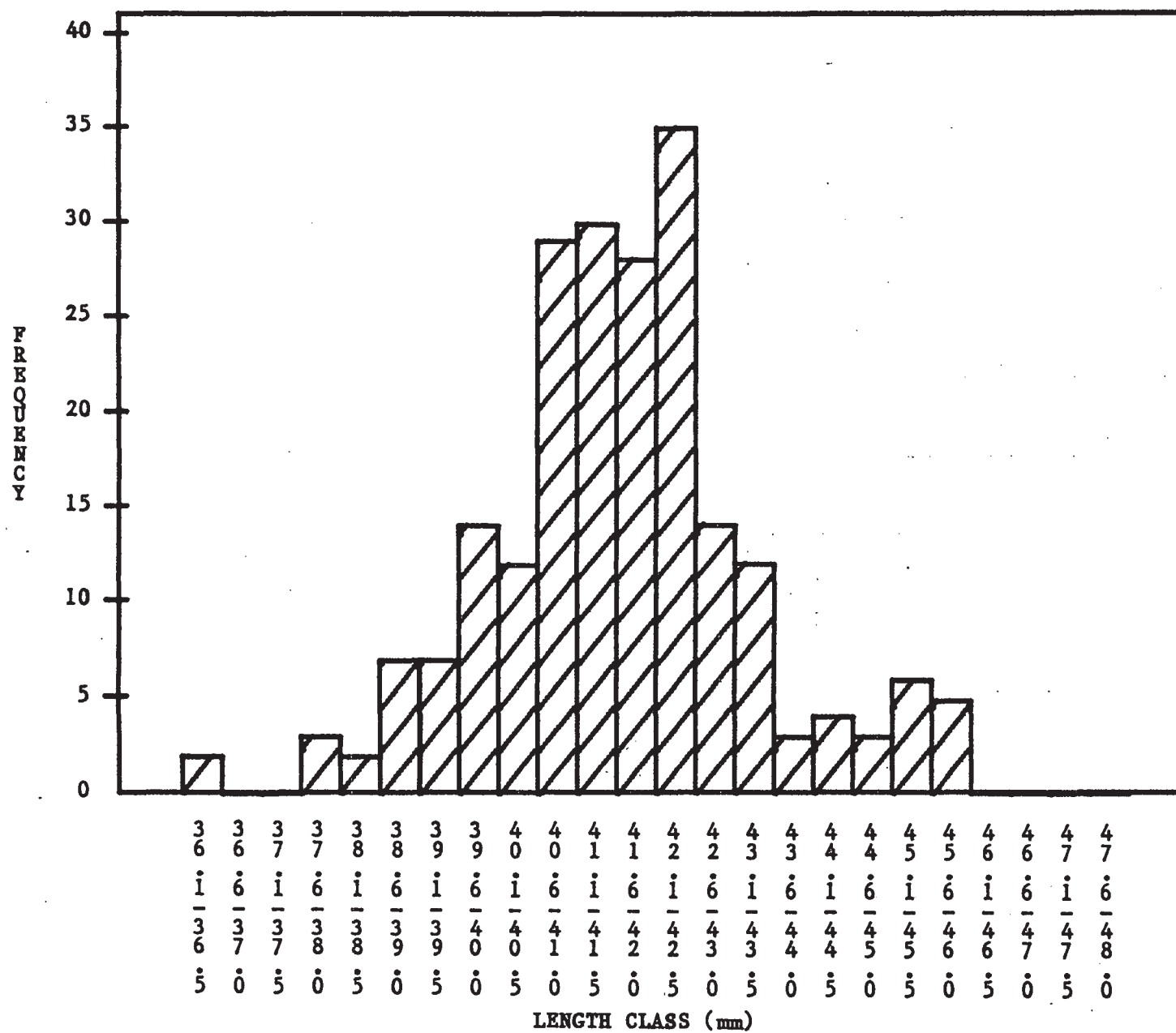
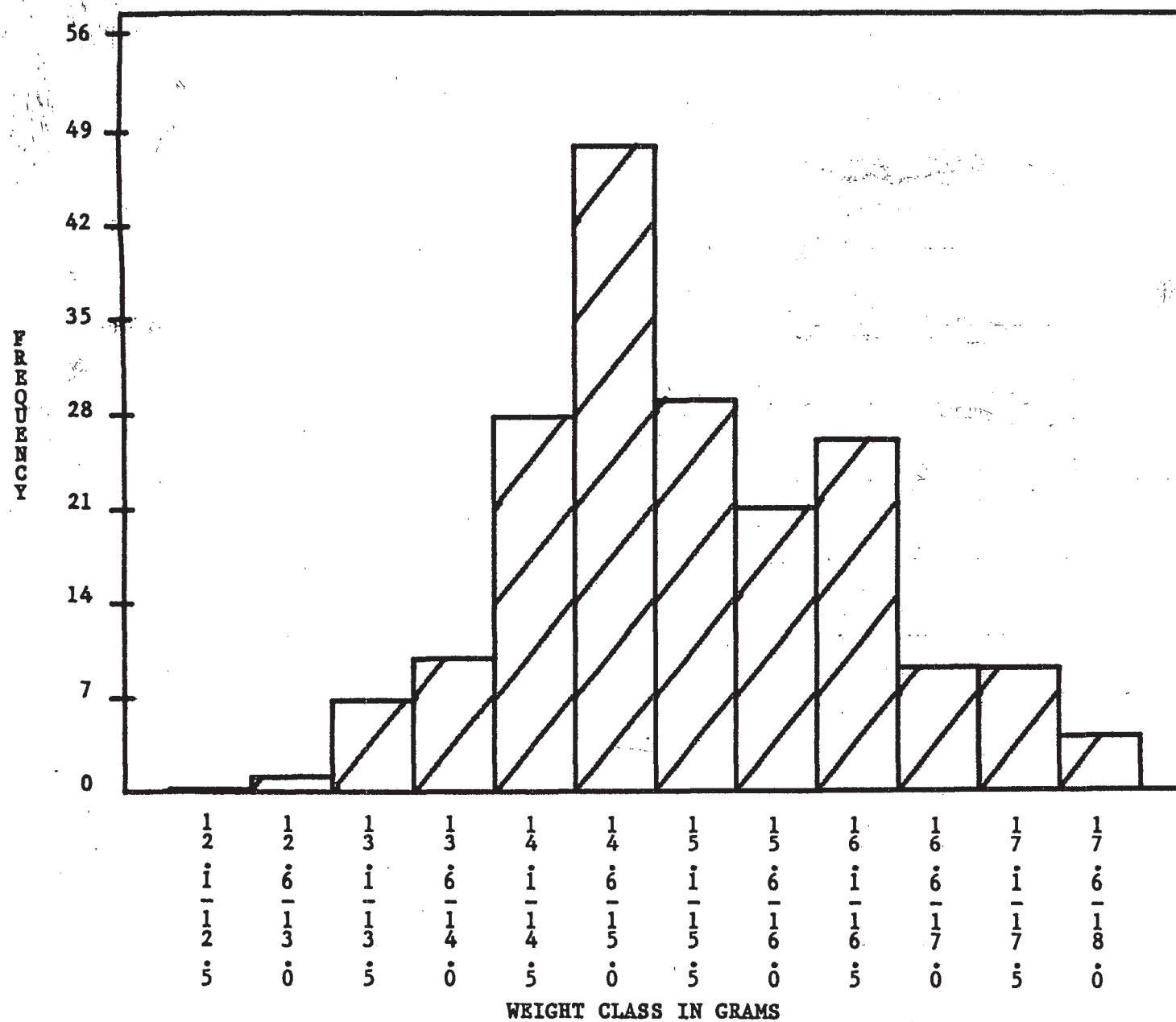
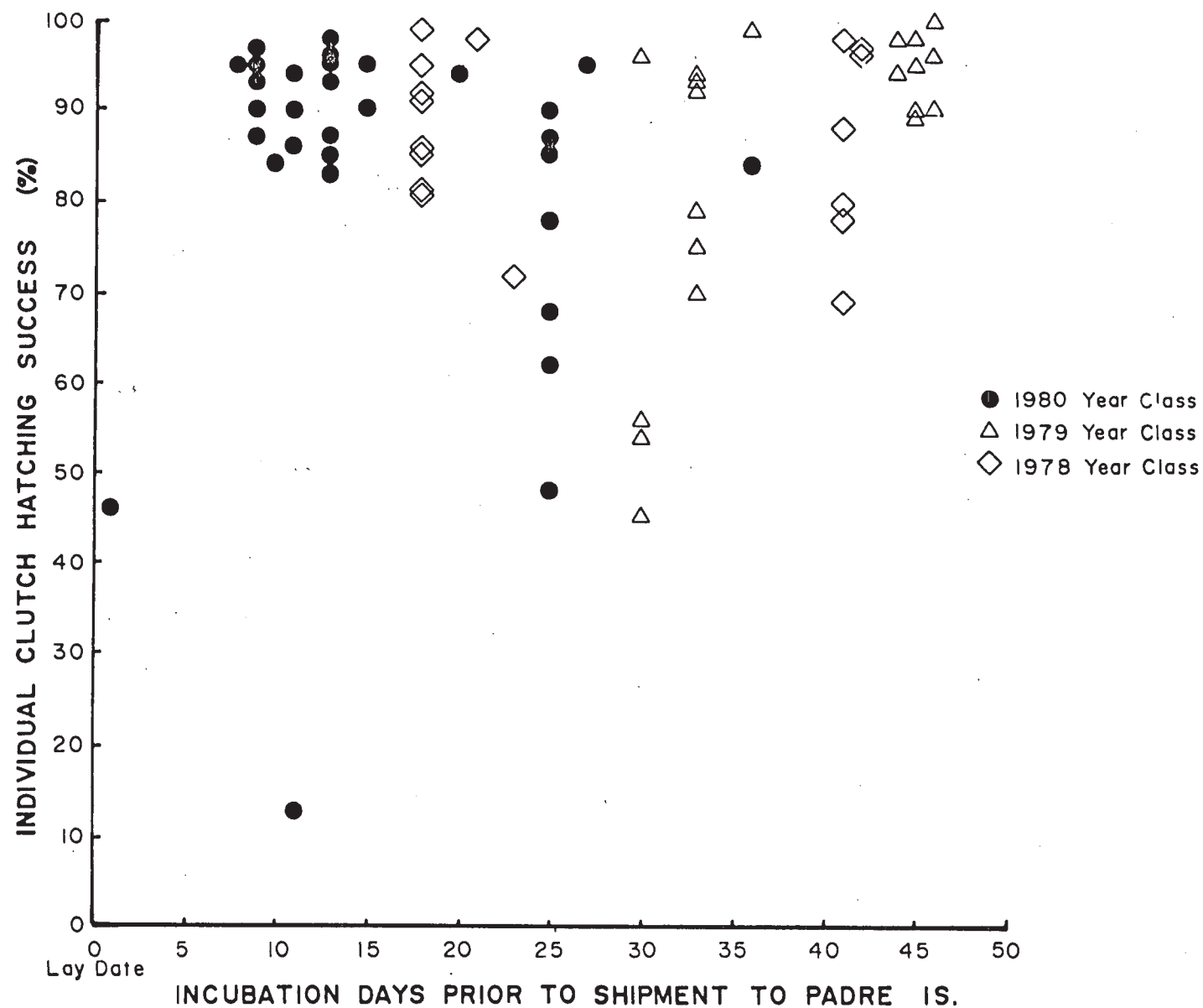


FIGURE 5. 1983 KEMP'S RIDLEY HATCHLING WEIGHT HISTOGRAM N=233



Graph 1. Individual clutch success vs. number of incubation days before transport from Rancho Nuevo, Mexico to Padre Island National Seashore for years 1978, 1979, and 1980.



Graph 2. Individual clutch success vs. number of incubation days before transport from Rancho Nuevo, Mexico to Padre Island National Seashore for years 1981, 1982, and 1983.

