

## FILE FOLDER

### DESCRIPTION ON TAB:

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Turtle Report

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**\*Scanned as next image**

Sea Turtle

1979

Inventory

ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979.

Natural Resources and Environmental Affairs Division

Base Maintenance Department

Marine Corps Base

Camp Lejeune, North Carolina 28542

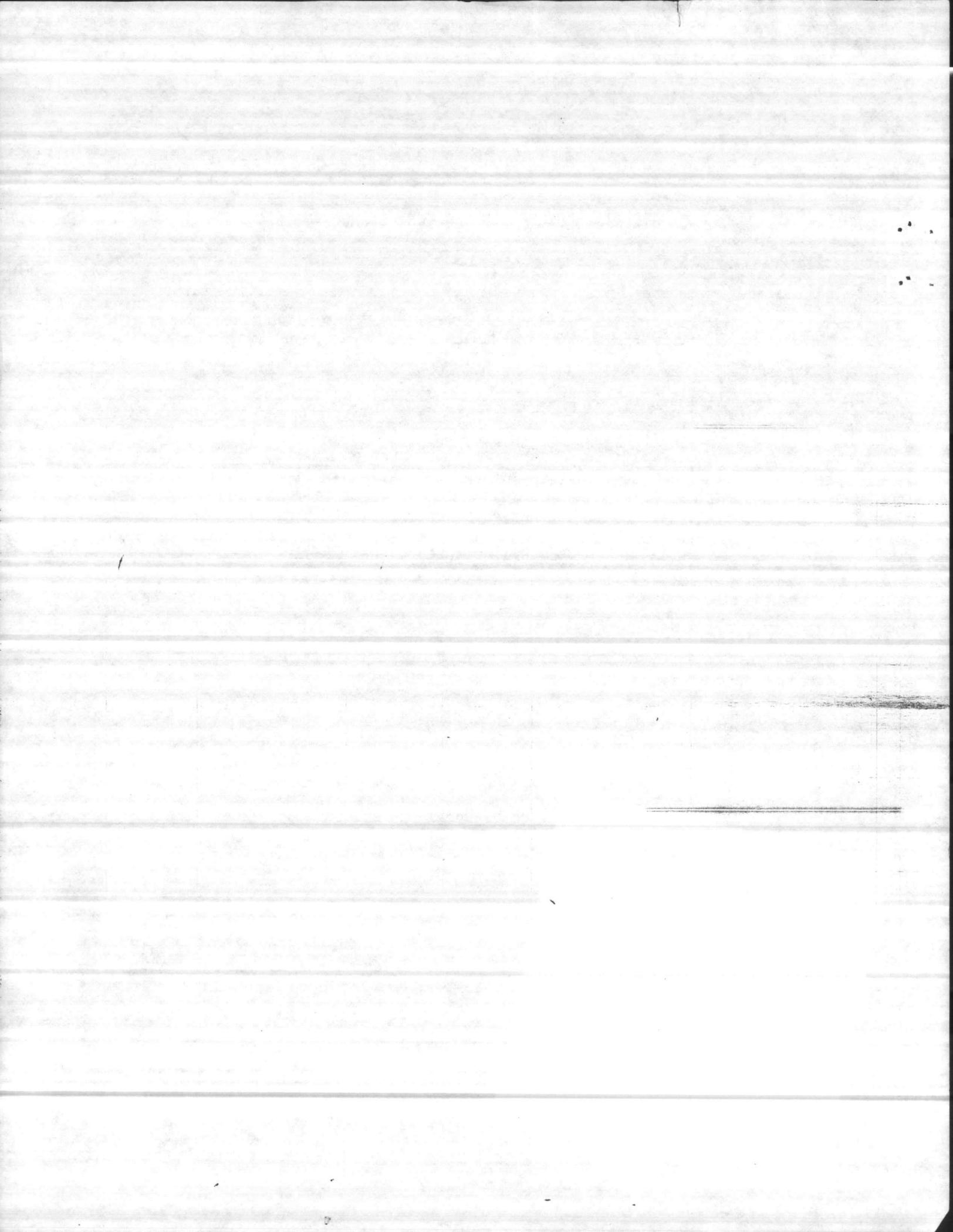
Submitted by

Hugh R. Passingham

November 1979

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ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979..

Natural Resources and Environmental Affairs Division

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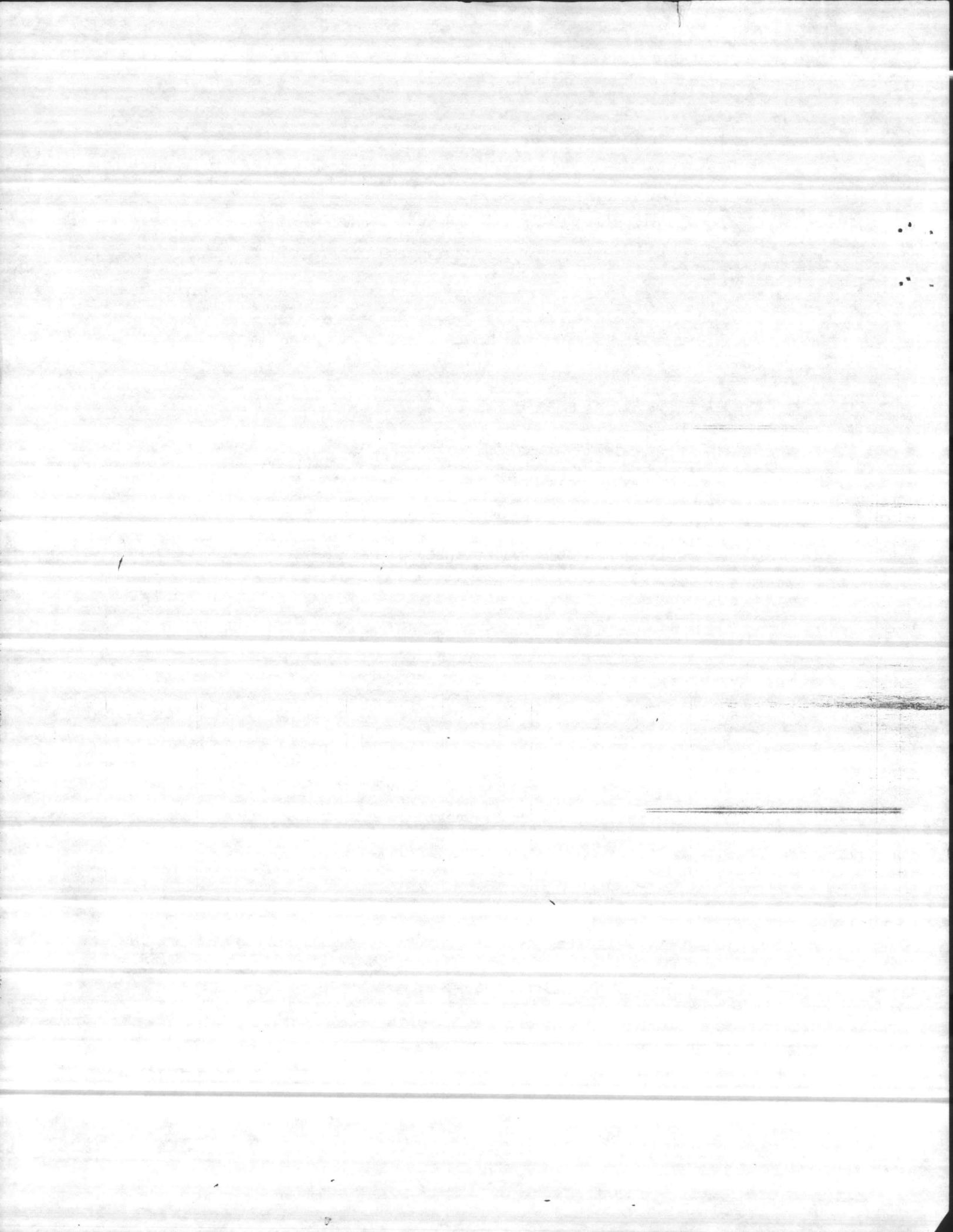
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## BACKGROUND

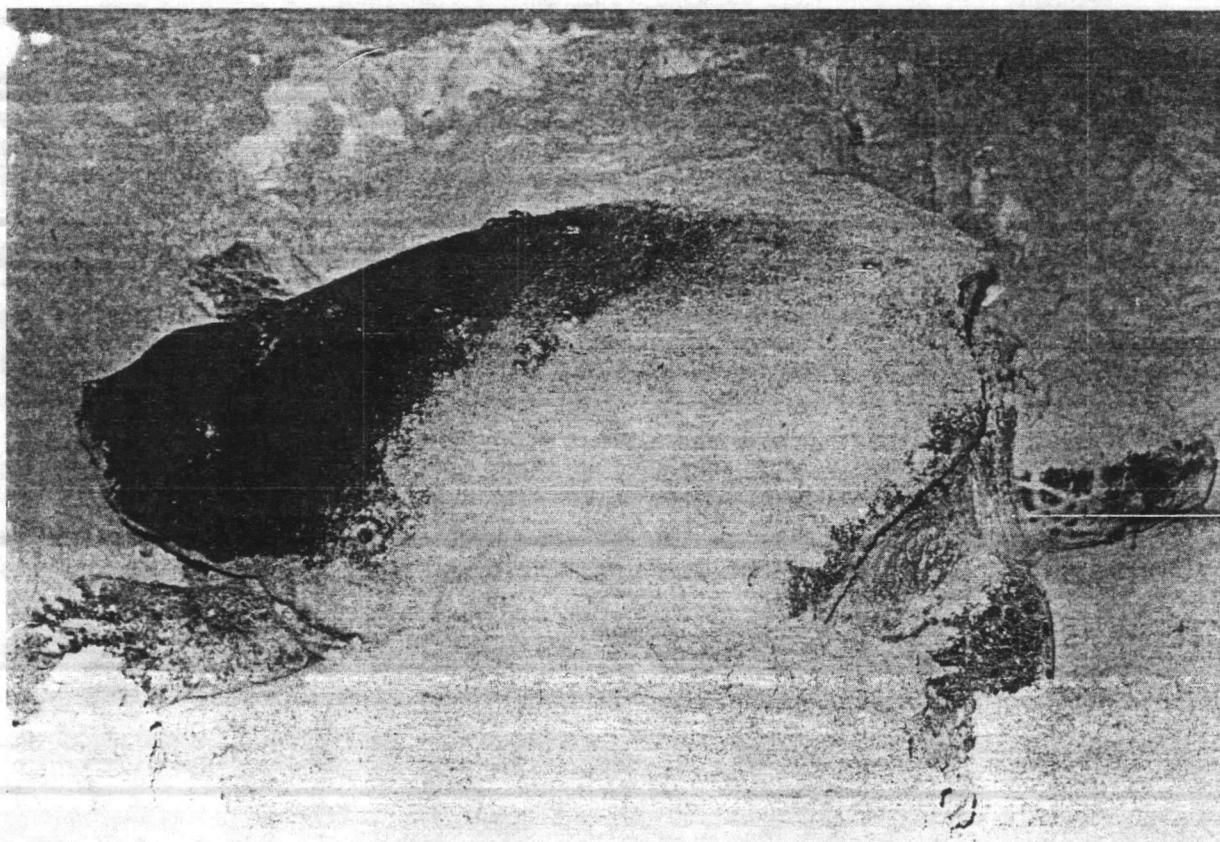
The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered

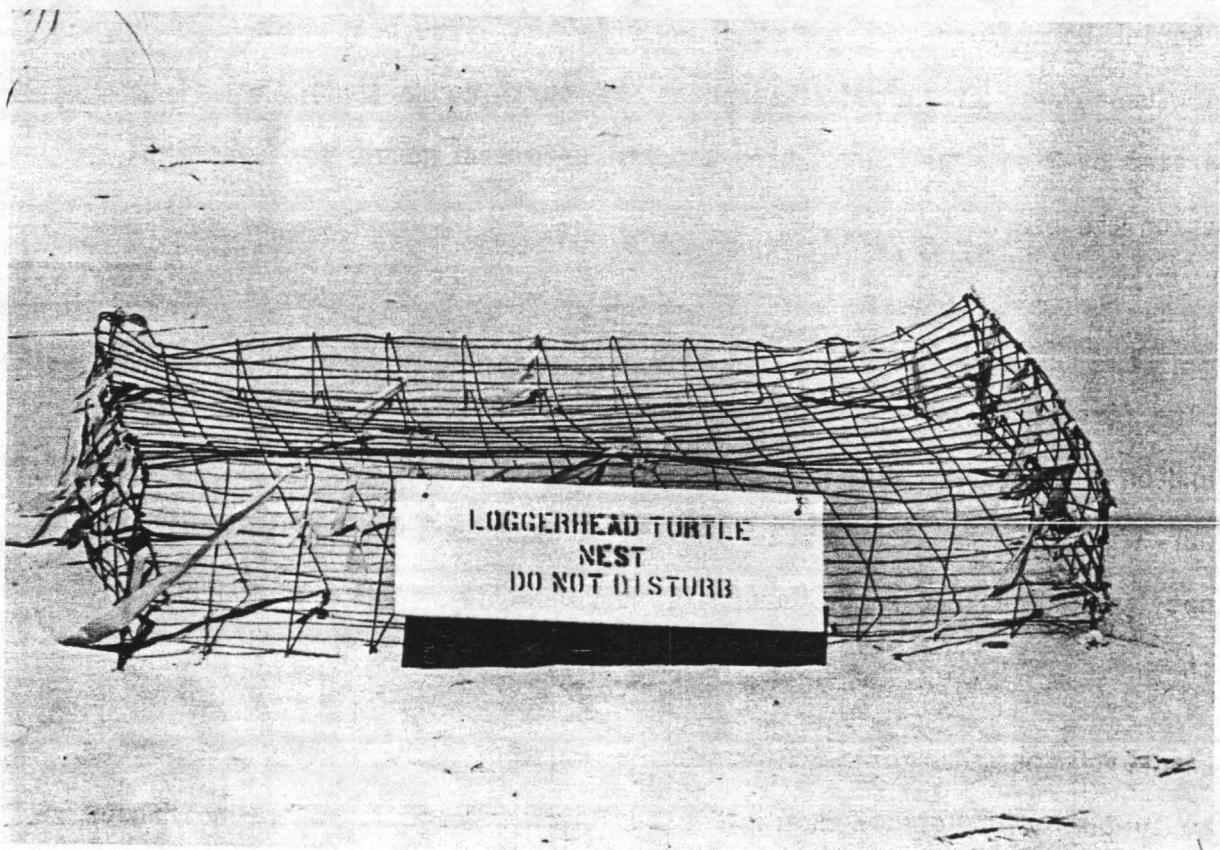
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Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and it's management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## METHODS

The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

A search was made for turtle tracks or turtles just leaving the surf. If no turtles were located during a patrol, there would be a one-half hour wait before beginning the next patrol. Upon location of turtles, all lights were extinguished until it could be ascertained whether or not the

turtle would nest. After a turtle nested, a numbered tag was attached to a posterior marginal scute. Midway through the nesting season, carapace tags (actually a small disc fish tag) were replaced by live stock ear tags, which were attached on the trailing edge of the right front flipper. During the tagging operation, measurements of the carapace, head, right front and rear flippers and identifying characteristics of each turtle were noted. This data was recorded on the Sea Turtle Inventory (Nesting Data) form (See pages 15 and 16). Nests laid in areas of heavy human use, below the tideline or other seemingly undesirable locations, were relocated, generally at the base of the dunes above the tideline in relatively unused areas of the beach. Nests located in an area extending from Riseley's Pier south approximately two miles to a training observation tower were removed and sent to IMS. These eggs were counted and allowed to hatch under controlled conditions. All other nests, after being located, were protected by burying to a depth of six inches, a four foot square, eighteen inches high cage, made of 2" by 4" electrically welded wire, over the nest. The case was then marked with yellow surveyors plastic tape and a 8" by 20" white sign with red lettering stating "Endangered Wildlife Nest Do Not Disturb." Each nest was tagged using a small plastic tag attached to the protection cage. This tag was marked with the date, nest number, location and number of eggs in the nest. Once a nest was protected, it was checked occasionally until hatch-out of the young was observed. When hatch-out occurred, which was normally from fifty to seventy days, the nest was re-entered and the unhatched eggs were counted. The number of eggs that did not hatch were compared to the total number of eggs for each nest to determine hatching success.

The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter), New River to assist in making sightings and counts of turtle crawls and apparent nest sights along the beach strands of the coastal islands involved in the survey. Flights were not always over the entire coastal area, but were divided into a northern section and a southern section. The northern section included the barrier islands from Onslow Beach to Cape Lookout. The southern section included the barrier islands from Onslow Beach to Smith's "Baldhead" Island. There were nine flights total; four during June and five during July. All flights were made during the prime nesting period before, during and after the full moon for each month (Table II). The data from the aerial surveys was compared to other aerial surveys conducted by Dr. Schwartz of IMS.

### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out any chance of hatch-out of 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

successful nests had an incubation period of sixty days or more. A total of 7,077 eggs were counted from all nests, protected or removed, with a hatch-out of 4,037 for a year's success of 57% (Table III).

Of the sixty-three nests, twenty-six turtles were tagged. Three of these turtles had been previously tagged on Onslow Beach and one had been tagged by the University of Georgia in Athens with the number "NC00020" (Table I).

Other data taken during the nesting season which has some bearing on nesting activity is sea water temperatures, lunar cycle and weather conditions. Graphs I, II and III detail the results of lunar cycle and temperature effects.

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rainy weather but very few nests were completed. It seemed that the wetness of the sand discouraged the turtles.

Lights on the beach, especially stationary lights, appeared to have little or no effect on turtles choice of nest sites. Turtles nested often near very well lighted buildings. Moving lights, either vehicular or pedestrian flashlights, caused immediate abortive reactions by nearly all turtles that were approached.

There was one case of nest predation of a protected nest due to technician error. This nest site had two clutches of eggs deposited under one protective cage. The error occurred after one nest was checked for hatching, at which time the cage was improperly replaced allowing space for raccoons to reach through the cage into the nest. Fifteen hatchlings were destroyed in this case.

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artificially incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

Nesting activity seemed to be determined by individual turtle cycles,

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#### DISCUSSION

Nesting during June was minimal, probably due to early summer cool temperatures. Once the air and sea water temperatures rose to twenty-two degrees celsius, nesting activity began to increase.

Lunar cycle as evidenced by Graph II seems to have little effect on nesting activity. The tides also had less effect than expected, since turtles were observed to crawl up the beach at all tides, including dead low tides.

Weather had some effect on nesting activity. Crawls were made during rainy weather but very few nests were completed. It seemed that the wetness of the sand discouraged the turtles.

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not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796, later tagged IMS 26 flipper tag. This turtle returned to the beach after 14 days (July 12 and July 26, 1979). The first clutch was laid on a rainy night at 2215 hours and contained 149 eggs. The second nest was laid on a fair night with good visibility but no moon at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time, and for each nesting the tide was near high.

Several unusual eggs were discovered during the study. Many subnormal size eggs were found. The most unusual eggs were a double and one triple yolk. Both these eggs were transported to IMS where they were artificially incubated. Neither of the unusual eggs hatched.

Hurricane David which passed through the study area in late August 1979 destroyed six nests, inundated six nests and deposited up to eighteen inches of sand over four of the inundated nests. The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. Nest of July 24, 1979 had 123 eggs hatch for 100% hatch out. Another nest, however, under nearly identical conditions and laid on the same day, had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm, no clear conclusions can be drawn. The nests that had sand deposited over them by the storm would have failed completely without human intervention. One nest of 150 eggs laid on July 5, 1979 produced 101 hatchlings for 67.3% success. When this nest was entered, about eighteen inches of sand and matted sargassum weed were removed from

over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page . The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

TABLE I

## GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
May	0	0	0	0	0
June	32	16	14	2	2
July	31	26	19	7*	12**
August	9	21	15	5***	12****

Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

\*\* - Two of the 12 were returns

\*\*\* - (8-6-79) removed, triple yolk egg from protected nest

\*\*\*\* - Three of these turtles previously tagged July 79 on Only Beach - 1 turtle previously tagged by University of Georgia, Athens (#NC0020)

TABLE II

## ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July									
	15		19		20		21		5		6		10*		11**		12***	
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N
Onslow Beach		5		2			3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3					2	2	5	6	5	
Hammock Beach			1	1		2		3				4		3				
Bogue Banks			1	1		1			1				2					
Shackleford Banks																		
Cape Lookout	1							1									2	1
Topsail Island	1	2			3	3					1	4		2	3	4	2	
1st Island																		1
Riches Island																	1	2
Figure 8 Island																		
Wrightsville Beach												1						
Masonborough Island																		
Carolina Beach												2						1
Smith Island											2	8					1	5

## Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
14	(1)	118	100	84.5
14	(2)	135	127	94.1
14		141	98	69.5
15		138	119	86.2
16	(2)	96	57	59.4
19	(2)	106	92	86.8
21	(2)	80	68	85.0
22		98	84	85.7
23		105	86	81.9
26	(2)	150	143	95.3
28	(2)	121	114	94.2
28		136	116	85.9
29	(3)	93	86	92.5
July 1	(1)	92	35	38.1
1	(2) (4)	113	2	1.8
1	(1)	121	68	72.7
2	(4)	121	0	0
3	(2)	151	137	90.7
5	(2)	150	101	67.3
6		133	121	91.0
7	(5) (2)	146	133	91.1
9		108	86	79.6

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<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
July 9	(1)	106	101	95.3
12	(5)	109	103	94.5
12	(5)	149	136	91.3
14	(6)	150	0	0
17	(7) (5)	114	106	93.0
17	(5)	113	106	93.8
17	(4)	118	0	0
18	(1)	73	66	90.4
18	(4)	92	3	3.3
19	(2)	101	99	98.0
21	(3)	39	0	0
22	(4)	115	90	78.3
24	(1)	133	113	84.9
24	(2)	159	76	47.8
24	(4) (2)	123	123	100
26	(1)	156	24	15.4
31	(1)	123	122	99.2
Aug 1	(6) (2)	109	0	0
1	(8)	105		
1	(2) (6)	109	0	0
2	(2) (6)	92	0	0
2	(2) (6)	105	0	0
3	(2) (8)	99	14	14
3	(2) (6)	97	0	0
6	(8)	124	47	37.3

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

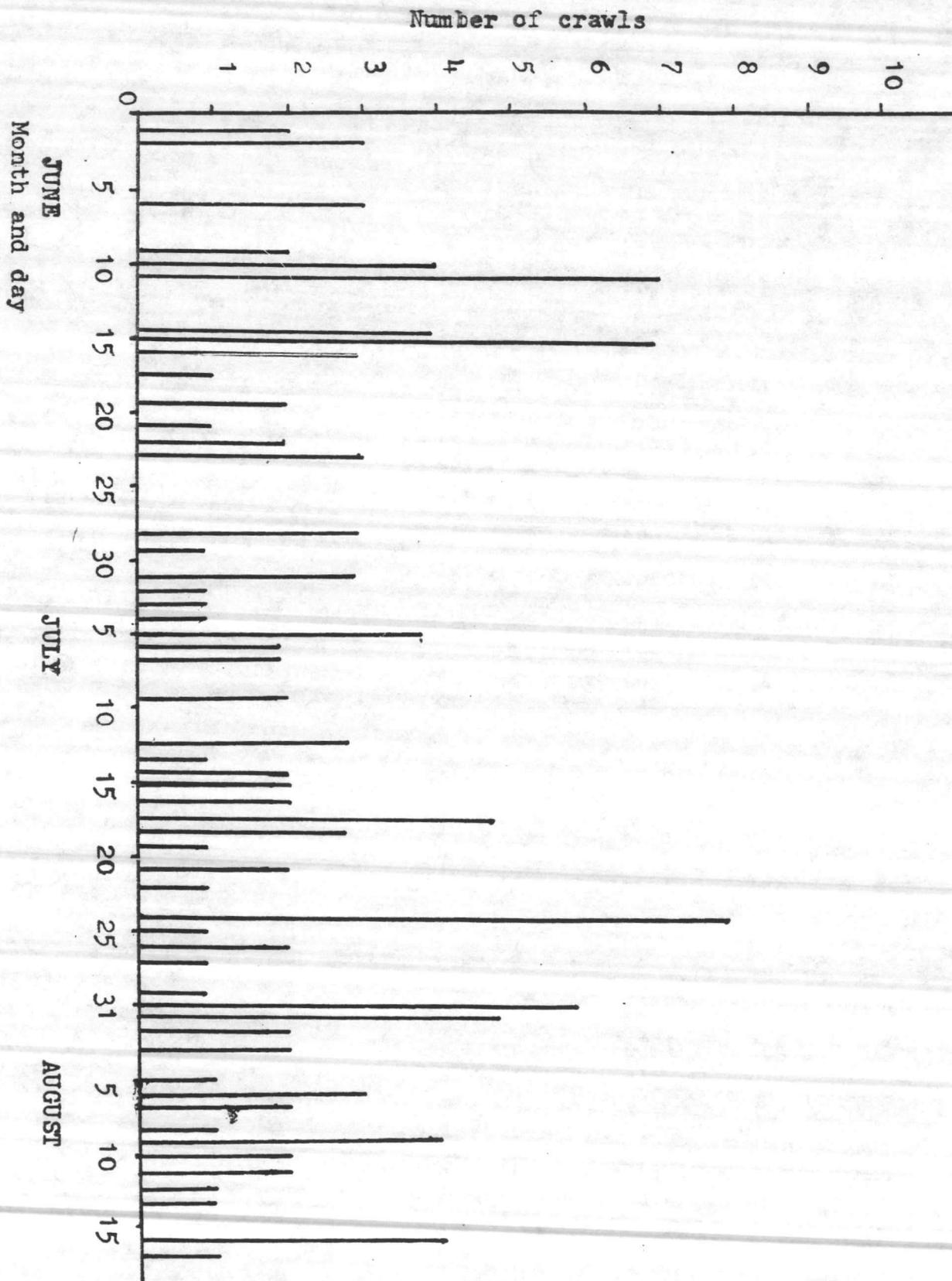
<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
Aug 7	(8)	156	8	5.3
8	(1)	104	36	34.6
9	(8)	116	22	18.9
9	(1)	110		
9	(1)	110	18	8.2
9	(2) (8)	130	1	0.8
11	(1)	125	63	50.2
14	(8)	125	92	73.6
16	(9)	100	- -	- -
16	(2) (8)	92	43	47.5
16	(2) (8)	99	85	84.8
16	(1)	98	75	76.5
17	(9)	100	- -	- -
63	(10)	7077	4037	57
40	(11)	4439	2747	61.8
14	(1)	1595	912	57.2
9	(8)	1043	378	36.2

## Note:

- (1) - Removed for Headstart
- (2) - Redeposited Eggs
- (3) - Nest opened by Raccoons
- (4) - Inundated by tide at full moon or David
- (5) - Released all Hatchlings
- (6) - Destroyed by David
- (7) - Double Yolk
- (8) - Late nests taken up after 60 days and sent to IMS
- (9) - Unprotected or not counted
- (10) - 1979 Totals
- (11) - 1979 total minus all nests removed for IMS (Notes 1 & 8)

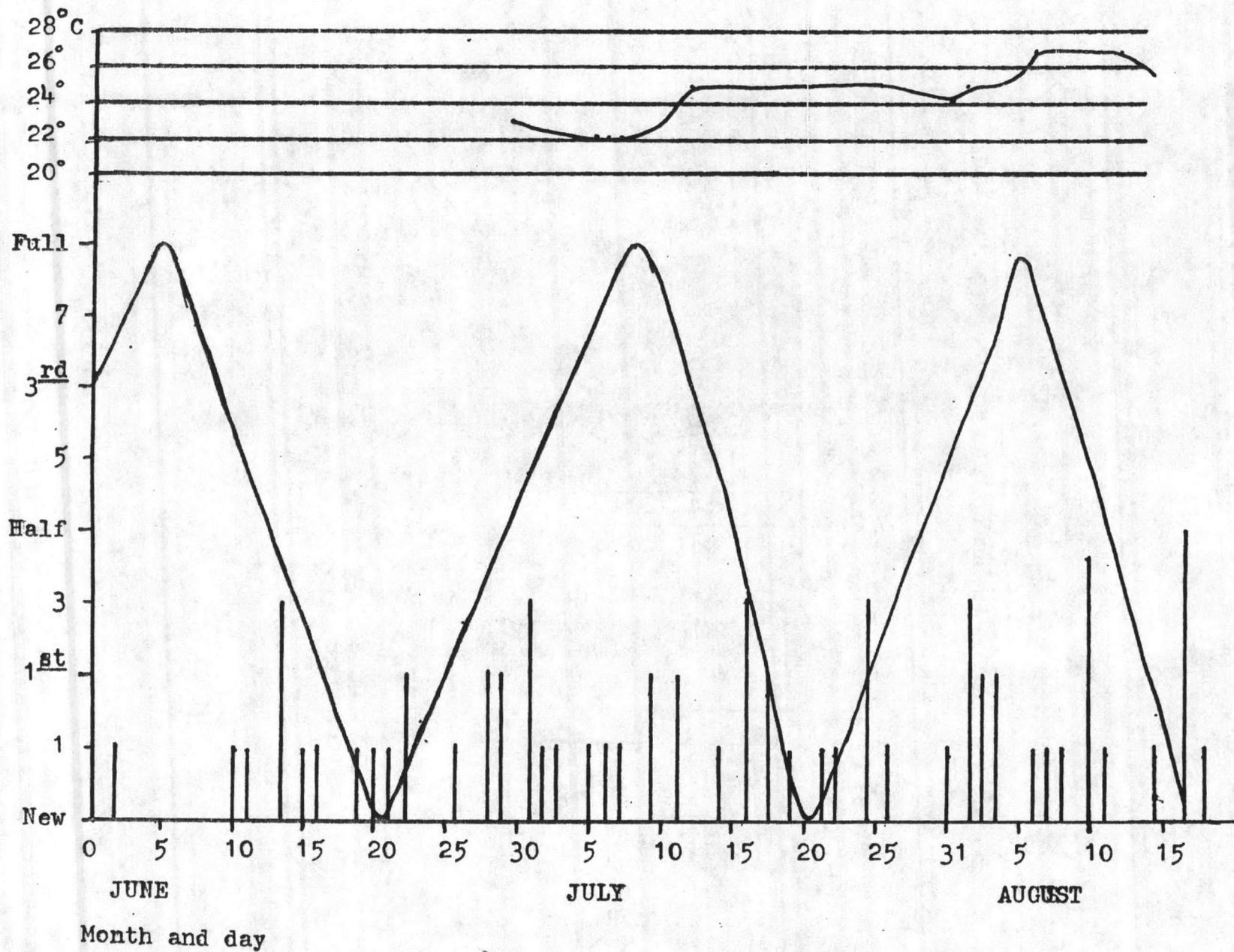
Graph 1

Turtle crawls including those that ended in nesting



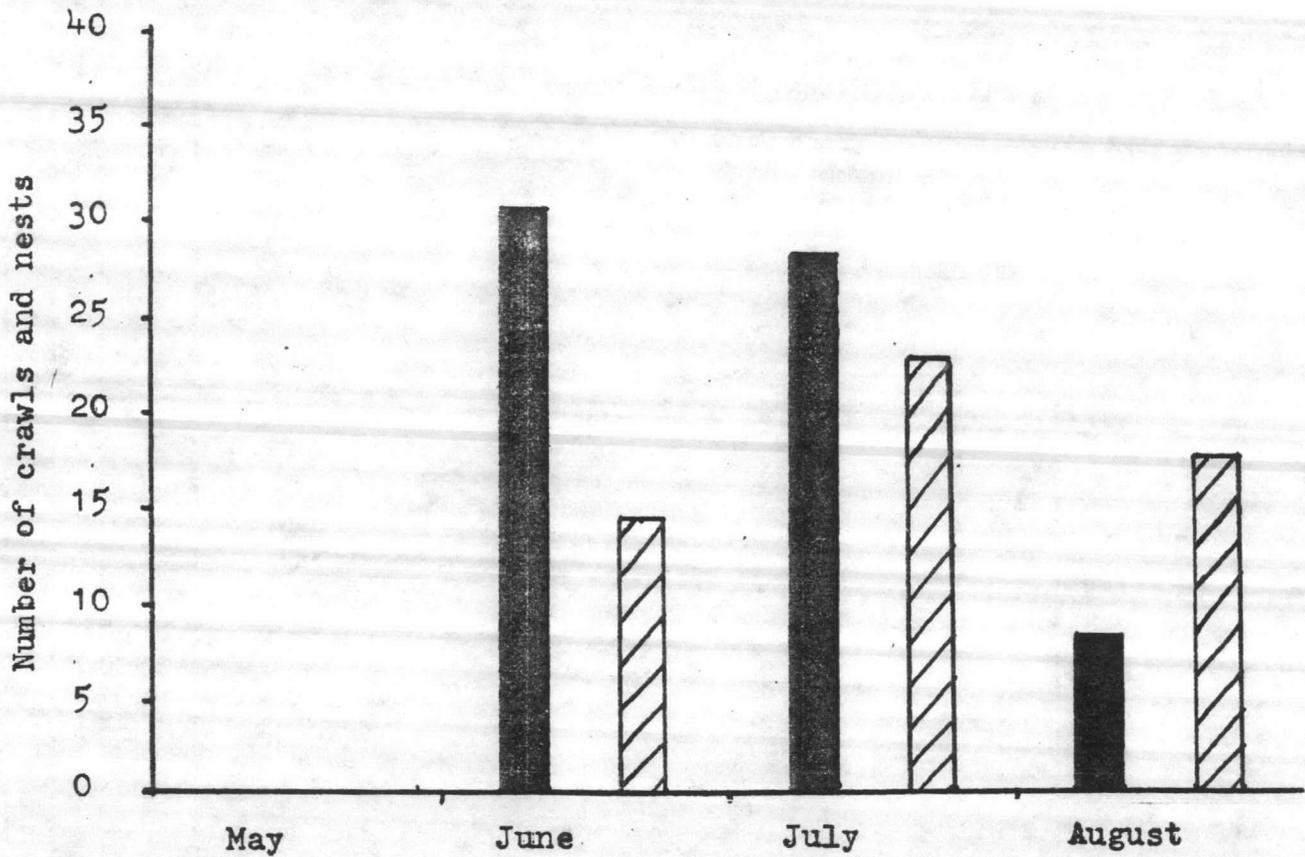
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season



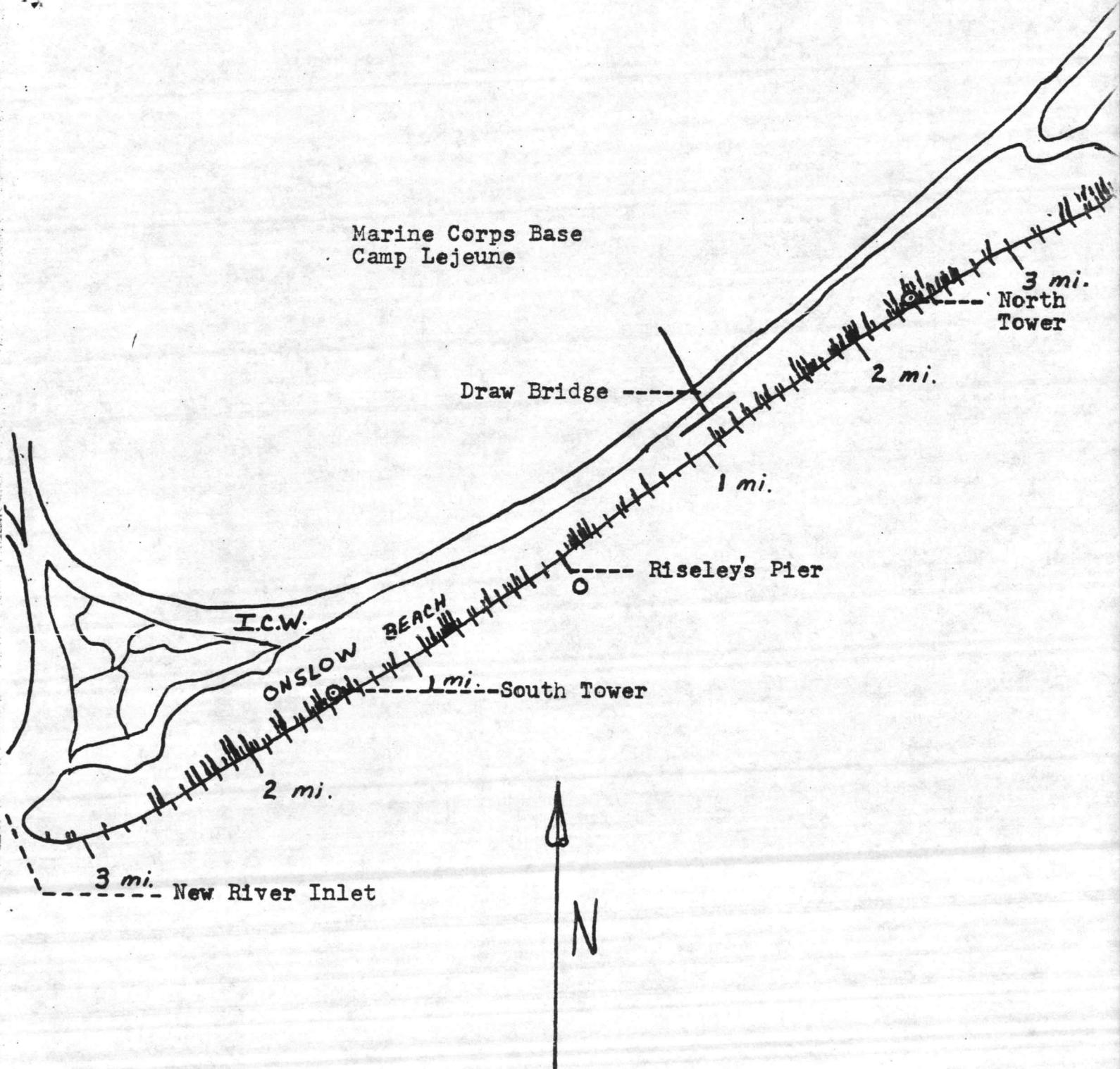
Total turtle crawls not including those that nested.

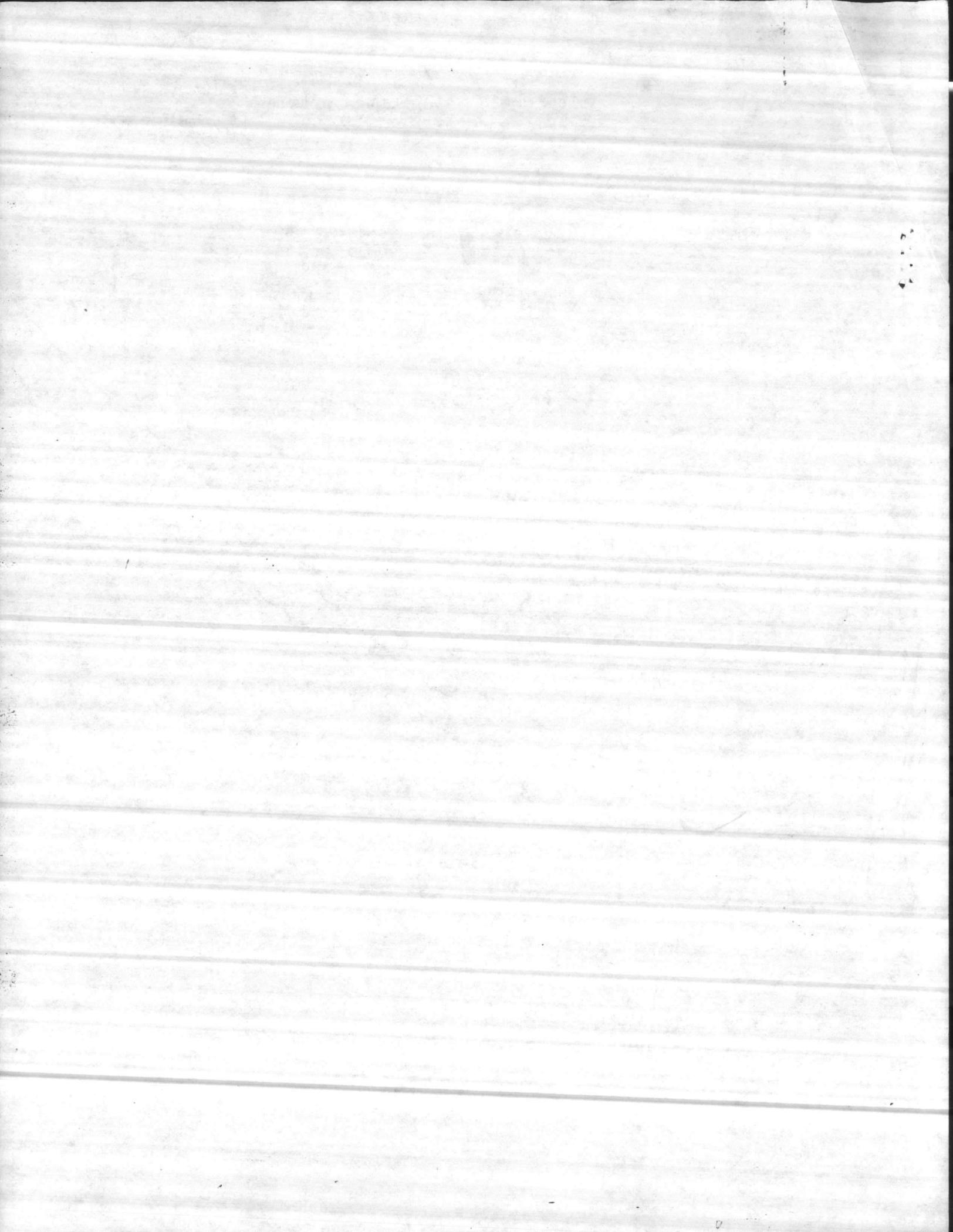


Total turtle nests.

Onslow Beach with Turtle Crawls  
and Turtle Nests Year 1979

— Crawls  
← Nests





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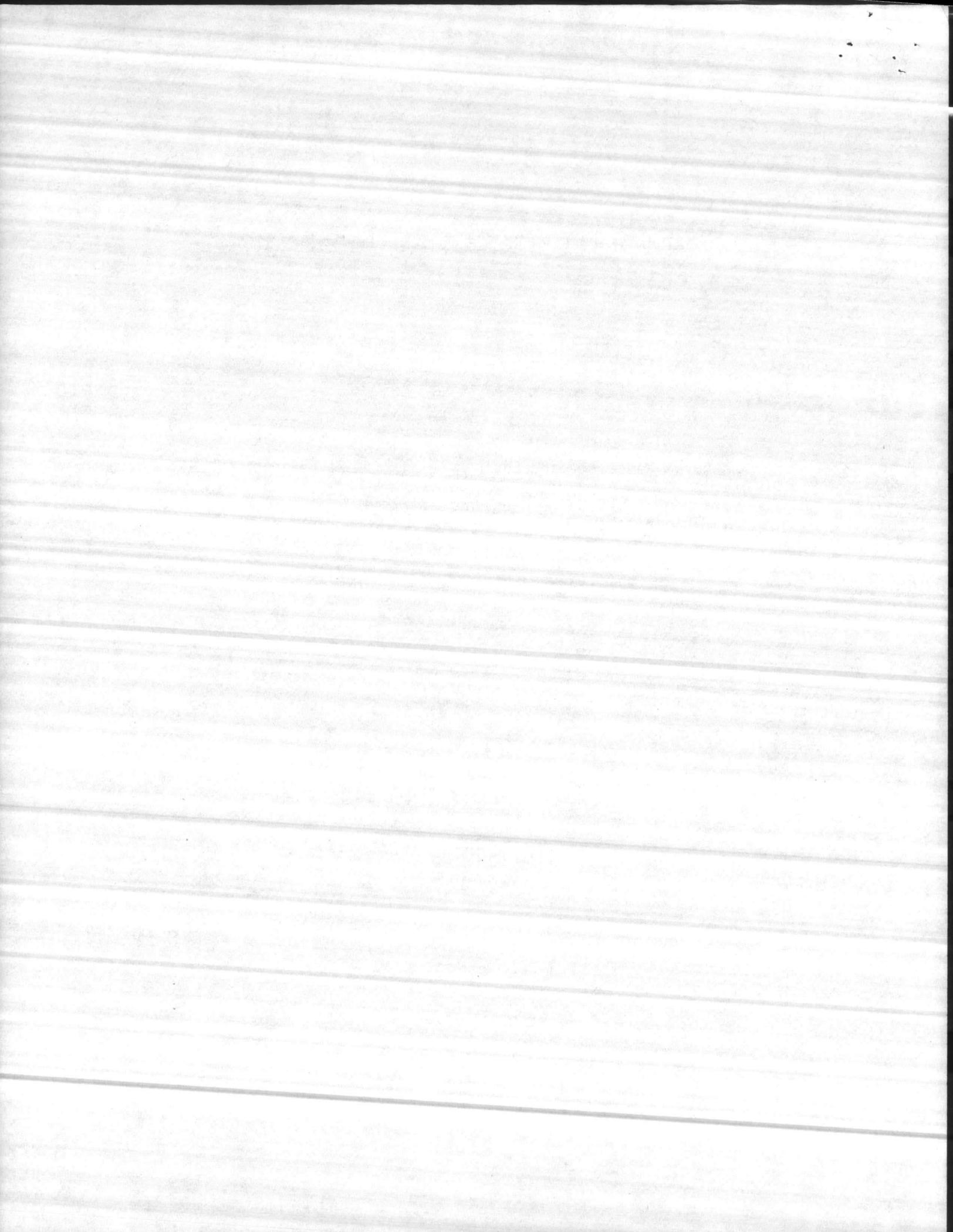
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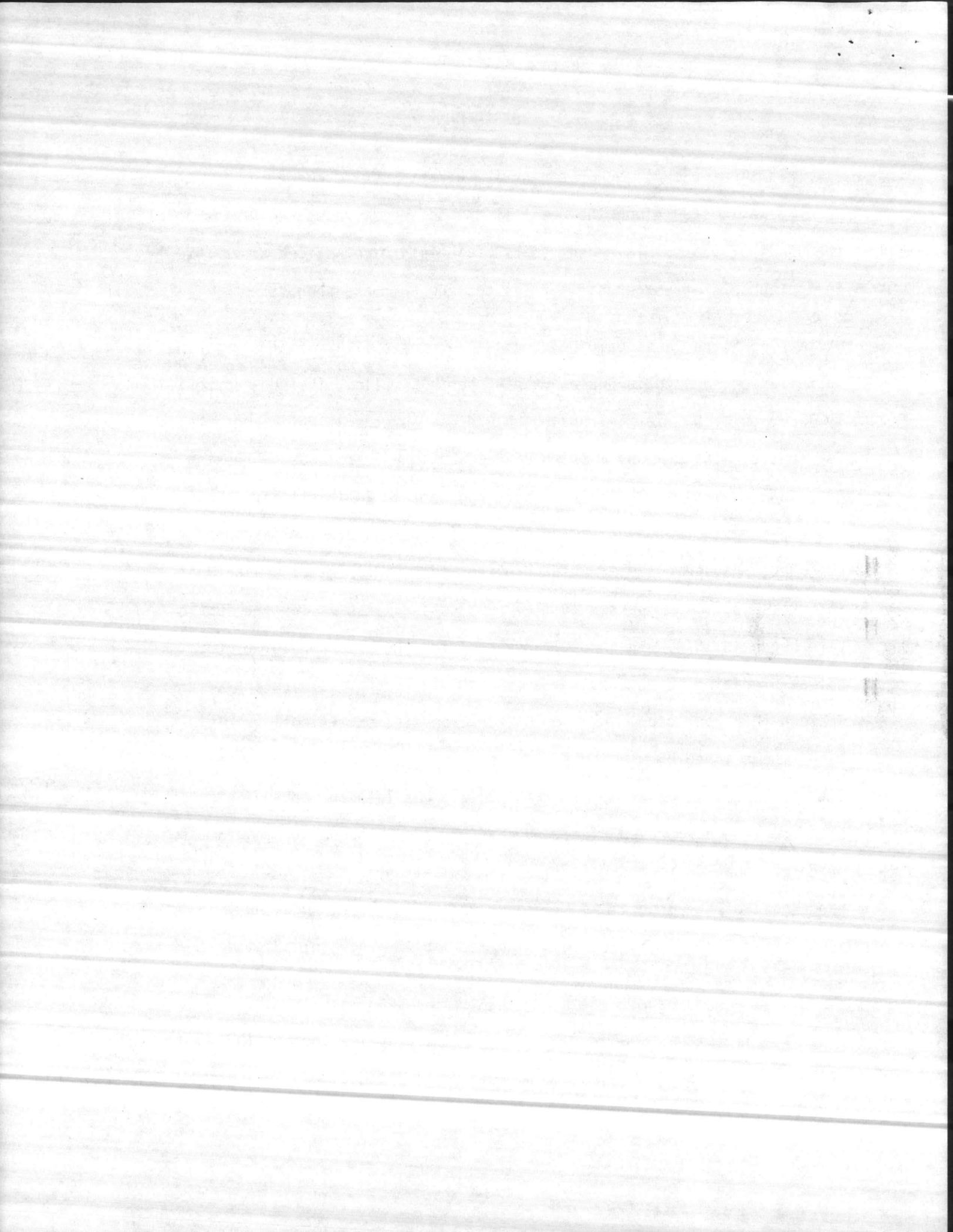


## BACKGROUND

The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

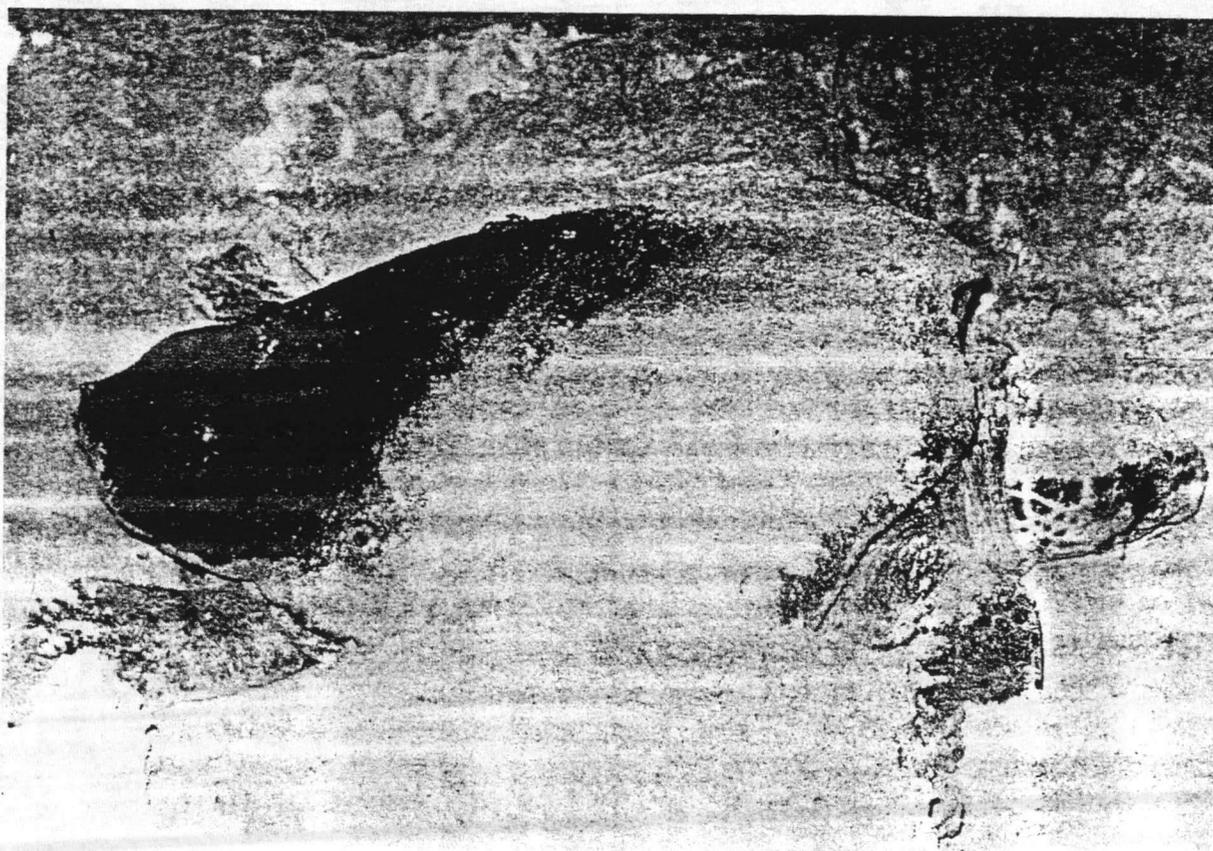
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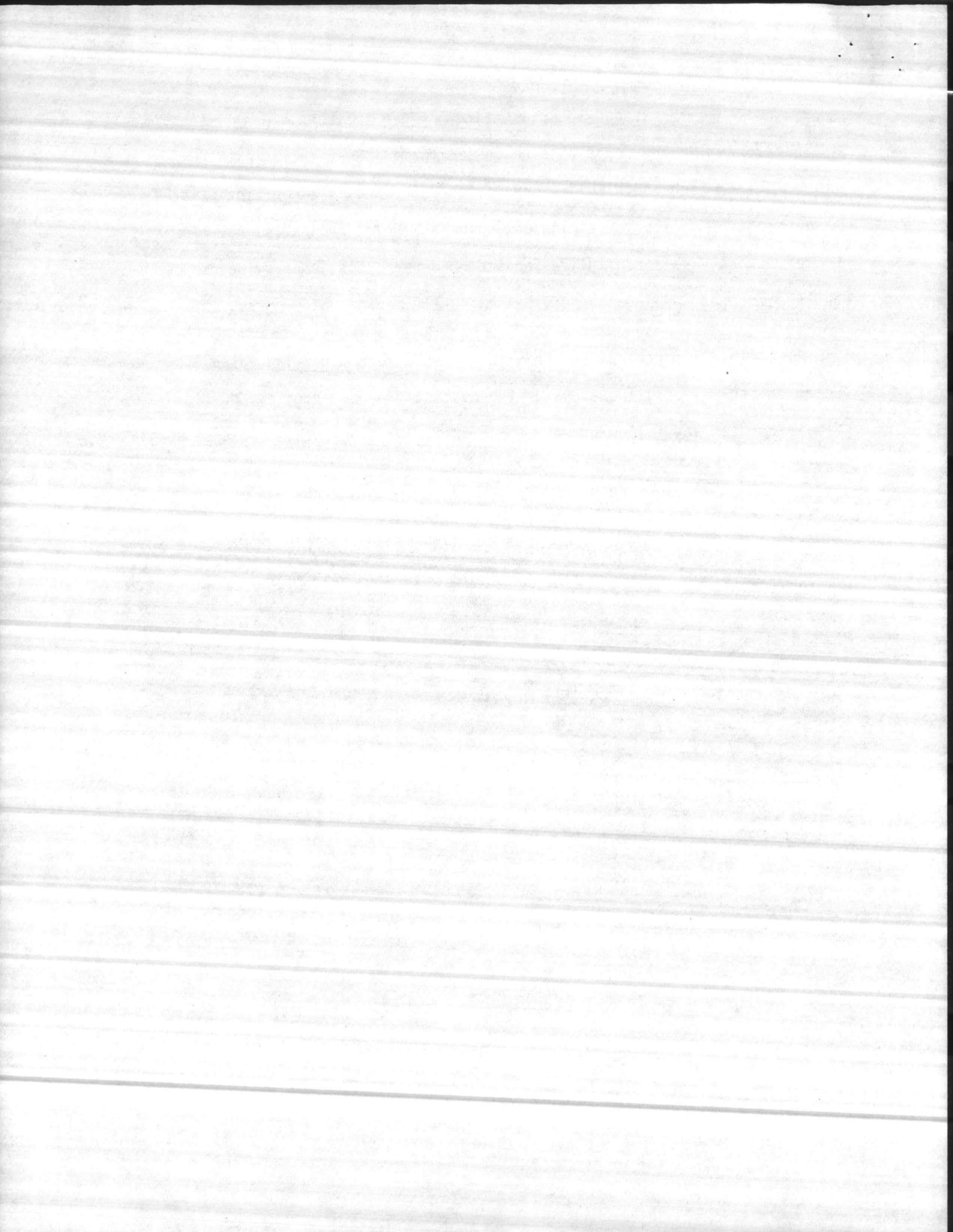
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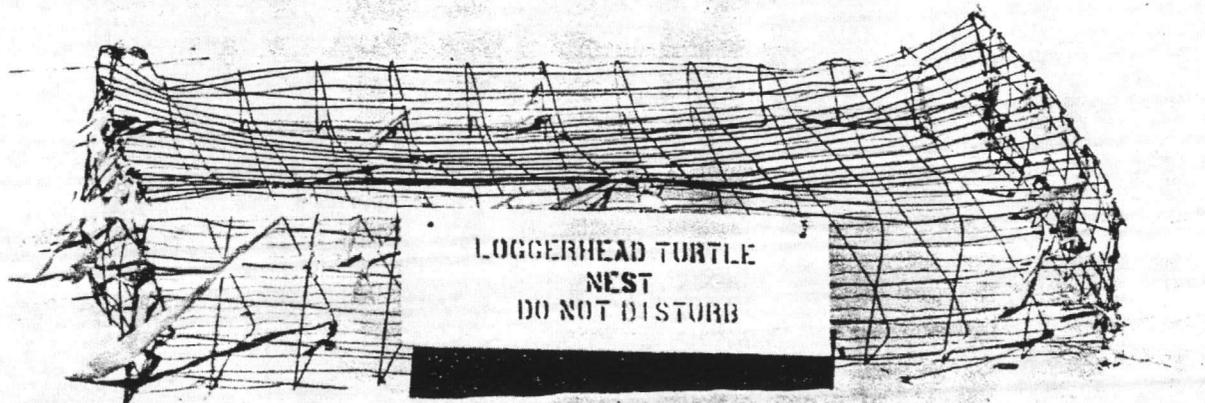
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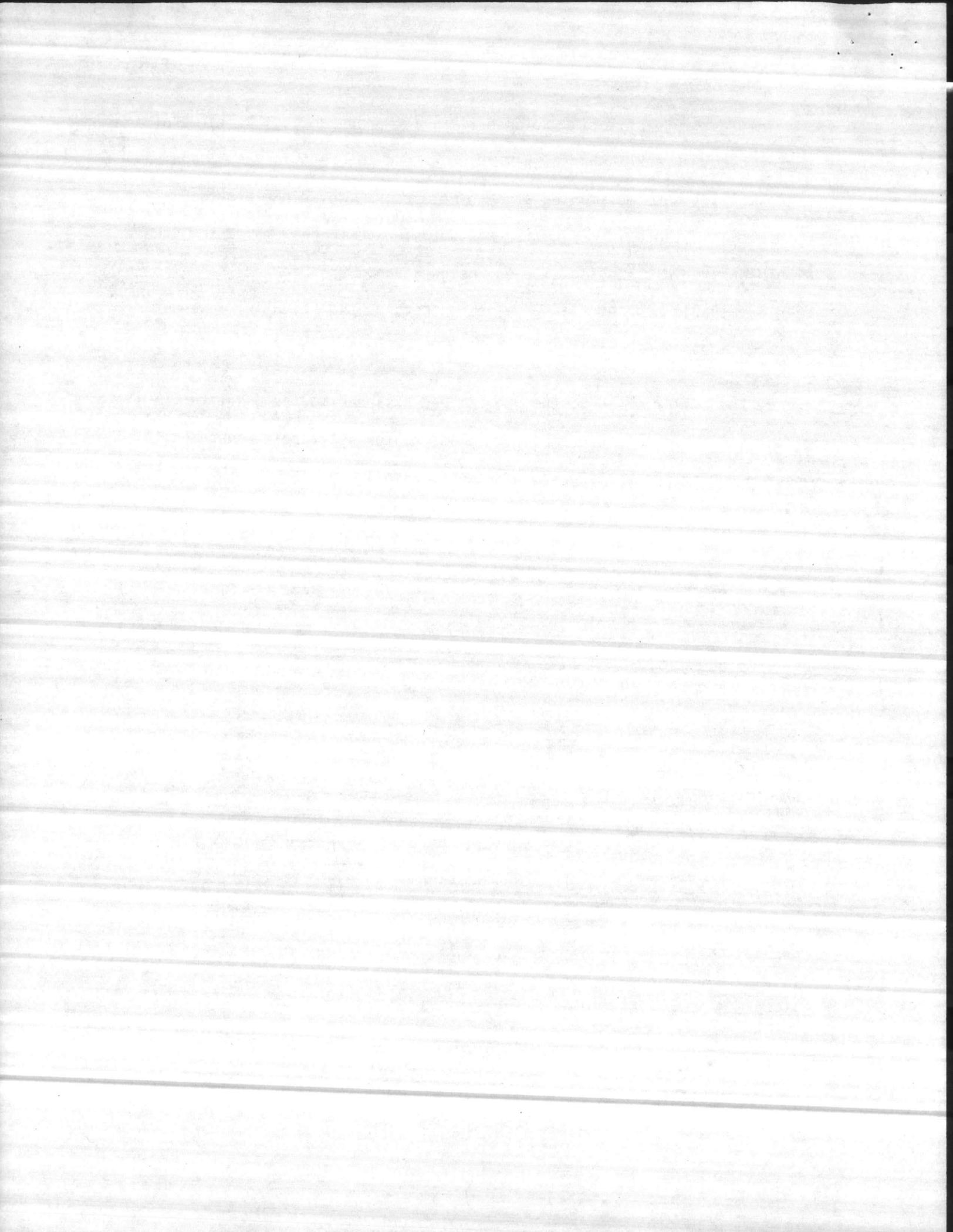




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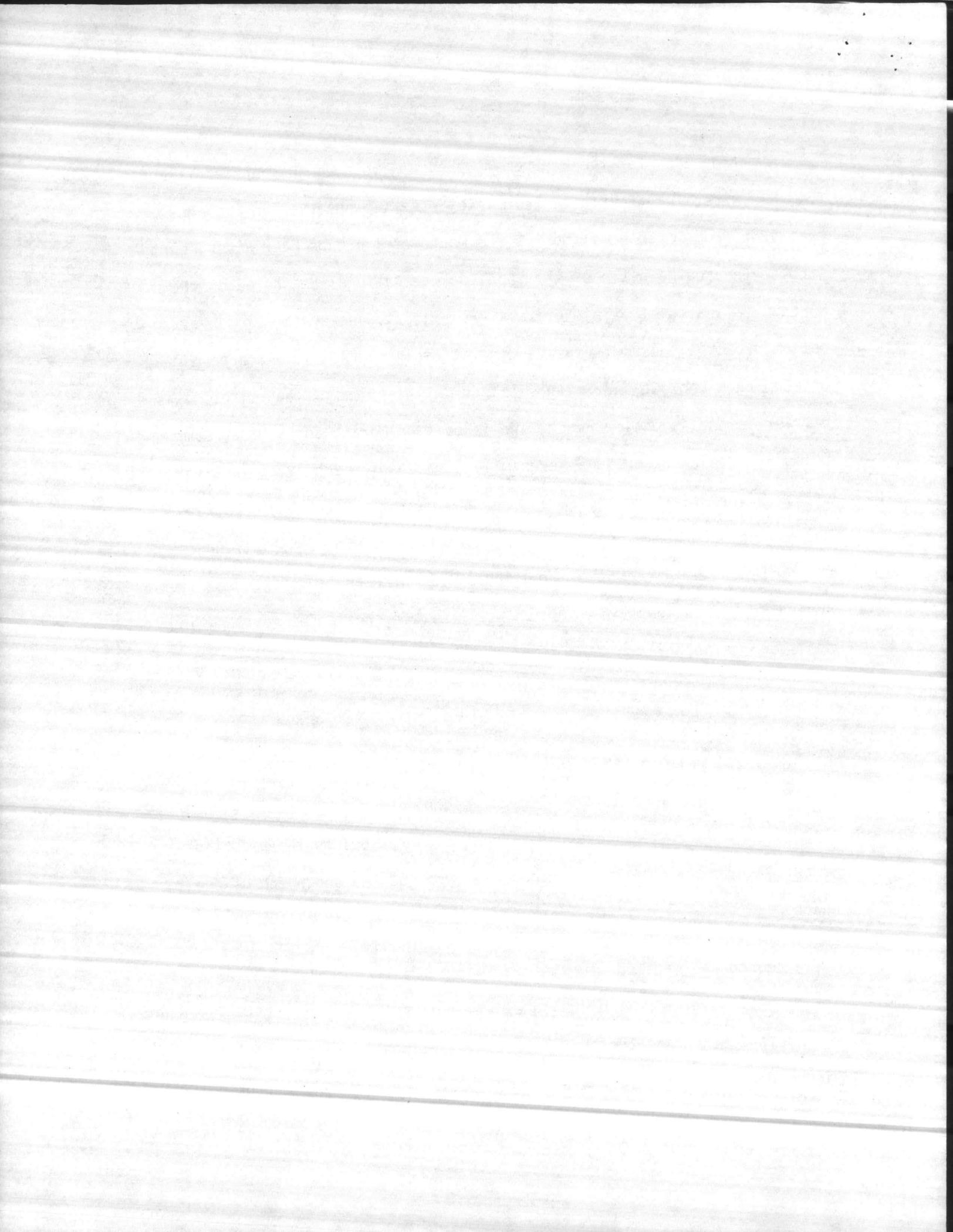
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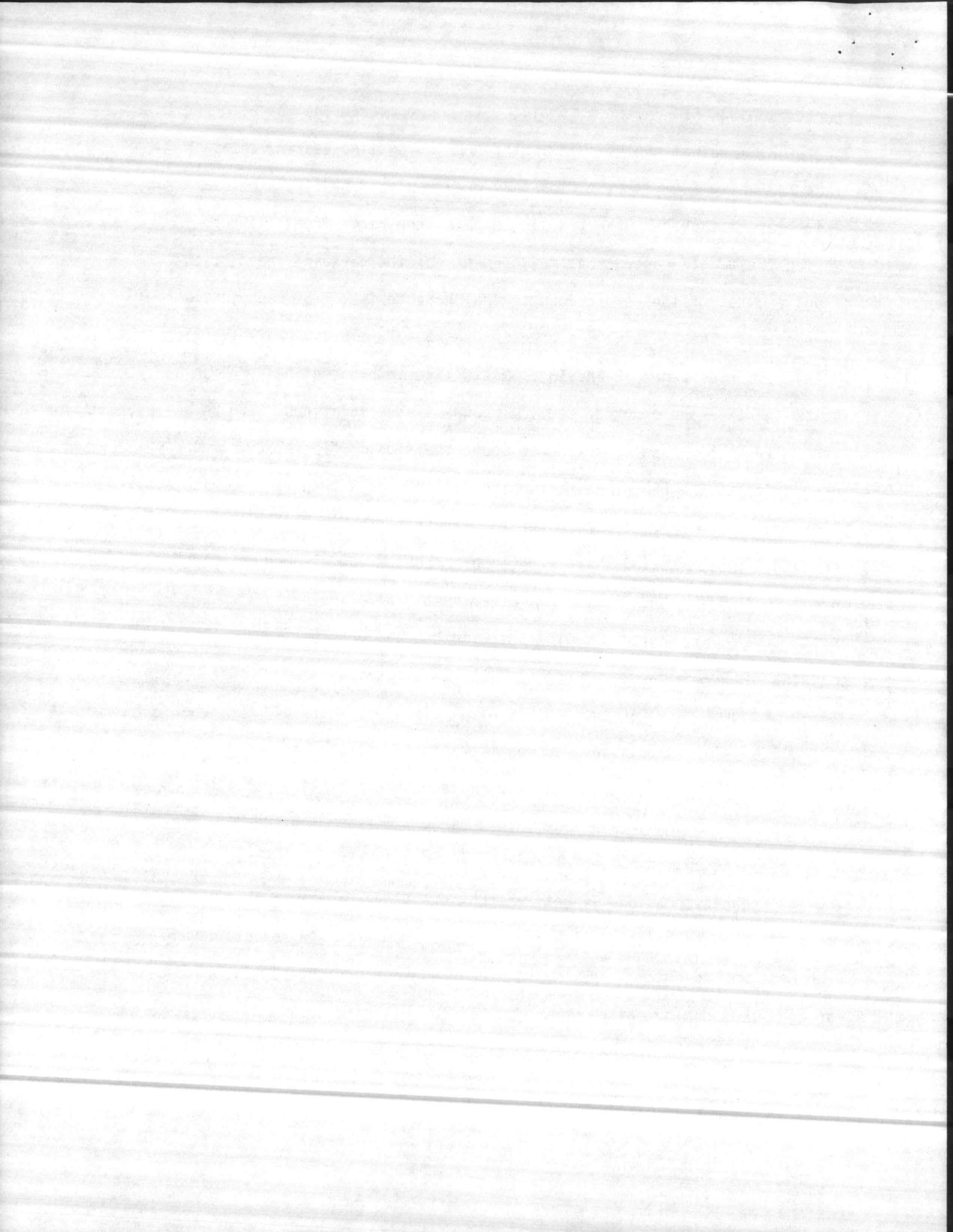
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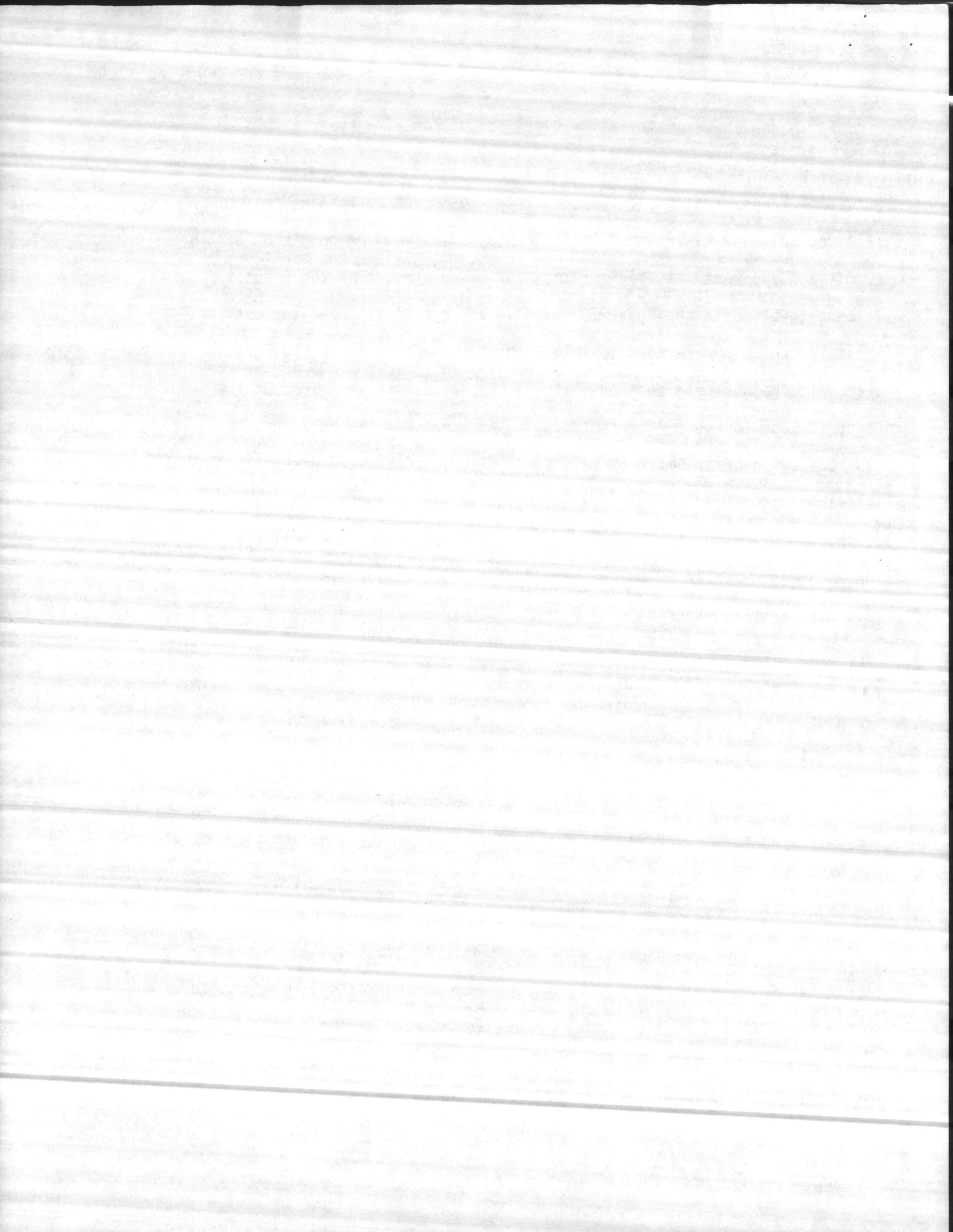
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successful nests had an incubation period of sixty days or more. A total of 7,077 eggs were counted from all nests, protected or removed, with a hatch-out of 4,037 for a year's success of 57% (Table III).

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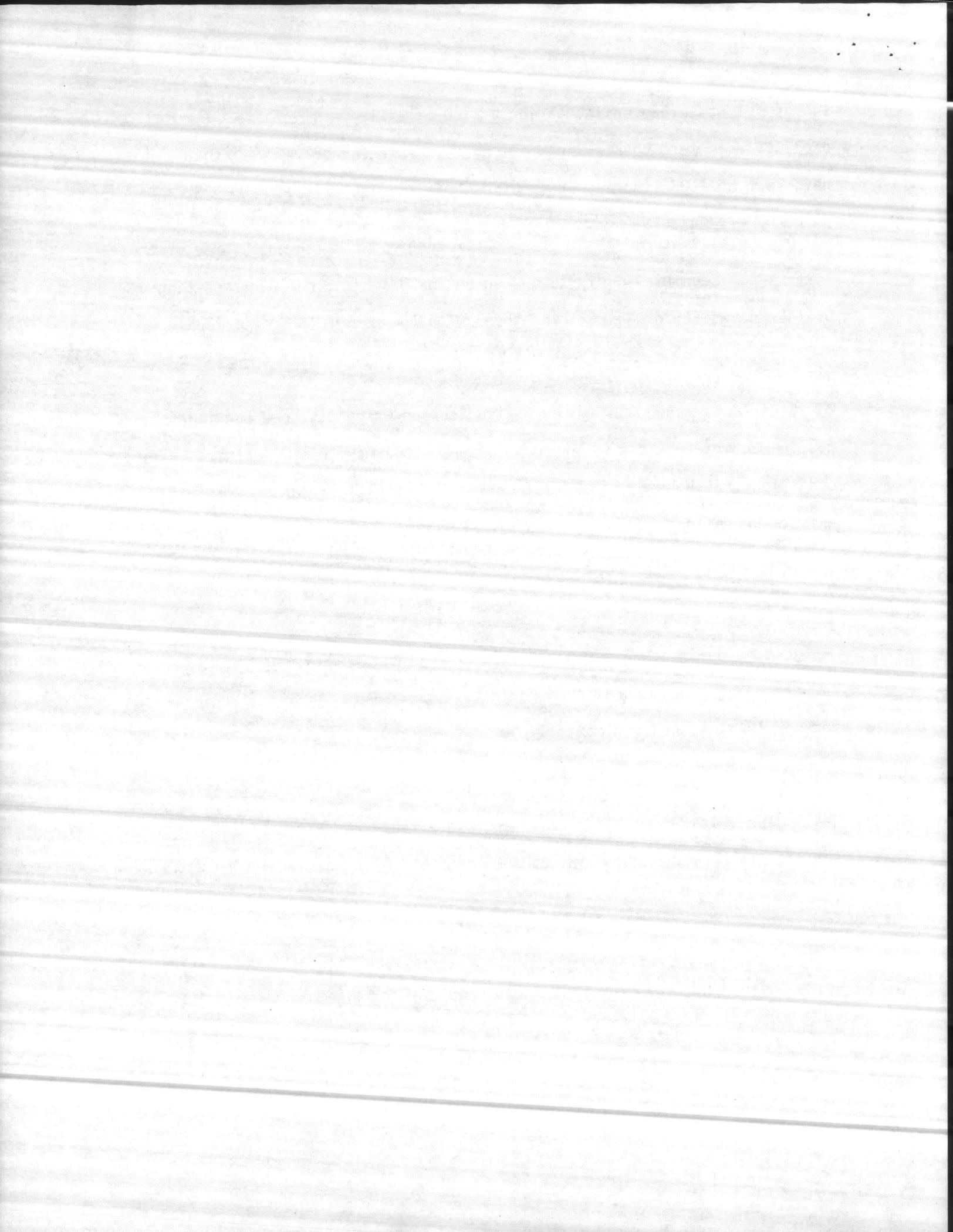
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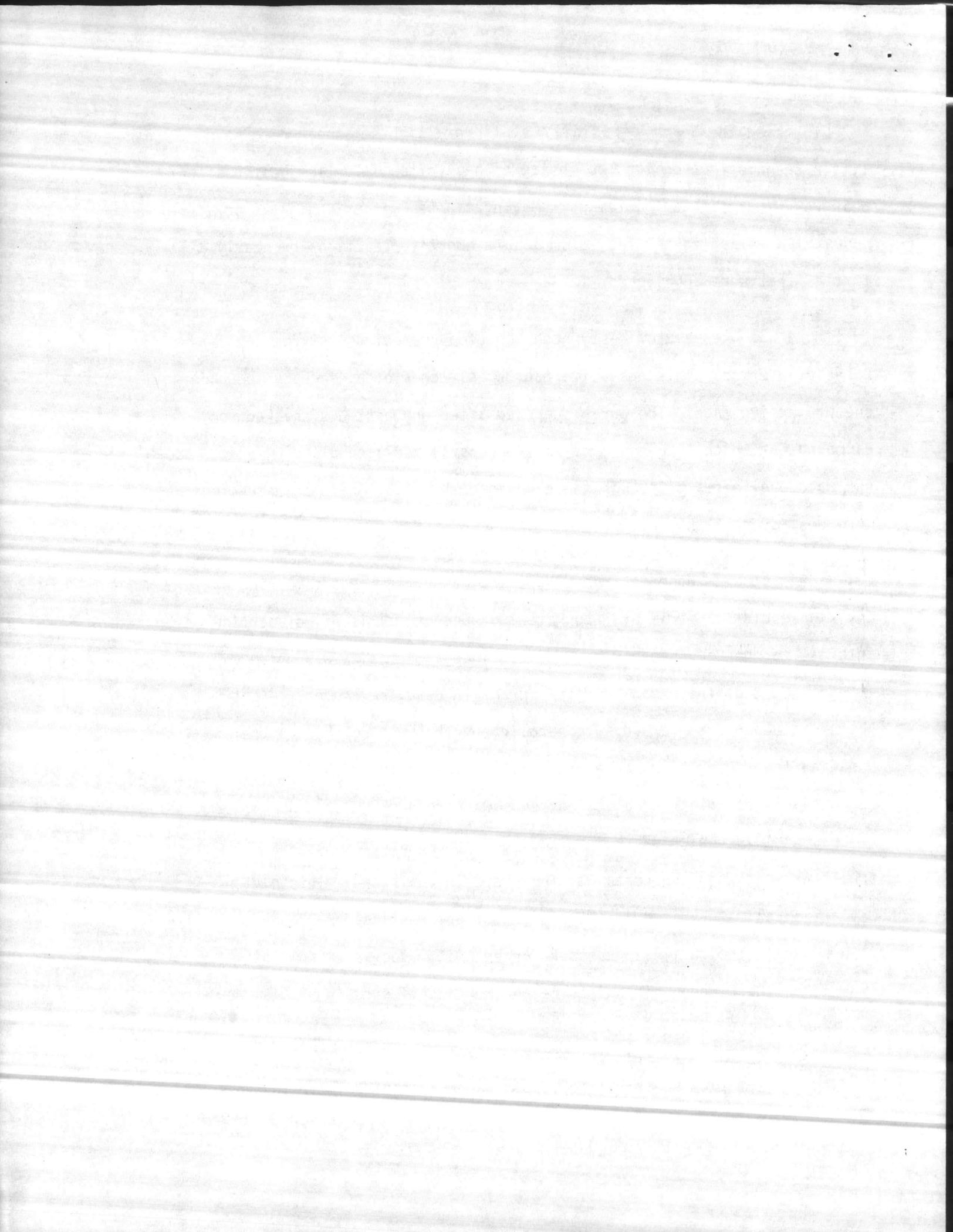


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There was one case of nest predation of a protected nest due to technician error. This nest site had two clutches of eggs deposited under one protective cage. The error occurred after one nest was checked for hatching, at which time the cage was improperly replaced allowing space for raccoons to reach through the cage into the nest. Fifteen hatchlings were destroyed in this case.

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artificially incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

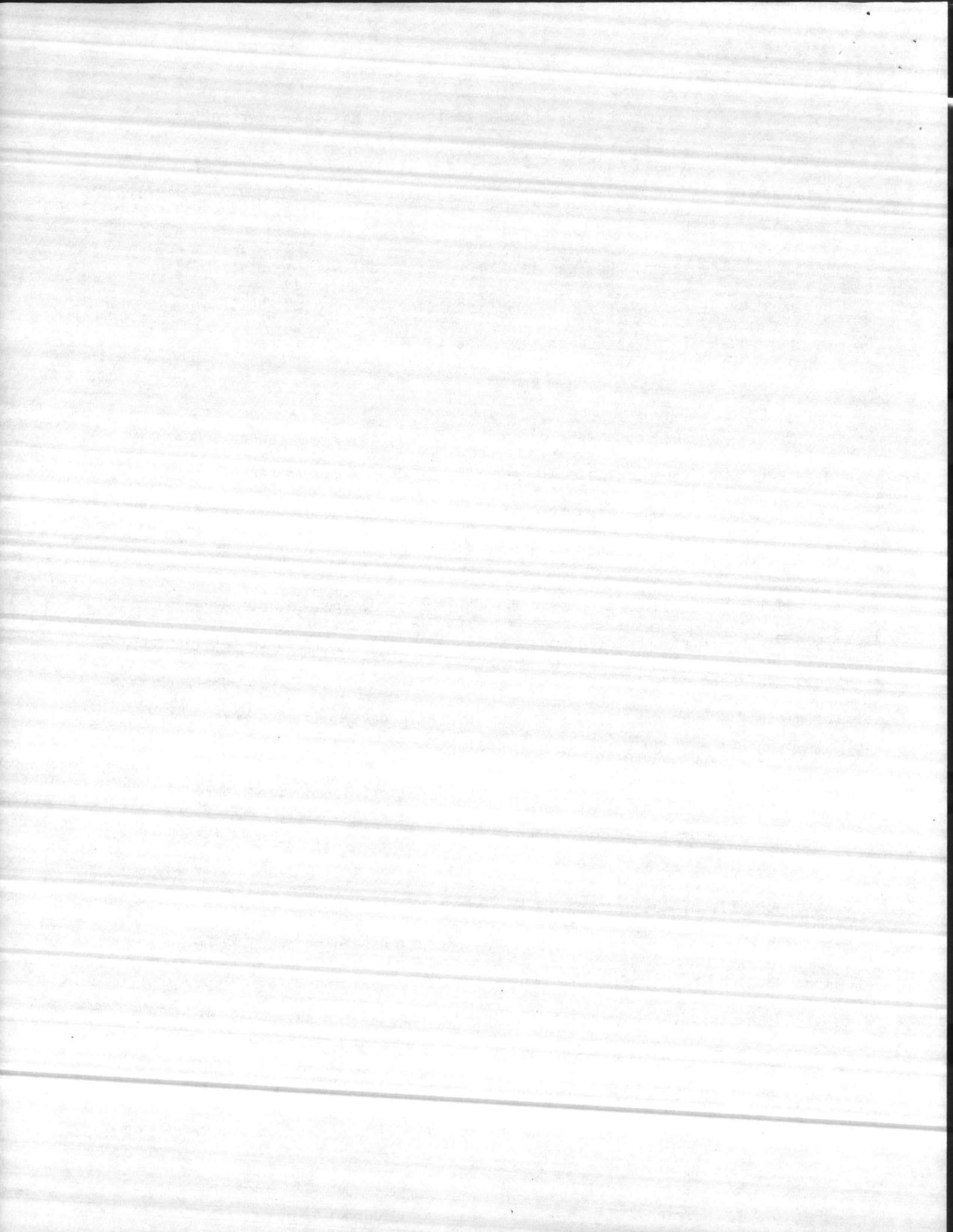
Nesting activity seemed to be determined by individual turtle cycles,



not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796, later tagged IMS 26 flipper tag. This turtle returned to the beach after 14 days (July 12 and July 26, 1979). The first clutch was laid on a rainy night at 2215 hours and contained 149 eggs. The second nest was laid on a fair night with good visibility but no moon at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time, and for each nesting the tide was near high.

Several unusual eggs were discovered during the study. Many subnormal size eggs were found. The most unusual eggs were a double and one triple yolk. Both these eggs were transported to IMS where they were artificially incubated. Neither of the unusual eggs hatched.

Hurricane David which passed through the study area in late August 1979 destroyed six nests, inundated six nests and deposited up to eighteen inches of sand over four of the inundated nests. The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. Nest of July 24, 1979 had 123 eggs hatch for 100% hatch out. Another nest, however, under nearly identical conditions and laid on the same day, had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm, no clear conclusions can be drawn. The nests that had sand deposited over them by the storm would have failed completely without human intervention. One nest of 150 eggs laid on July 5, 1979 produced 101 hatchlings for 67.3% success. When this nest was entered, about eighteen inches of sand and matted sargassum weed were removed from



over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page . The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

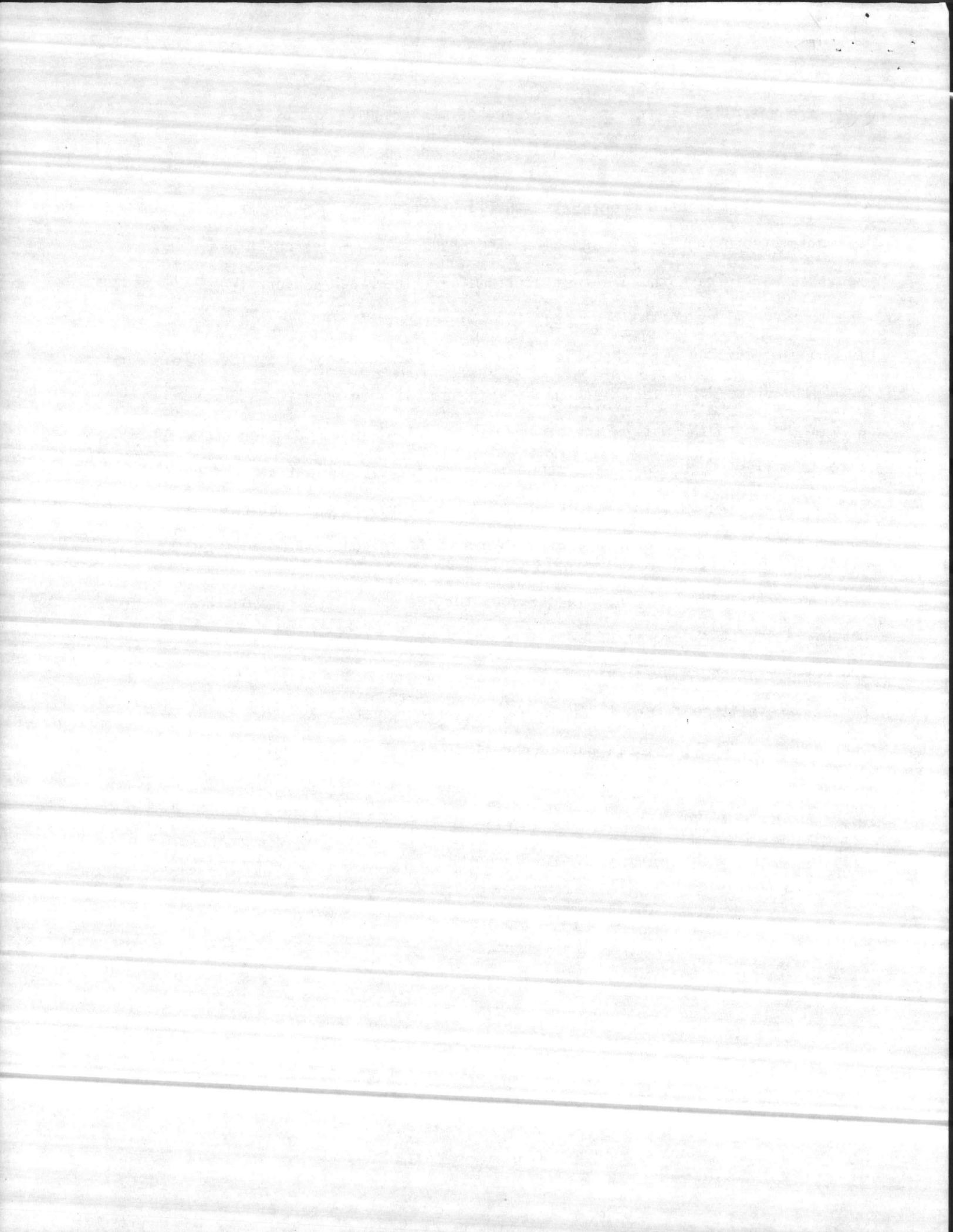


TABLE I

## GROUND SURVEY ONSLOW BEACH

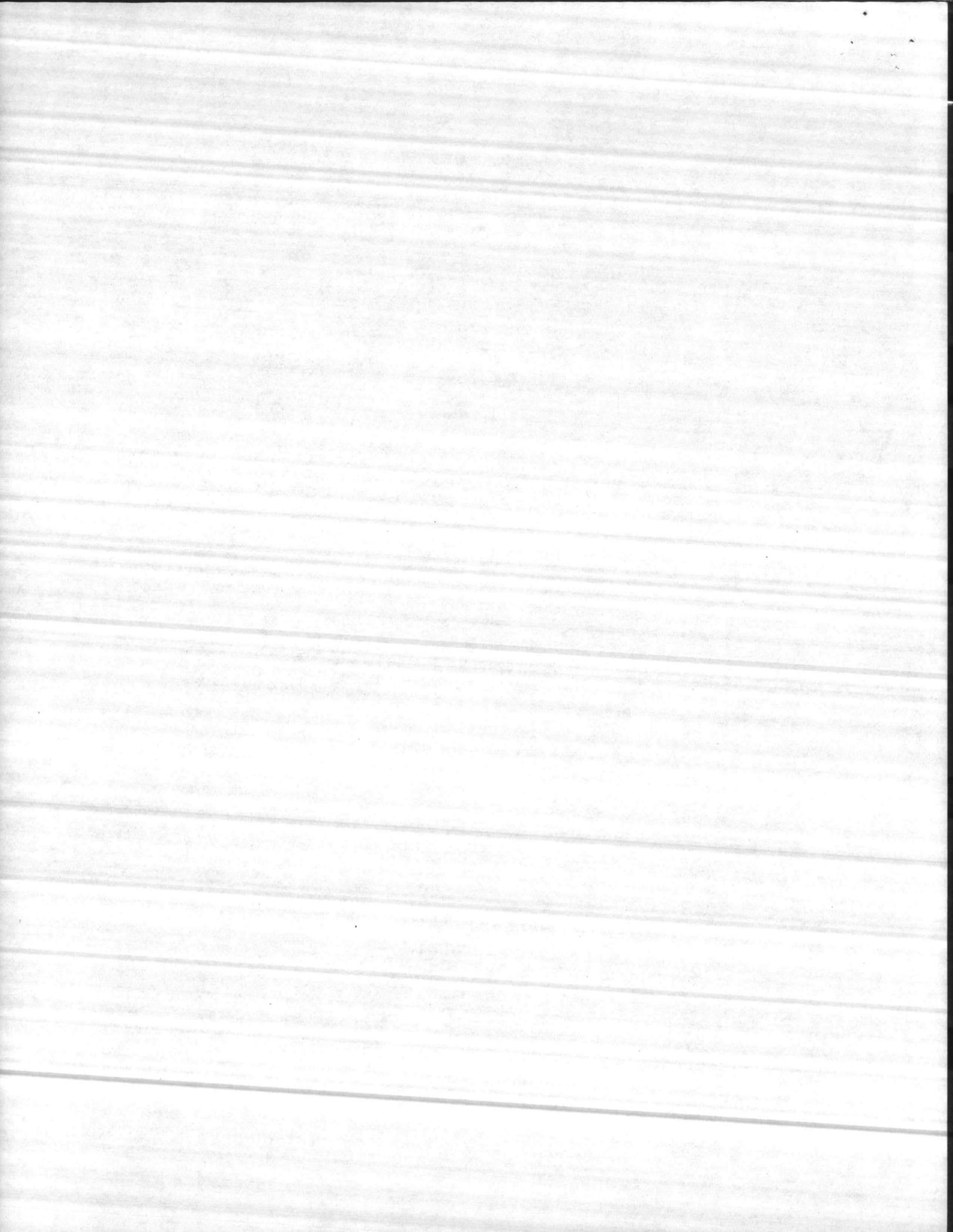
	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
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Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

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ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979.

Natural Resources and Environmental Affairs Division

Base Maintenance Department

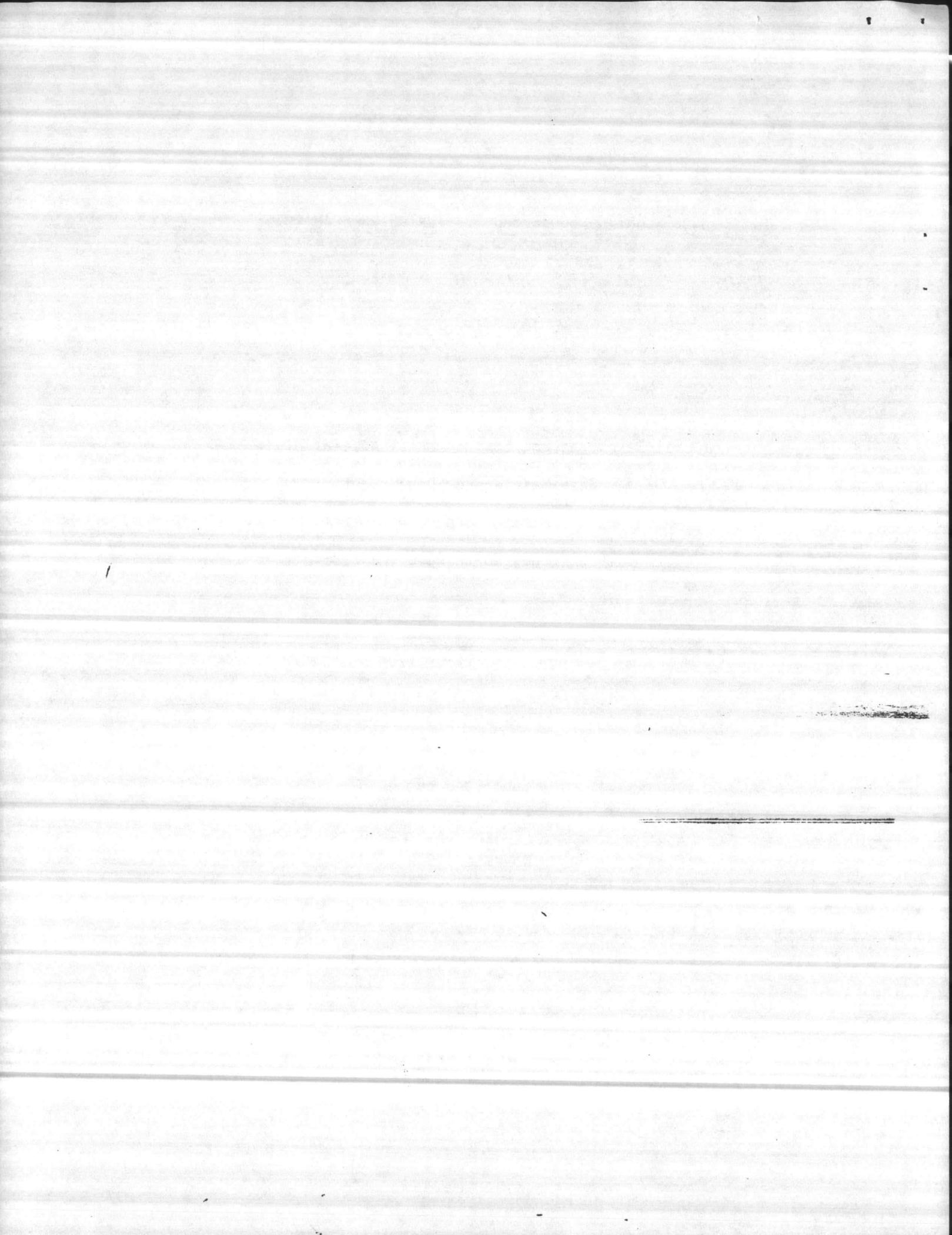
Marine Corps Base

Camp Lejeune, North Carolina 28542

Submitted by

Hugh R. Passingham

November 1979



## BACKGROUND

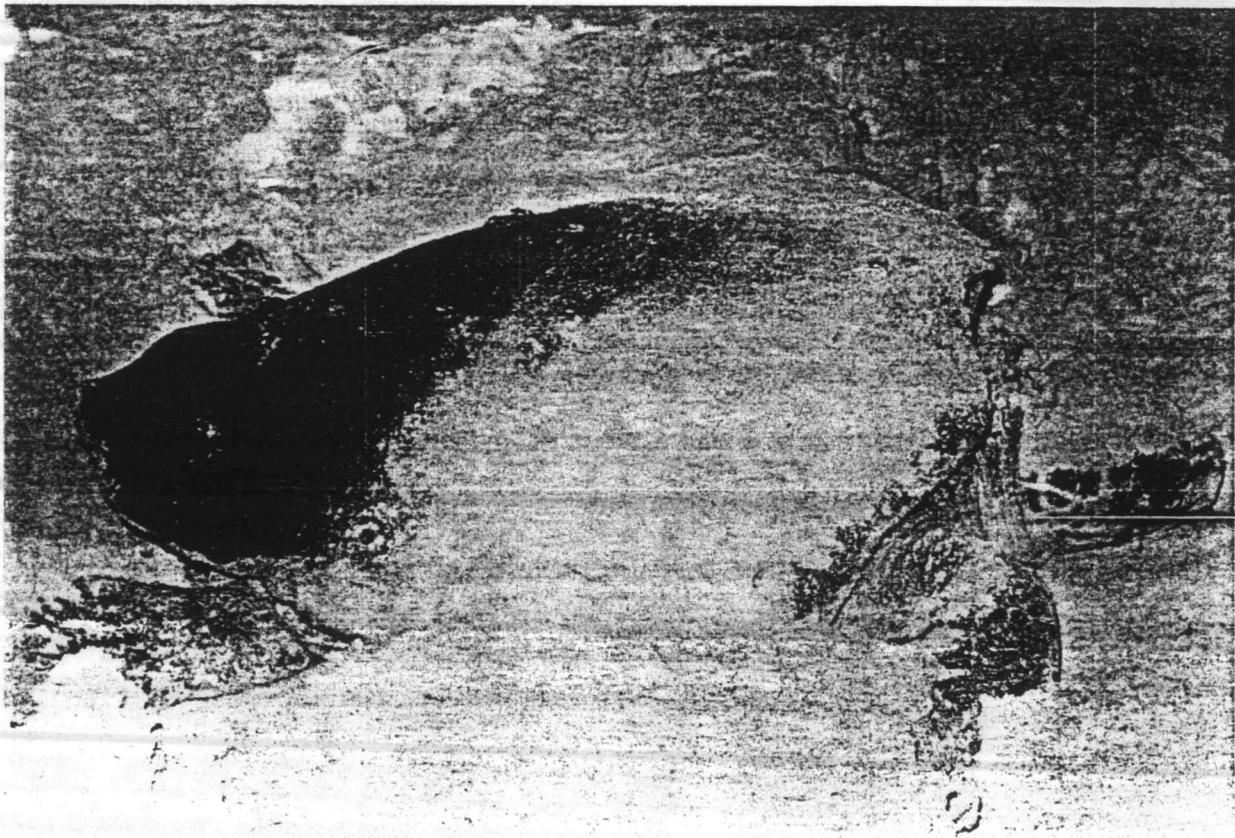
The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered

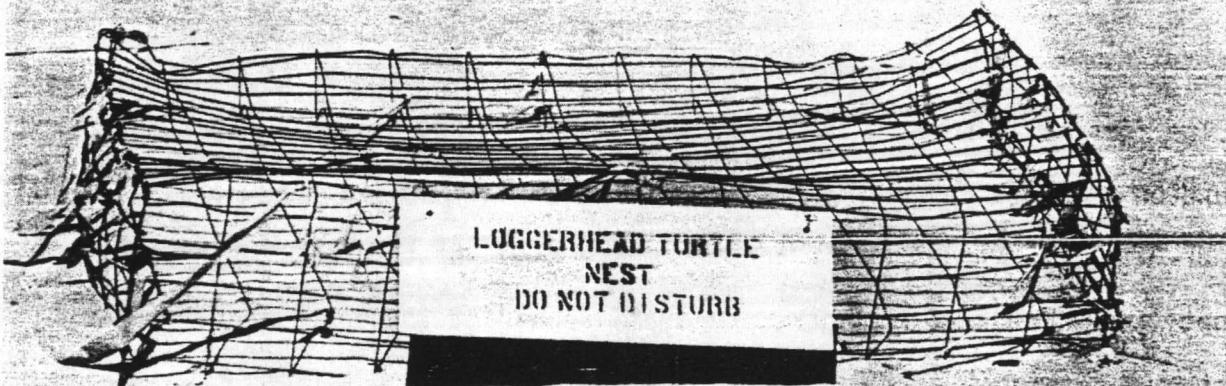
Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Browns Island. The United States Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and it's management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

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TABLE I

## GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
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TABLE II  
ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July									
	15		19		20		21		5		6		10*		11**		12***	
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N
Onslow Beach		5		2			3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3				2	2	5	6	5		
Hammock Beach			1	1		2		3				4		3				
Bogue Banks			1	1		1			1			2						
Shackleford Banks																		
Cape Lookout	1							1									2	1
Topsail Island	1	2			3	3				1	4		2	3	4	2		
1st Island																		1
Riches Island																	1	2
Figure 8 Island																		
Wrightsville Beach											1							
Masonborough Island																		
Carolina Beach											2							1
Smith Island										2	8						1	5

Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.

TABLE III  
SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
14	(1)	118	100	84.5
14	(2)	135	127	94.1
14		141	98	69.5
15		138	119	86.2
16	(2)	96	57	59.4
19	(2)	106	92	86.8
21	(2)	80	68	85.0
22		98	84	85.7
23		105	86	81.9
26	(2)	150	143	95.3
28	(2)	121	114	94.2
28		136	116	85.9
29	(3)	93	86	92.5
July 1	(1)	92	35	38.1
1	(2) (4)	113	2	1.8
1	(1)	121	68	72.7
2	(4)	121	0	0
3	(2)	151	137	90.7
5	(2)	150	101	67.3
6		133	121	91.0
7	(5) (2)	146	133	91.1
9		108	86	79.6

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<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
July 9	(1)	106	101	95.3
12	(5)	109	103	94.5
12	(5)	149	136	91.3
14	(6)	150	0	0
17	(7) (5)	114	106	93.0
17	(5)	113	106	93.8
17	(4)	118	0	0
18	(1)	73	66	90.4
18	(4)	92	3	3.3
19	(2)	101	99	98.0
21	(3)	39	0	0
22	(4)	115	90	78.3
24	(1)	133	113	84.9
24	(2)	159	76	47.8
24	(4) (2)	123	123	100
26	(1)	156	24	15.4
31	(1)	123	122	99.2
Aug 1	(6) (2)	109	0	0
1	(8)	105		
1	(2) (6)	109	0	0
2	(2) (6)	92	0	0
2	(2) (6)	105	0	0
3	(2) (8)	99	14	14
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6	(8)	124	47	37.3
			14	

TABLE III  
SUMMARY OF NESTING ACTIVITIES AND SUCCESS

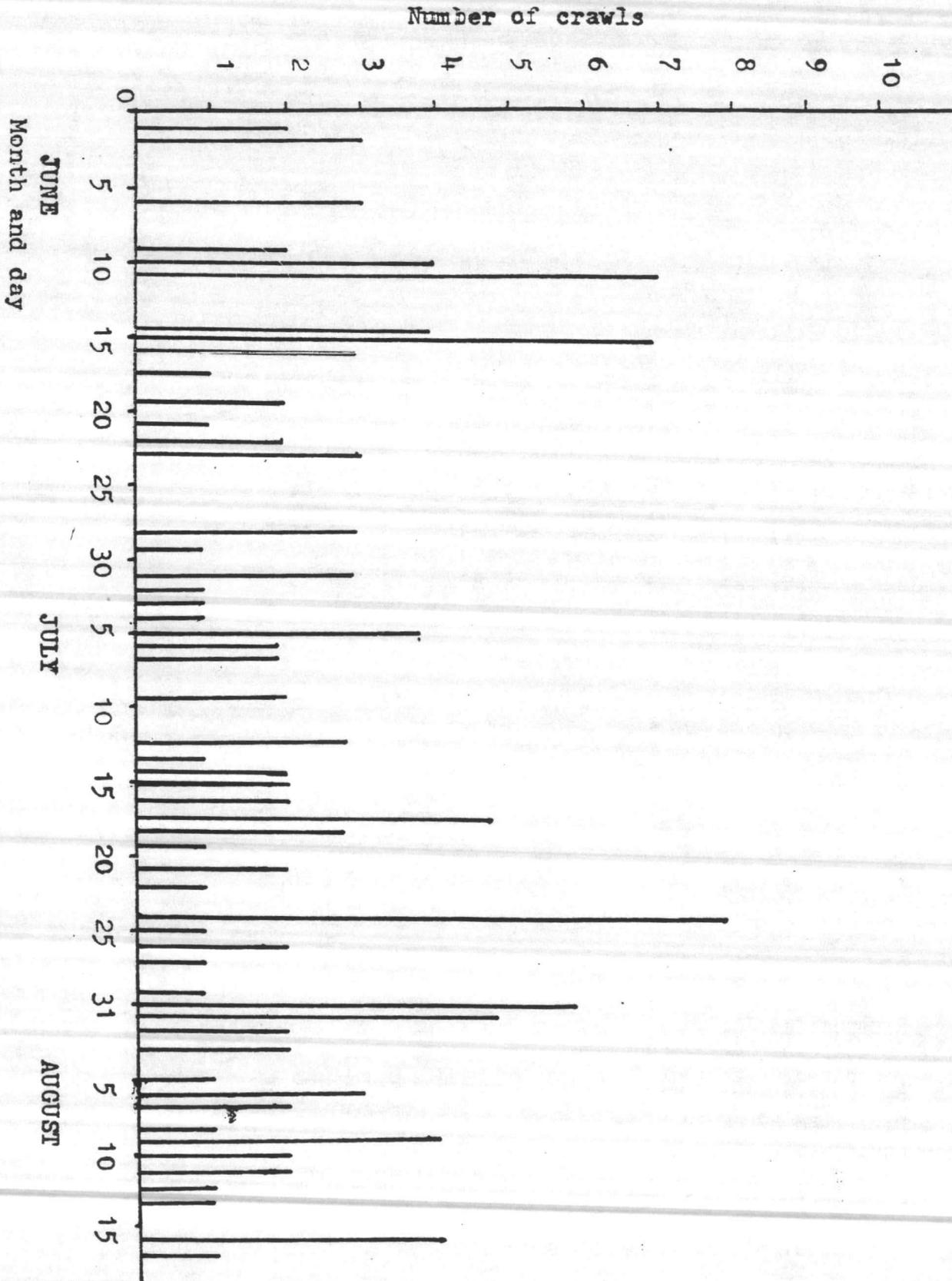
<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
Aug 7	(8)	156	8	5.3
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9	(8)	116	22	18.9
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Note:

- (1) - Removed for Headstart
- (2) - Redeposited Eggs
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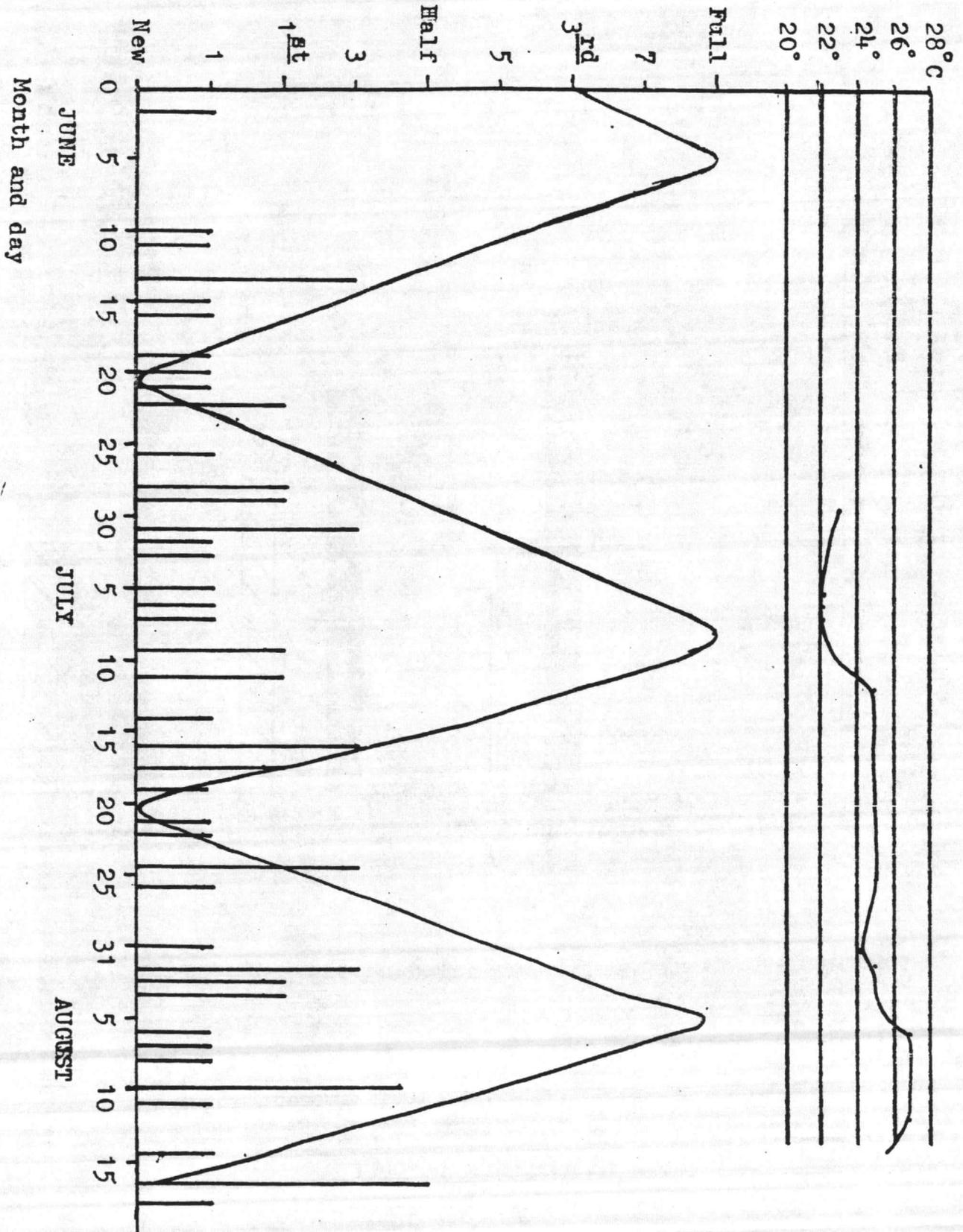
Graph 1

Turtle crawls including those that ended in nesting



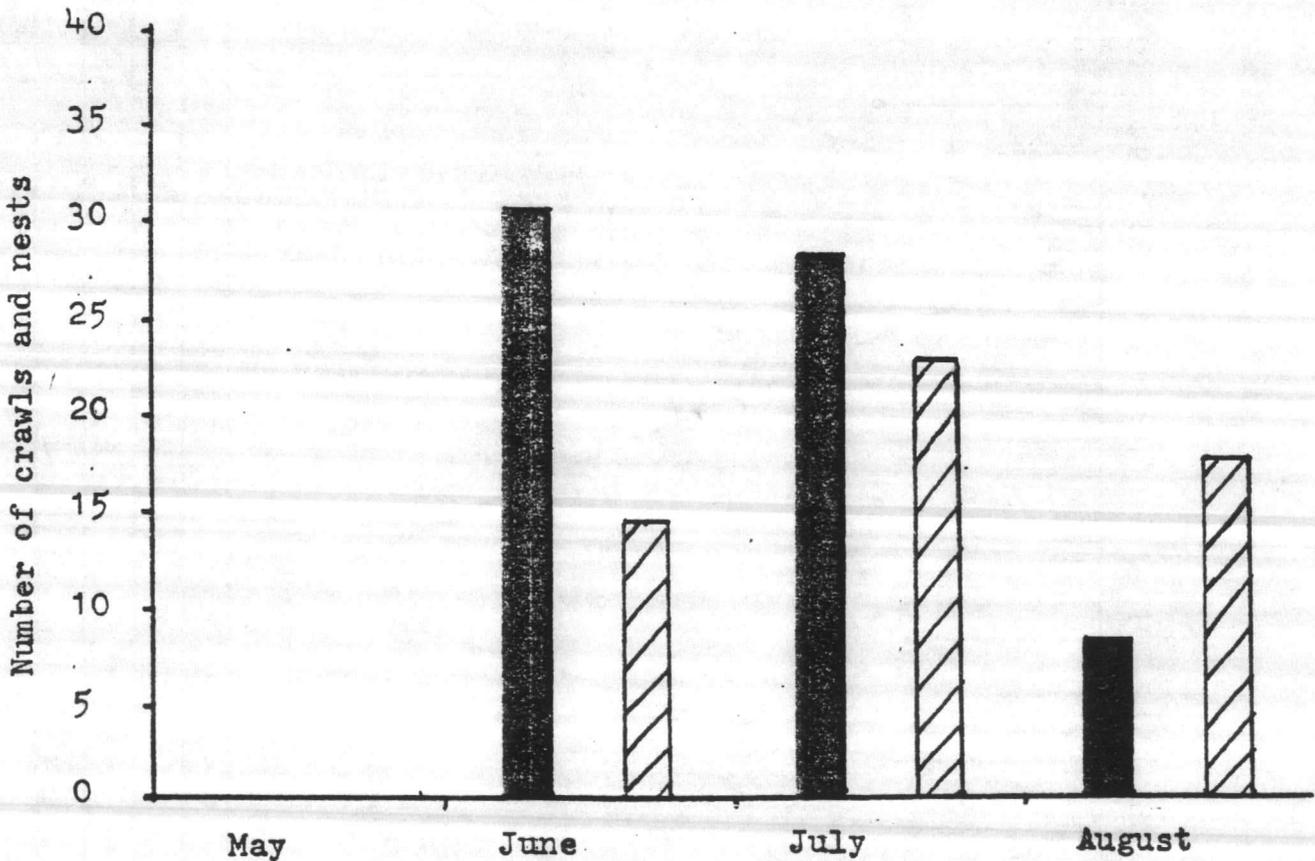
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season



Total turtle crawls not including those that nested.

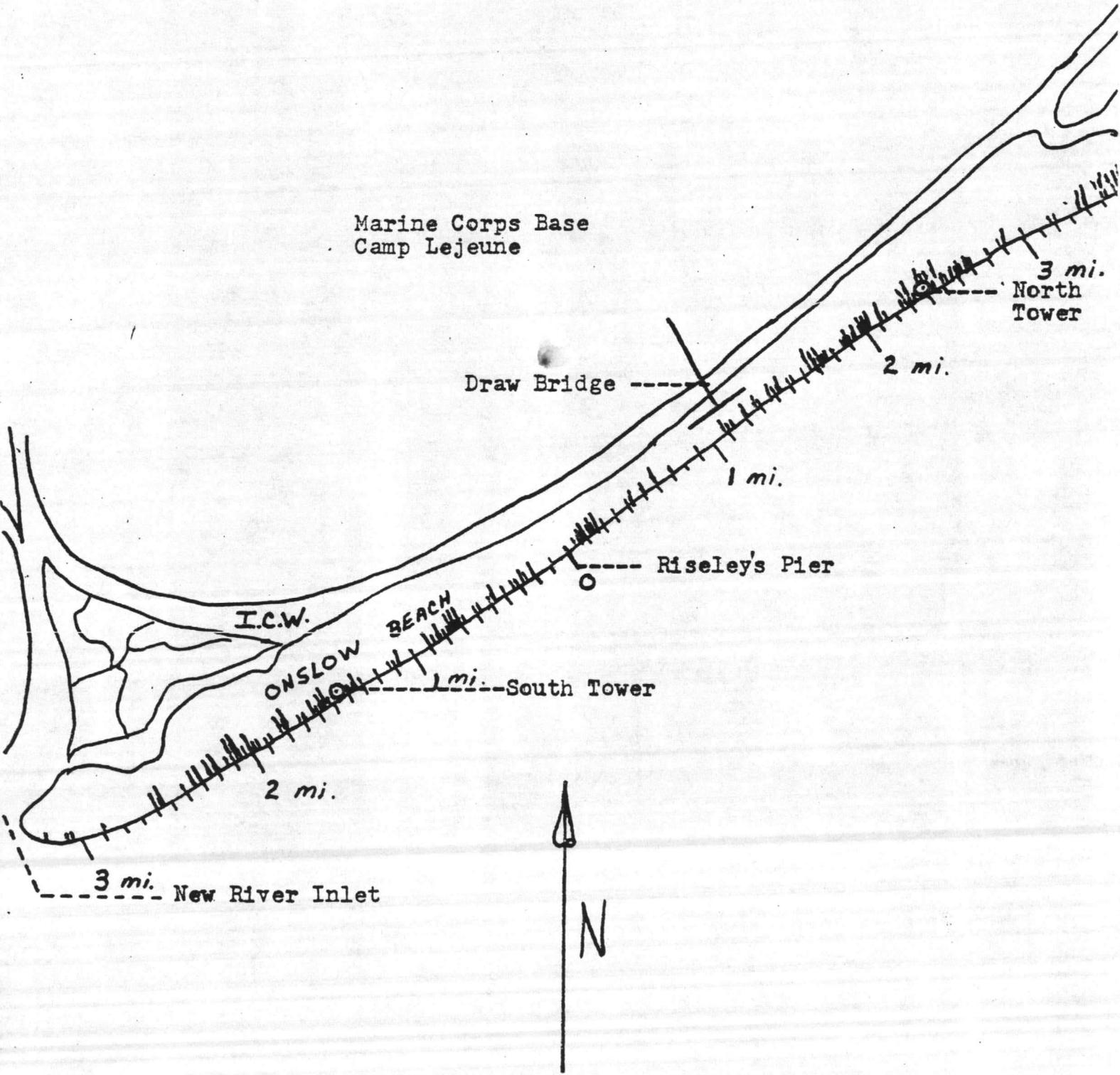


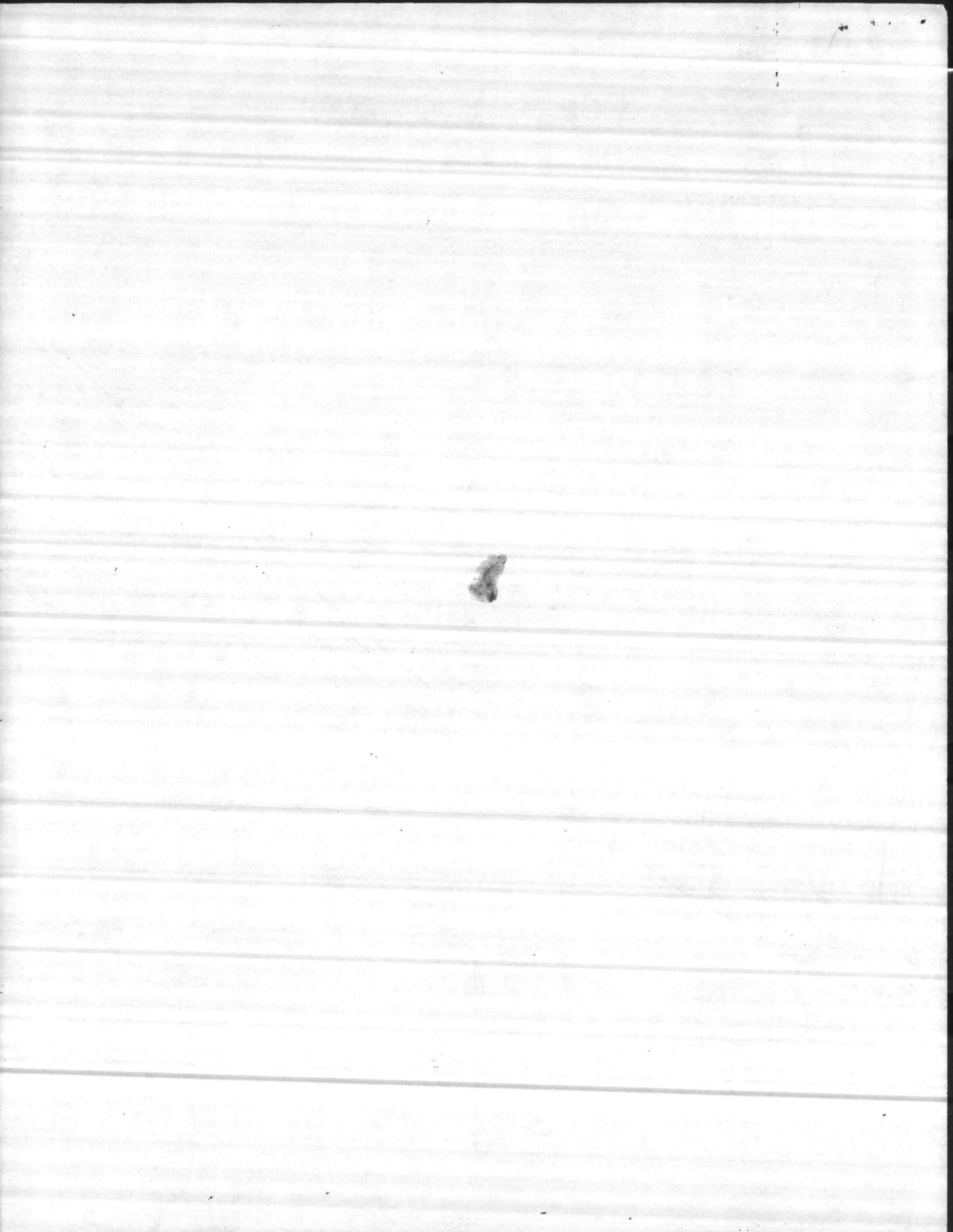
Total turtle nests.

Onslow Beach with Turtle Crawls  
and Turtle Nests Year 1979

- Crawls

← Nests





ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979..

Natural Resources and Environmental Affairs Division

Base Maintenance Department

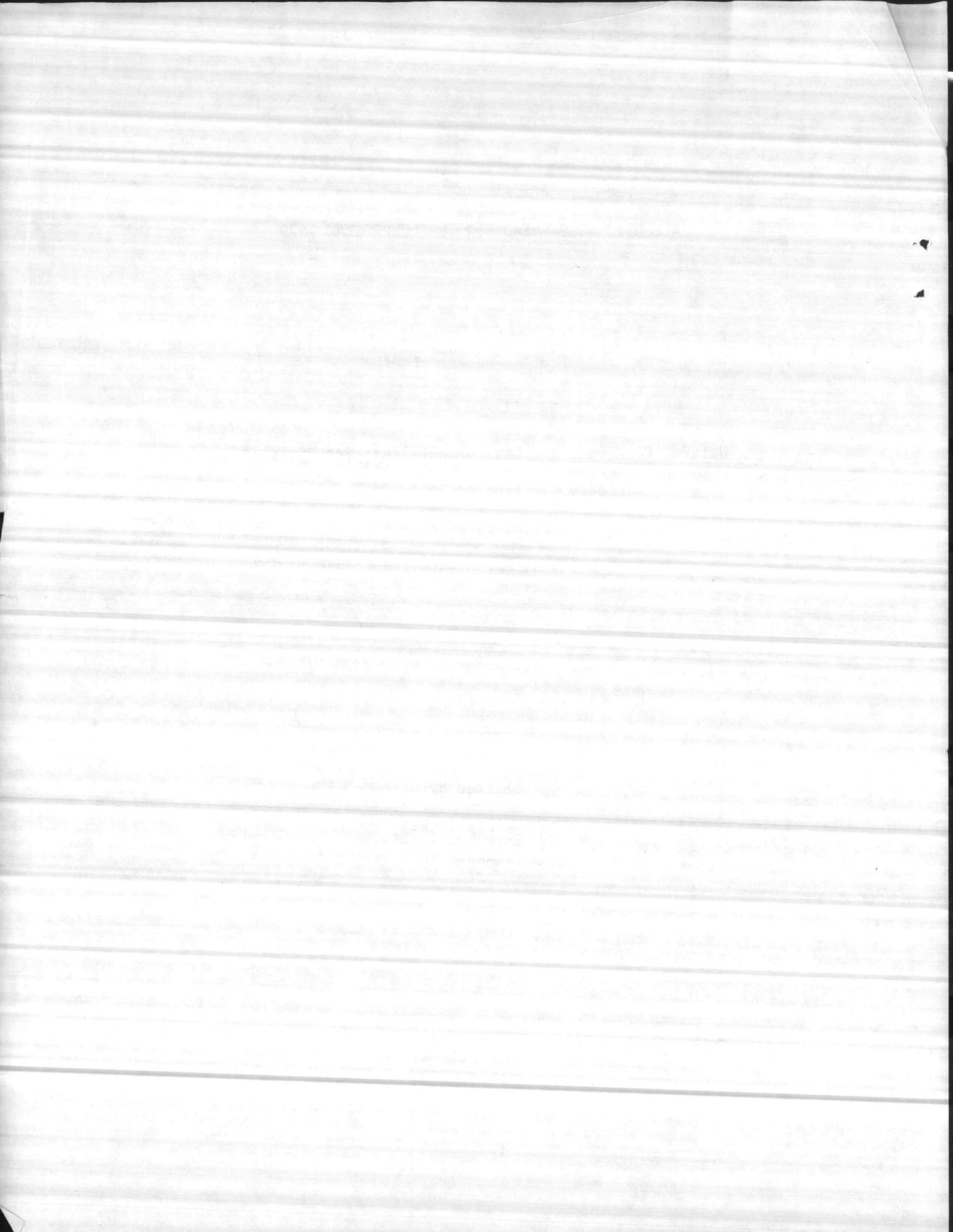
Marine Corps Base

Camp Lejeune, North Carolina 28542

Submitted by

Hugh R. Passingham

November 1979



## BACKGROUND

The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered

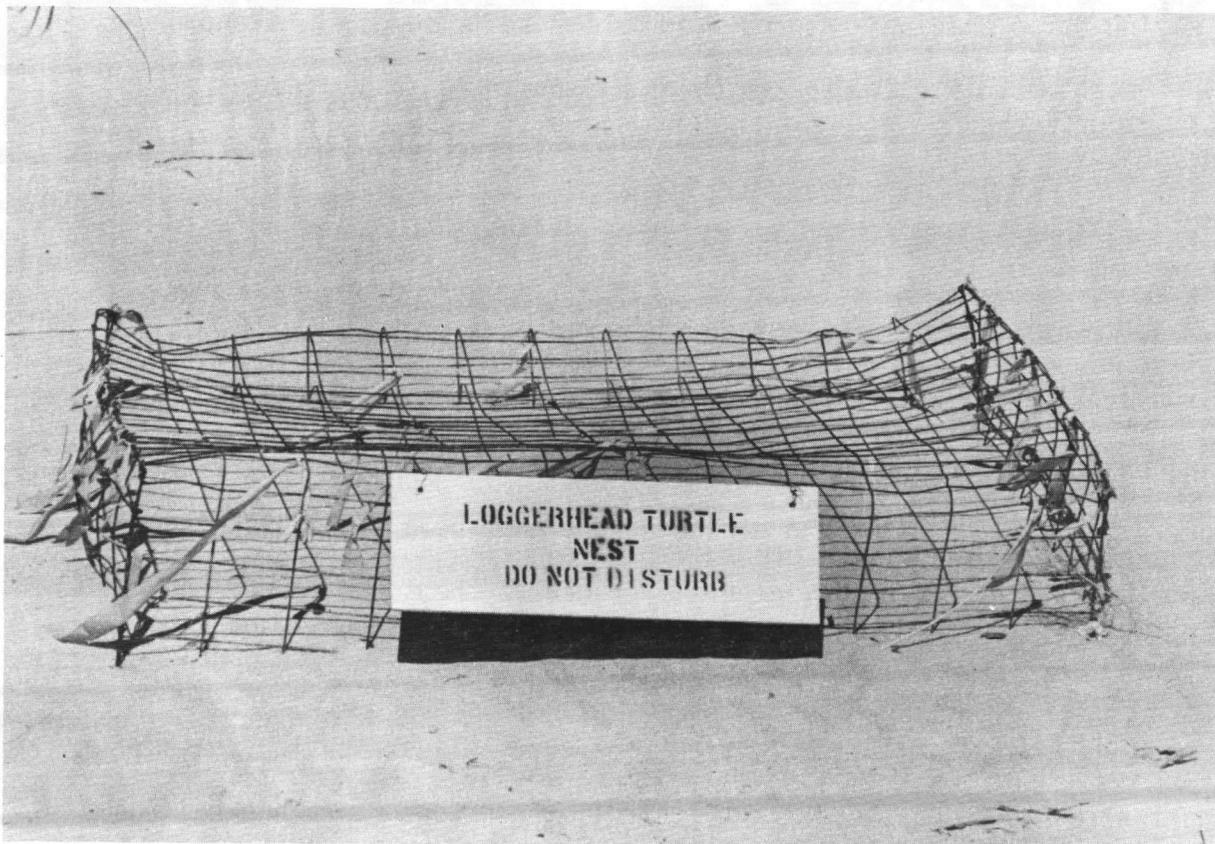
Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Browns Island. The United States Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and it's management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## METHODS

The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

A search was made for turtle tracks or turtles just leaving the surf. If no turtles were located during a patrol, there would be a one-half hour wait before beginning the next patrol. Upon location of turtles, all lights were extinguished until it could be ascertained whether or not the

turtle would nest. After a turtle nested, a numbered tag was attached to a posterior marginal scute. Midway through the nesting season, carapace tags (actually a small disc fish tag) were replaced by live stock ear tags, which were attached on the trailing edge of the right front flipper. During the tagging operation, measurements of the carapace, head, right front and rear flippers and identifying characteristics of each turtle were noted. This data was recorded on the Sea Turtle Inventory (Nesting Data) form (See pages 15 and 16). Nests laid in areas of heavy human use, below the tideline or other seemingly undesirable locations, were relocated, generally at the base of the dunes above the tideline in relatively unused areas of the beach. Nests located in an area extending from Riseley's Pier south approximately two miles to a training observation tower were removed and sent to IMS. These eggs were counted and allowed to hatch under controlled conditions. All other nests, after being located, were protected by burying to a depth of six inches, a four foot square, eighteen inches high cage, made of 2" by 4" electrically welded wire, over the nest. The case was then marked with yellow surveyors plastic tape and an 8" by 20" white sign with red lettering stating "Endangered Wildlife Nest Do Not Disturb." Each nest was tagged using a small plastic tag attached to the protection cage. This tag was marked with the date, nest number, location and number of eggs in the nest. Once a nest was protected, it was checked occasionally until hatch-out of the young was observed. When hatch-out occurred, which was normally from fifty to seventy days, the nest was re-entered and the unhatched eggs were counted. The number of eggs that did not hatch were compared to the total number of eggs for each nest to determine hatching success.

The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter), New River to assist in making sightings and counts of turtle crawls and apparent nest sights along the beach strands of the coastal islands involved in the survey. Flights were not always over the entire coastal area, but were divided into a northern section and a southern section. The northern section included the barrier islands from Onslow Beach to Cape Lookout. The southern section included the barrier islands from Onslow Beach to Smith's "Baldhead" Island. There were nine flights total; four during June and five during July. All flights were made during the prime nesting period before, during and after the full moon for each month (Table II). The data from the aerial surveys was compared to other aerial surveys conducted by Dr. Schwartz of IMS.

#### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out much chance of survival. Of the nine nests there were 1,043 eggs with a hatch-out of 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

successful nests had an incubation period of sixty days or more. A total of 7,077 eggs were counted from all nests, protected or removed, with a hatch-out of 4,037 for a year's success of 57% (Table III).

Of the sixty-three nests, twenty-six turtles were tagged. Three of these turtles had been previously tagged on Onslow Beach and one had been tagged by the University of Georgia in Athens with the number "NC00020" (Table I).

Other data taken during the nesting season which has some bearing on nesting activity is sea water temperatures, lunar cycle and weather conditions. Graphs I, II and III detail the results of lunar cycle and temperature effects.

#### DISCUSSION

Nesting during June was minimal, probably due to early summer cool temperatures. Once the air and sea water temperatures rose to twenty-two degrees celsius, nesting activity began to increase.

Lunar cycle as evidenced by Graph II seems to have little effect on nesting activity. The tides also had less effect than expected, since turtles were observed to crawl up the beach at all tides, including dead low tides.

Weather had some effect on nesting activity. Crawls were made during rainy weather but very few nests were completed. It seemed that the wetness of the sand discouraged the turtles.

Lights on the beach, especially stationary lights, appeared to have little or no effect on turtles choice of nest sites. Turtles nested often near very well lighted buildings. Moving lights, either vehicular or pedestrian flashlights, caused immediate abortive reactions by nearly all turtles that were approached.

There was one case of nest predation of a protected nest due to technician error. This nest site had two clutches of eggs deposited under one protective cage. The error occurred after one nest was checked for hatching, at which time the cage was improperly replaced allowing space for raccoons to reach through the cage into the nest. Fifteen hatchlings were destroyed in this case.

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artifically incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

Nesting activity seemed to be determined by individual turtle cycles,

not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796, later tagged IMS 26 flipper tag. This turtle returned to the beach after 14 days (July 12 and July 26, 1979). The first clutch was laid on a rainy night at 2215 hours and contained 149 eggs. The second nest was laid on a fair night with good visibility but no moon at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time, and for each nesting the tide was near high.

Several unusual eggs were discovered during the study. Many subnormal size eggs were found. The most unusual eggs were a double and one triple yolk. Both these eggs were transported to IMS where they were artificially incubated. Neither of the unusual eggs hatched.

Hurricane David which passed through the study area in late August 1979 destroyed six nests, inundated six nests and deposited up to eighteen inches of sand over four of the inundated nests. The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. Nest of July 24, 1979 had 123 eggs hatch for 100% hatch out. Another nest, however, under nearly identical conditions and laid on the same day, had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm, no clear conclusions can be drawn. The nests that had sand deposited over them by the storm would have failed completely without human intervention. One nest of 150 eggs laid on July 5, 1979 produced 101 hatchlings for 67.3% success. When this nest was entered, about eighteen inches of sand and matted sargassum weed were removed from

over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page 19. The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

TABLE I

## GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
May	0	0	0	0	0
June	32	16	14	2	2
July	31	26	19	7*	12**
August	9	21	15	5***	12****

Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

\*\* - Two of the 12 were returns

\*\*\* - (8-6-79) removed, triple yolk egg from protected nest

\*\*\*\* - Three of these turtles previously tagged July 79 on Only Beach - 1 turtle previously tagged by University of Georgia, Athens (#NCO020)

TABLE II

## ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July									
	15		19		20		21		5		6		10*		11**		12***	
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N
Onslow Beach		5		2			3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3				2	2	5	6	5		
Hammock Beach			1	1		2		3				4		3				
Bogue Banks			1	1		1			1			2						
Shackleford Banks																		
Cape Lookout	1							1									2	1
Topsail Island	1	2			3	3				1	4		2	3	4	2		
1st Island																		1
Riches Island																	1	2
Figure 8 Island																		
Wrightsville Beach											1							
Masonborough Island																		
Carolina Beach											2							1
Smith Island										2	8						1	5

## Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
14	(1)	118	100	84.5
14	(2)	135	127	94.1
14		141	98	69.5
15		138	119	86.2
16	(2)	96	57	59.4
19	(2)	106	92	86.8
21	(2)	80	68	85.0
22		98	84	85.7
23		105	86	81.9
26	(2)	150	143	95.3
28	(2)	121	114	94.2
28		136	116	85.9
29	(3)	93	86	92.5
July 1	(1)	92	35	38.1
1	(2) (4)	113	2	1.8
1	(1)	121	68	72.7
2	(4)	121	0	0
3	(2)	151	137	90.7
5	(2)	150	101	67.3
6		133	121	91.0
7	(5) (2)	146	133	91.1
9		108	86	79.6

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18	(1)	73	66	90.4
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24	(4) (2)	123	123	100
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1	(8)	105		
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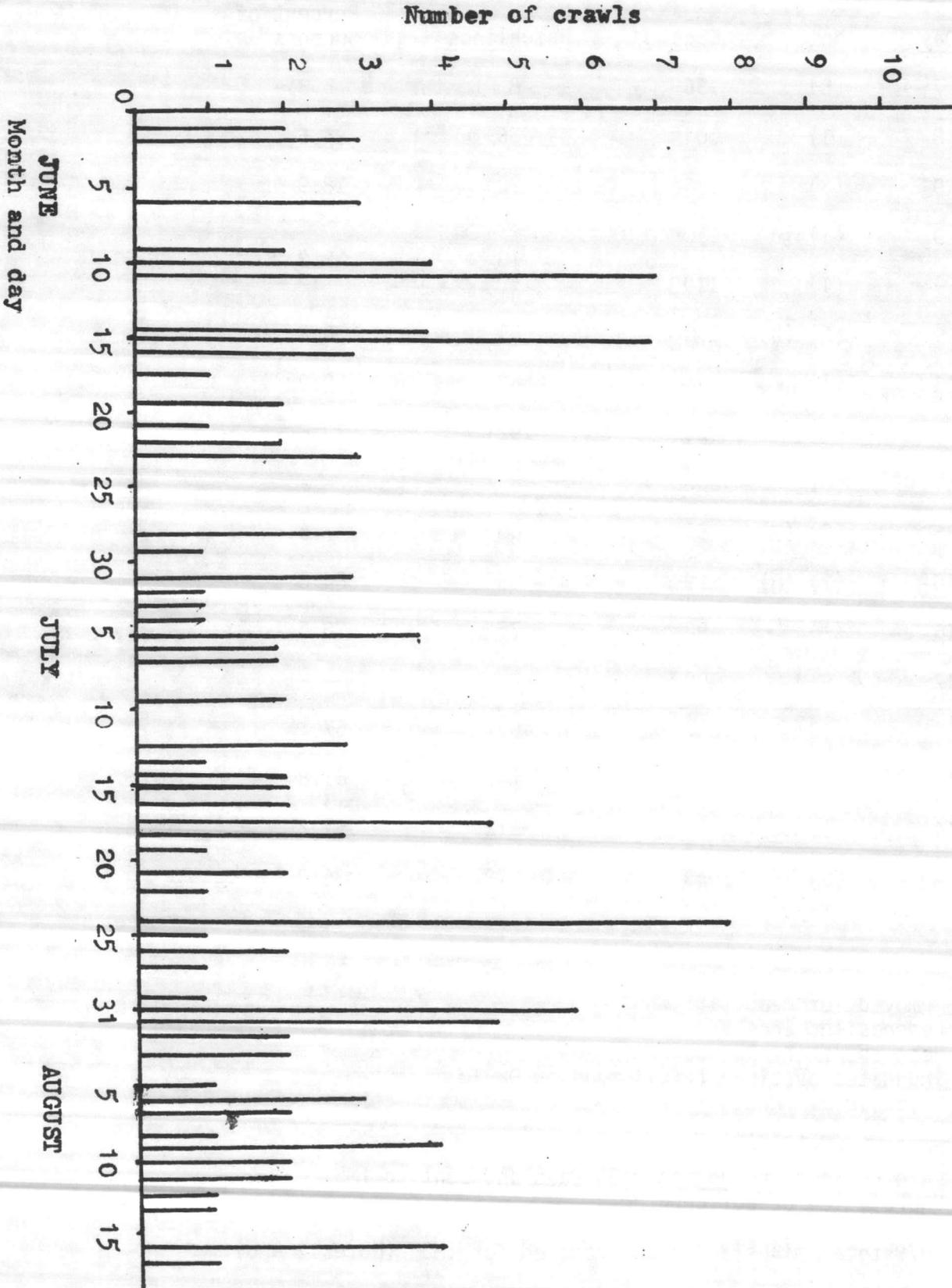
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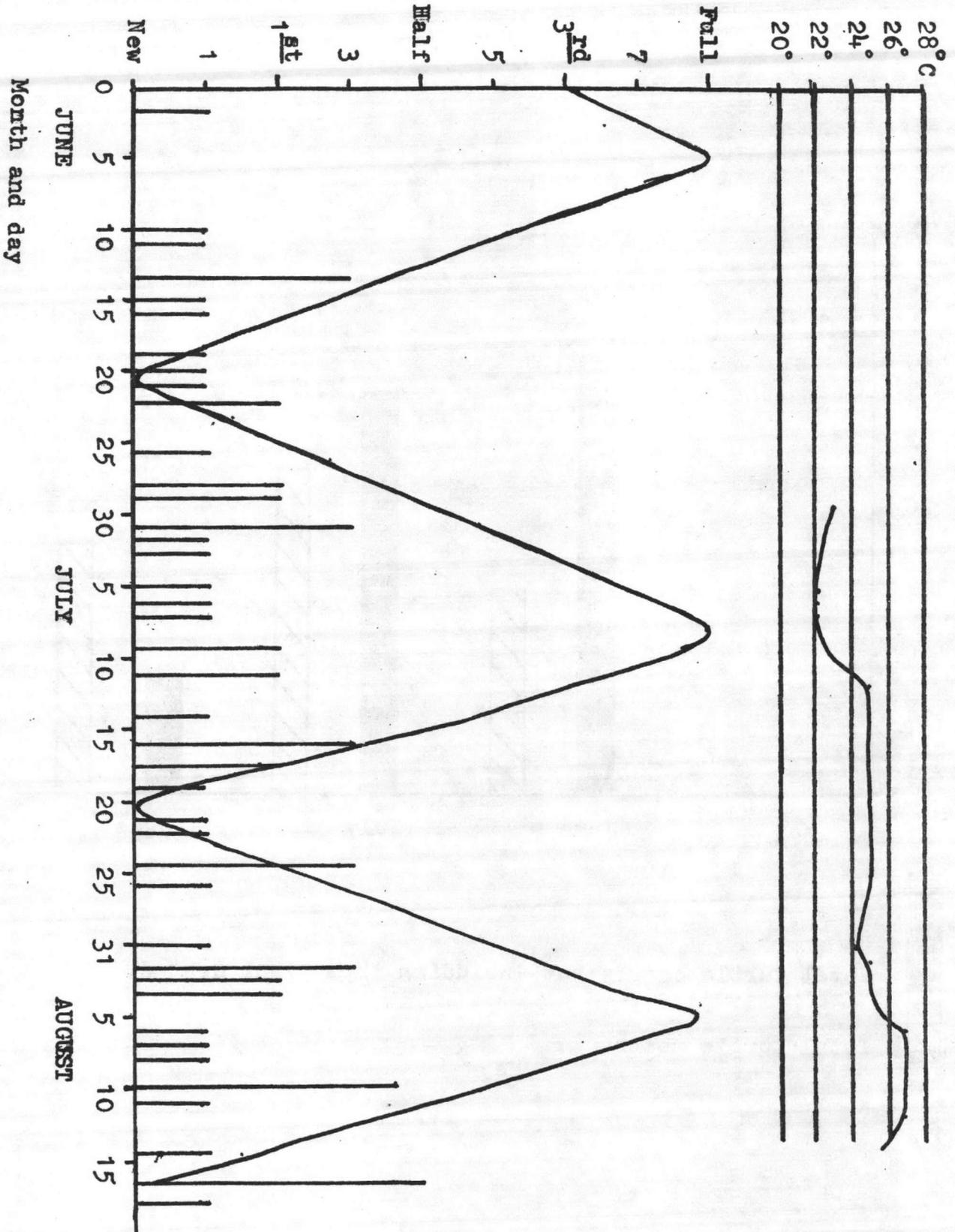
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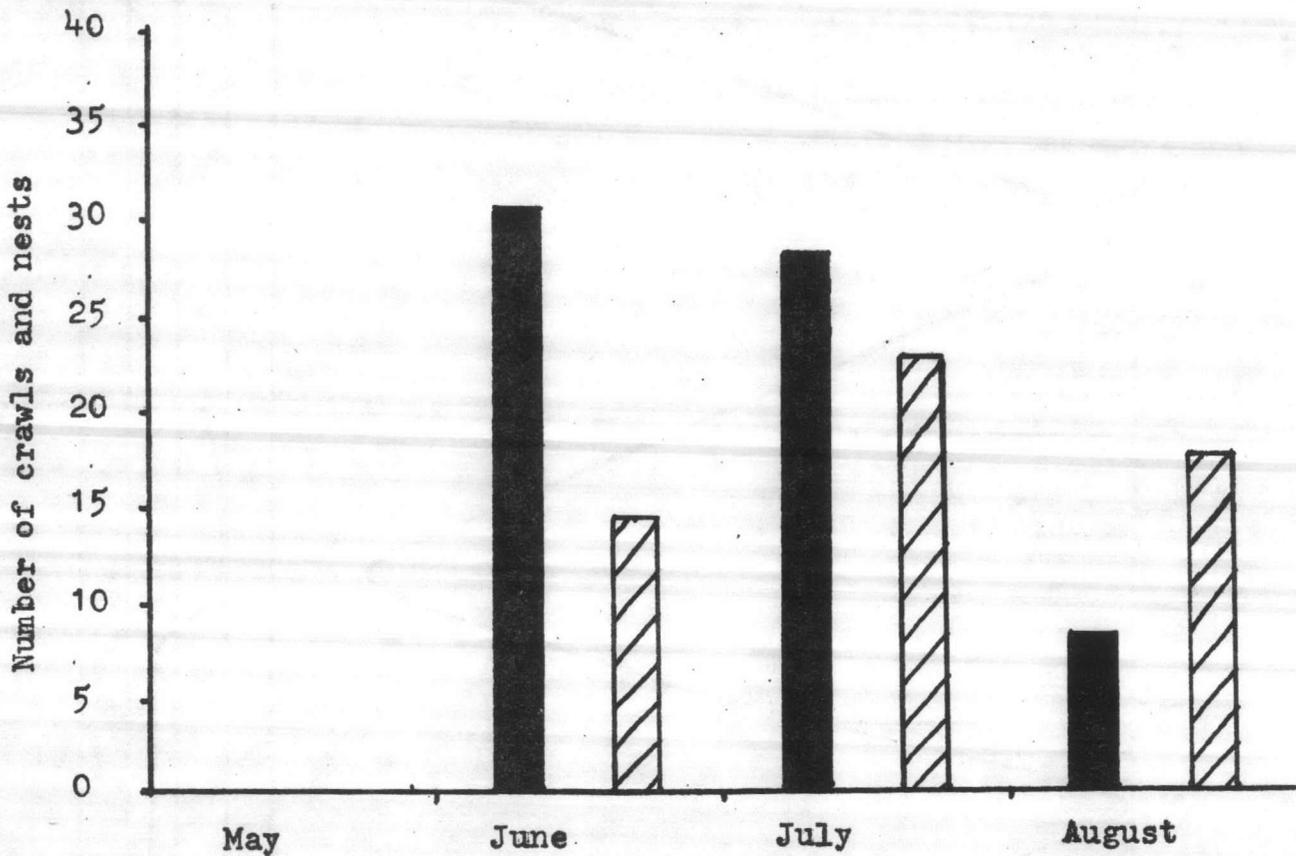
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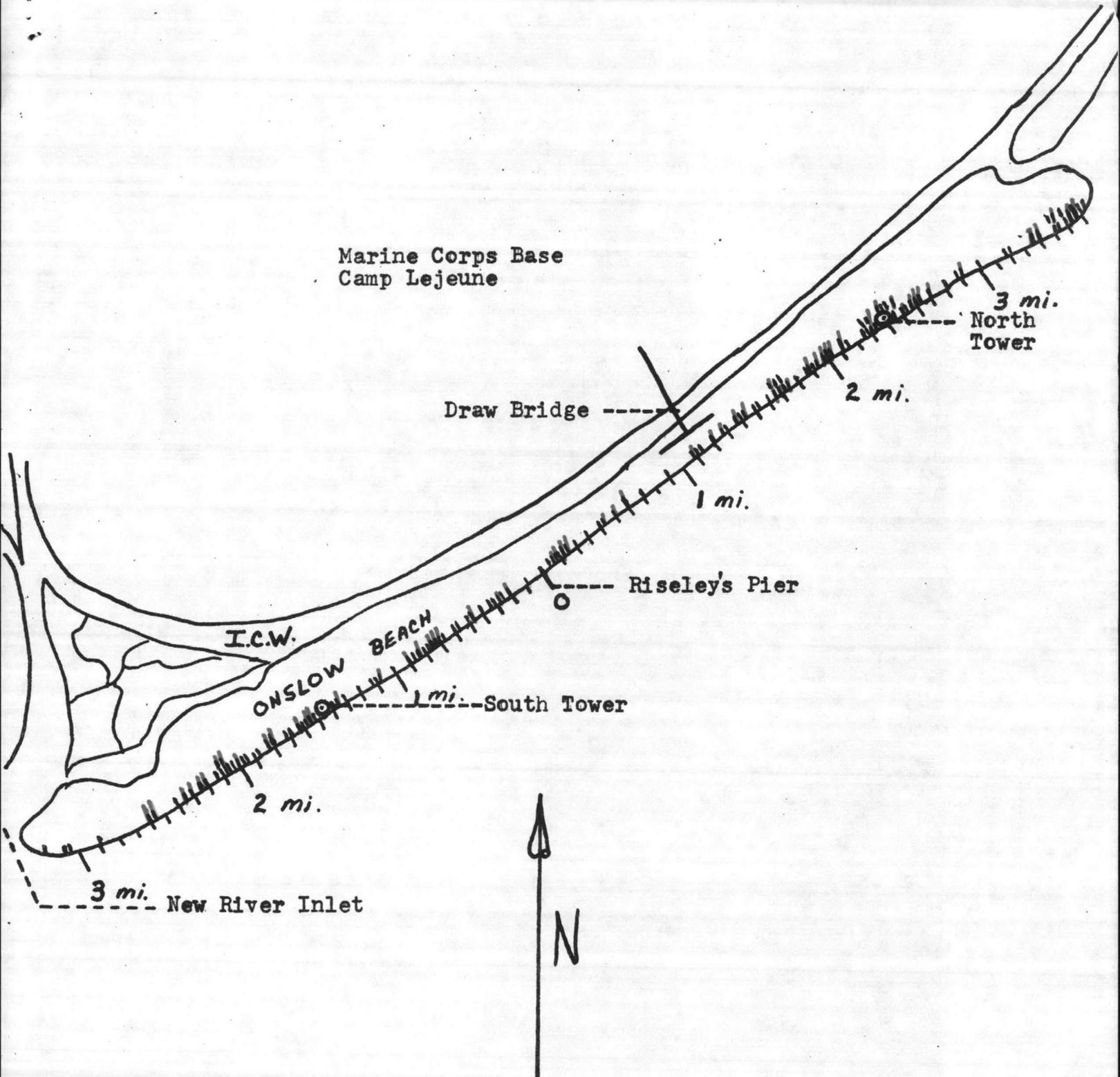


Total turtle nests.

Onslow Beach with Turtle Crawls  
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- Crawls

— Nests





ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979.

Natural Resources and Environmental Affairs Division

Base Maintenance Department

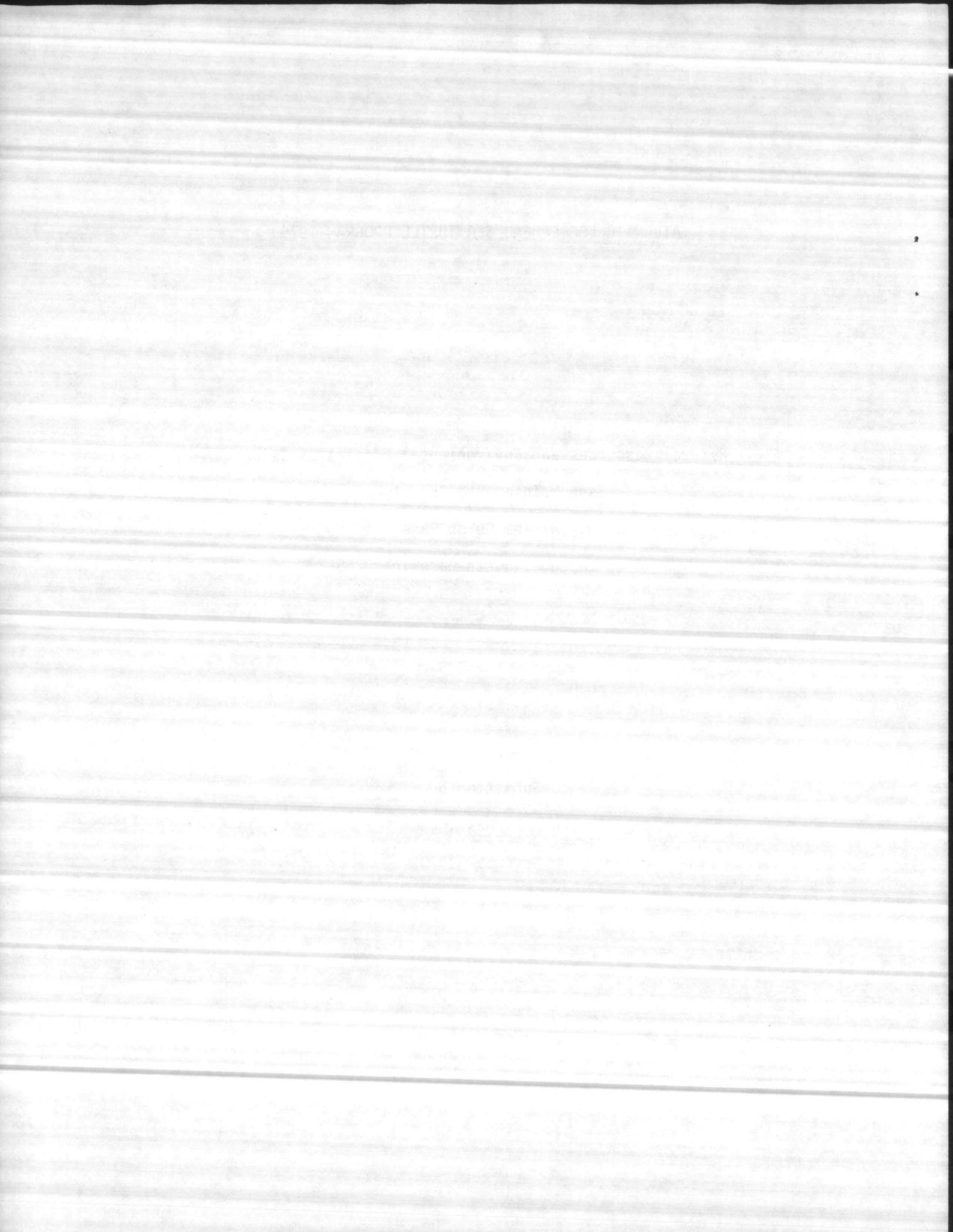
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Submitted by

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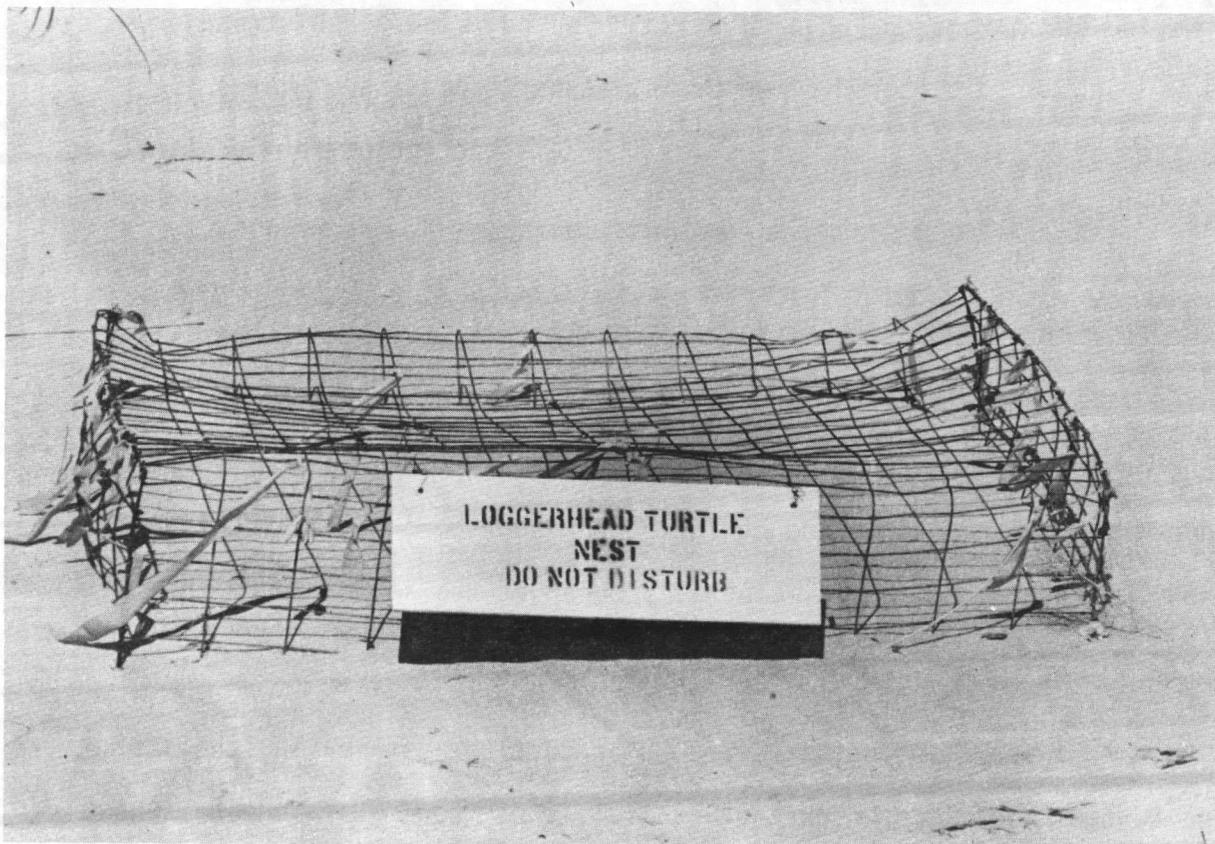
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Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artifically incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

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Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

TABLE I  
GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
May	0	0	0	0	0
June	32	16	14	2	2
July	31	26	19	7*	12**
August	9	21	15	5***	12****

Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

\*\* - Two of the 12 were returns

\*\*\* - (8-6-79) removed, triple yolk egg from protected nest

\*\*\*\* - Three of these turtles previously tagged July 79 on Only Beach - 1 turtle previously tagged by University of Georgia, Athens (#NCO020)

TABLE II

## ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July										
	15		19		20		21		5		6		10*		11**		12***		
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	
Onslow Beach		5		2				3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3					2	2	5	6	5		
Hammock Beach			1	1		2		3					4		3				
Bogue Banks			1	1		1				1				2					
Shackleford Banks																			
Cape Lookout	1							1										2	1
Topsail Island	1	2			3	3					1	4		2	3	4	2		
1st Island																			1
Riches Island																		1	2
Figure 8 Island																			
Wrightsville Beach												1							
Masonborough Island																			
Carolina Beach												2							1
Smith Island											2	8						1	5

## Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
14	(1)	118	100	84.5
14	(2)	135	127	94.1
14		141	98	69.5
15		138	119	86.2
16	(2)	96	57	59.4
19	(2)	106	92	86.8
21	(2)	80	68	85.0
22		98	84	85.7
23		105	86	81.9
26	(2)	150	143	95.3
28	(2)	121	114	94.2
28		136	116	85.9
29	(3)	93	86	92.5
July 1	(1)	92	35	38.1
1	(2) (4)	113	2	1.8
1	(1)	121	68	72.7
2	(4)	121	0	0
3	(2)	151	137	90.7
5	(2)	150	101	67.3
6		133	121	91.0
7	(5) (2)	146	133	91.1
9		108	86	79.6

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<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
July 9	(1)	106	101	95.3
12	(5)	109	103	94.5
12	(5)	149	136	91.3
14	(6)	150	0	0
17	(7) (5)	114	106	93.0
17	(5)	113	106	93.8
17	(4)	118	0	0
18	(1)	73	66	90.4
18	(4)	92	3	3.3
19	(2)	101	99	98.0
21	(3)	39	0	0
22	(4)	115	90	78.3
24	(1)	133	113	84.9
24	(2)	159	76	47.8
24	(4) (2)	123	123	100
26	(1)	156	24	15.4
31	(1)	123	122	99.2
Aug 1	(6) (2)	109	0	0
1	(8)	105		
1	(2) (6)	109	0	0
2	(2) (6)	92	0	0
2	(2) (6)	105	0	0
3	(2) (8)	99	14	14
3	(2) (6)	97	0	0
6	(8)	124	47	37.3

TABLE III  
SUMMARY OF NESTING ACTIVITIES AND SUCCESS

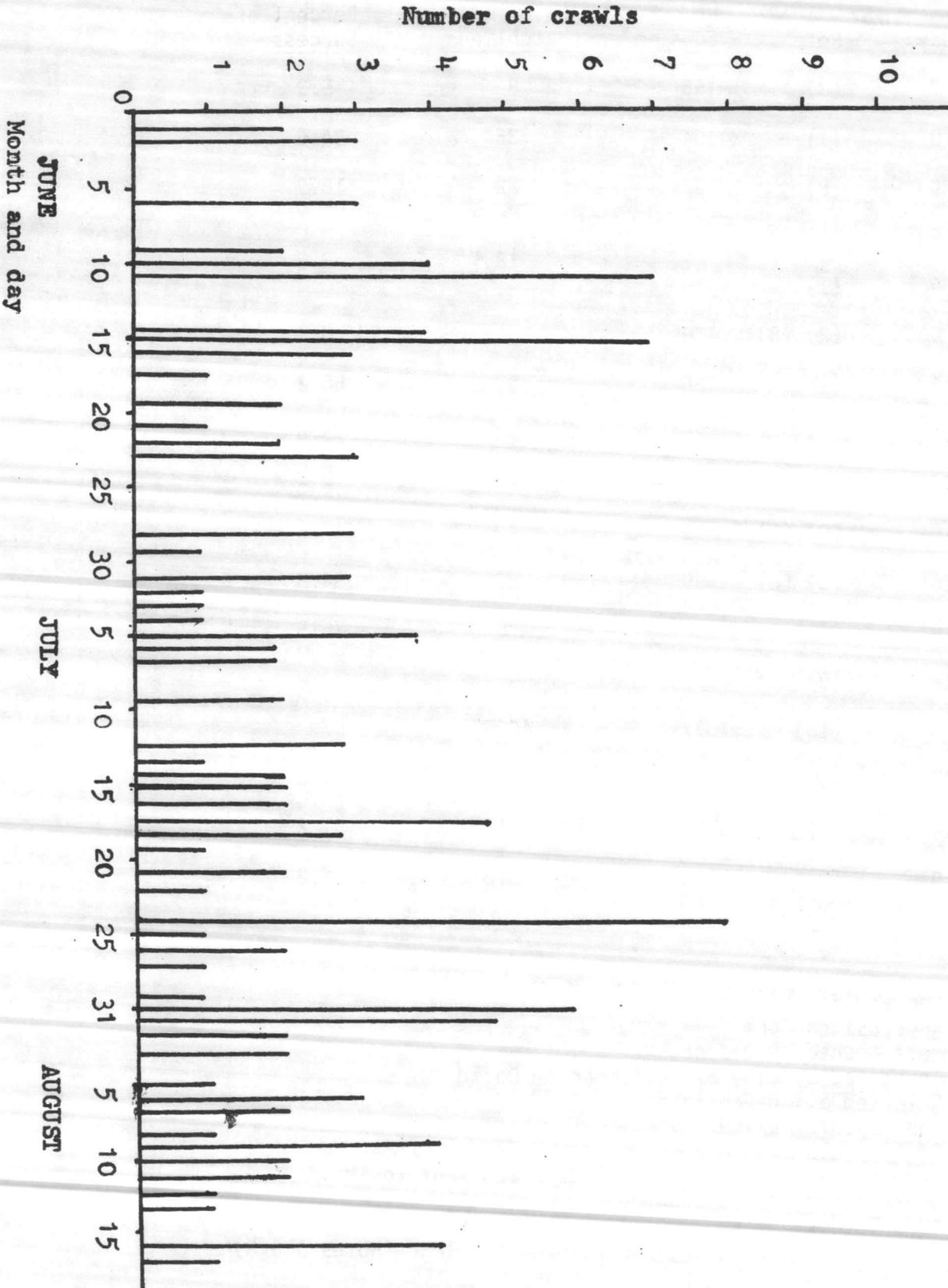
<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
Aug 7	(8)	156	8	5.3
8	(1)	104	36	34.6
9	(8)	116	22	18.9
9	(1)	110		
9	(1)	110	18	8.2
9	(2) (8)	130	1	0.8
11	(1)	125	63	50.2
14	(8)	125	92	73.6
16	(9)	100	- -	- -
16	(2) (8)	92	43	47.5
16	(2) (8)	99	85	84.8
16	(1)	98	75	76.5
17	(9)	100	- -	- -
63	(10)	7077	4037	57
40	(11)	4439	2747	61.8
14	(1)	1595	912	57.2
9	(8)	1043	378	36.2

Note:

- (1) - Removed for Headstart
- (2) - Redeposited Eggs
- (3) - Nest opened by Raccoons
- (4) - Inundated by tide at full moon or David
- (5) - Released all Hatchlings
- (6) - Destroyed by David
- (7) - Double Yolk
- (8) - Late nests taken up after 60 days and sent to IMS
- (9) - Unprotected or not counted
- (10) - 1979 Totals
- (11) - 1979 total minus all nests removed for IMS (Notes 1 & 8)

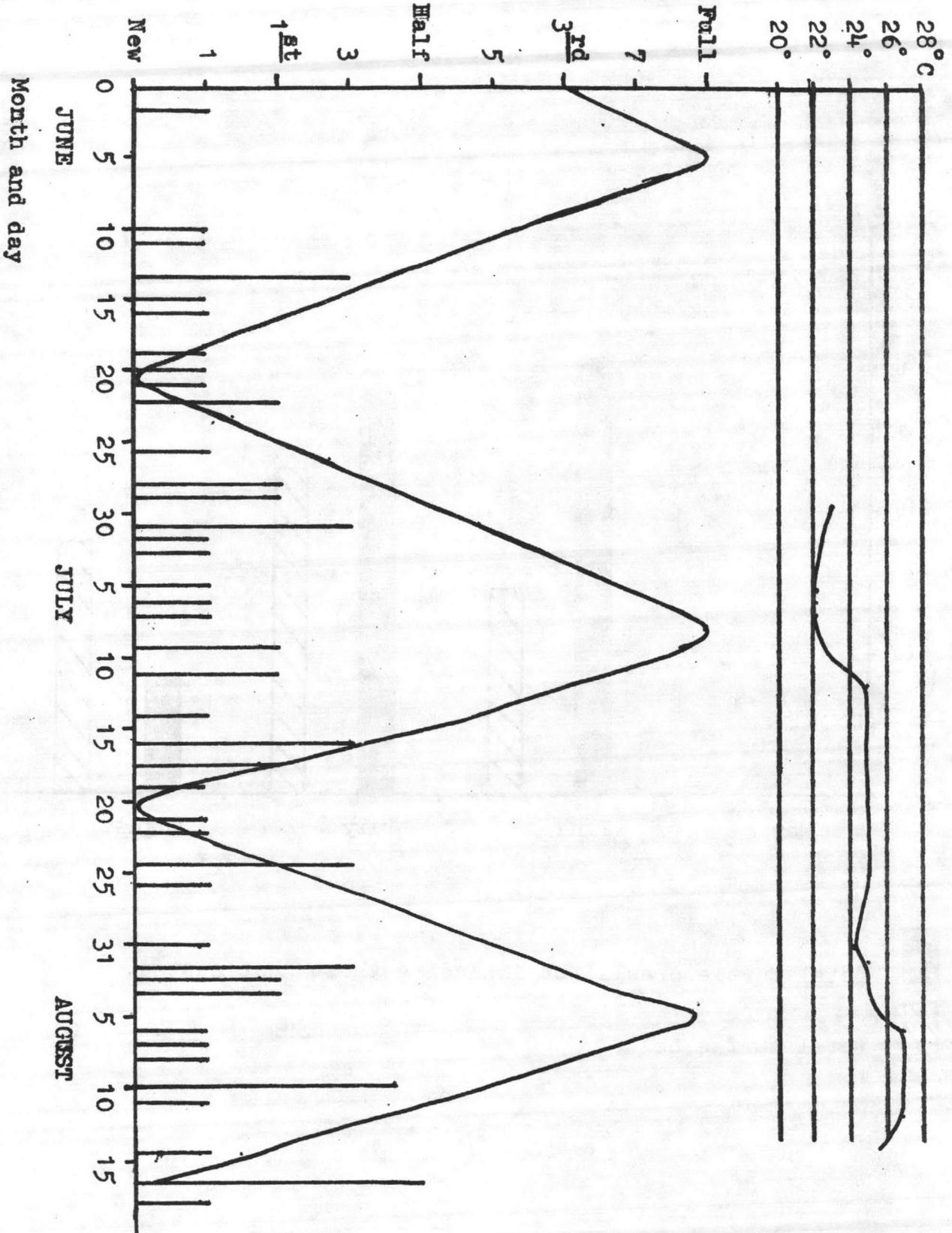
Graph 1

Turtle crawls including those that ended in nesting



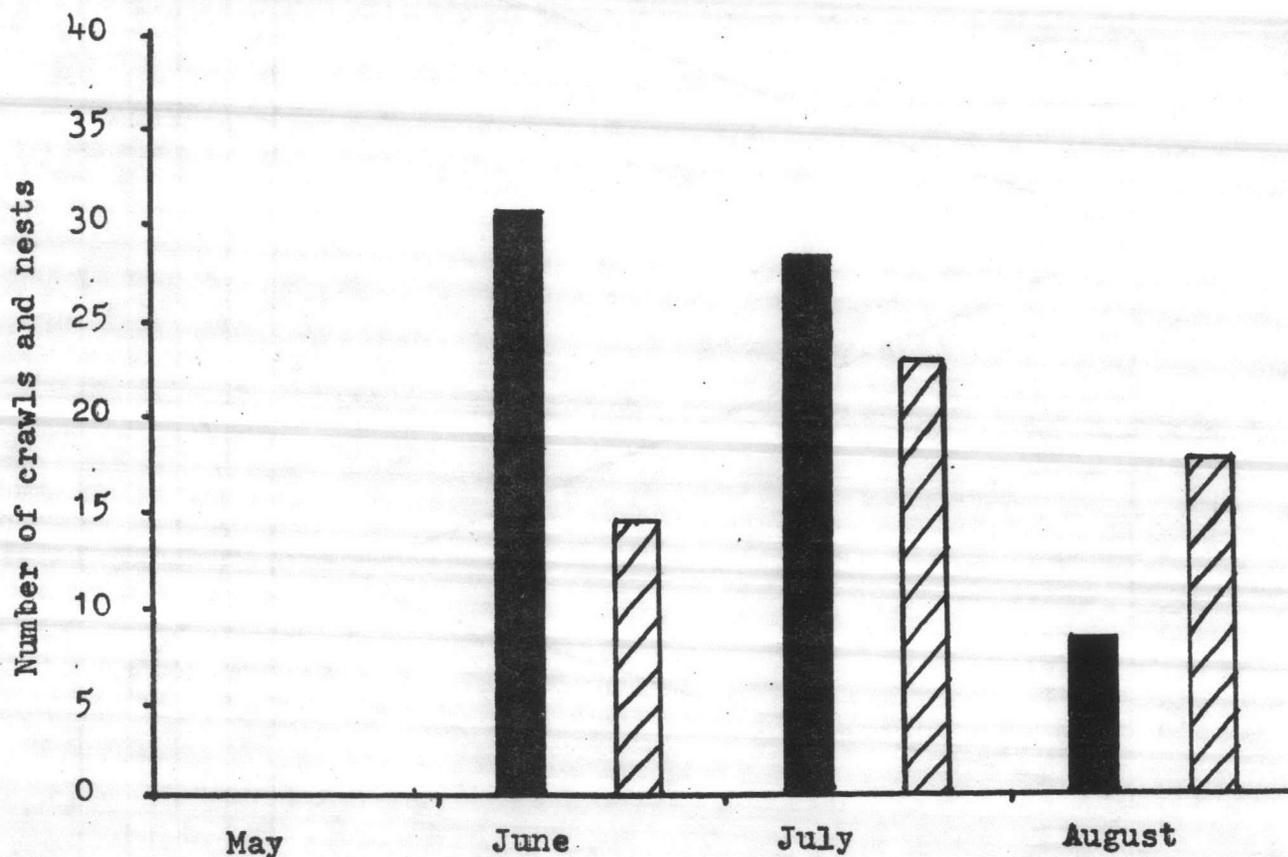
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season



Total turtle crawls not including those that nested.

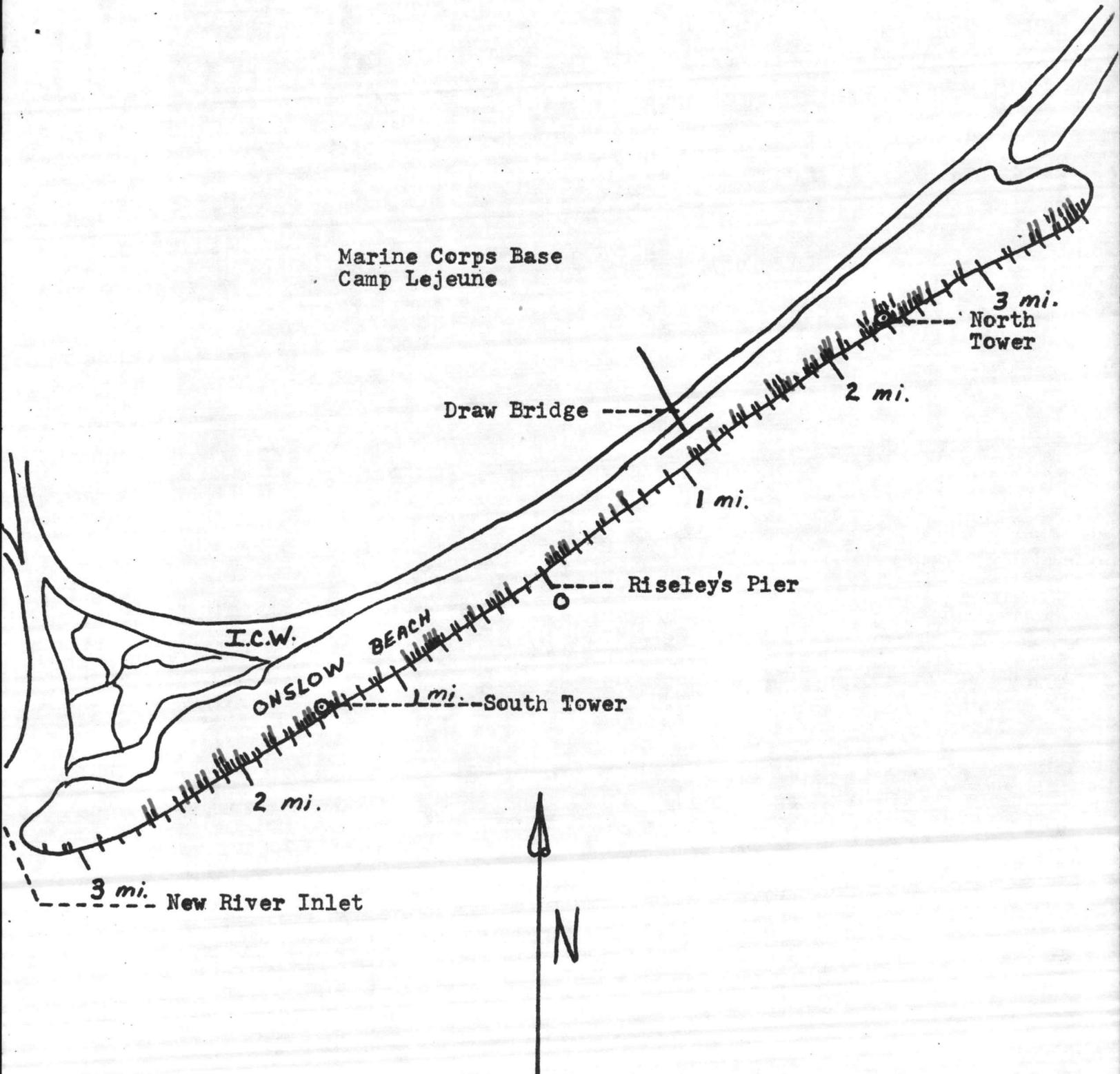


Total turtle nests.

Onslow Beach with Turtle Crawls  
and Turtle Nests Year 1979

— Crawls

— Nests



1000

1000

1000

1000

1000

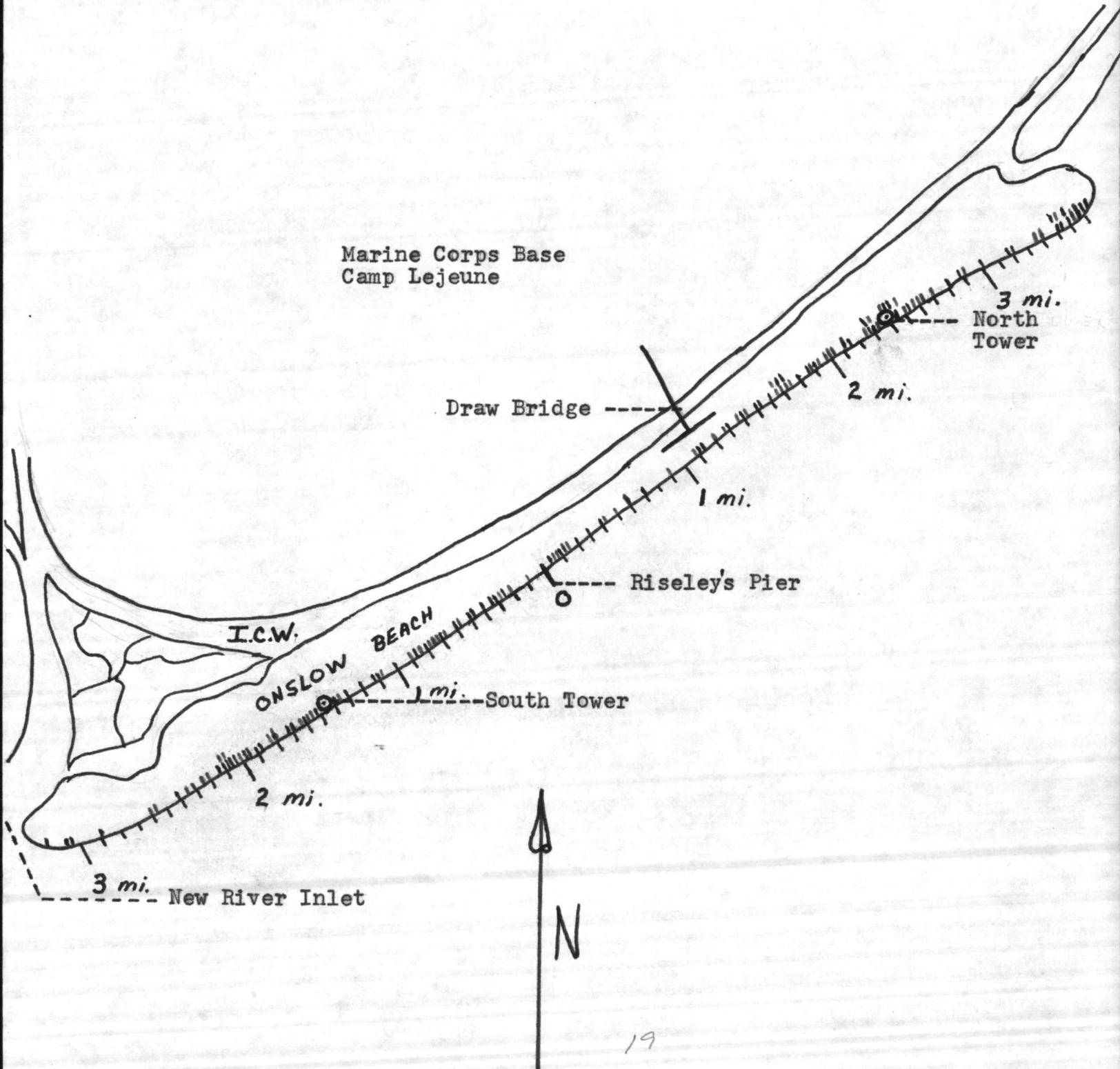
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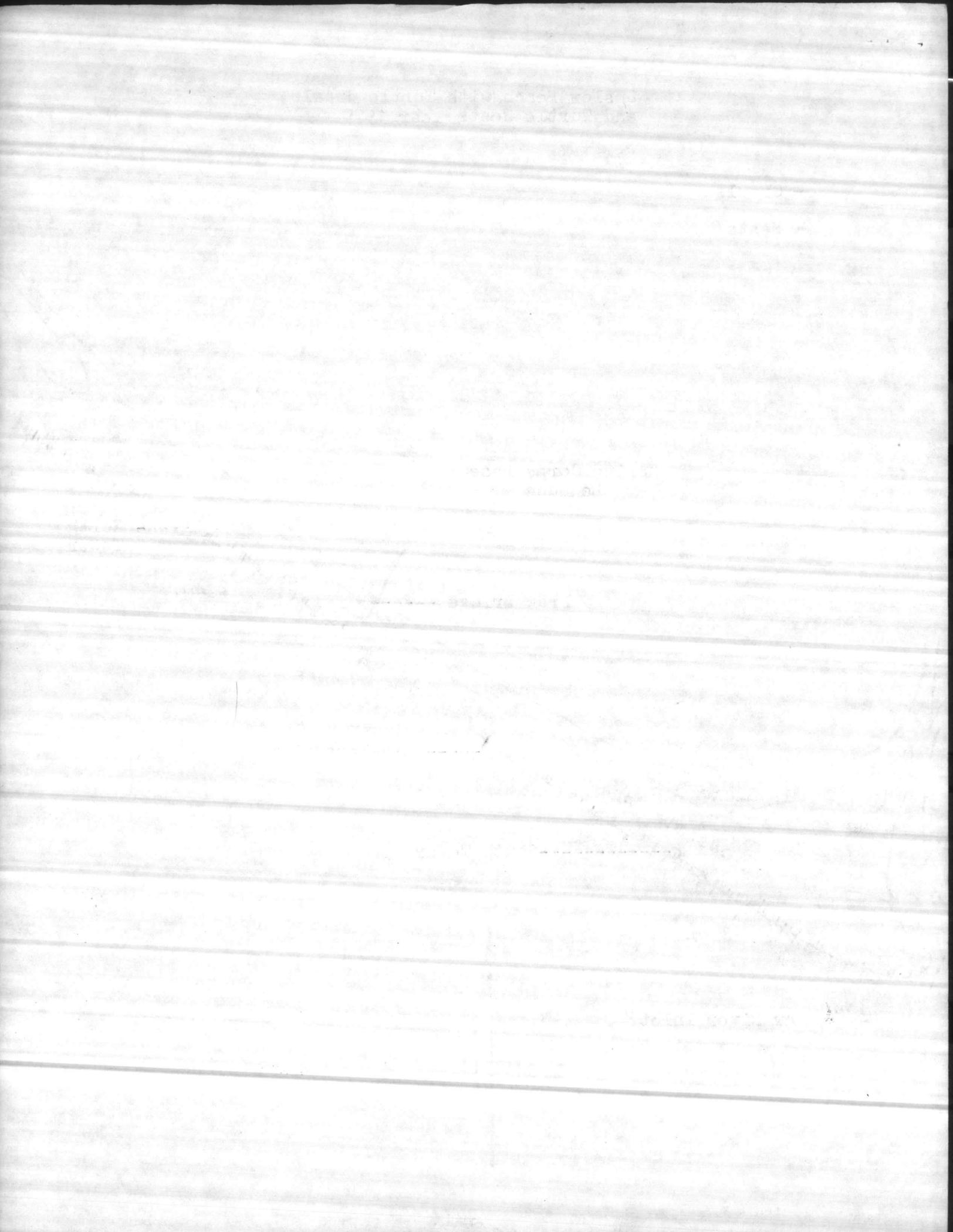
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# Onslow Beach with Turtle Crawls and Turtle Nests Year 1979

- Crawls
- Nests





ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979.

Natural Resources and Environmental Affairs Division

Base Maintenance Department

Marine Corps Base

Camp Lejeune, North Carolina 28542

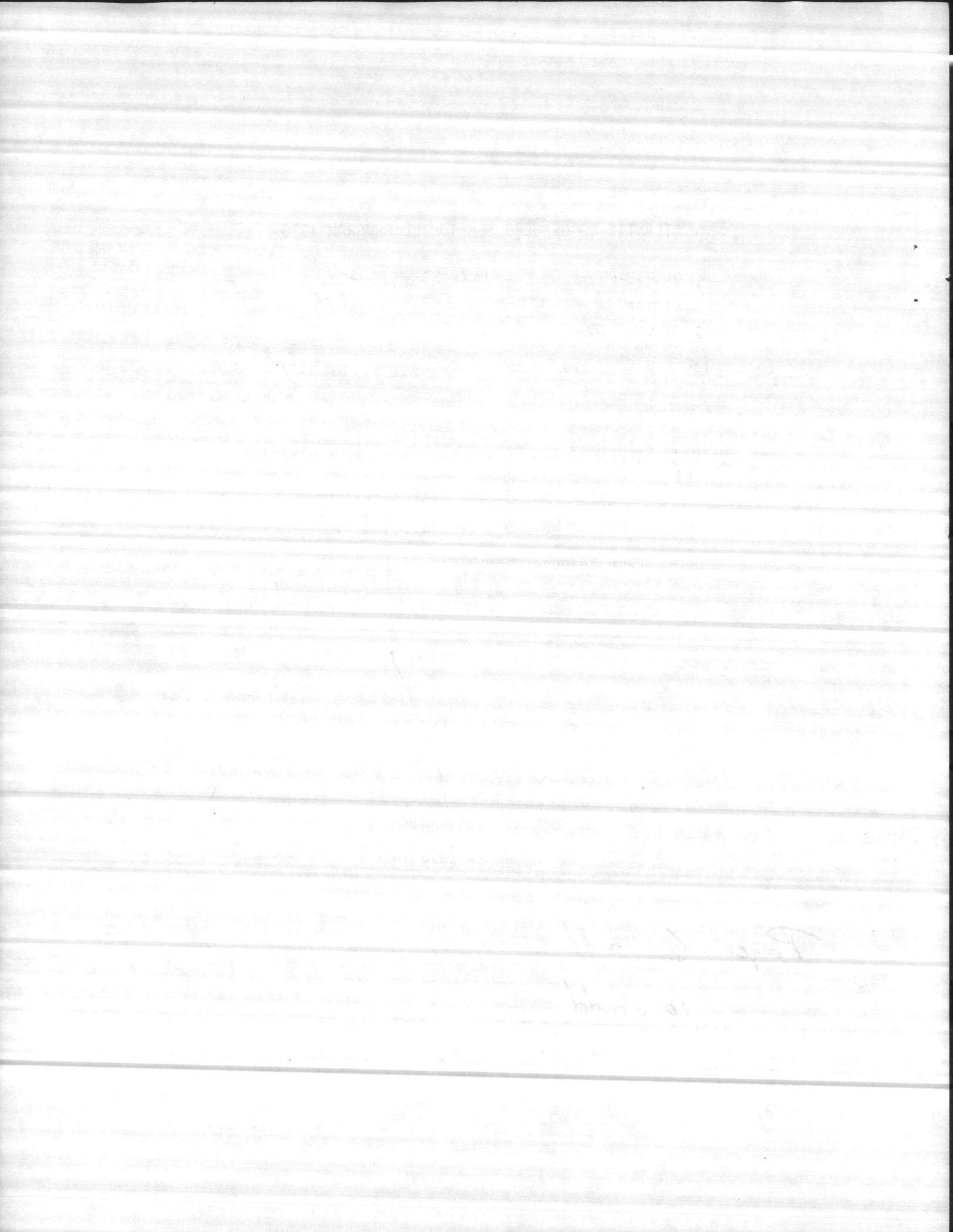
Submitted by

Hugh R. Passingham

November 1979

Page 6 add

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## BACKGROUND

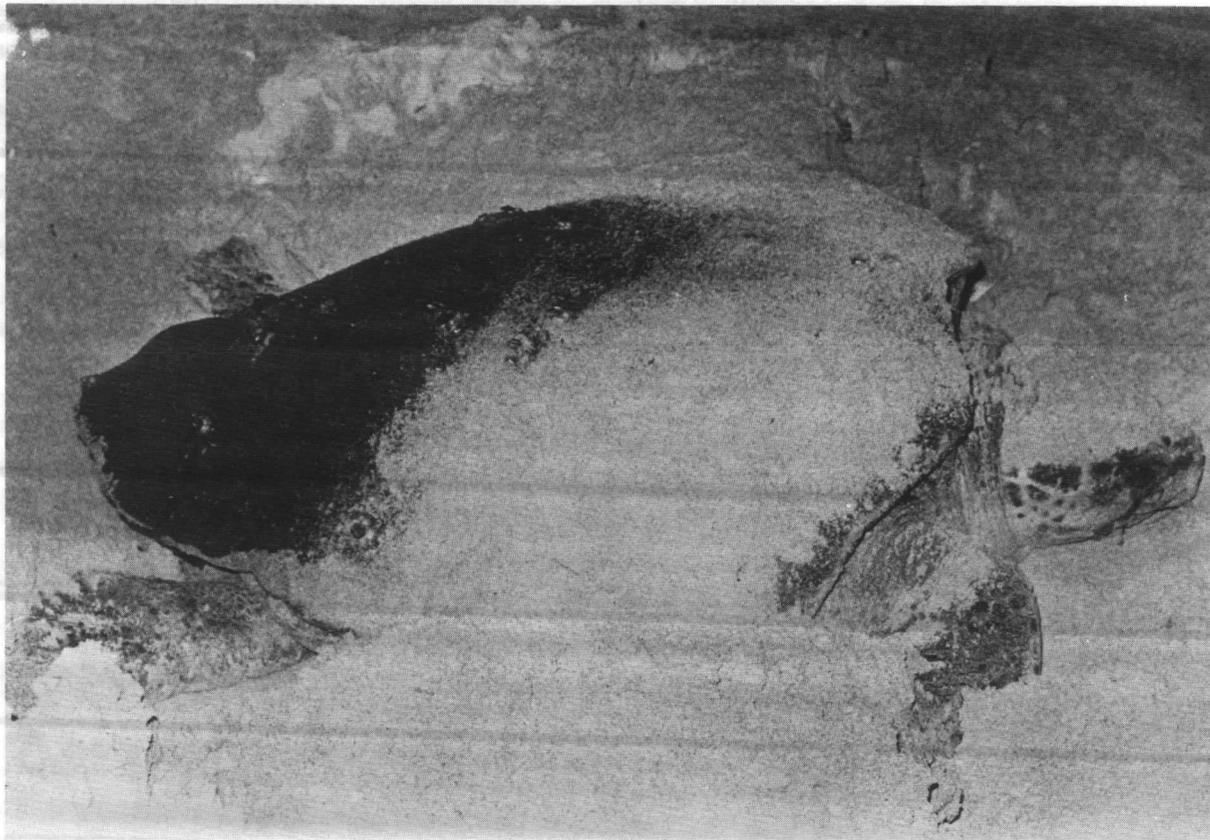
The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered

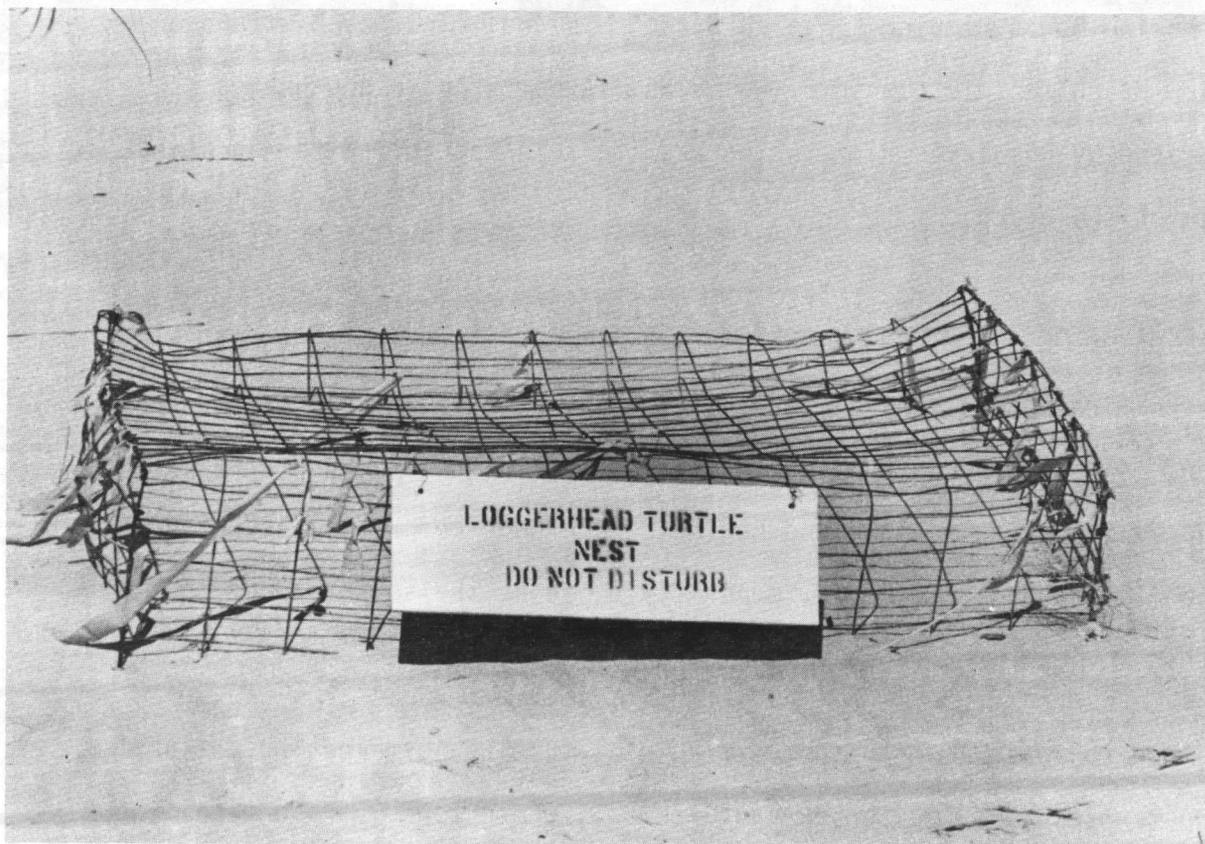
Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Browns Island. The United States Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and it's management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## METHODS

The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

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Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

TABLE I  
GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
May	0	0	0	0	0
June	32	16	14	2	2
July	31	26	19	7*	12**
August	9	21	15	5***	12****

Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

\*\* - Two of the 12 were returns

\*\*\* - (8-6-79) removed, triple yolk egg from protected nest

\*\*\*\* - Three of these turtles previously tagged July 79 on Only Beach - 1 turtle previously tagged by University of Georgia, Athens (#NCO020)

TABLE II

## ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July									
	15		19		20		21		5		6		10*		11**		12***	
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N
Onslow Beach		5		2			3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3				2	2	5	6	5		
Hammock Beach			1	1		2		3				4		3				
Bogue Banks			1	1		1			1				2					
Shackleford Banks																		
Cape Lookout	1							1									2	1
Topsail Island	1	2			3	3				1	4		2	3	4	2		
1st Island																		1
Riches Island																	1	2
Figure 8 Island																		
Wrightsville Beach											1							
Masonborough Island																		
Carolina Beach											2							1
Smith Island										2	8						1	5

## Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
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22	(4)	115	90	78.3
24	(1)	133	113	84.9
24	(2)	159	76	47.8
24	(4) (2)	123	123	100
26	(1)	156	24	15.4
31	(1)	123	122	99.2
Aug 1	(6) (2)	109	0	0
1	(8)	105		
1	(2) (6)	109	0	0
2	(2) (6)	92	0	0
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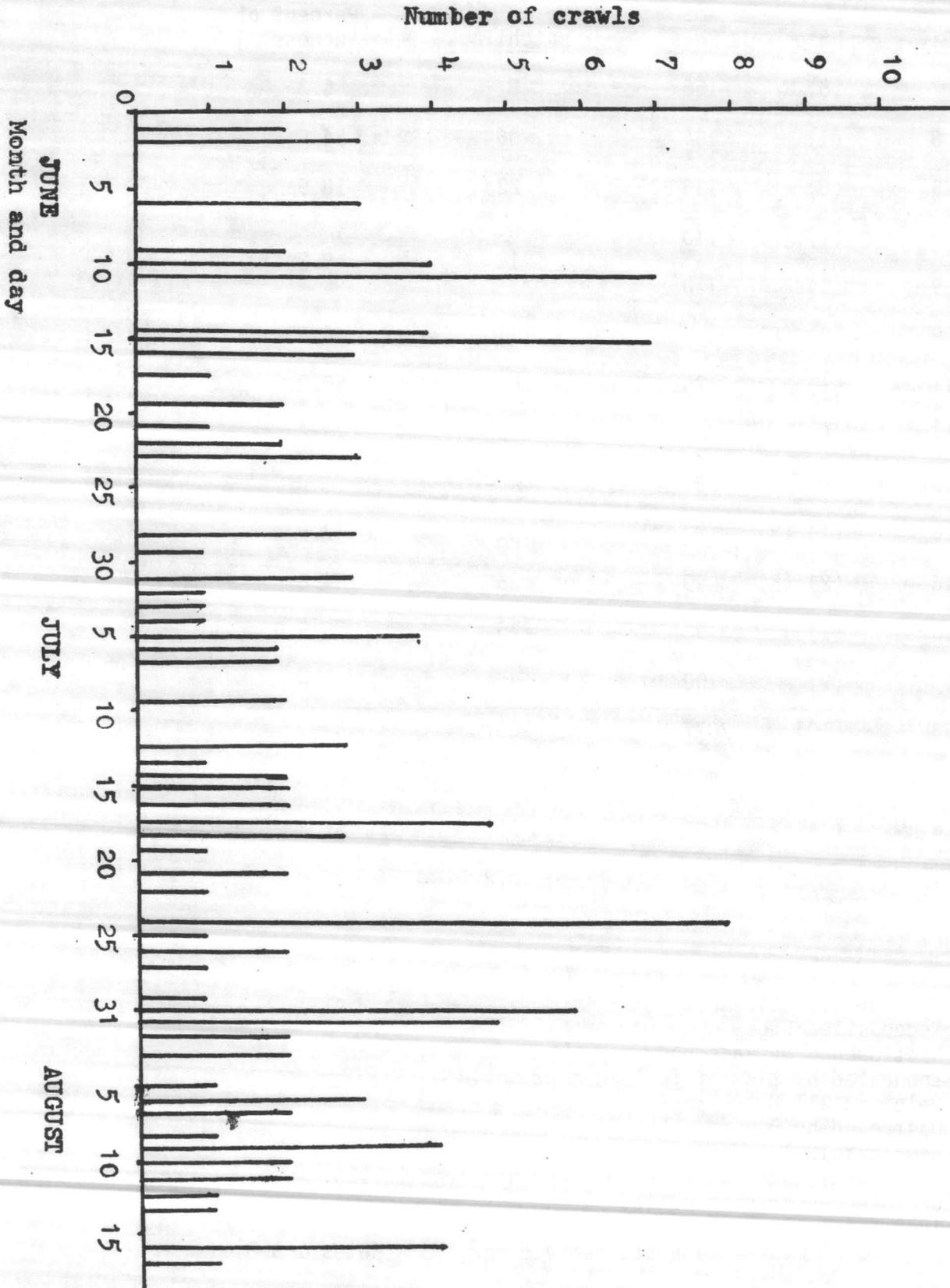
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11	(1)	125	63	50.2
14	(8)	125	92	73.6
16	(9)	100	- -	- -
16	(2) (8)	92	43	47.5
16	(2) (8)	99	85	84.8
16	(1)	98	75	76.5
17	(9)	100	- -	- -
63	(10)	7077	4037	57
40	(11)	4439	2747	61.8
14	(1)	1595	912	57.2
9	(8)	1043	378	36.2

Note:

- (1) - Removed for Headstart
- (2) - Redeposited Eggs
- (3) - Nest opened by Raccoons
- (4) - Inundated by tide at full moon or David
- (5) - Released all Hatchlings
- (6) - Destroyed by David
- (7) - Double Yolk
- (8) - Late nests taken up after 60 days and sent to IMS
- (9) - Unprotected or not counted
- (10) - 1979 Totals
- (11) - 1979 total minus all nests removed for IMS (Notes 1 & 8)

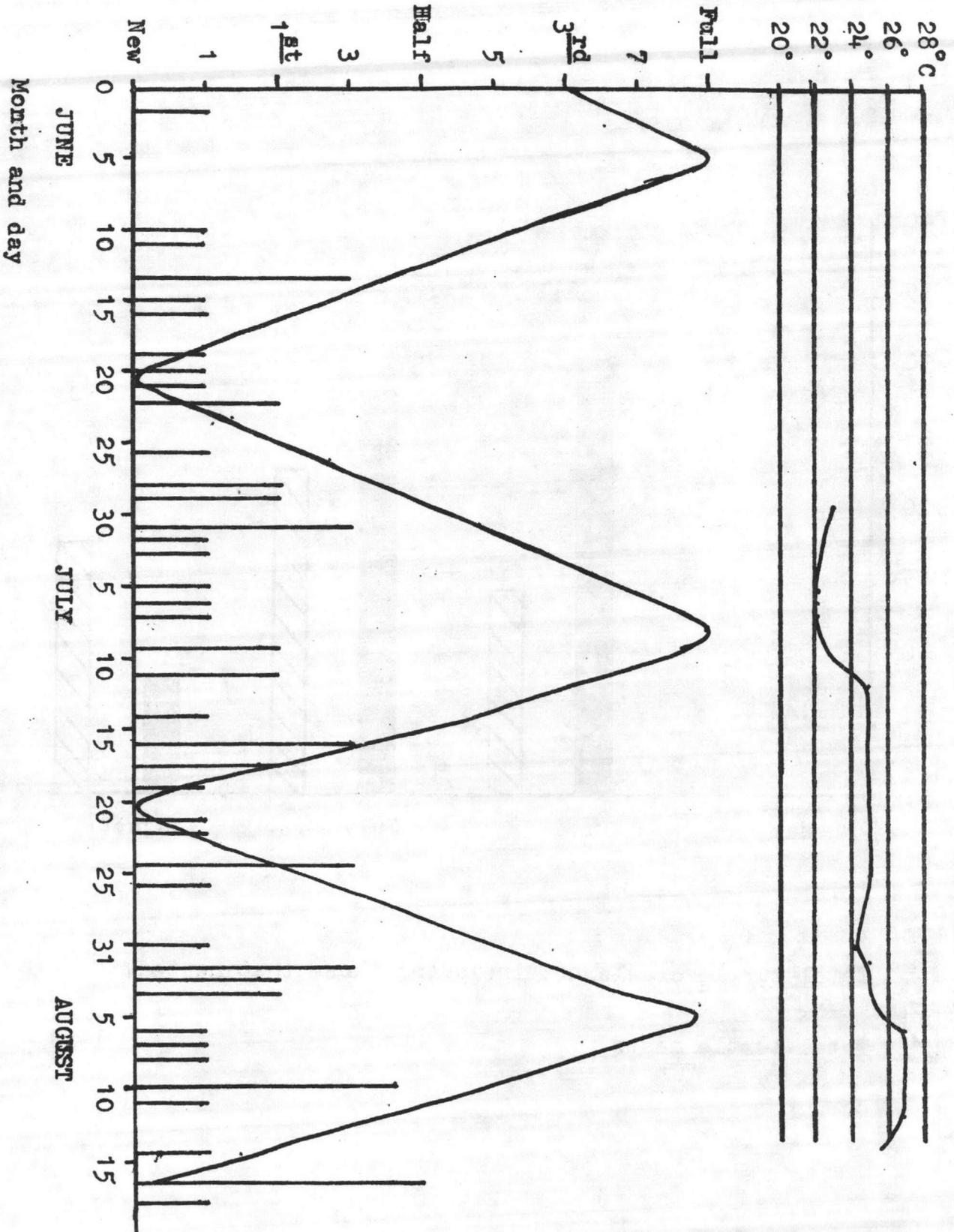
Graph 1

Turtle crawls including those that ended in nesting



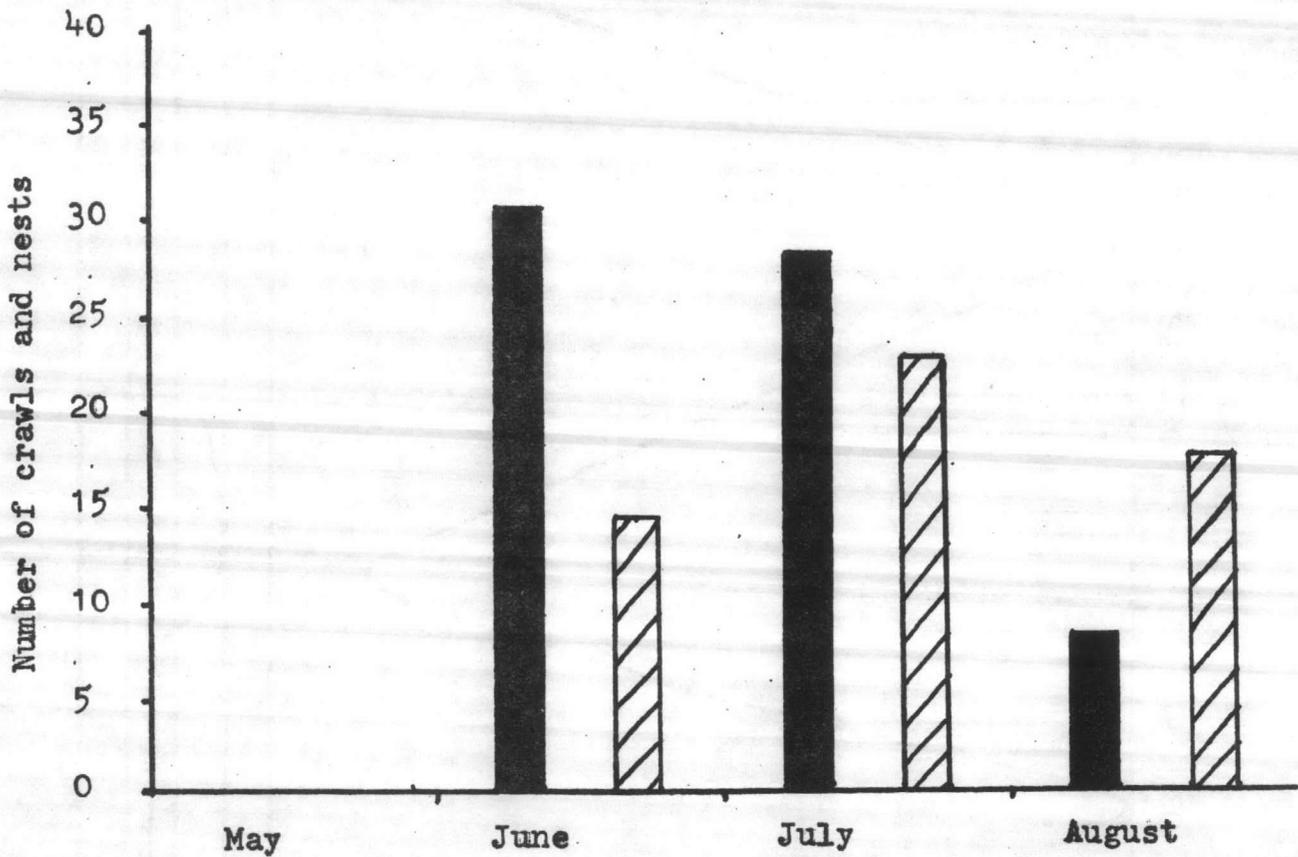
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season



Total turtle crawls not including those that nested.

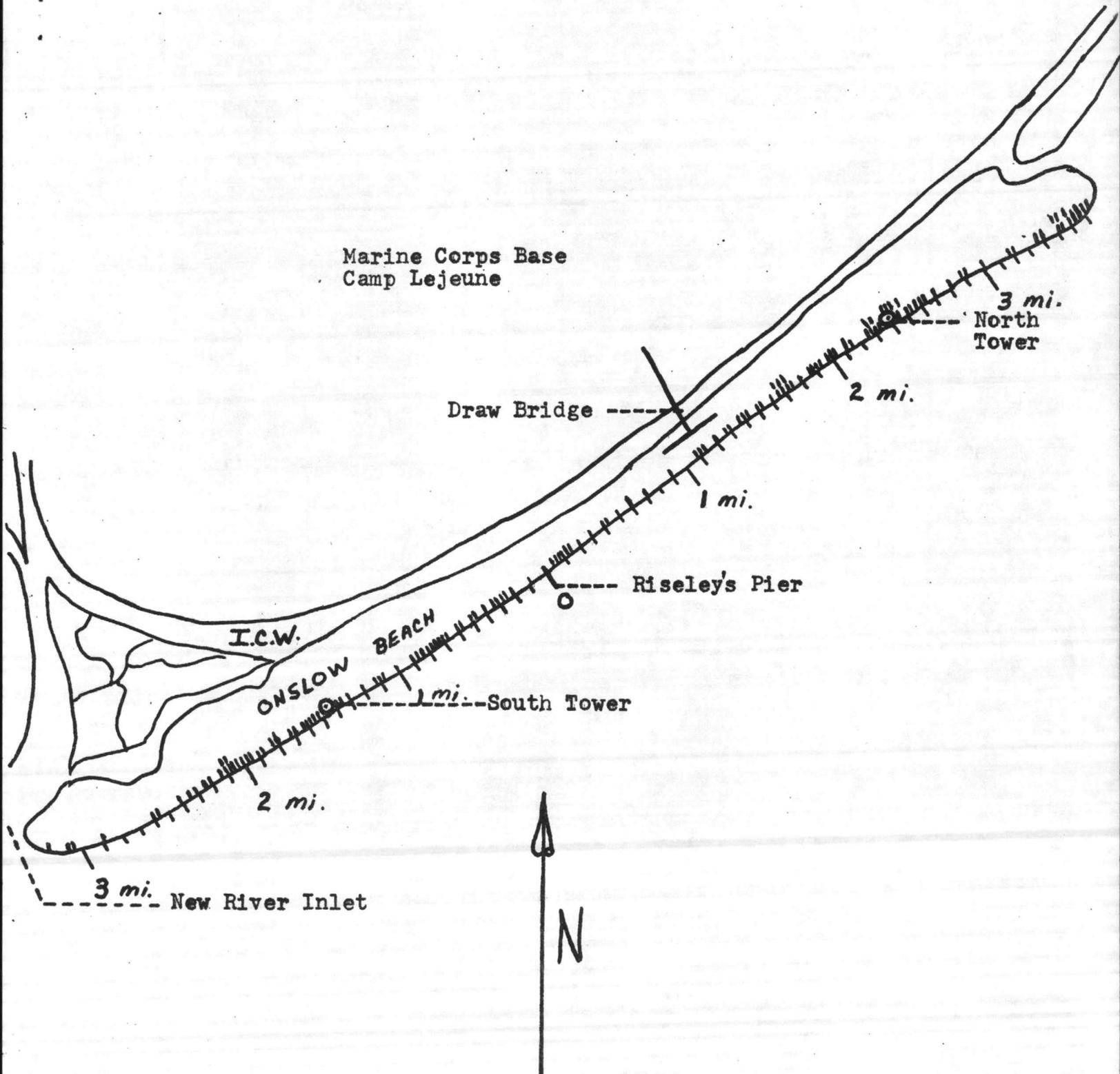


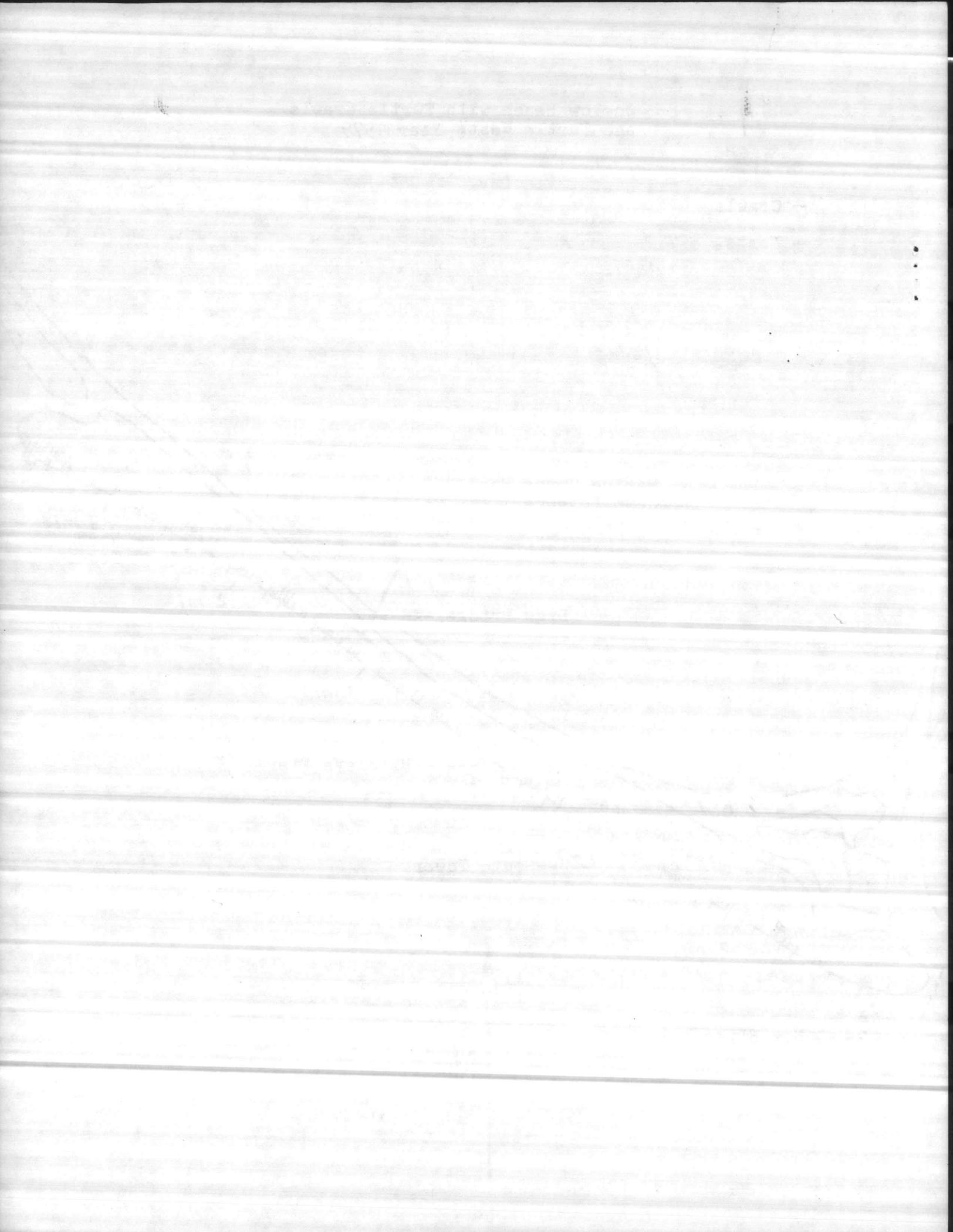
Total turtle nests.

Onslow Beach with Turtle Crawls  
and Turtle Nests Year 1979

- Crawls

- Nests





ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979.

Natural Resources and Environmental Affairs Division

Base Maintenance Department

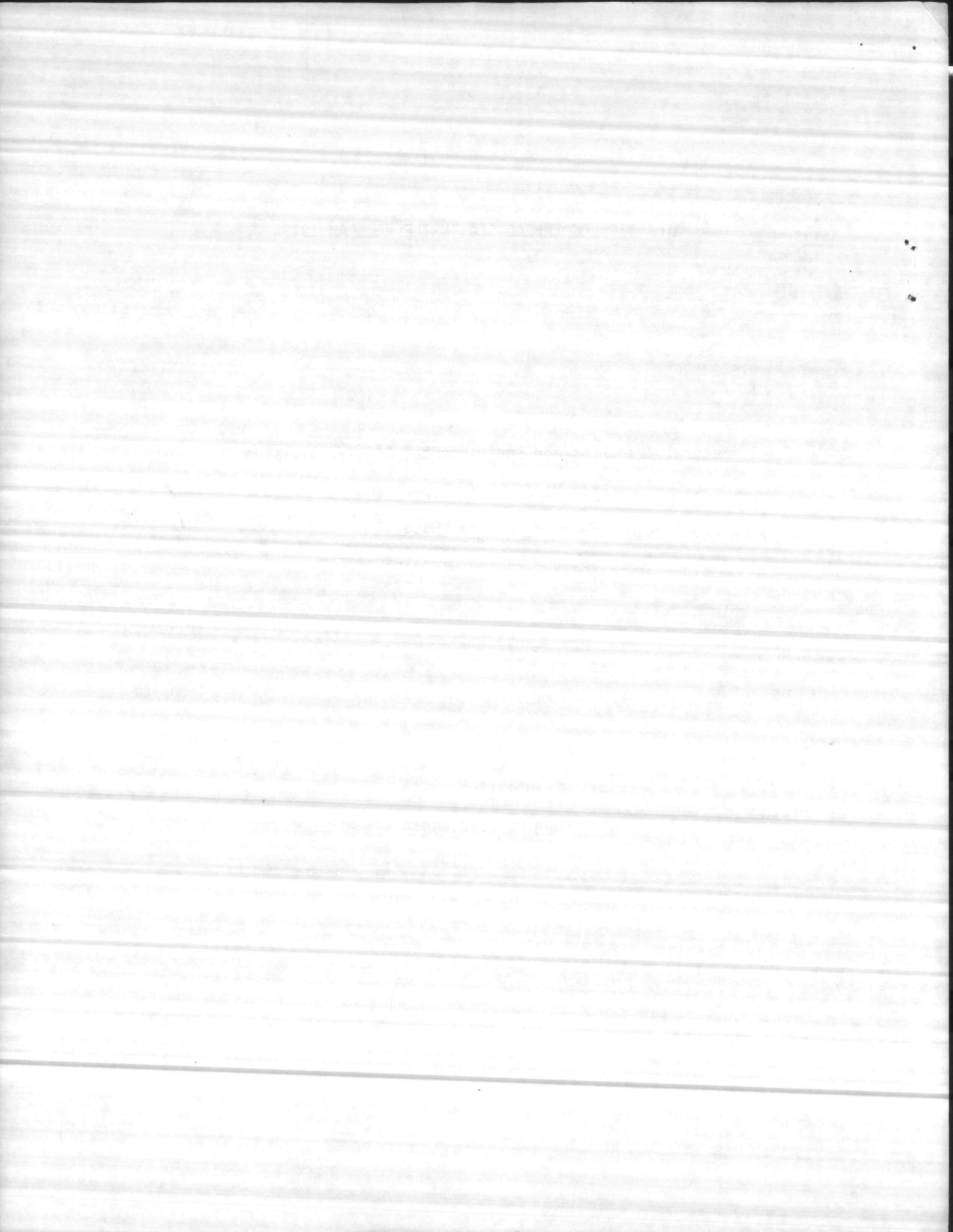
Marine Corps Base

Camp Lejeune, North Carolina 28542

Submitted by

Hugh R. Passingham

November 1979



## BACKGROUND

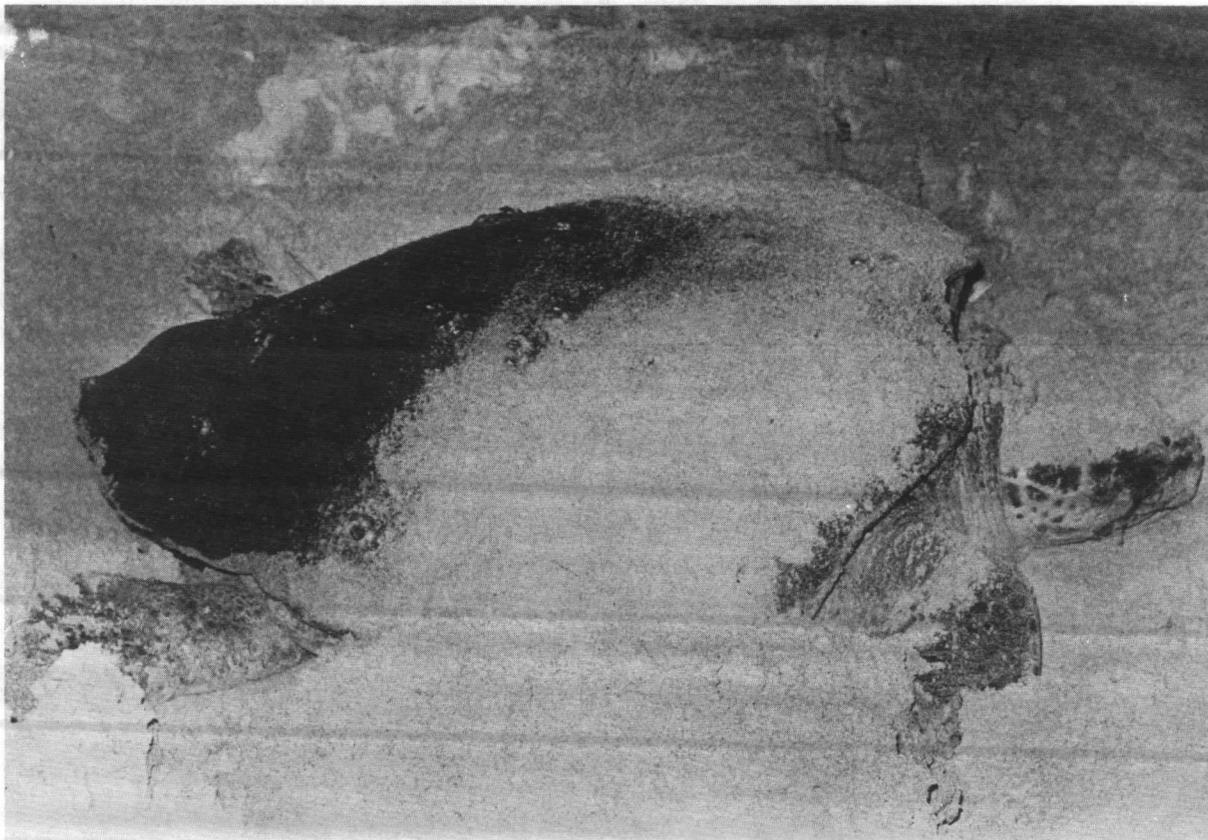
The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered

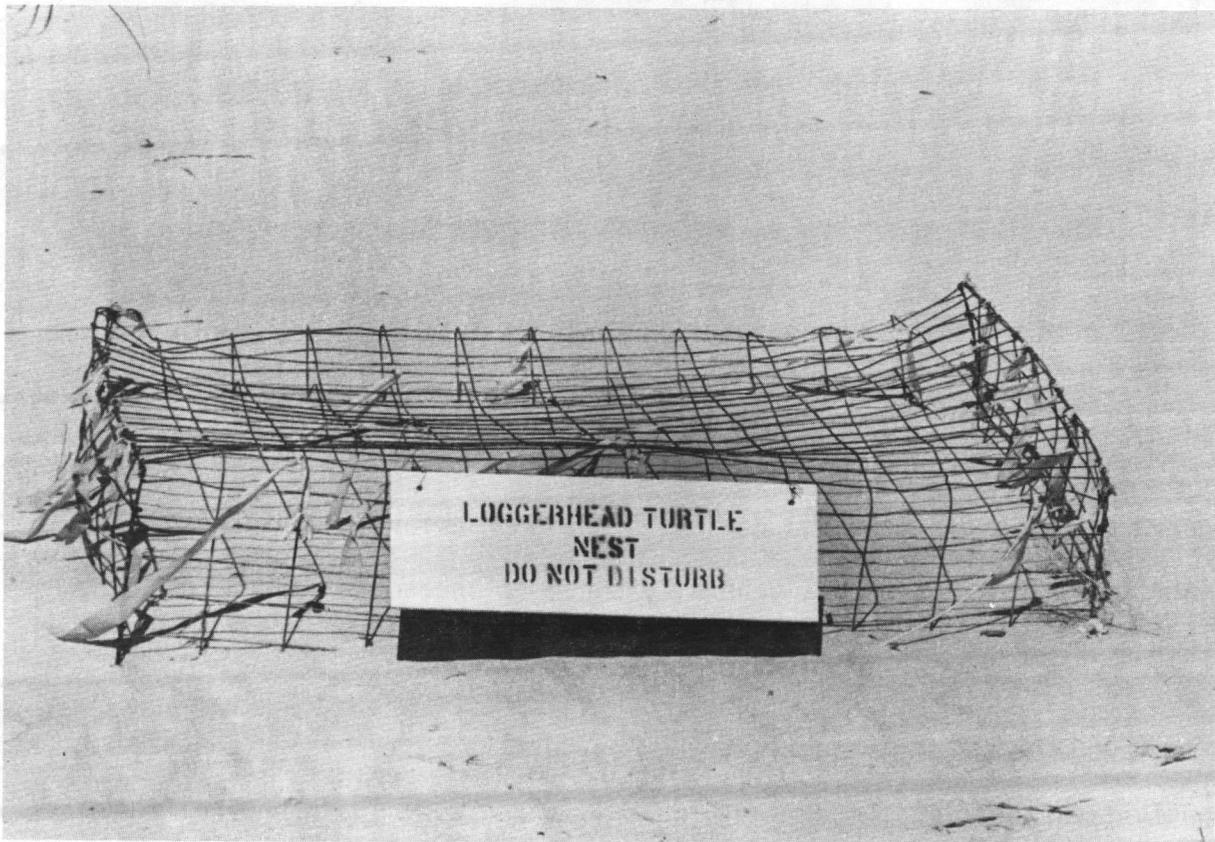
Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Browns Island. The United States Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and it's management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## METHODS

The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

A search was made for turtle tracks or turtles just leaving the surf. If no turtles were located during a patrol, there would be a one-half hour wait before beginning the next patrol. Upon location of turtles, all lights were extinguished until it could be ascertained whether or not the

turtle would nest. After a turtle nested, a numbered tag was attached to a posterior marginal scute. Midway through the nesting season, carapace tags (actually a small disc fish tag) were replaced by live stock ear tags, which were attached on the trailing edge of the right front flipper. During the tagging operation, measurements of the carapace, head, right front and rear flippers and identifying characteristics of each turtle were noted. This data was recorded on the Sea Turtle Inventory (Nesting Data) form (See pages 15 and 16). Nests laid in areas of heavy human use, below the tideline or other seemingly undesirable locations, were relocated, generally at the base of the dunes above the tideline in relatively unused areas of the beach. Nests located in an area extending from Riseley's Pier south approximately two miles to a training observation tower were removed and sent to IMS. These eggs were counted and allowed to hatch under controlled conditions. All other nests, after being located, were protected by burying to a depth of six inches, a four foot square, eighteen inches high cage, made of 2" by 4" electrically welded wire, over the nest. The case was then marked with yellow surveyors plastic tape and a 8" by 20" white sign with red lettering stating "Endangered Wildlife Nest Do Not Disturb." Each nest was tagged using a small plastic tag attached to the protection cage. This tag was marked with the date, nest number, location and number of eggs in the nest. Once a nest was protected, it was checked occasionally until hatch-out of the young was observed. When hatch-out occurred, which was normally from fifty to seventy days, the nest was re-entered and the unhatched eggs were counted. The number of eggs that did not hatch were compared to the total number of eggs for each nest to determine hatching success.

The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter), New River to assist in making sightings and counts of turtle crawls and apparent nest sights along the beach strands of the coastal islands involved in the survey. Flights were not always over the entire coastal area, but were divided into a northern section and a southern section. The northern section included the barrier islands from Onslow Beach to Cape Lookout. The southern section included the barrier islands from Onslow Beach to Smith's "Baldhead" Island. There were nine flights total; four during June and five during July. All flights were made during the prime nesting period before, during and after the full moon for each month (Table II). The data from the aerial surveys was compared to other aerial surveys conducted by Dr. Schwartz of IMS.

### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out any chance of hatch-out of 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

successful nests had an incubation period of sixty days or more. A total of 7,077 eggs were counted from all nests, protected or removed, with a hatch-out of 4,037 for a year's success of 57% (Table III).

Of the sixty-three nests, twenty-six turtles were tagged. Three of these turtles had been previously tagged on Onslow Beach and one had been tagged by the University of Georgia in Athens with the number "NC00020" (Table I).

Other data taken during the nesting season which has some bearing on nesting activity is sea water temperatures, lunar cycle and weather conditions. Graphs I, II and III detail the results of lunar cycle and temperature effects.

#### DISCUSSION

Nesting during June was minimal, probably due to early summer cool temperatures. Once the air and sea water temperatures rose to twenty-two degrees celsius, nesting activity began to increase.

Lunar cycle as evidenced by Graph II seems to have little effect on nesting activity. The tides also had less effect than expected, since turtles were observed to crawl up the beach at all tides, including dead low tides.

Weather had some effect on nesting activity. Crawls were made during rainy weather but very few nests were completed. It seemed that the wetness of the sand discouraged the turtles.

Lights on the beach, especially stationary lights, appeared to have little or no effect on turtles choice of nest sites. Turtles nested often near very well lighted buildings. Moving lights, either vehicular or pedestrian flashlights, caused immediate abortive reactions by nearly all turtles that were approached.

There was one case of nest predation of a protected nest due to technician error. This nest site had two clutches of eggs deposited under one protective cage. The error occurred after one nest was checked for hatching, at which time the cage was improperly replaced allowing space for raccoons to reach through the cage into the nest. Fifteen hatchlings were destroyed in this case.

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artifically incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

Nesting activity seemed to be determined by individual turtle cycles,

not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796, later tagged IMS 26 flipper tag. This turtle returned to the beach after 14 days (July 12 and July 26, 1979). The first clutch was laid on a rainy night at 2215 hours and contained 149 eggs. The second nest was laid on a fair night with good visibility but no moon at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time, and for each nesting the tide was near high.

Several unusual eggs were discovered during the study. Many subnormal size eggs were found. The most unusual eggs were a double and one triple yolk. Both these eggs were transported to IMS where they were artificially incubated. Neither of the unusual eggs hatched.

Hurricane David which passed through the study area in late August 1979 destroyed six nests, inundated six nests and deposited up to eighteen inches of sand over four of the inundated nests. The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. Nest of July 24, 1979 had 123 eggs hatch for 100% hatch out. Another nest, however, under nearly identical conditions and laid on the same day, had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm, no clear conclusions can be drawn. The nests that had sand deposited over them by the storm would have failed completely without human intervention. One nest of 150 eggs laid on July 5, 1979 produced 101 hatchlings for 67.3% success. When this nest was entered, about eighteen inches of sand and matted sargassum weed were removed from

over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page 9. The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

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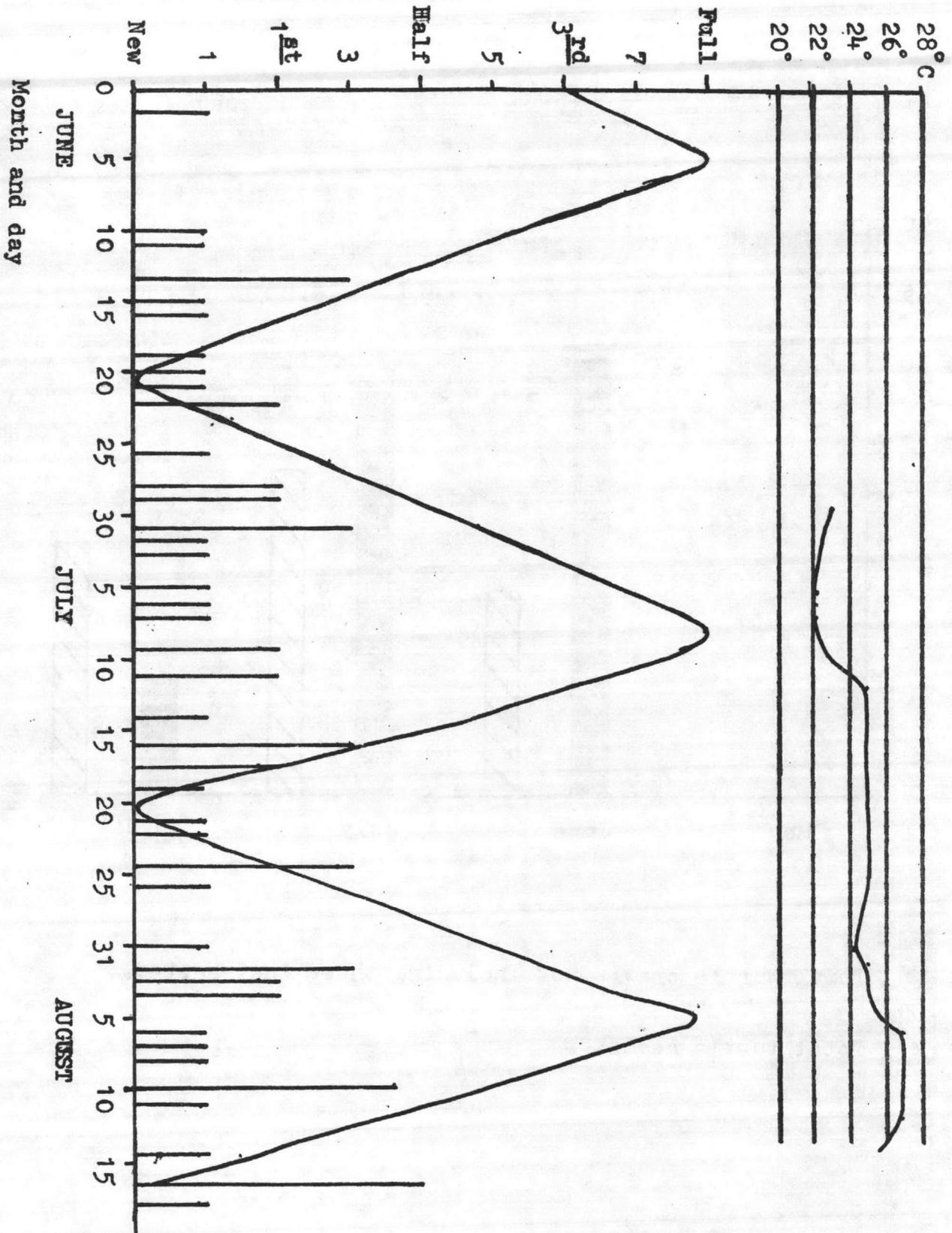
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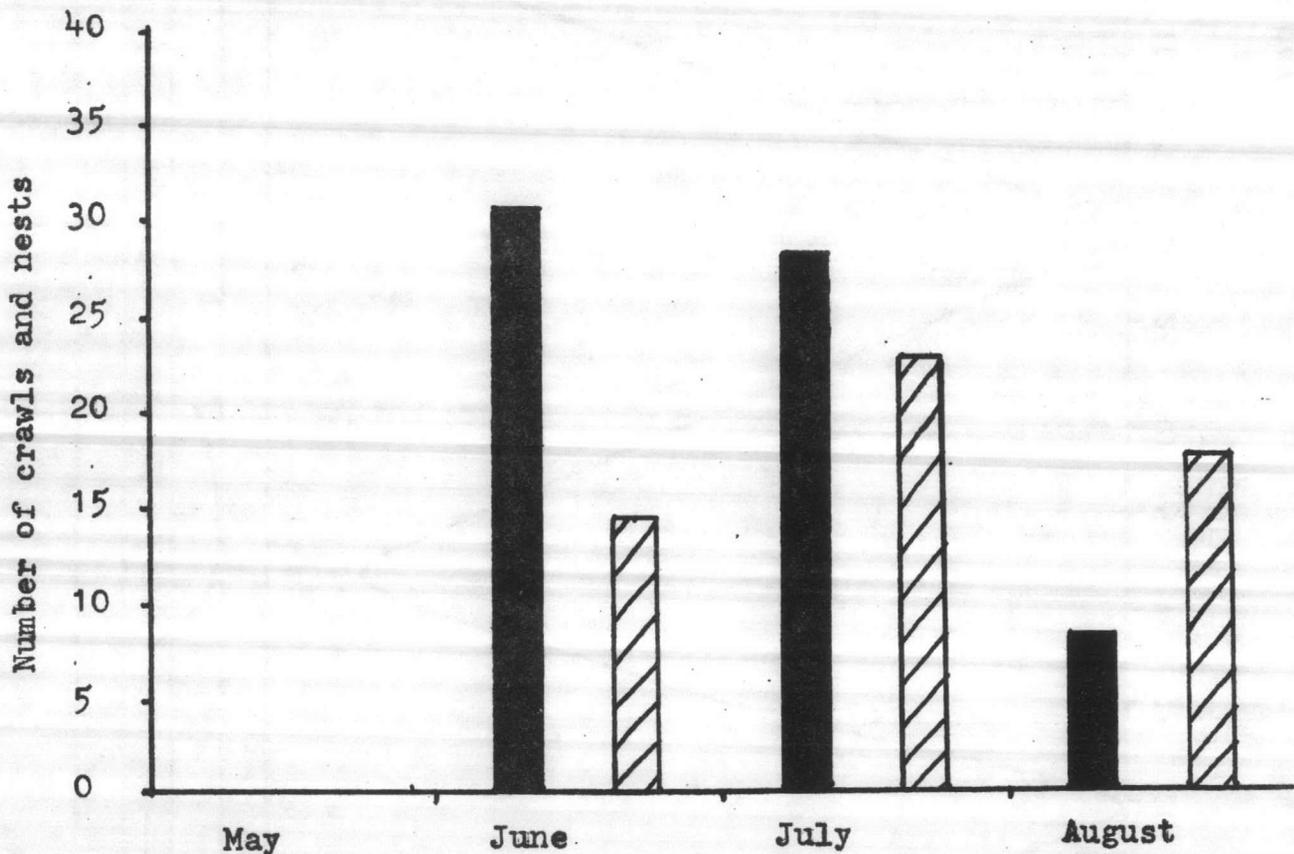
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season



Total turtle crawls not including those that nested.



Total turtle nests.

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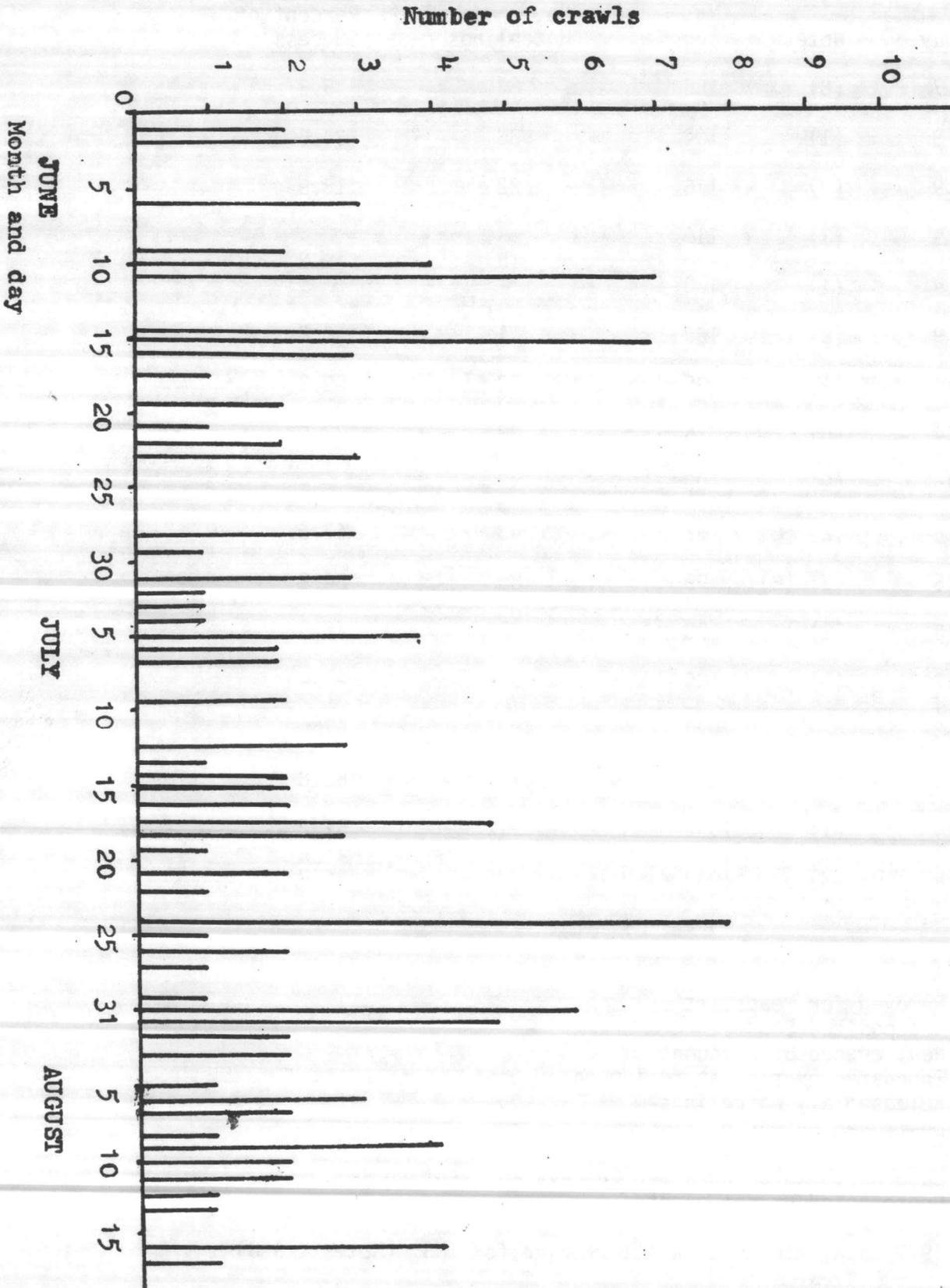
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9	(1)	110	18	8.2
9	(2) (8)	130	1	0.8
11	(1)	125	63	50.2
14	(8)	125	92	73.6
16	(9)	100	- -	- -
16	(2) (8)	92	43	47.5
16	(2) (8)	99	85	84.8
16	(1)	98	75	76.5
17	(9)	100	- -	- -
63	(10)	7077	4037	57
40	(11)	4439	2747	61.8
14	(1)	1595	912	57.2
9	(8)	1043	378	36.2

Note:

- (1) - Removed for Headstart
- (2) - Redeposited Eggs
- (3) - Nest opened by Raccoons
- (4) - Inundated by tide at full moon or David
- (5) - Released all Hatchlings
- (6) - Destroyed by David
- (7) - Double Yolk
- (8) - Late nests taken up after 60 days and sent to IMS
- (9) - Unprotected or not counted
- (10) - 1979 Totals
- (11) - 1979 total minus all nests removed for IMS (Notes 1 & 8)

Graph 1

Turtle crawls including those that ended in nesting



Onslow Beach with Turtle Crawls  
and Turtle Nests Year 1979

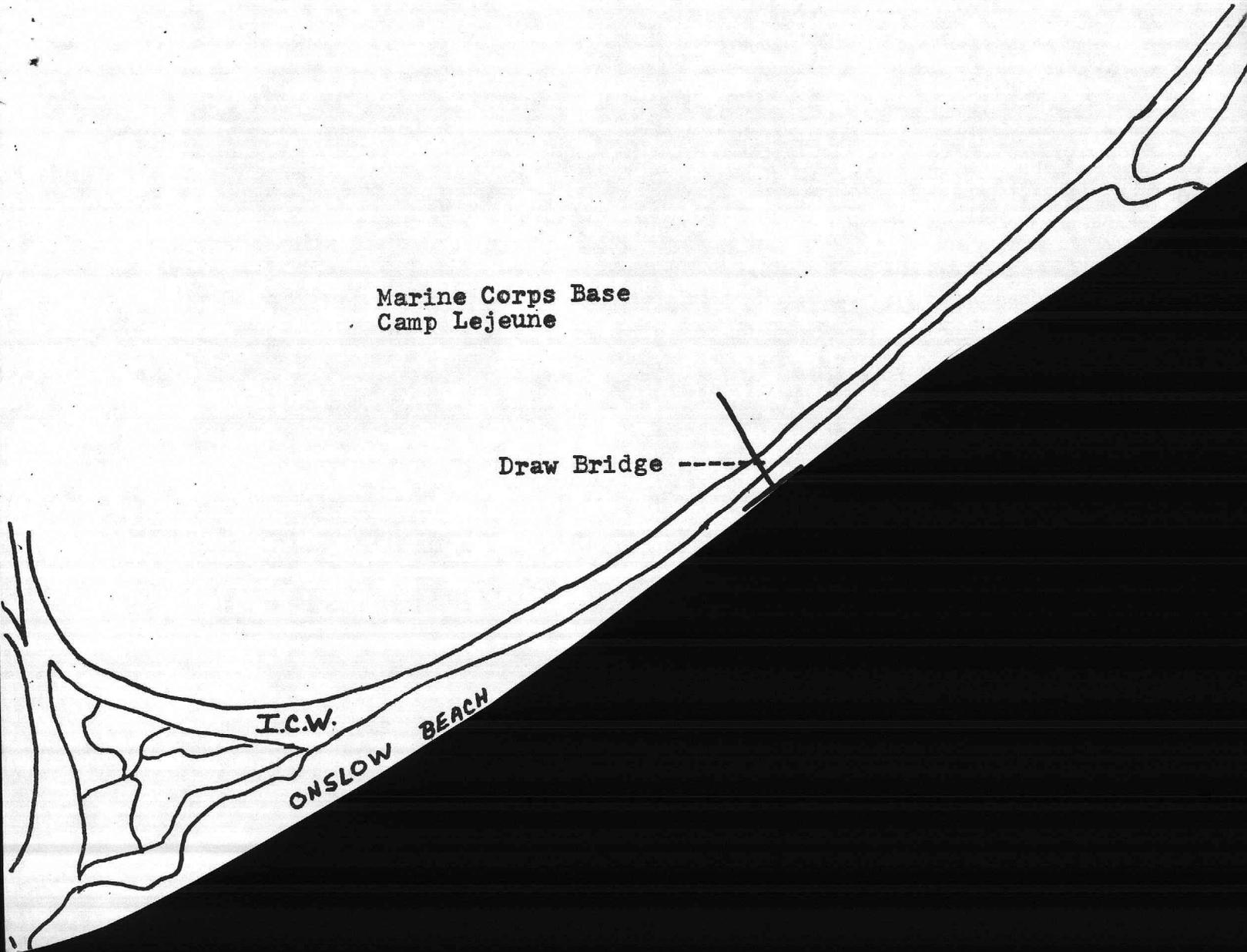
- Crawls
- Nests

Marine Corps Base  
Camp Lejeune

Draw Bridge -----

I.C.W.

ONSLow BEACH





ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979..

Natural Resources and Environmental Affairs Division

Base Maintenance Department

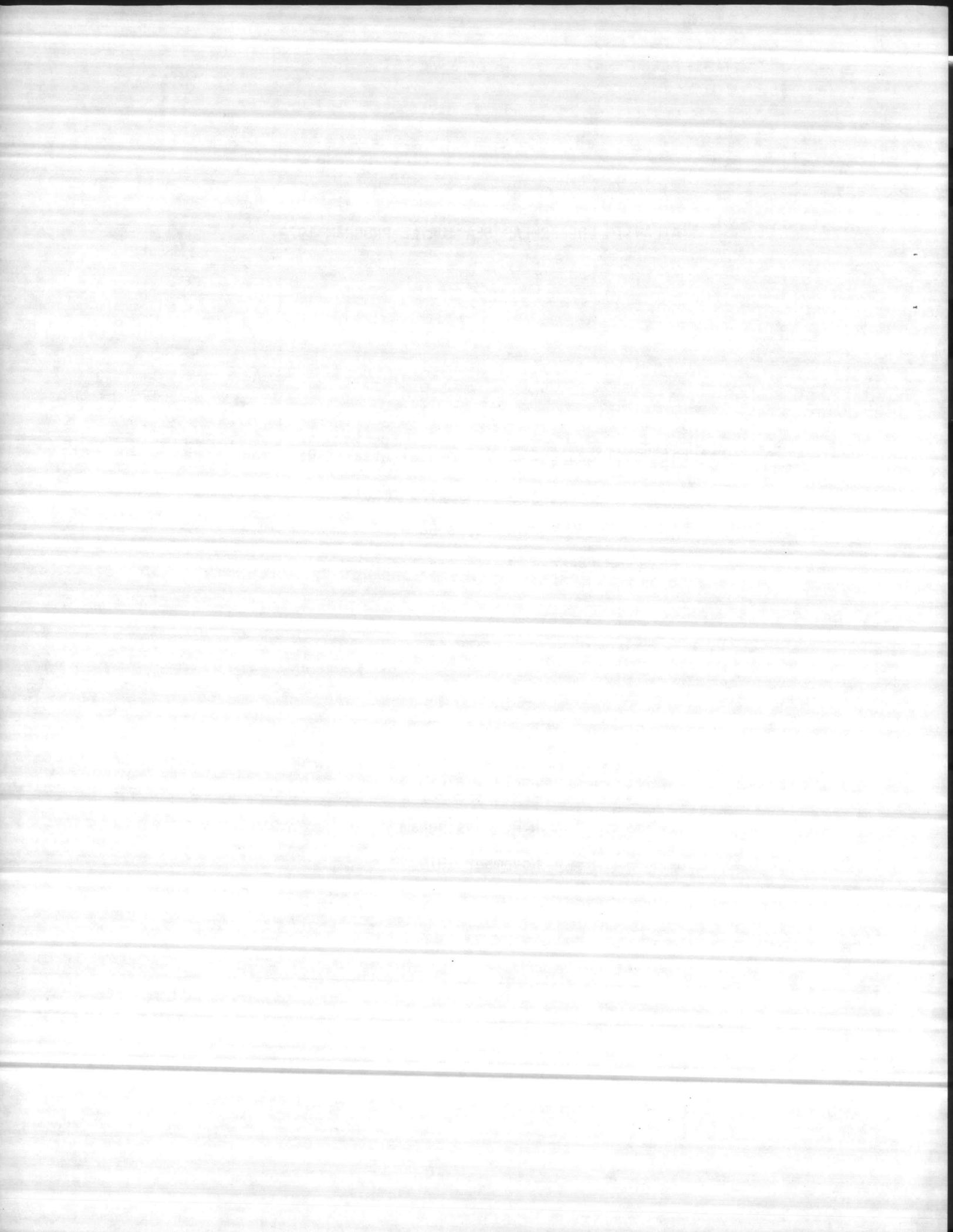
Marine Corps Base

Camp Lejeune, North Carolina 28542

Submitted by

Hugh R. Passingham

November 1979



## BACKGROUND

The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered

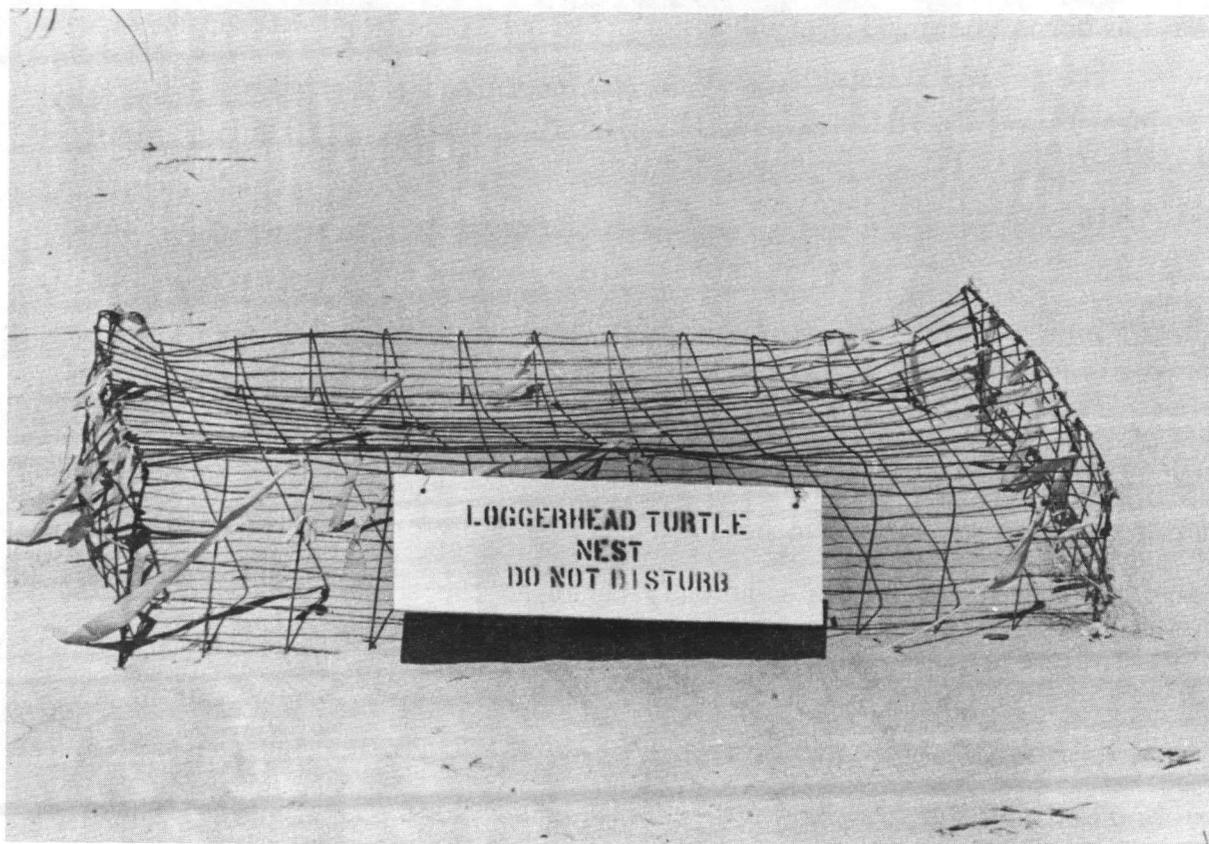
Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Browns Island. The United States Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and it's management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## METHODS

The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

A search was made for turtle tracks or turtles just leaving the surf. If no turtles were located during a patrol, there would be a one-half hour wait before beginning the next patrol. Upon location of turtles, all lights were extinguished until it could be ascertained whether or not the

turtle would nest. After a turtle nested, a numbered tag was attached to a posterior marginal scute. Midway through the nesting season, carapace tags (actually a small disc fish tag) were replaced by live stock ear tags, which were attached on the trailing edge of the right front flipper. During the tagging operation, measurements of the carapace, head, right front and rear flippers and identifying characteristics of each turtle were noted. This data was recorded on the Sea Turtle Inventory (Nesting Data) form (See pages 15 and 16). Nests laid in areas of heavy human use, below the tideline or other seemingly undesirable locations, were relocated, generally at the base of the dunes above the tideline in relatively unused areas of the beach. Nests located in an area extending from Riseley's Pier south approximately two miles to a training observation tower were removed and sent to IMS. These eggs were counted and allowed to hatch under controlled conditions. All other nests, after being located, were protected by burying to a depth of six inches, a four foot square, eighteen inches high cage, made of 2" by 4" electrically welded wire, over the nest. The case was then marked with yellow surveyors plastic tape and a 8" by 20" white sign with red lettering stating "Endangered Wildlife Nest Do Not Disturb." Each nest was tagged using a small plastic tag attached to the protection cage. This tag was marked with the date, nest number, location and number of eggs in the nest. Once a nest was protected, it was checked occasionally until hatch-out of the young was observed. When hatch-out occurred, which was normally from fifty to seventy days, the nest was re-entered and the unhatched eggs were counted. The number of eggs that did not hatch were compared to the total number of eggs for each nest to determine hatching success.

The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter), New River to assist in making sightings and counts of turtle crawls and apparent nest sights along the beach strands of the coastal islands involved in the survey. Flights were not always over the entire coastal area, but were divided into a northern section and a southern section. The northern section included the barrier islands from Onslow Beach to Cape Lookout. The southern section included the barrier islands from Onslow Beach to Smith's "Baldhead" Island. There were nine flights total; four during June and five during July. All flights were made during the prime nesting period before, during and after the full moon for each month (Table II). The data from the aerial surveys was compared to other aerial surveys conducted by Dr. Schwartz of IMS.

### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out <sup>much</sup> ~~any~~ chance of ~~hatch-out~~ <sup>survival</sup> ~~of~~ <sup>the nine nests there were 1043 eggs with a hatchout of</sup> 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

successful nests had an incubation period of sixty days or more. A total of 7,077 eggs were counted from all nests, protected or removed, with a hatch-out of 4,037 for a year's success of 57% (Table III).

Of the sixty-three nests, twenty-six turtles were tagged. Three of these turtles had been previously tagged on Onslow Beach and one had been tagged by the University of Georgia in Athens with the number "NC00020" (Table I).

Other data taken during the nesting season which has some bearing on nesting activity is sea water temperatures, lunar cycle and weather conditions. Graphs I, II and III detail the results of lunar cycle and temperature effects.

#### DISCUSSION

Nesting during June was minimal, probably due to early summer cool temperatures. Once the air and sea water temperatures rose to twenty-two degrees celsius, nesting activity began to increase.

Lunar cycle as evidenced by Graph II seems to have little effect on nesting activity. The tides also had less effect than expected, since turtles were observed to crawl up the beach at all tides, including dead low tides.

Weather had some effect on nesting activity. Crawls were made during rainy weather but very few nests were completed. It seemed that the wetness of the sand discouraged the turtles.

Lights on the beach, especially stationary lights, appeared to have little or no effect on turtles choice of nest sites. Turtles nested often near very well lighted buildings. Moving lights, either vehicular or pedestrian flashlights, caused immediate abortive reactions by nearly all turtles that were approached.

There was one case of nest predation of a protected nest due to technician error. This nest site had two clutches of eggs deposited under one protective cage. The error occurred after one nest was checked for hatching, at which time the cage was improperly replaced allowing space for raccoons to reach through the cage into the nest. Fifteen hatchlings were destroyed in this case.

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artificially incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

Nesting activity seemed to be determined by individual turtle cycles,

TABLE I

## GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
May	0	0	0	0	0
June	32	16	14	2	2
July	31	26	19	7*	12**
August	9	21	15	5***	12****

Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

\*\* - Two of the 12 were returns

\*\*\* - (8-6-79) removed, triple yolk egg from protected nest

\*\*\*\* - Three of these turtles previously tagged July 79 on Only Beach - 1 turtle previously tagged by University of Georgia, Athens (#NC0020)

TABLE II

## ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July									
	15		19		20		21		5		6		10*		11**		12***	
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N
Onslow Beach		5		2			3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3					2	2	5	6	5	
Hammock Beach			1	1		2	3						4		3			
Bogue Banks			1	1		1			1				2					
Shackleford Banks																		
Cape Lookout	1						1										2	1
Topsail Island	1	2			3	3					1	4		2	3	4	2	
1st Island																		1
Riches Island																	1	2
Figure 8 Island																		
Wrightsville Beach												1						
Masonborough Island																		
Carolina Beach												2						1
Smith Island											2	8					1	5

## Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
14	(1)	118	100	84.5
14	(2)	135	127	94.1
14		141	98	69.5
15		138	119	86.2
16	(2)	96	57	59.4
19	(2)	106	92	86.8
21	(2)	80	68	85.0
22		98	84	85.7
23		105	86	81.9
26	(2)	150	143	95.3
28	(2)	121	114	94.2
28		136	116	85.9
29	(3)	93	86	92.5
July 1	(1)	92	35	38.1
1	(2) (4)	113	2	1.8
1	(1)	121	68	72.7
2	(4)	121	0	0
3	(2)	151	137	90.7
5	(2)	150	101	67.3
6		133	121	91.0
7	(5) (2)	146	133	91.1
9		108	86	79.6

TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
July 9	(1)	106	101	95.3
12	(5)	109	103	94.5
12	(5)	149	136	91.3
14	(6)	150	0	0
17	(7) (5)	114	106	93.0
17	(5)	113	106	93.8
17	(4)	118	0	0
18	(1)	73	66	90.4
18	(4)	92	3	3.3
19	(2)	101	99	98.0
21	(3)	39	0	0
22	(4)	115	90	78.3
24	(1)	133	113	84.9
24	(2)	159	76	47.8
24	(4) (2)	123	123	100
26	(1)	156	24	15.4
31	(1)	123	122	99.2
Aug 1	(6) (2)	109	0	0
1	(8)	105		
1	(2) (6)	109	0	0
2	(2) (6)	92	0	0
2	(2) (6)	105	0	0
3	(2) (8)	99	14	14
3	(2) (6)	97	0	0
6	(8)	124	47	37.3

TABLE III  
SUMMARY OF NESTING ACTIVITIES AND SUCCESS

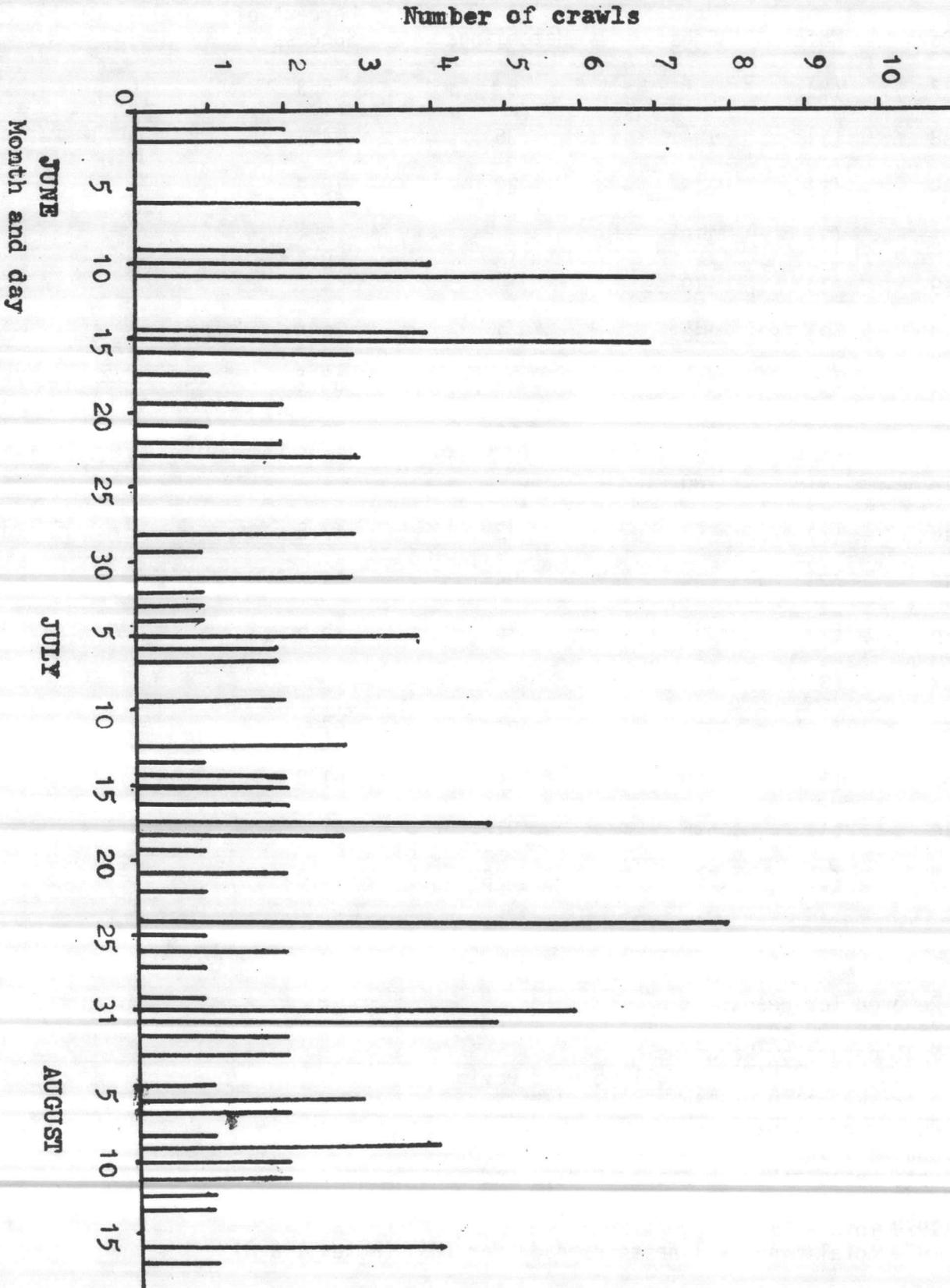
<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
Aug 7	(8)	156	8	5.3
8	(1)	104	36	34.6
9	(8)	116	22	18.9
9	(1)	110		
9	(1)	110	18	8.2
9	(2) (8)	130	1	0.8
11	(1)	125	63	50.2
14	(8)	125	92	73.6
16	(9)	100	- -	- -
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Note:

- (1) - Removed for Headstart
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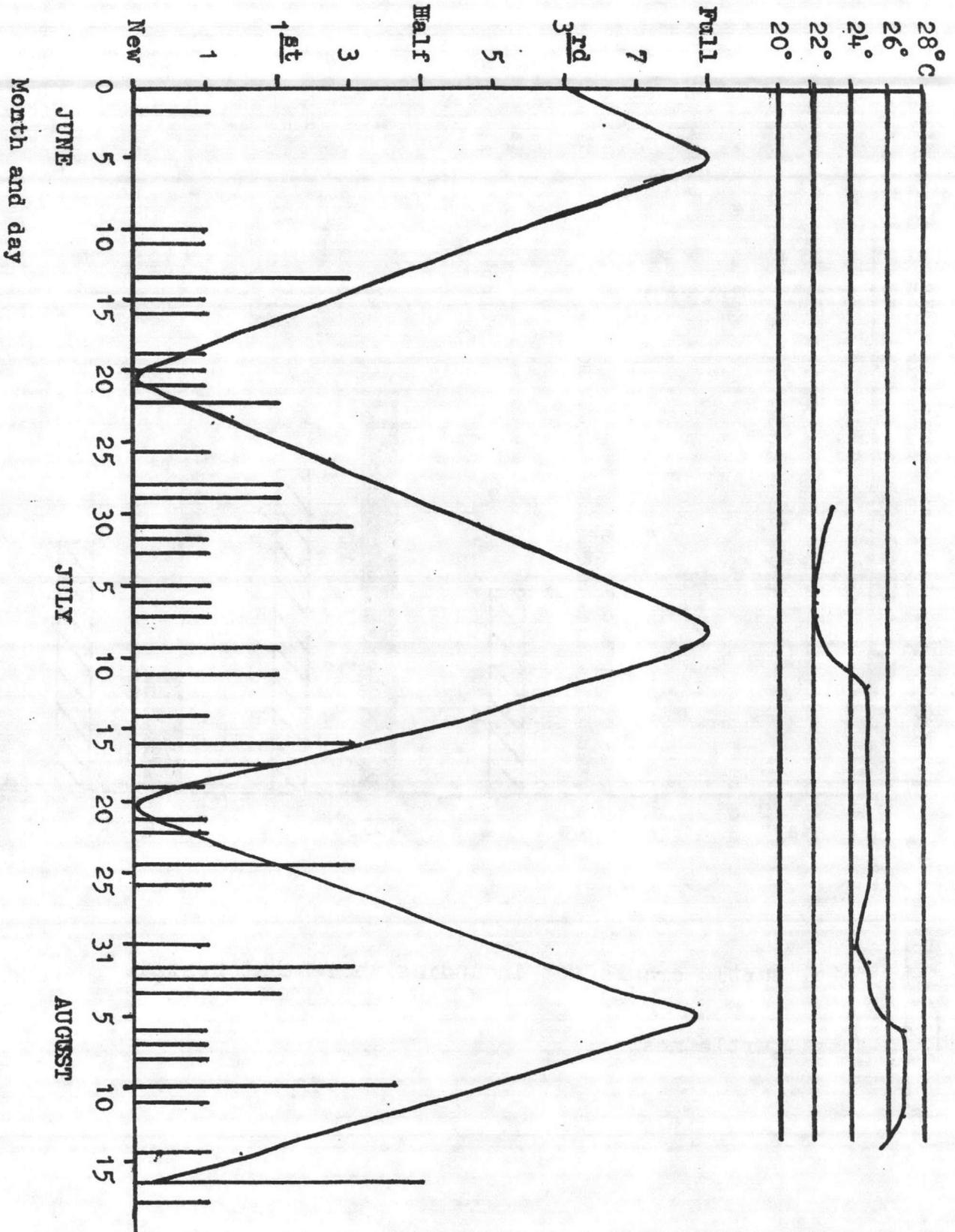
Graph 1

Turtle crawls including those that ended in nesting



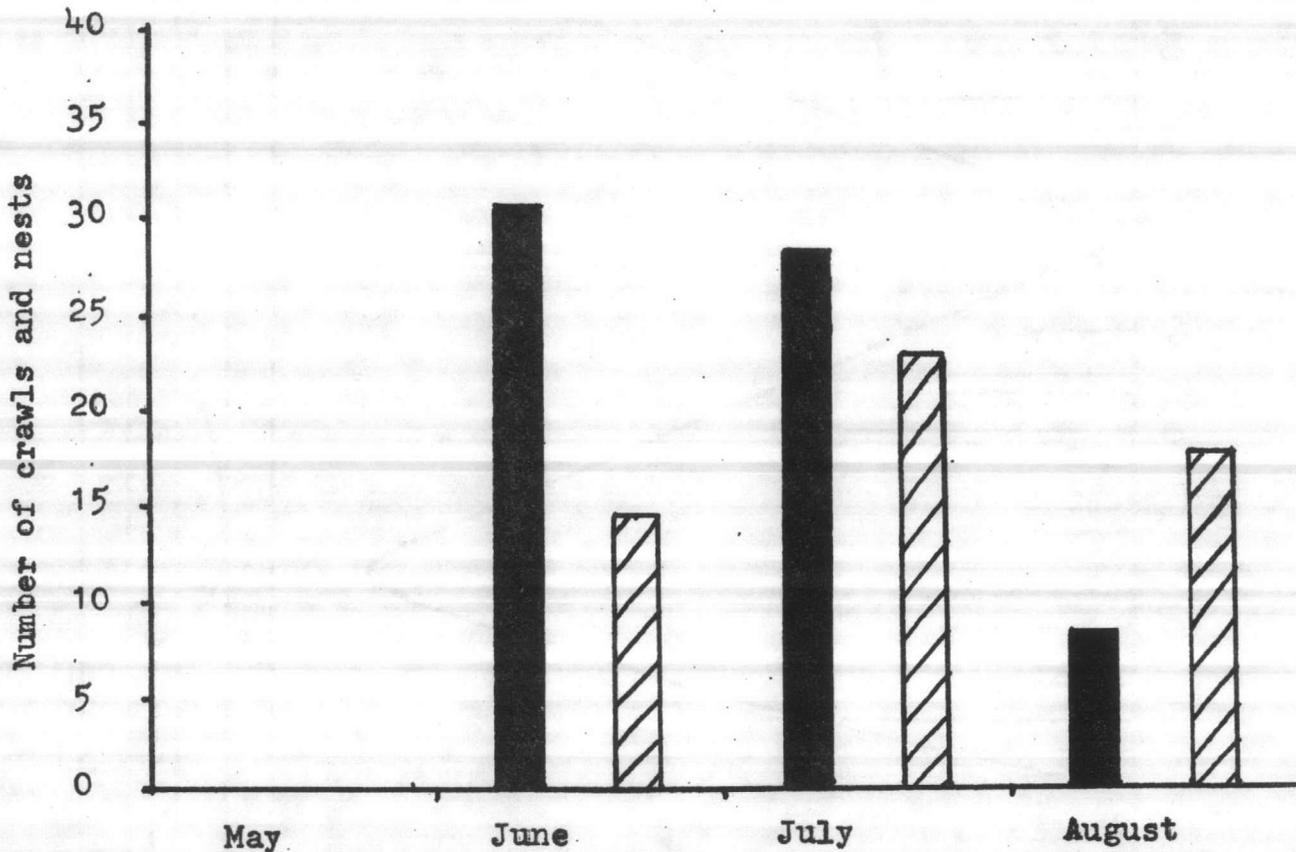
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season



Total turtle crawls not including those that nested.

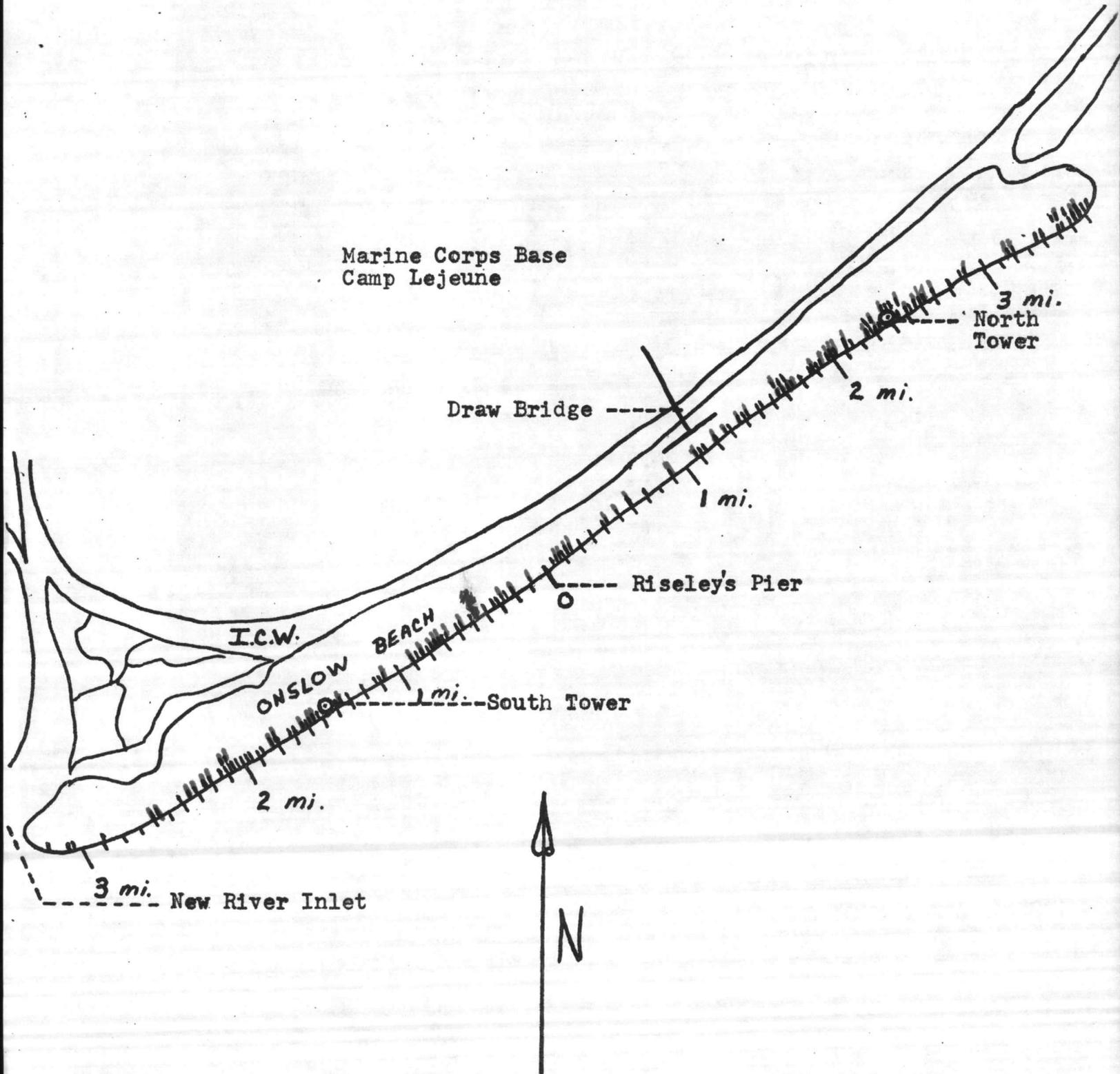


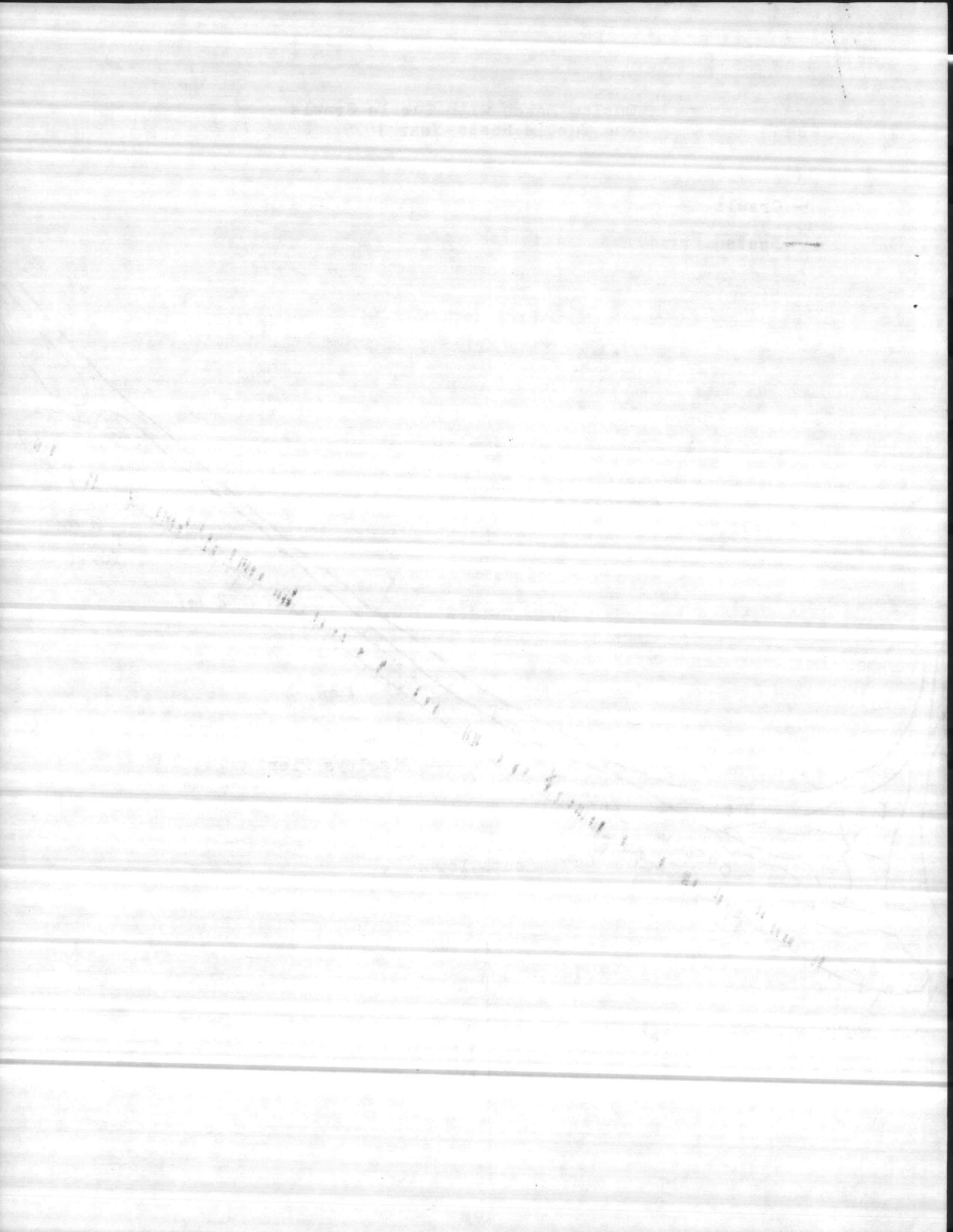
Total turtle nests.

Onslow Beach with Turtle Crawls  
and Turtle Nests Year 1979

— Crawls

— Nests





turtle would nest. After a turtle nested, a numbered tag was attached to a posterior marginal scute. Midway through the nesting season, carapace tags (actually a small disc fish tag) were replaced by live stock ear tags, which were attached on the trailing edge of the right front flipper. During the tagging operation, measurements of the carapace, head, right front and rear flippers and identifying characteristics of each turtle were noted. This data was recorded on the Sea Turtle Inventory (Nesting Data) form (See pages 15 and 16). Nests laid in areas of heavy human use, below the tideline or other seemingly undesirable locations, were relocated, generally at the base of the dunes above the tideline in relatively unused areas of the beach. Nests located in an area extending from Riseley's Pier south approximately two miles to a training observation tower were removed and sent to IMS. These eggs were counted and allowed to hatch under controlled conditions. All other nests, after being located, were protected by burying to a depth of six inches, a four foot square, eighteen inches high cage, made of 2" by 4" electrically welded wire, over the nest. The case was then marked with yellow surveyors plastic tape and a 8" by 20" white sign with red lettering stating "Endangered Wildlife Nest Do Not Disturb." Each nest was tagged using a small plastic tag attached to the protection cage. This tag was marked with the date, nest number, location and number of eggs in the nest. Once a nest was protected, it was checked occasionally until hatch-out of the young was observed. When hatch-out occurred, which was normally from fifty to seventy days, the nest was re-entered and the unhatched eggs were counted. The number of eggs that did not hatch were compared to the total number of eggs for each nest to determine hatching success.

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### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out any chance of hatch-out of 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page . The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796, later tagged IMS 26 flipper tag. This turtle returned to the beach after 14 days (July 12 and July 26, 1979). The first clutch was laid on a rainy night at 2215 hours and contained 149 eggs. The second nest was laid on a fair night with good visibility but no moon at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time, and for each nesting the tide was near high.

Several unusual eggs were discovered during the study. Many subnormal size eggs were found. The most unusual eggs were a double and one triple yolk. Both these eggs were transported to IMS where they were artificially incubated. Neither of the unusual eggs hatched.

Hurricane David which passed through the study area in late August 1979 destroyed six nests, inundated six nests and deposited up to eighteen inches of sand over four of the inundated nests. The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. Nest of July 24, 1979 had 123 eggs hatch for 100% hatch out. Another nest, however, under nearly identical conditions and laid on the same day, had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm, no clear conclusions can be drawn. The nests that had sand deposited over them by the storm would have failed completely without human intervention. One nest of 150 eggs laid on July 5, 1979 produced 101 hatchlings for 67.3% success. When this nest was entered, about eighteen inches of sand and matted sargassum weed were removed from

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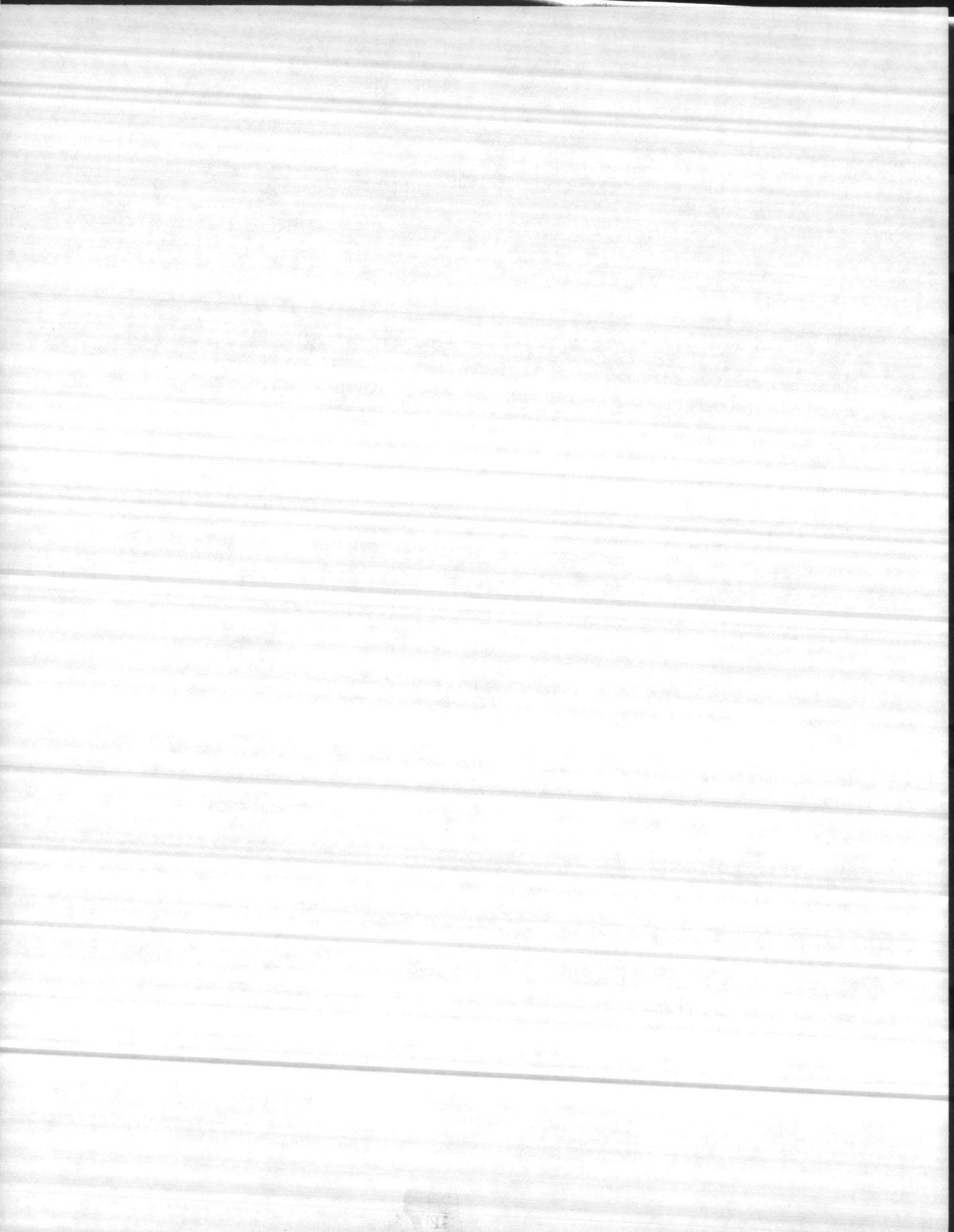
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TABLE III

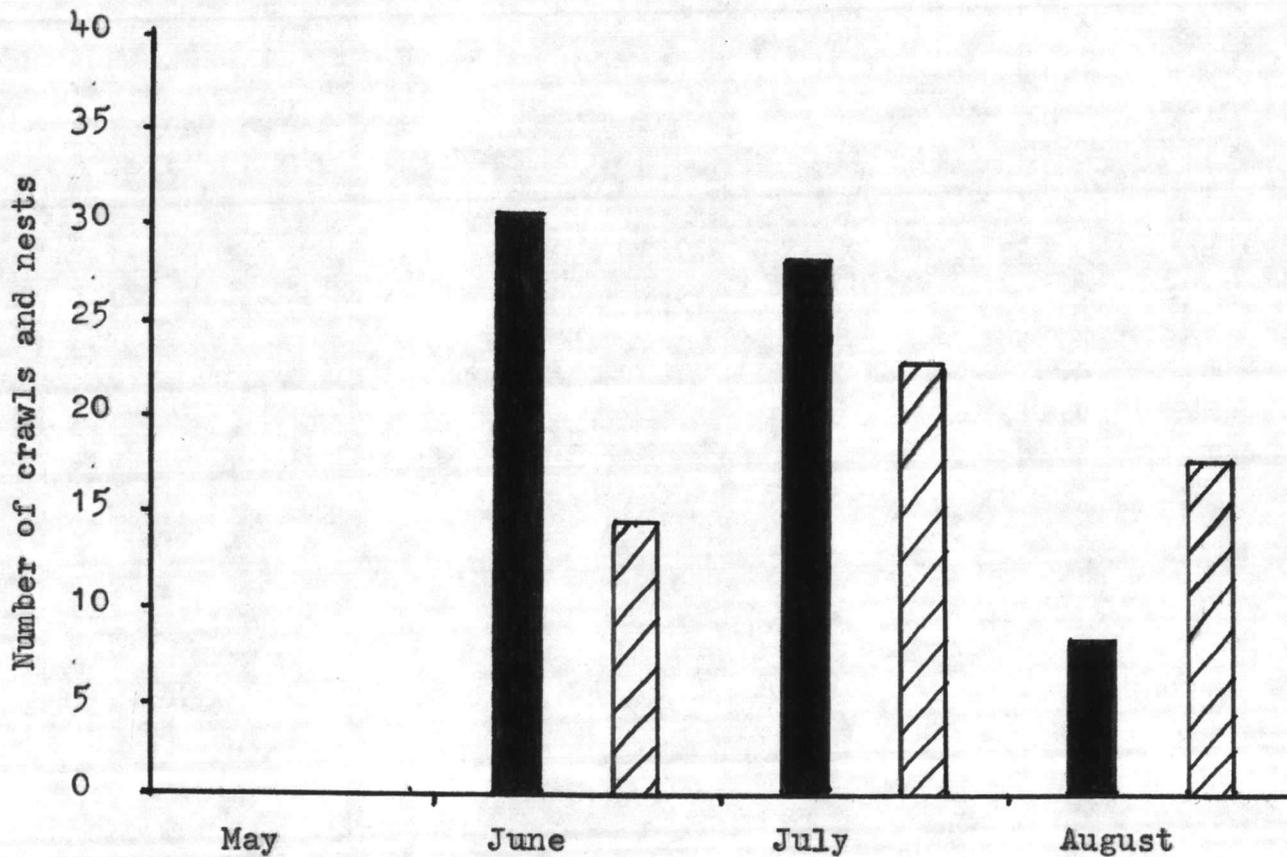
## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
July 9	(1)	106	101	95.3
12	(5)	109	103	94.5
12	(5)	149	136	91.3
14	(6)	150	0	0
17	(7) (5)	114	106	93.0
17	(5)	113	106	93.8
17	(4)	118	0	0
18	(1)	73	66	90.4
18	(4)	92	3	3.3
19	(2)	101	99	98.0
21	(3)	39	0	0
22	(4)	115	90	78.3
24	(1)	133	113	84.9
24	(2)	159	76	47.8
24	(4) (2)	123	123	100
26	(1)	156	24	15.4
31	(1)	123	122	99.2
Aug 1	(6) (2)	109	0	0
1	(8)	105		
1	(2) (6)	109	0	0
2	(2) (6)	92	0	0
2	(2) (6)	105	0	0
3	(2) (8)	99	14	14
3	(2) (6)	97	0	0
6	(8)	124	47	37.3



Graph 3

Turtle crawl activity / nest activity for the entire 1979 nesting season

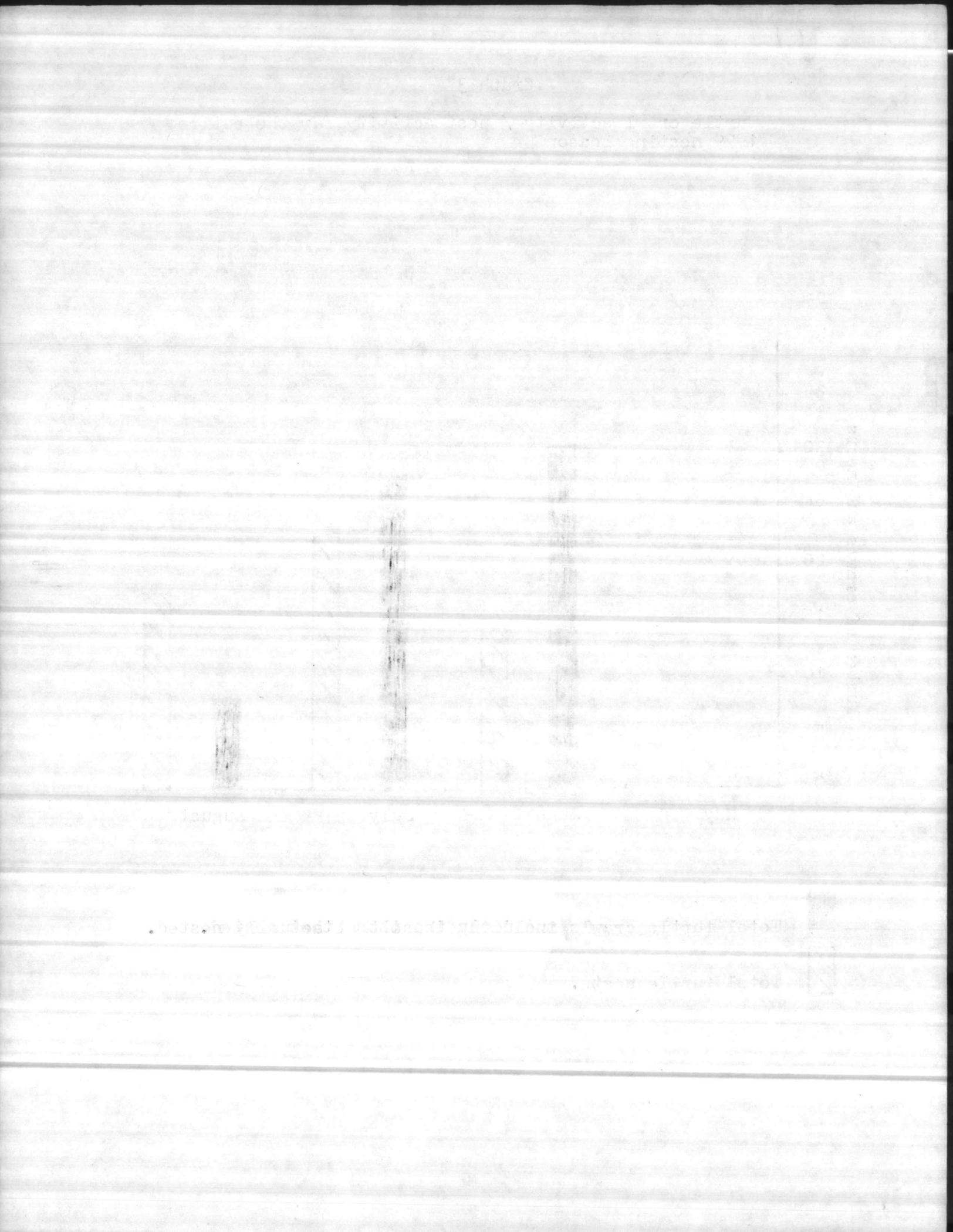


Total turtle crawls not including those that nested.



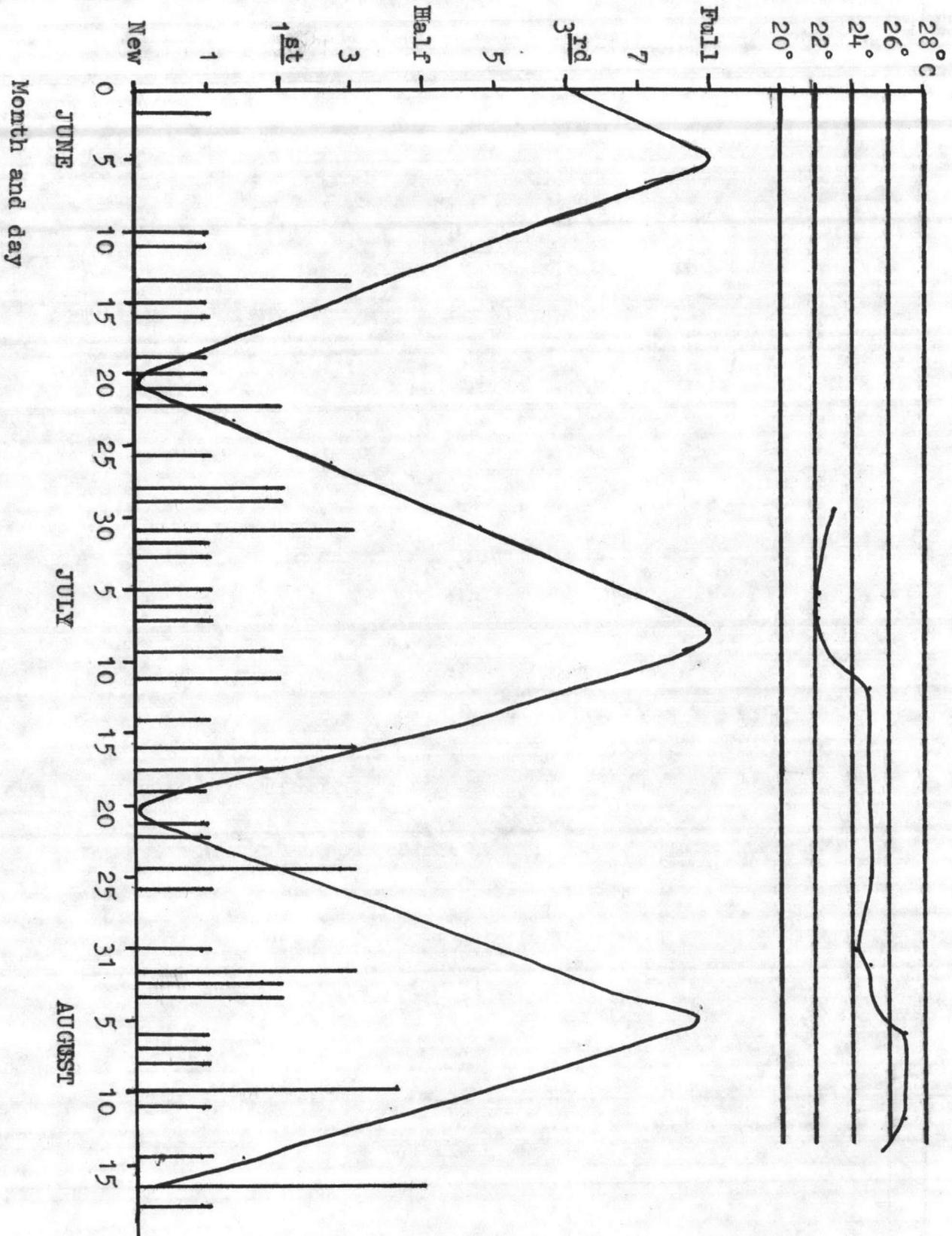
Total turtle nests.

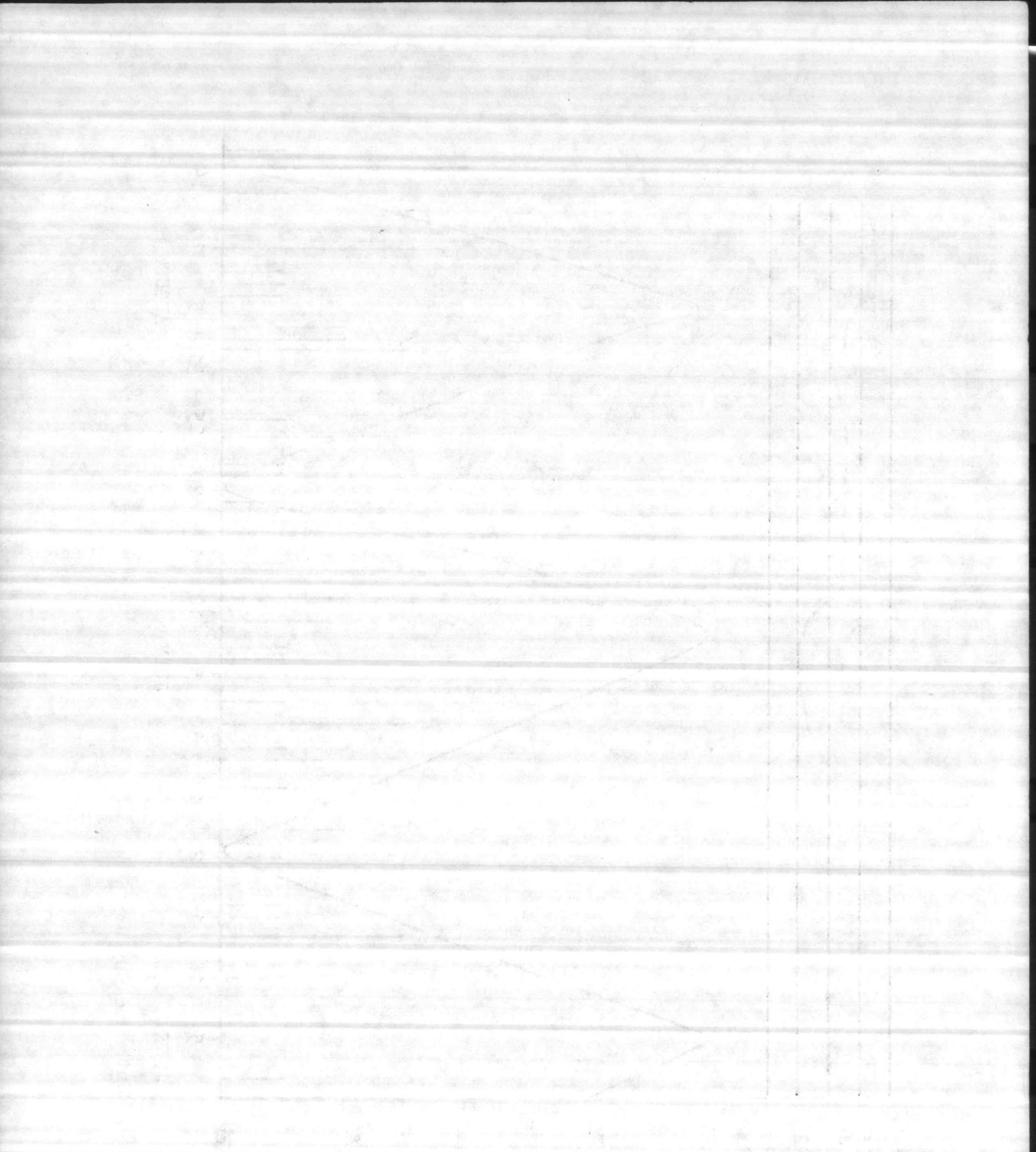
18



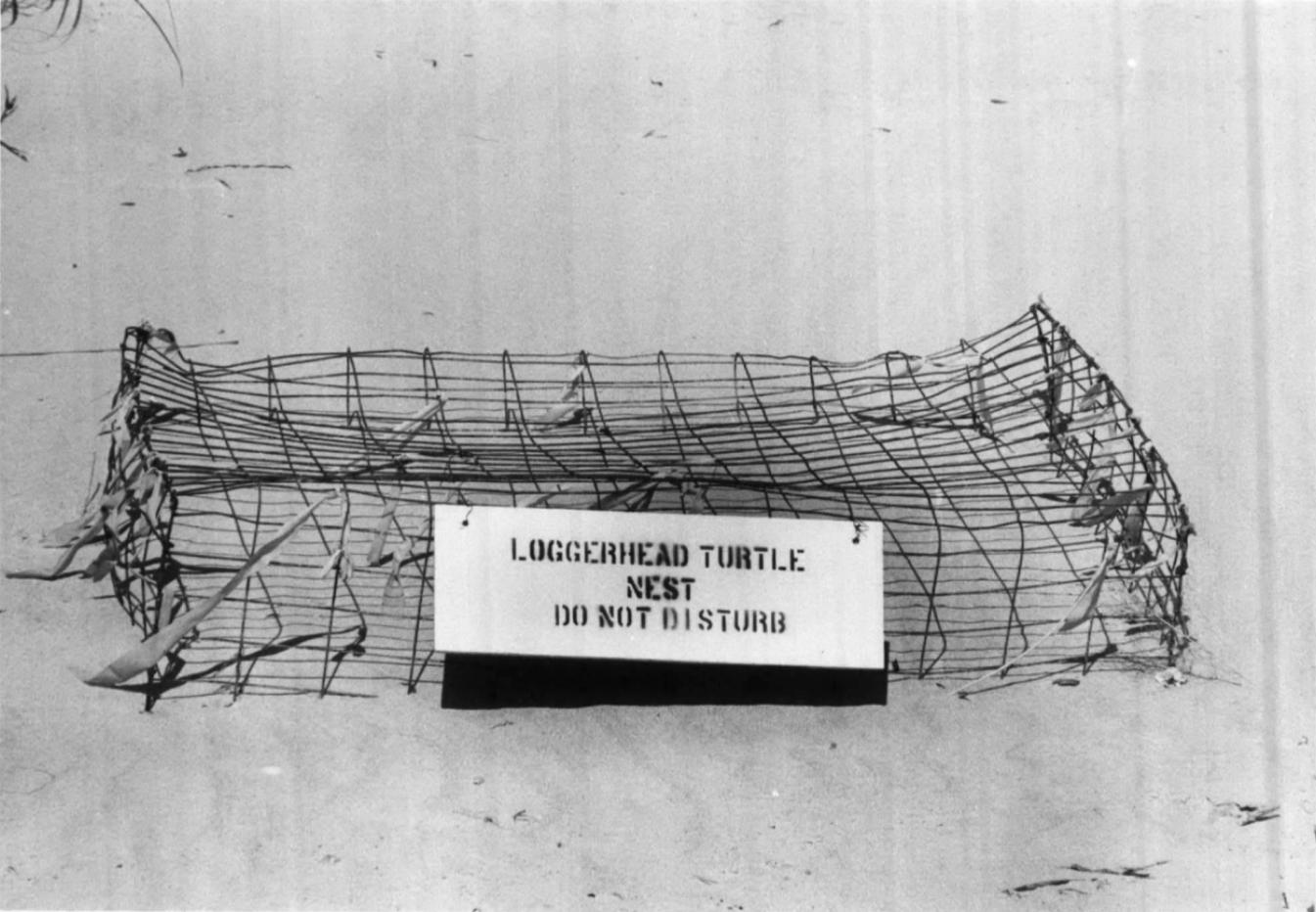
Graph 2

Comparison of water temperature at the surf line, lunar cycle, and number of nests





THE UNIVERSITY OF CHICAGO  
DIVISION OF THE PHYSICAL SCIENCES



**LOGGERHEAD TURTLE  
NEST  
DO NOT DISTURB**

JF19-2

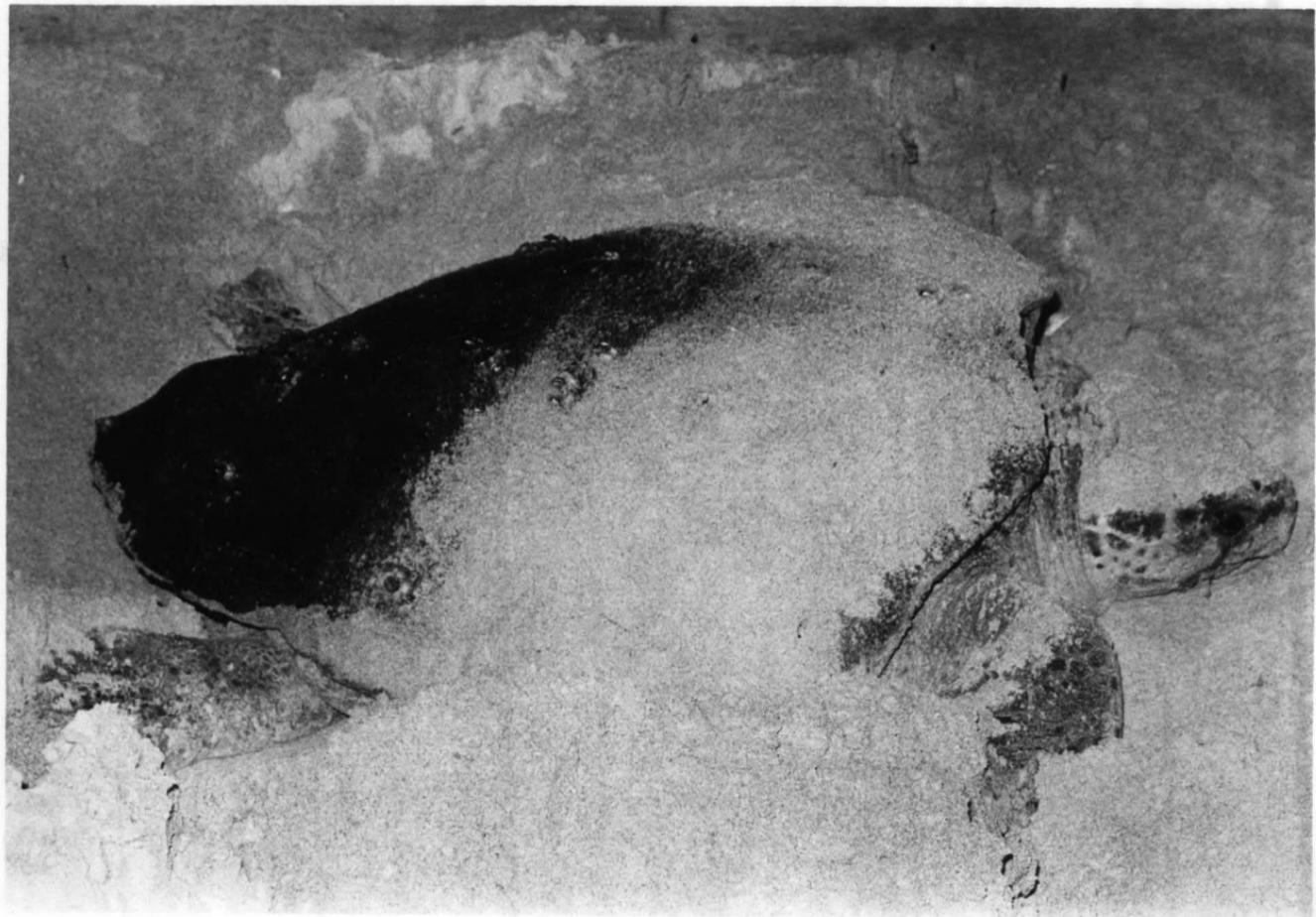


Fig 1  
Photo

79

1900

013

Photo 1



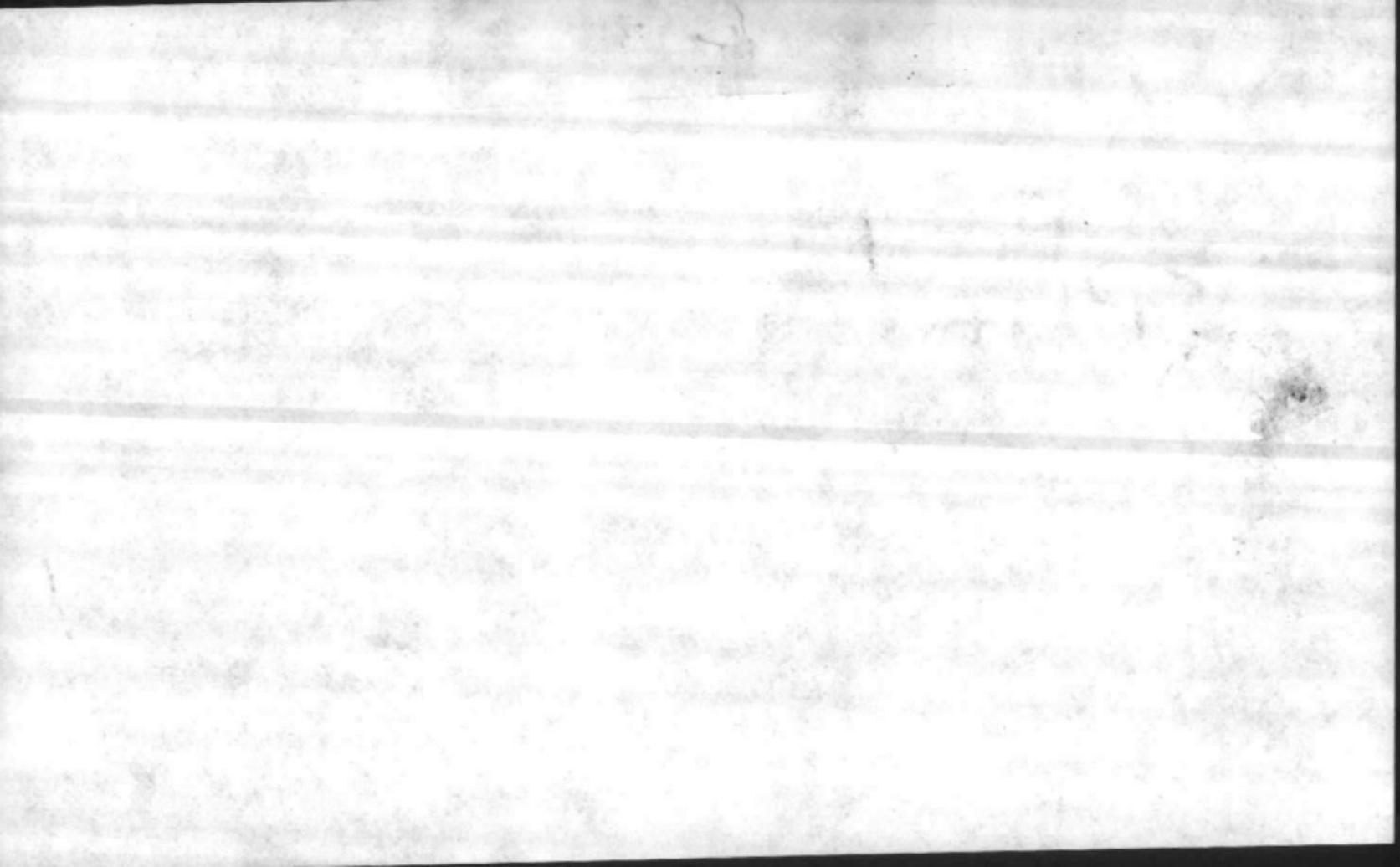
*Photo 1*

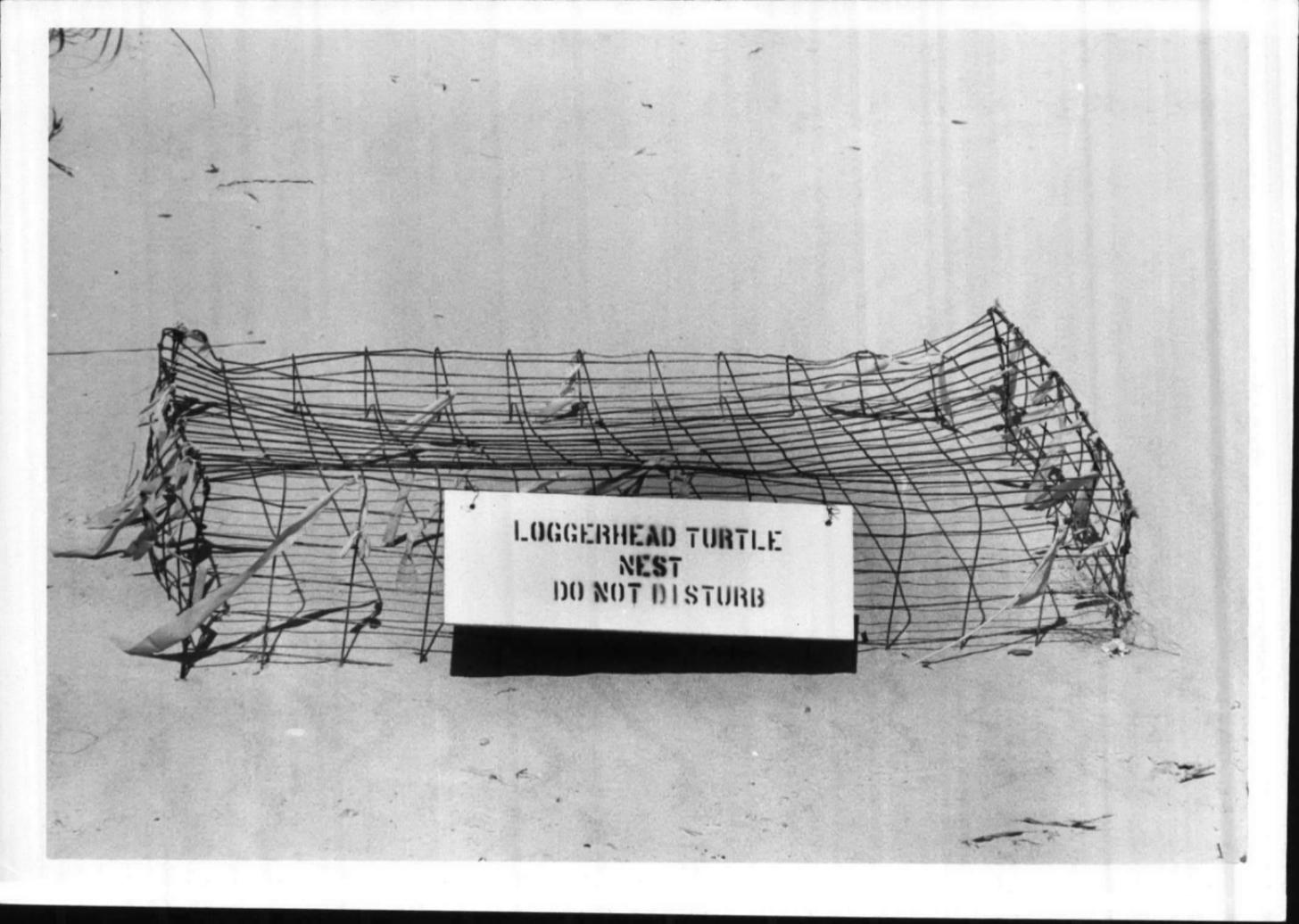
**013**

**1900**

**79**

FIG 1  
Photo





LOGGERHEAD TURTLE  
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JF19-2

*INSTRUCTIONS*

1. USE BLACK RIBBON. ALL LETTERS MUST APPEAR OPEN AND SHARPLY DEFINED.
2. TYPE INSIDE SOLID LINE.
3. FIRST PAGE: START BELOW BROKEN LINE.
4. SUCCEEDING PAGES: **ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979**
5. WHEN NO COMMAND OR ACTIVITY HEADING IS REPRODUCED, THE ENTIRE AREA WITHIN THE SOLID LINE MAY BE USED.

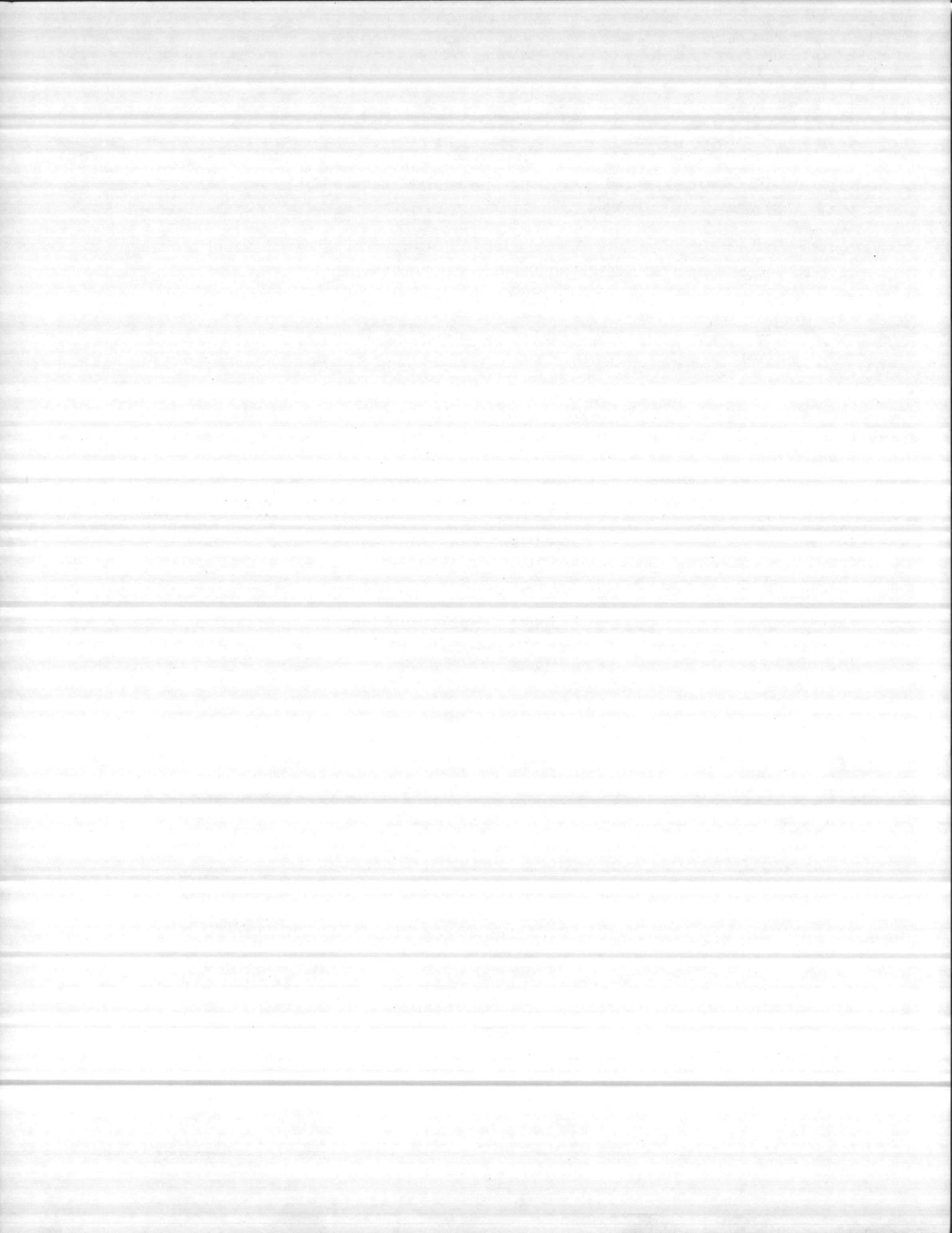
Natural Resources and Environmental Affairs Division  
Base Maintenance Department  
Marine Corps Base  
Camp Lejeune, North Carolina 28542

Submitted by  
Hugh R. Passingham  
November 1979

EVEN PAGE ENCLOSURE IDENTIFICATION

PAGE

ODD PAGE ENCLOSURE IDENTIFICATION

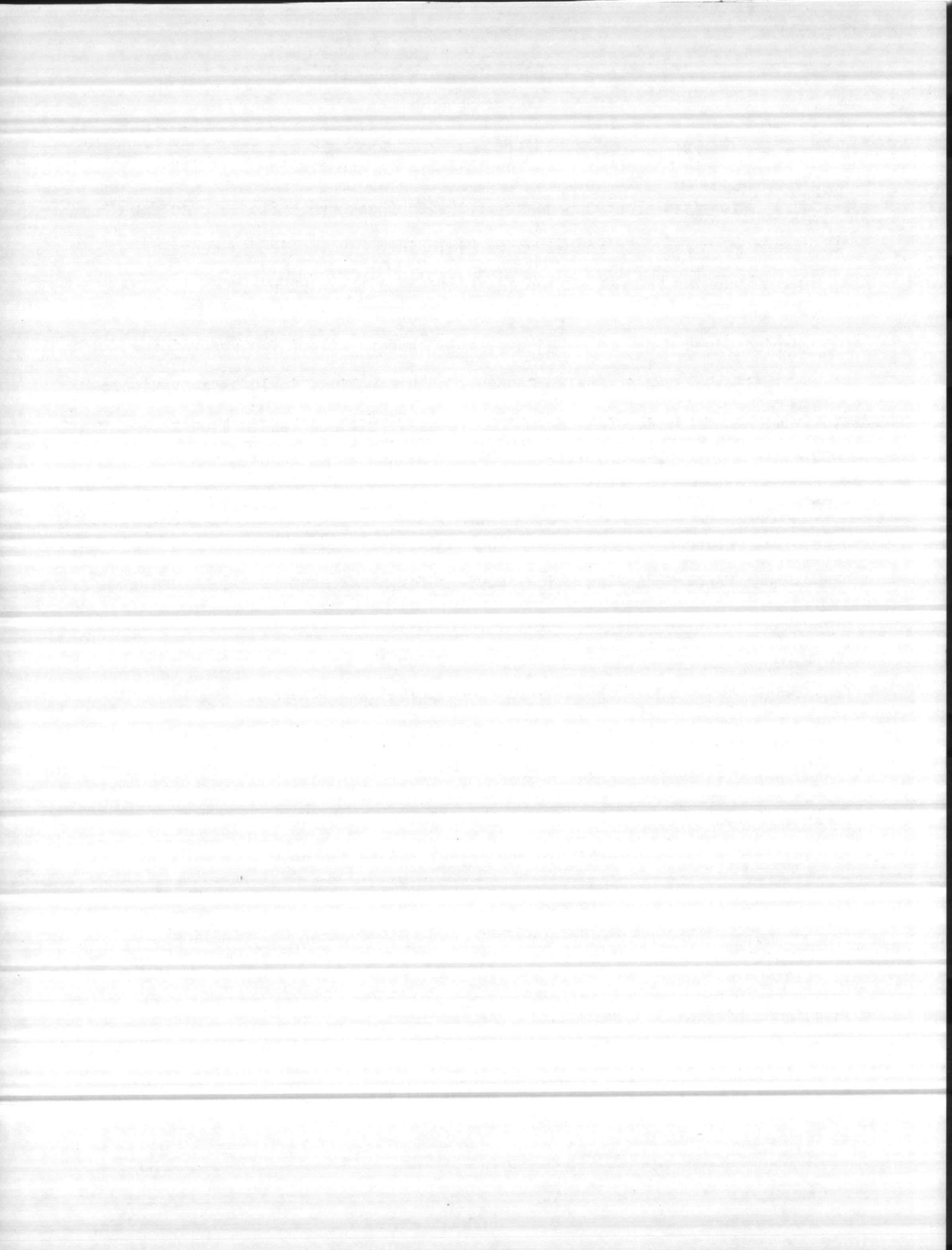


## BACKGROUND

The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of Loggerhead turtles nesting on these shores.

Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

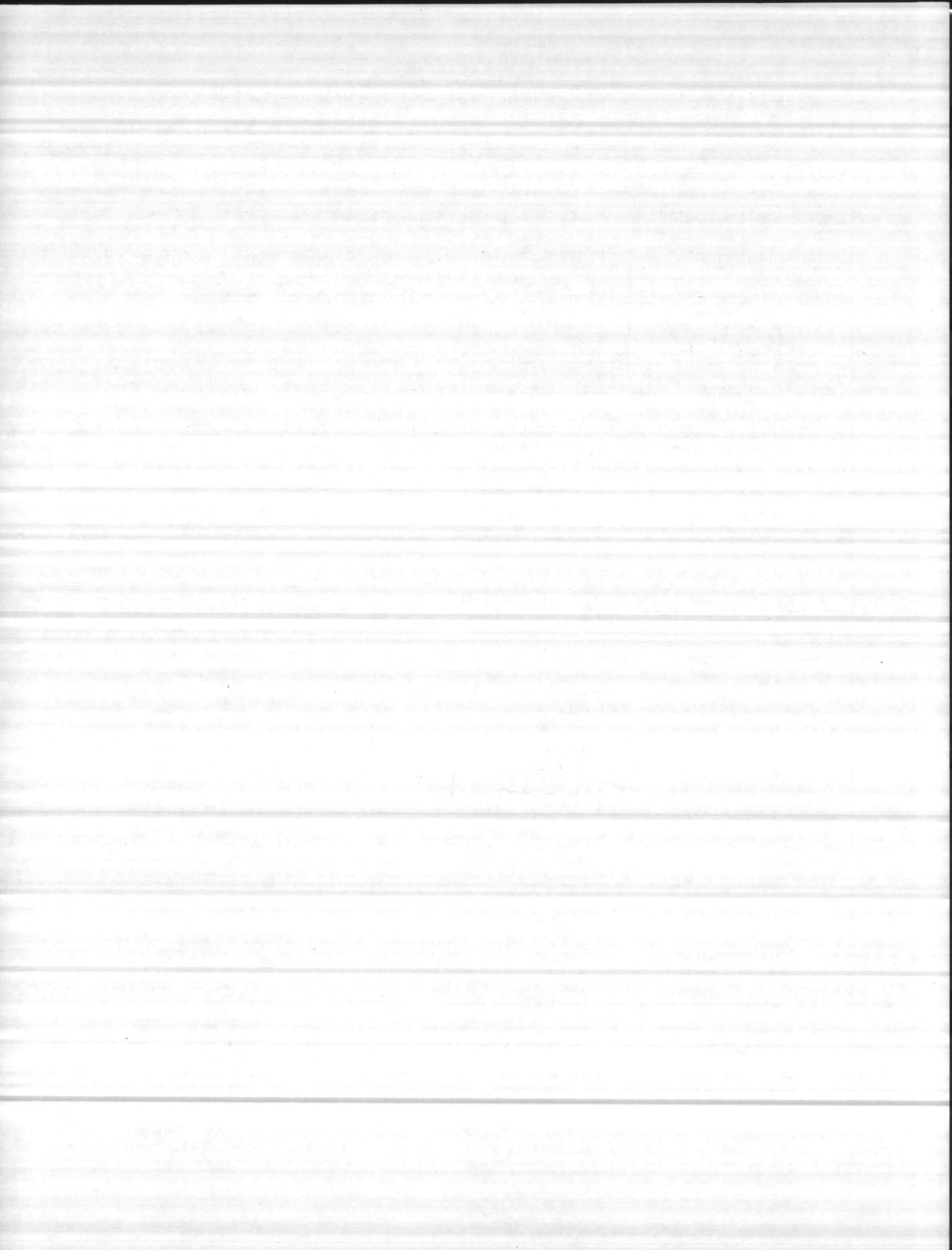
Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered



Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Browns Island. The United States Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.

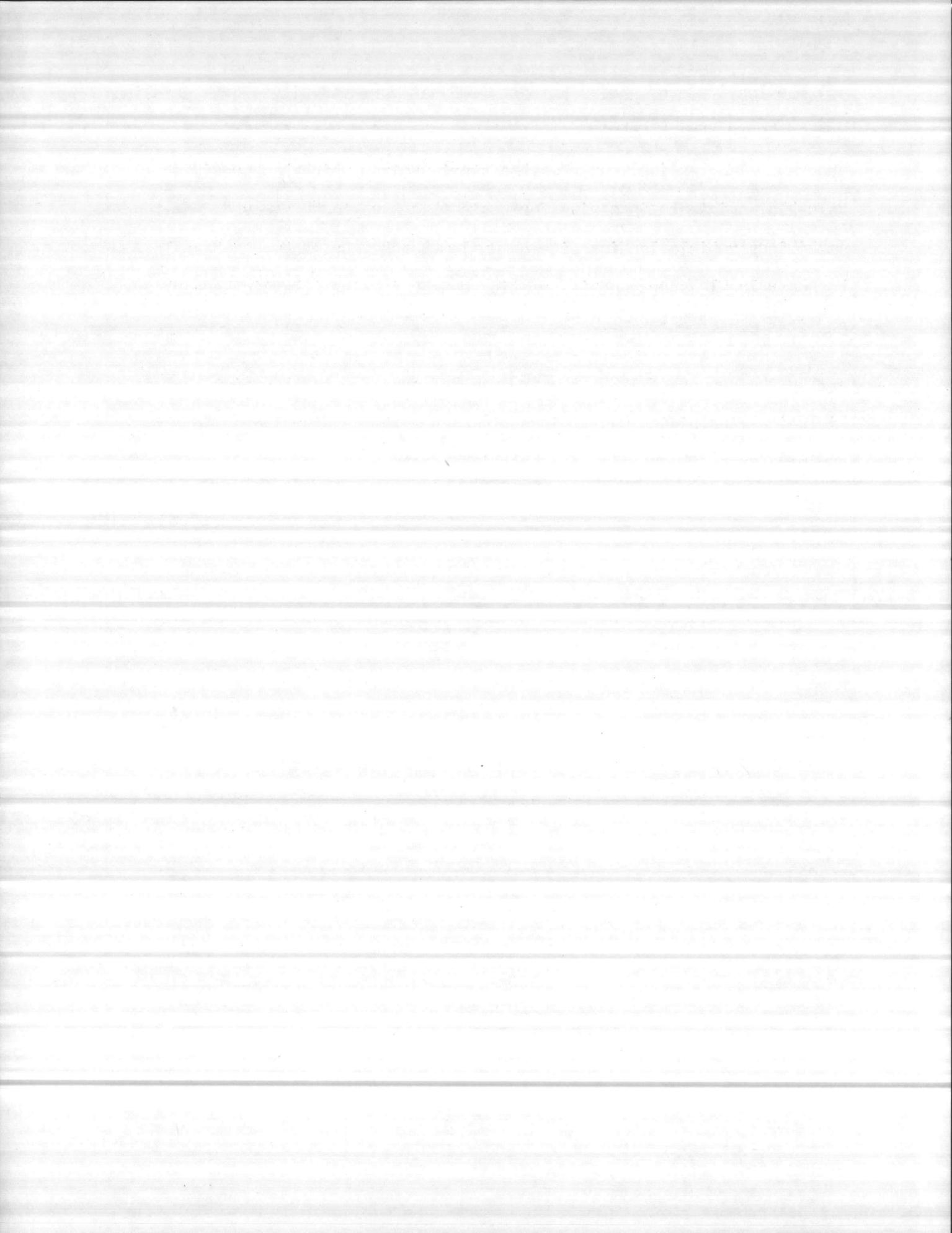
Fig  
Photo 1



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank Schwartz, has shown a keen interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nests that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. Schwartz has also been a valuable source of information concerning the Atlantic Loggerhead and its management.

By the summer of 1979, the program had expanded to the point that a biological technician was employed to assume the sea turtle management program during the nesting and hatching season.

Fig - 2



## STUDY AREA

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## METHODS

The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

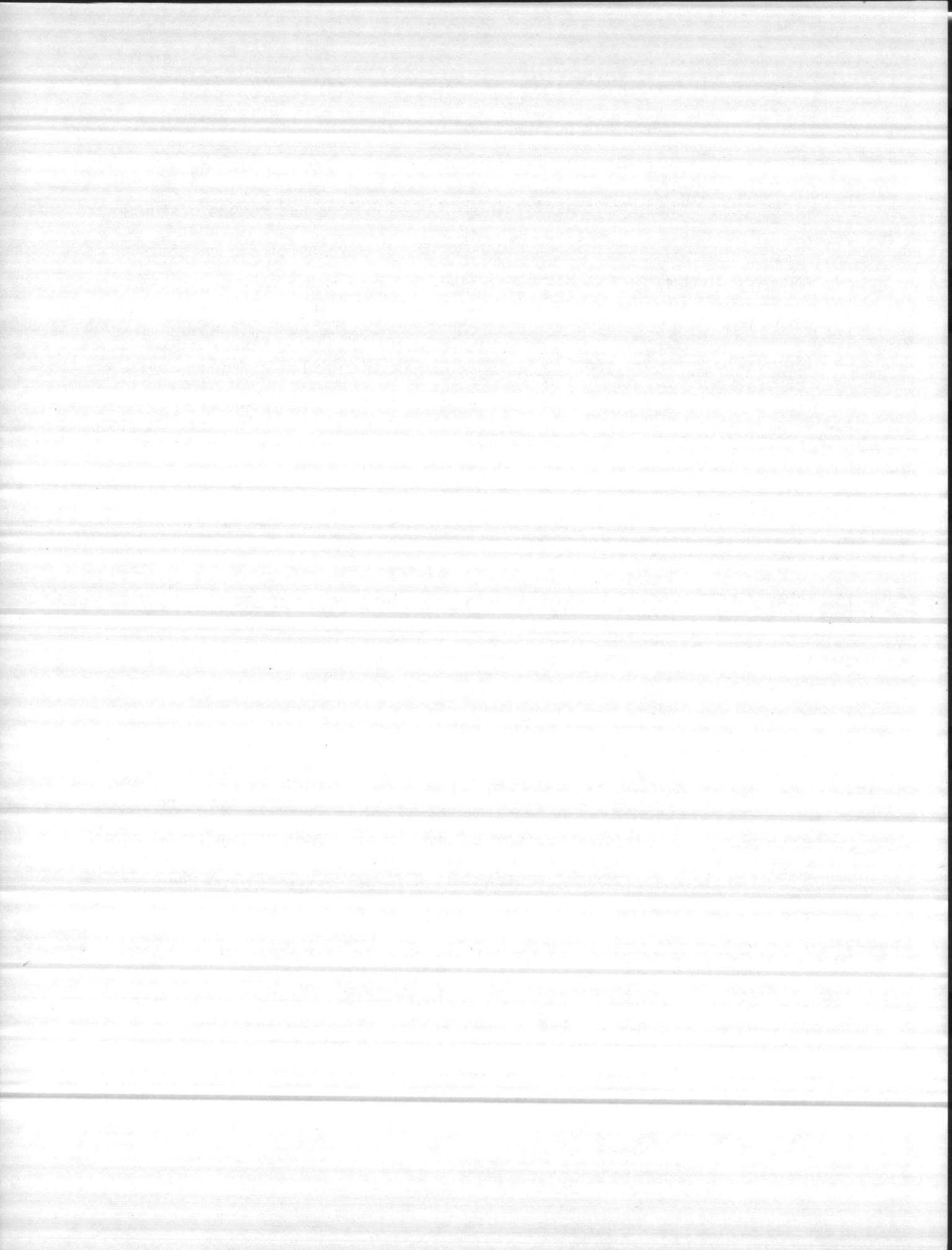
A search was made for turtle tracks or turtles just leaving the surf. If no turtles were located during a patrol, there would be a one-half hour wait before beginning the next patrol. Upon location of turtles, all lights were extinguished until it could be ascertained whether or not the

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... Data) form (see pages 13 and 14). Nests laid in areas of heavy human use,  
... below the tideline or other seemingly undesirable locations, were relocated,  
... generally at the back of the dune above the tideline to relatively low  
... used areas of the beach. Nests located in an area extending from the  
... five feet south approximately two miles to a suitable observation point were  
... removed and gone to 1950. These eggs were counted and allowed to hatch  
... under controlled conditions. All other nests after being located were  
... protected by placing a depth of six inches, a four foot square,  
... eighteen inch high cage, made of 2" by 4" electrically welded wire, over  
... the nest. The cage was then marked with yellow surveyor plastic tape  
... and a white sign with red lettering stating "SEA TURTLE NEST" and "NO  
... nest so not disturb". Each nest was traced using a small plastic tag  
... attached to the protection cage. This tag was marked with the date, nest  
... number, location and number of eggs in the nest. Once a nest was protected,  
... the hatch-out occurred, which was normally from 15 to 30 days later,  
... the nest was re-entered and the unhatched eggs were counted. The number

The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter), New River to assist in making sightings and counts of turtle crawls and apparent nest sights along the beach strands of the coastal islands involved in the survey. Flights were not always over the entire coastal area, but were divided into a northern section and a southern section. The northern section included the barrier islands from Onslow Beach to Cape Lookout. The southern section included the barrier islands from Onslow Beach to Smith's "Baldhead" Island. There were nine flights total; four during June and five during July. All flights were made during the prime nesting period before, during and after the full moon for each month (Table II). The data from the aerial surveys was compared to other aerial surveys conducted by Dr. Schwartz of IMS.

### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out any chance of hatch-out of 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

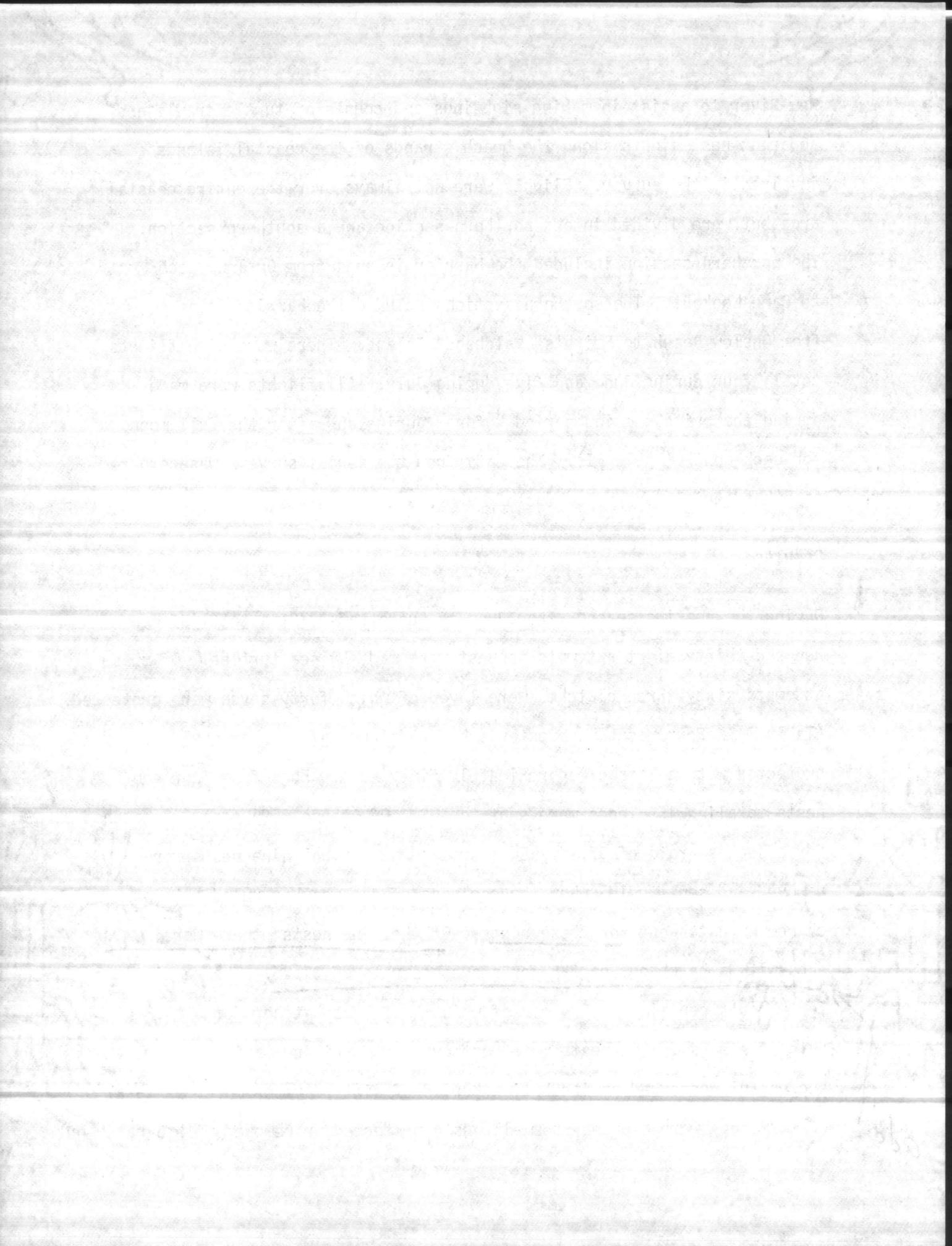


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add



successful nests had an incubation period of sixty days or more. A total of 7,077 eggs were counted from all nests, protected or removed, with a hatch-out of 4,037 for a year's success of 57% (Table III).

Of the sixty-three nests, twenty-six turtles were tagged. Three of these turtles had been previously tagged on Onslow Beach and one had been tagged by the University of Georgia in Athens with the number "NC00020" (Table I).

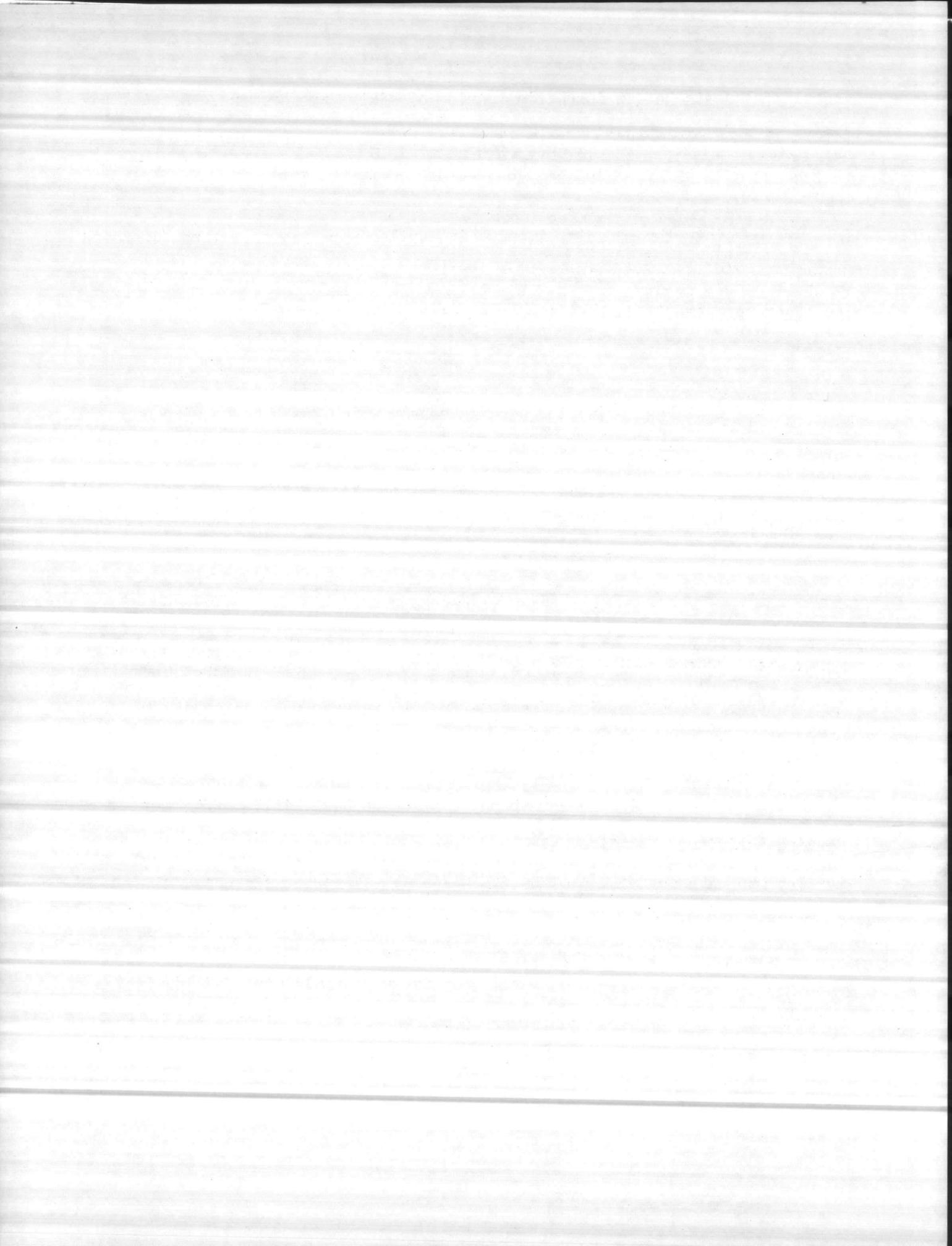
Other data taken during the nesting season which has some bearing on nesting activity is sea water temperatures, lunar cycle and weather conditions. Graphs I, II and III detail the results of lunar cycle and temperature effects.

#### DISCUSSION

Nesting during June was minimal, probably due to early summer cool temperatures. Once the air and sea water temperatures rose to twenty-two degrees celsius, nesting activity began to increase.

Lunar cycle as evidenced by Graph II seems to have little effect on nesting activity. The tides also had less effect than expected, since turtles were observed to crawl up the beach at all tides, including dead low tides.

Weather had some effect on nesting activity. Crawls were made during rainy weather but very few nests were completed. It seemed that the wetness of the sand discouraged the turtles.



Lights on the beach, especially stationary lights, appeared to have little or no effect on turtles choice of nest sites. Turtles nested often near very well lighted buildings. Moving lights, either vehicular or pedestrian flashlights, caused immediate abortive reactions by nearly all turtles that were approached.

There was one case of nest predation of a protected nest due to technician error. This nest site had two clutches of eggs deposited under one protective cage. The error occurred after one nest was checked for hatching, at which time the cage was improperly replaced allowing space for raccoons to reach through the cage into the nest. Fifteen hatchlings were destroyed in this case.

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Camp Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs was dropped. Clutch number 92 of July 24 1979, which was being removed for head-start (IMS) was dropped from four feet when the container they were in collapsed. This clutch was artifically incubated at IMS with excellent results, of 133 eggs (two broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in the 48-hour deadline for moving nests.

Nesting activity seemed to be determined by individual turtle cycles,

especially

mainly

often

not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796, later tagged IMS 26 flipper tag.

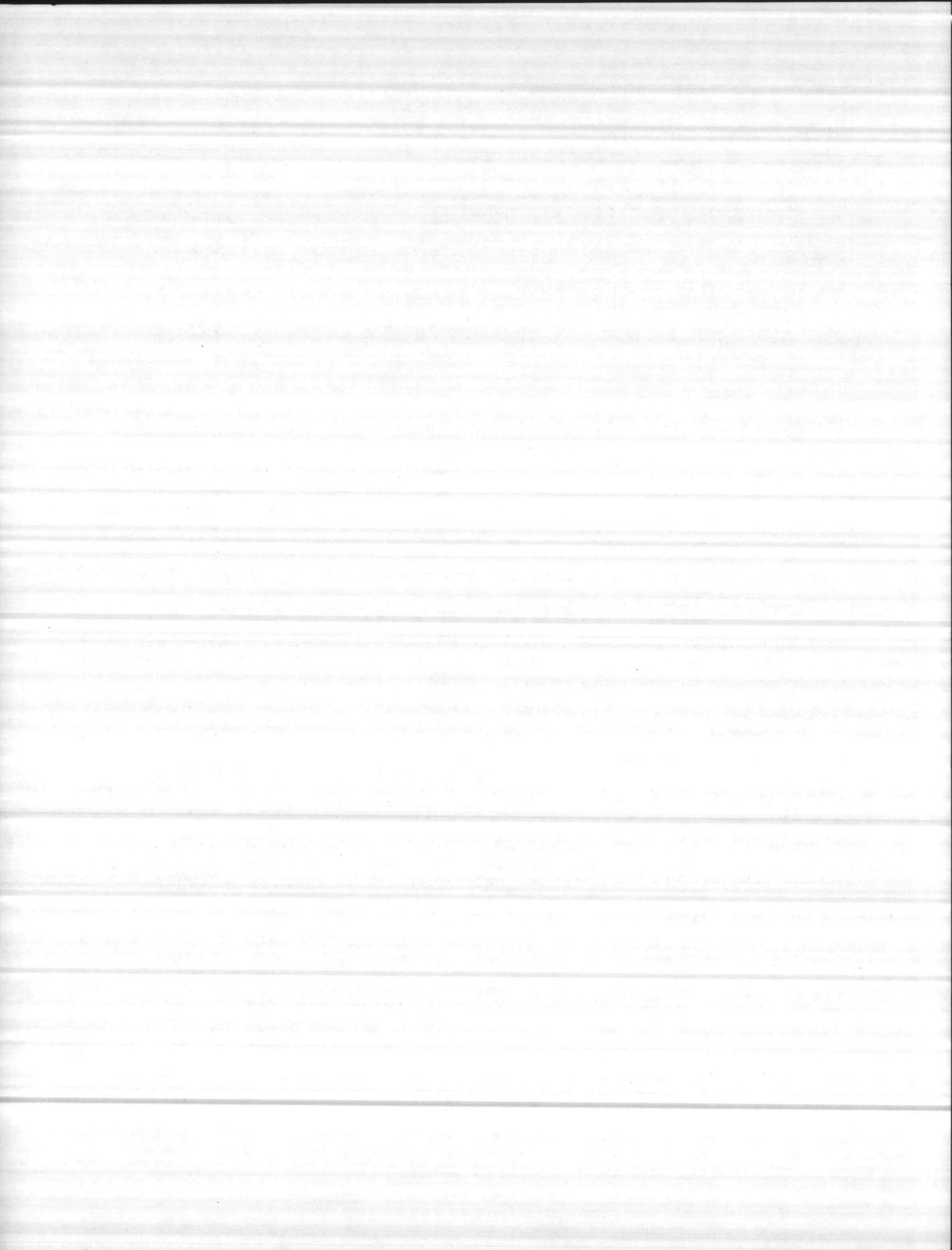
This turtle returned to the beach after 14 days (July 12 and July 26, 1979).

The first clutch was laid on a rainy night at 2215 hours and contained 149 eggs. The second nest was laid on a fair night with good visibility

but no moon at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time, and for each nesting the tide was near high.

Several unusual eggs were discovered during the study. Many subnormal size eggs were found. The most unusual eggs were a double and one triple yolk. Both these eggs were transported to IMS where they were artificially incubated. Neither of the unusual eggs hatched.

Hurricane David which passed through the study area in late August 1979 destroyed six nests, inundated six nests and deposited up to eighteen inches of sand over four of the inundated nests. The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. Nest of July 24, 1979 had 123 eggs hatch for 100% hatch out. Another nest, however, under nearly identical conditions and laid on the same day, had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm, no clear conclusions can be drawn. The nests that had sand deposited over them by the storm would have failed completely without human intervention. One nest of 150 eggs laid on July 5, 1979 produced 101 hatchlings for 67.3% success. When this nest was entered, about eighteen inches of sand and matted sargassum weed were removed from



over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

INSTRUCTIONS

Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page . The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

Toward the end of the nesting season, turtles spent less time on the beach. Also after several observations, it appeared that there was some urgency to the nesting activity. Turtles would choose the nest site rapidly, nest, then return to the ocean with fewer rests. Evidence being turtles missed by technician during normal 50-minute patrol cycle. Also, the choice of nest sites seemed to be done with less care. One nest, August 9, 1979 (130 eggs) as an example, was laid in front of a well lighted beach pavilion where the turtle pushed a trash can aside to use that spot to lay.

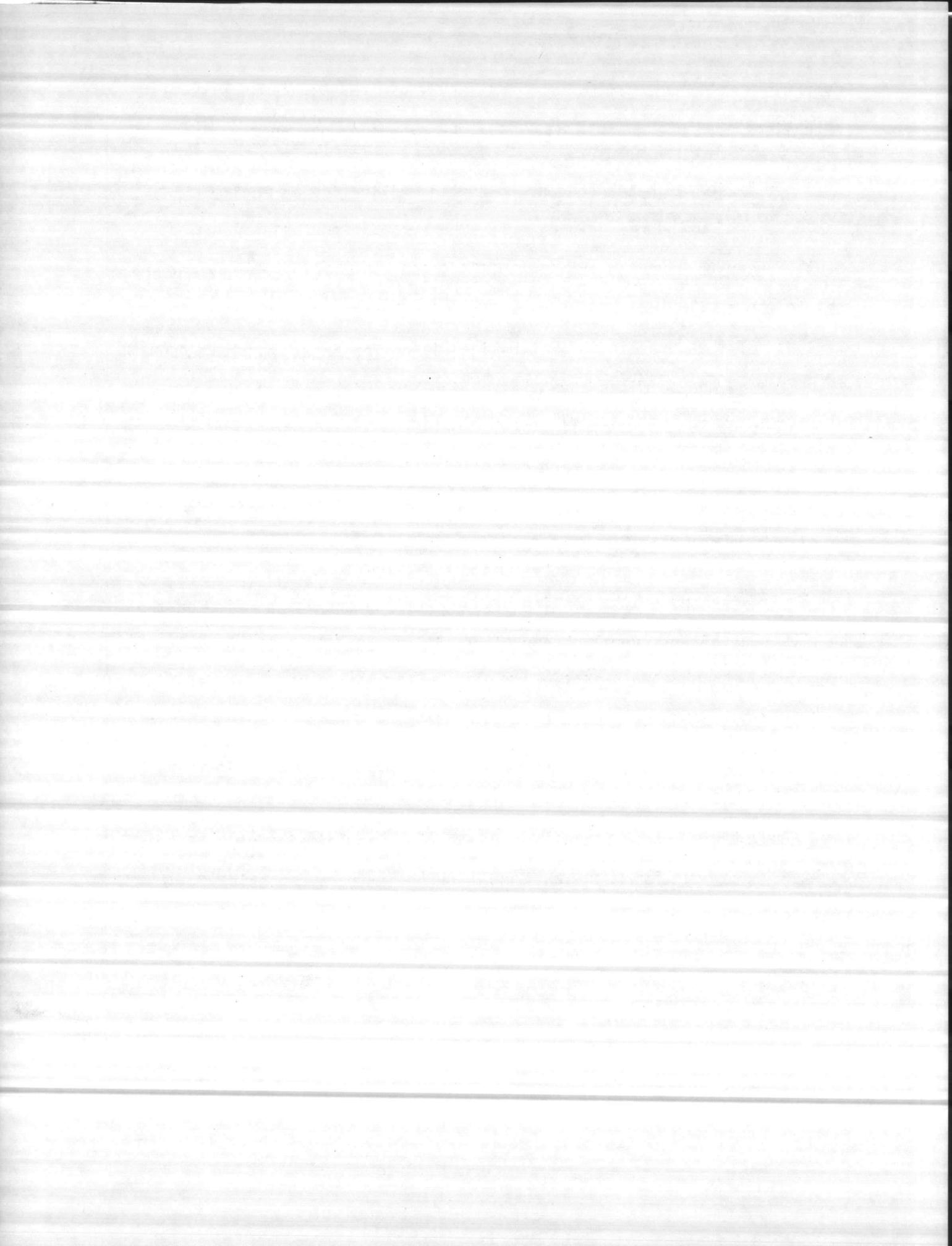


TABLE II

## ATLANTIC LOGGERHEAD SEA TURTLE HELICOPTER SURVEY 1979

Month Day Crawl or Nest	June								July										
	15		19		20		21		5		6		10*		11**		12***		
	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	C	N	
Onslow Beach		5		2				3	5	1	1							1	2
Brown's Island	3		1	3	2	4	1	3					2	2	5	6	5		
Hammock Beach			1	1		2		3					4		3				
Bogue Banks			1	1		1				1			2						
Shackleford Banks																			
Cape Lookout	1							1										2	1
Topsail Island	1	2			3	3					1	4		2	3	4	2		
1st Island																			1
Riches Island																		1	2
Figure 8 Island																			
Wrightsville Beach												1							
Masonborough Island																			
Carolina Beach												2							1
Smith Island												2	8					1	5

Note:

\* July 10 Flight sighted adult turtle swimming in Bogue Inlet.

\*\* July 11 Flight sighted adult turtle swimming off shore of Cape Lookout.

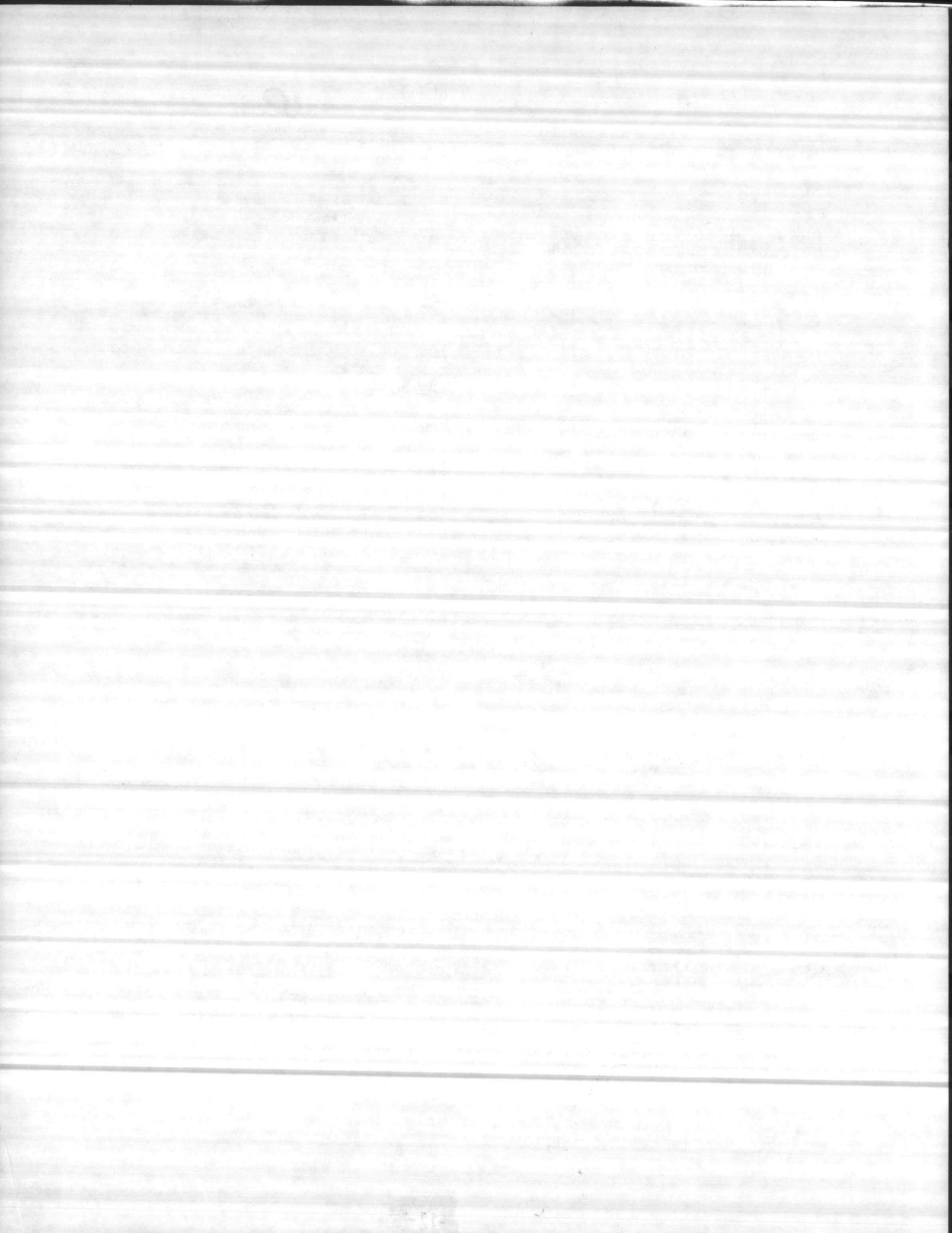
\*\*\* Dead Turtle (Juvenile) Picked up from Riches Island and subsequently taken to Institute of Marine Science in Morehead City.



TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
June 2		Uncounted	43	- -
10	(2)	124	92	74.2
11	(1)	126	89	70.6
14	(1)	118	100	84.5
14	(2)	135	127	94.1
14		141	98	69.5
15		138	119	86.2
16	(2)	96	57	59.4
19	(2)	106	92	86.8
21	(2)	80	68	85.0
22		98	84	85.7
23		105	86	81.9
26	(2)	150	143	95.3
28	(2)	121	114	94.2
28		136	116	85.9
29	(3)	93	86	92.5
July 1	(1)	92	35	38.1
1	(2) (4)	113	2	1.8
1	(1)	121	68	72.7
2	(4)	121	0	0
3	(2)	151	137	90.7
5	(2)	150	101	67.3
6		133	121	91.0
7	(5) (2)	146	133	91.1
9		108	86	79.6



The Institute of Marine Science (IMS) at Morehead City, North Carolina headed by Dr. Frank <sup>ck</sup>Swartz, has shown <sup>a KEEN</sup> interest in the management program. IMS has implemented a headstart program which has provided valuable assistance in caring for nest<sup>s</sup> that have to be removed from the amphibious vehicle landing site on Onslow Beach. Dr. <sup>ck</sup>Swartz has also been a valuable source of information concerning the Atlantic Loggerhead and its management.

By the summer of 1979 the program had become <sup>expanded to this point</sup> so successful that ~~Marine Corps Base decided to hire~~ <sup>that</sup> a <sup>was employed</sup> biological technician to assume the sea turtle management program during the nesting and hatching season.

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PHYSICS DEPARTMENT

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DATE: 1998

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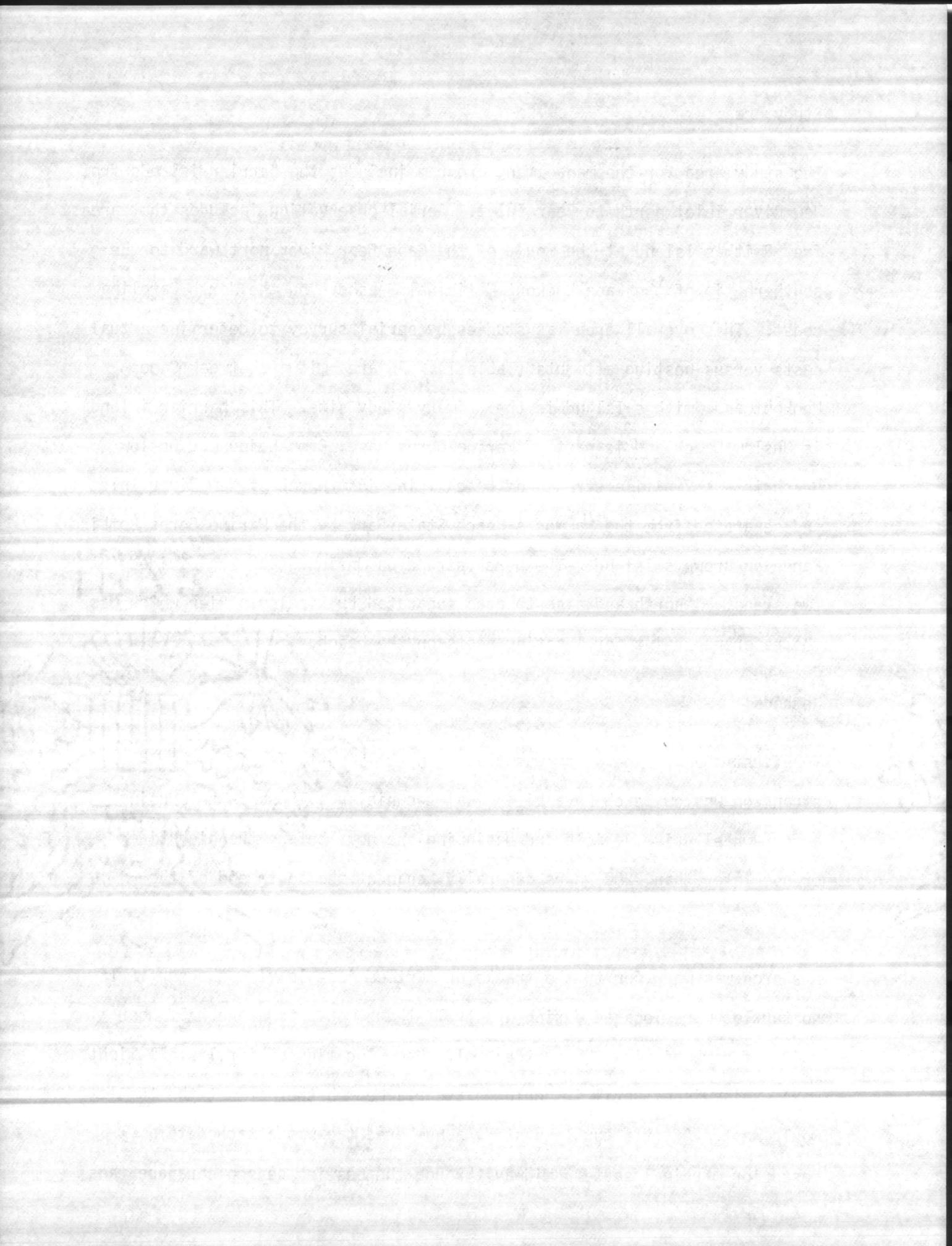
## Study Area:

The study area for the management program includes the barrier islands from New River Inlet north to Bear Inlet. Aerial observation includes that area from Smith's Island, at the mouth of the Cape Fear River, northward to the southern tip of the Cape Lookout National Seashore, on the North Carolina coast. This overall area was studied by aerial survey to determine actual nests versus nesting attempts (Table I). An area midway between Cape Lookout and Smith's Island is the primary study site. This barrier island is Onslow Beach, and is part of Marine Corps Base, Camp Lejeune. Onslow Beach is a seven mile stretch of beach lying just north of New River Inlet and separated from the Hammocks Beach State Park by the Marine Corps Bombing Range on Brown's Island. The beach strand on Onslow Beach was divided into two areas. A north and a south area separated by Riseley's Pier, which was the reference point for locating nests on the beach.

## Methods:

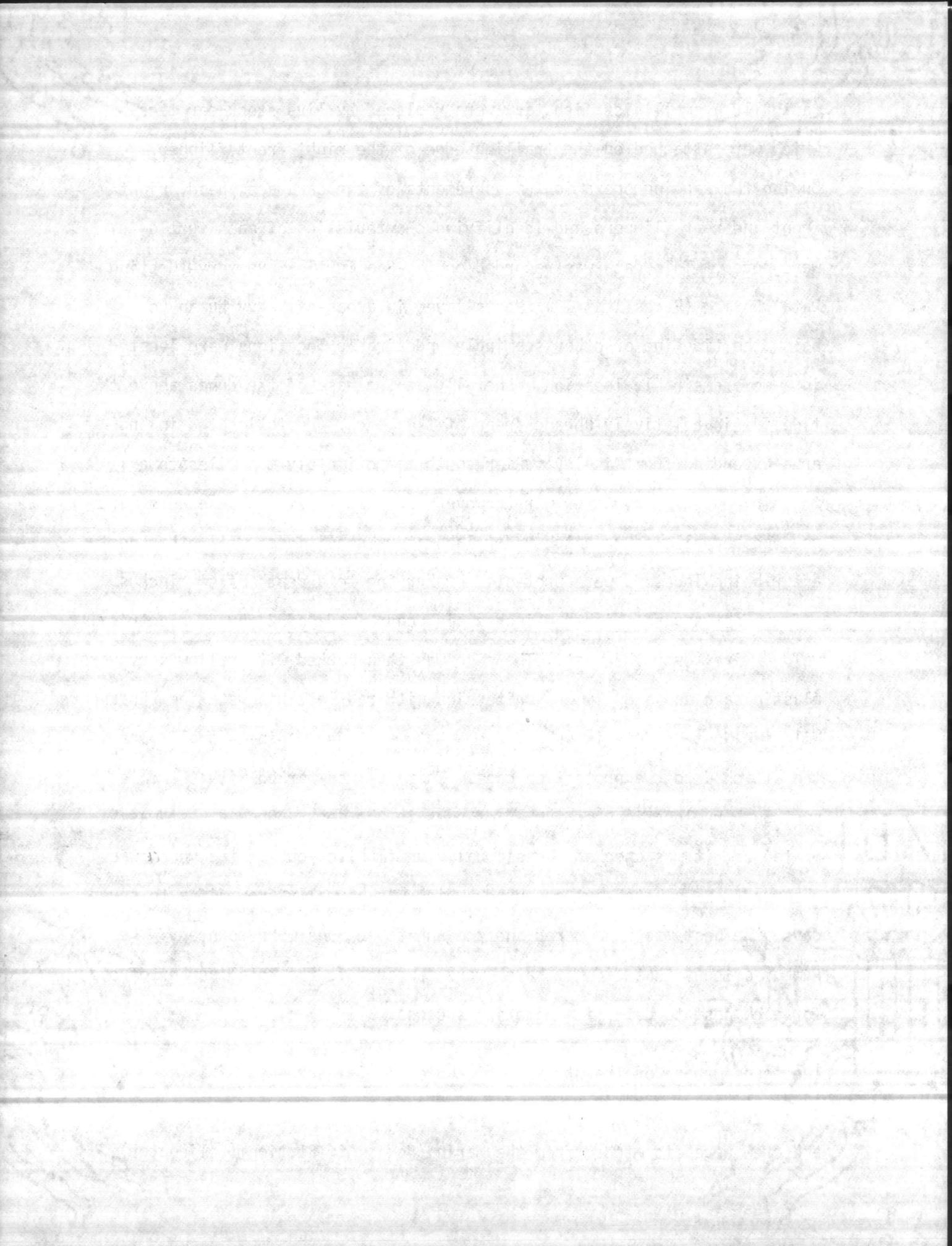
The first phase of the study was that of nightly patrols of the beach strand on Onslow Beach by a biological technician. These patrols, using a four-wheel drive vehicle and beginning one hour before the high tide or not later than 2200 hours, generally began at the south end of the beach.

A search was made for turtle tracks or turtles just leaving the surf. If no turtles were located during a patrol, there would be a one-half hour wait before beginning the next patrol. Upon location of turtles, all lights were extinguished until it could be ascertained whether or not the turtle would nest. After a turtle nested, a numbered tag was attached to a posterior marginal scute. Midway through the nesting season carapace tags



(actually a small disc fish tag) were replaced by live stock ear tags, which were attached on the trailing edge of the right front flipper. During the tagging operation, measurements of the carapace, head, right front and rear flippers and identifying characteristics of each turtle were noted. This data was recorded on the Sea Turtle Inventory (Nesting Data) Form, (Pages 15 & 16). Nests layed in areas of heavy human use, below the tideline or other seemingly undesirable locations, were ~~located~~ <sup>relocated</sup> in a more desirable location, generally at the base of the dunes above the tideline in relatively unused areas of the beach. Nests located in an area extending from Riseley's Pier south approximately two miles to a training observation tower were removed and sent to IMS. These eggs were counted and allowed to hatch under <sup>Controlled</sup> ~~laboratory~~ conditions. All other nests, after being located, were protected by burying to a depth of six inches, a four foot square, eighteen inches high cage, made of 2" by 4" electrically welded wire, over the nest. The cage was then marked with yellow surveyors plastic tape and a 8" by 20" white sign with red lettering stating "Endangered Wildlife Nest Do Not Disturb." Each nest was tagged using a small plastic tag attached to the protection cage. This tag was marked with the date, nest number, location and number of eggs in the nest. Once a nest was protected, it was checked occasionally until hatch-out of the young was observed. When hatch-out occurred, which was normally from fifty to seventy days, the nest was re-entered and the unhatched eggs were counted. The number of eggs that did not hatch were compared to the total number of eggs for each nest to determine hatching success.

The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter),



of 4037 for a year's success of 57% (Table III).

Of the sixty-three nests, twenty-six turtles were tagged. Three of these turtles had been previously tagged on Onslow Beach and one had been tagged by the University of Georgia in Athens with the number "NC00020" (Table I).

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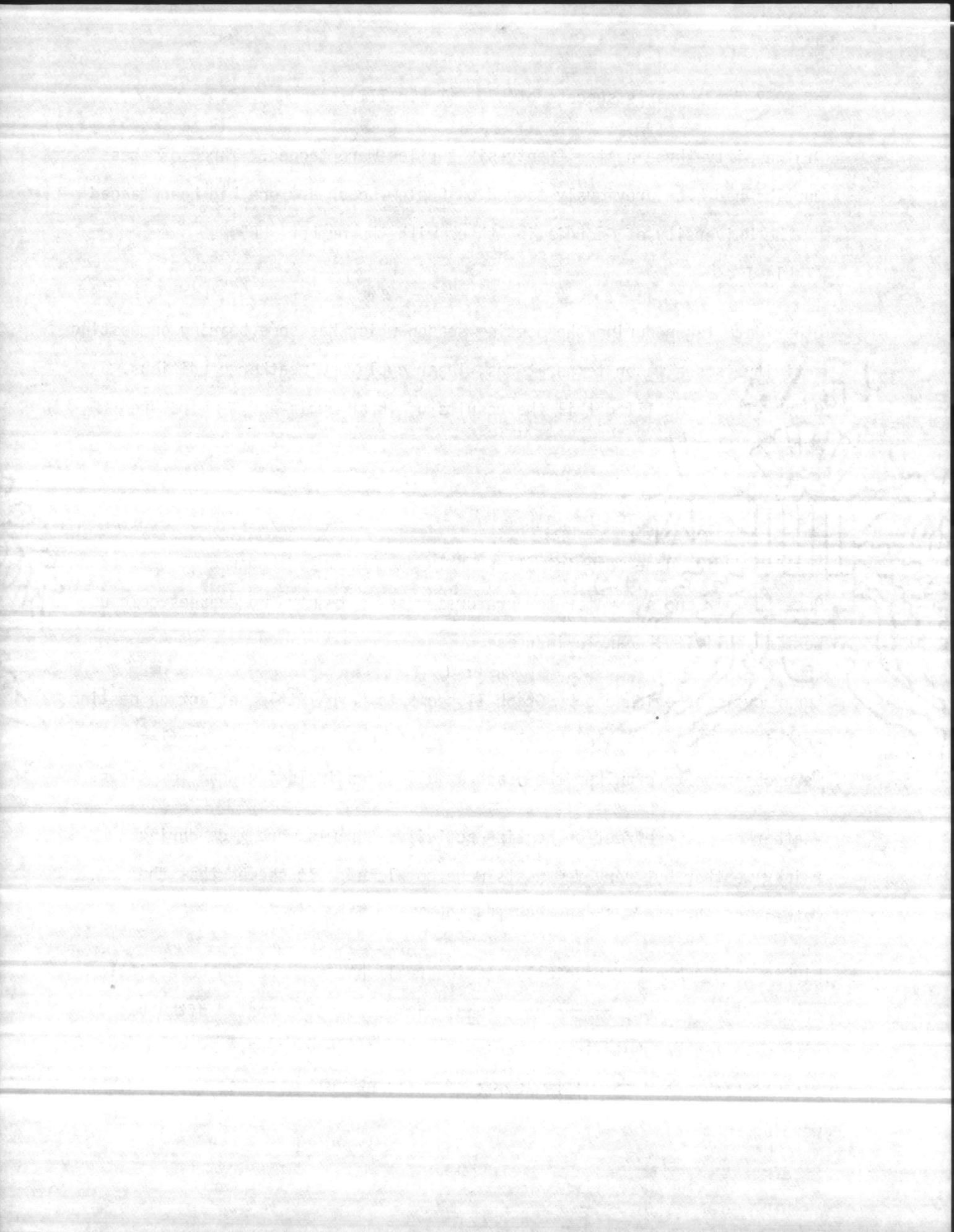
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2. Evidence being turtles missed by technician during normal 50 minute patrol cycle.

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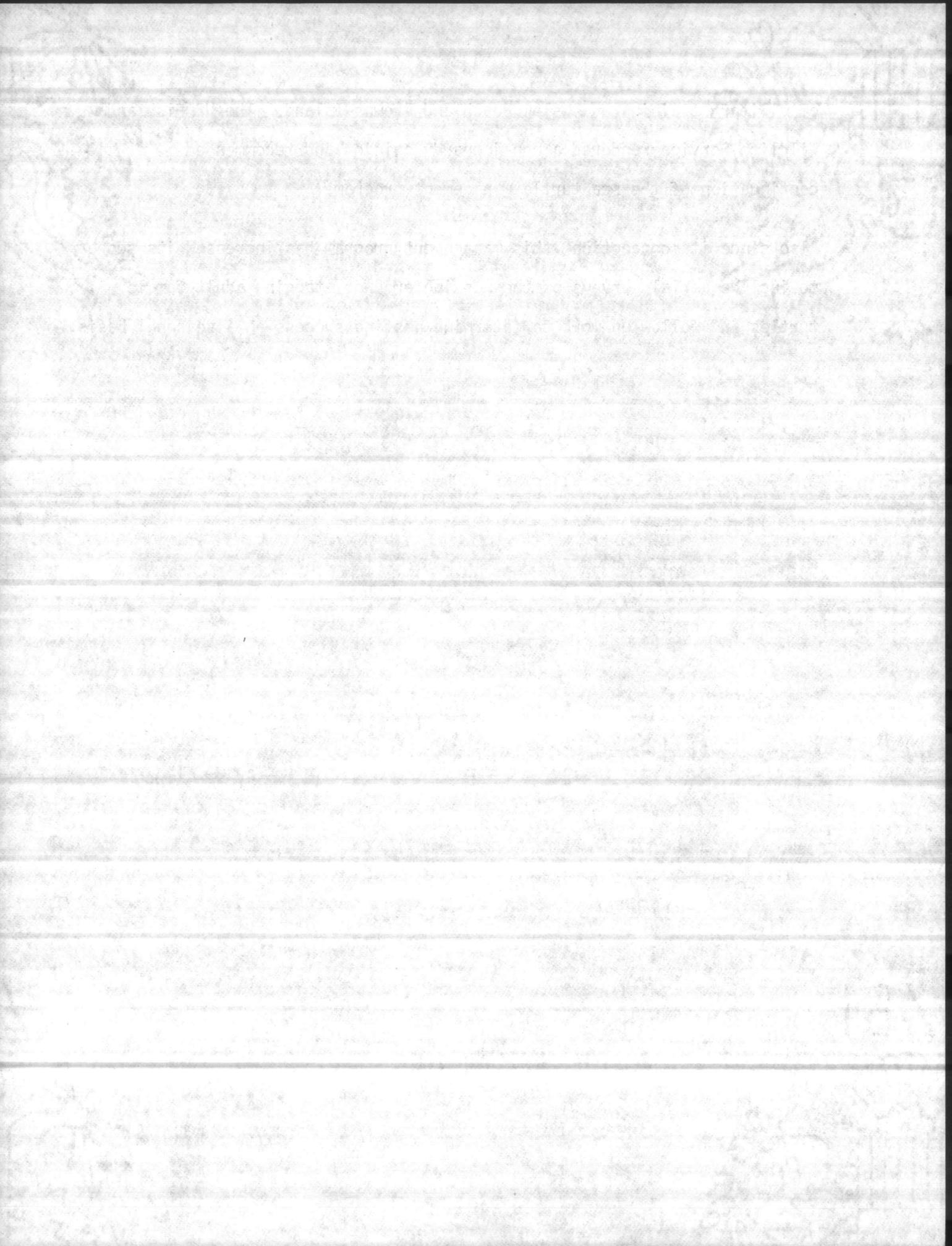
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of military training on Onslow Beach and Browns Island. The US Fish and Wildlife Service rendered a non-jeopardy opinion and recommended continuation of the sea turtle management program.

Also since its conception, this management program has increased its scope to include aerial surveys of the nesting grounds, tagging adult female turtles and follow-up work to determine nesting success on a seasonal basis.



ATLANTIC LOGGERHEAD SEA TURTLE PROGRAM 1979

Natural Resources and Environmental Affairs Division

Base Maintenance Department

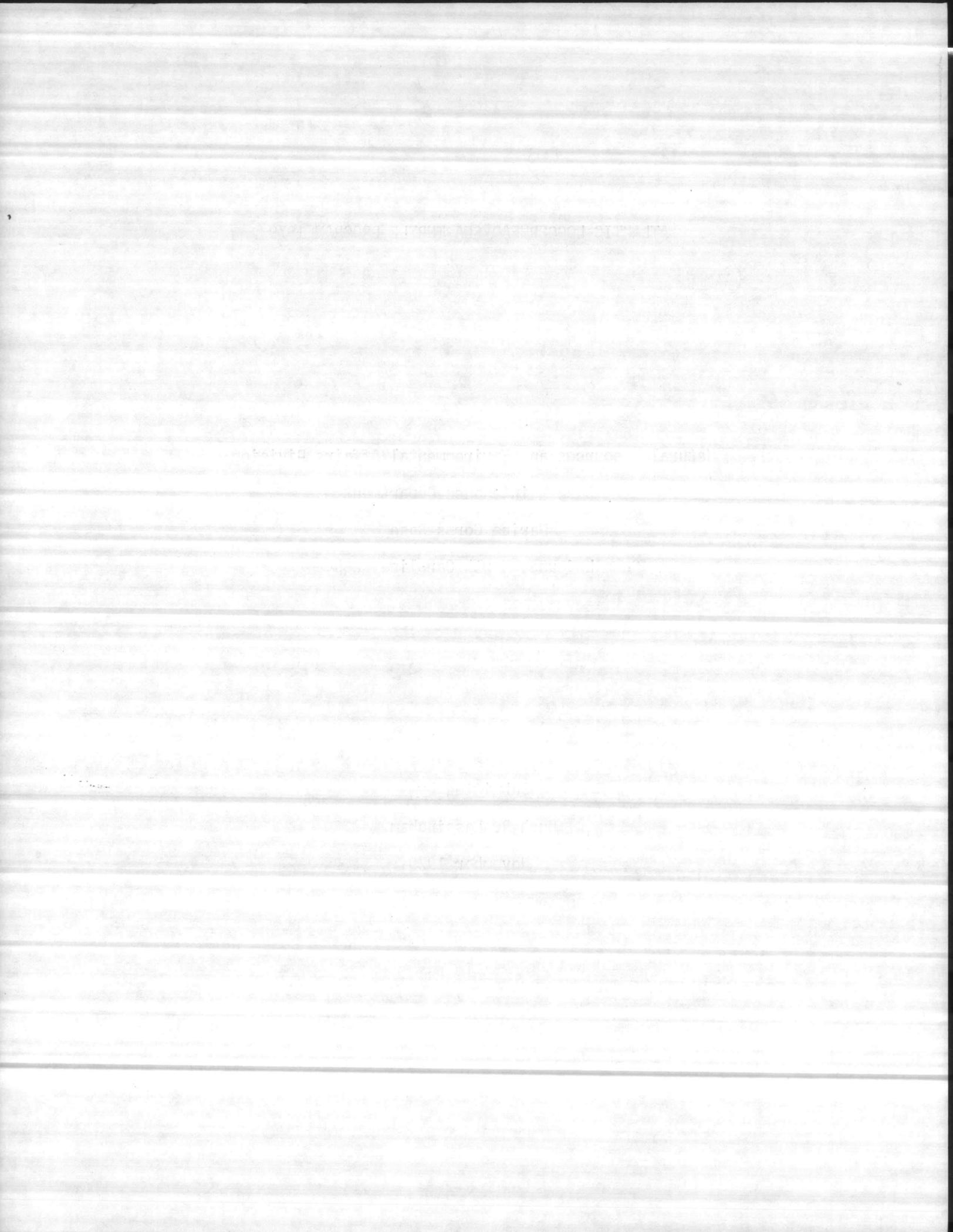
Marine Corps Base

Camp Lejeune, North Carolina 28542

Submitted by

Hugh R. Passingham

November 1979

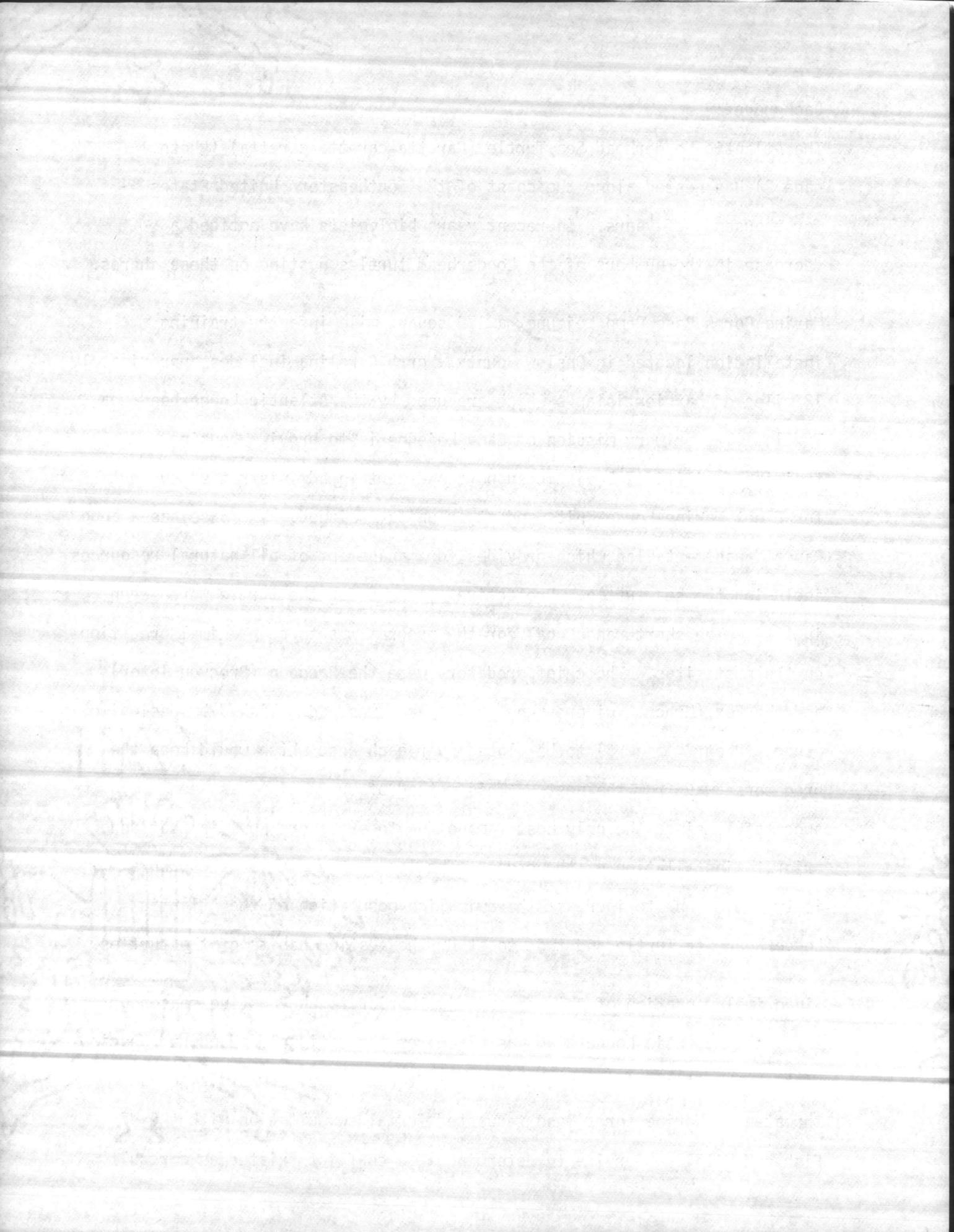


Background:

The Atlantic Loggerhead Sea Turtle (*Caretta caretta caretta*) (Photo 1, page 2) has nested along the coast of the Southeastern United States for thousands of years. In recent years biologists have noticed a decrease in the numbers of the Loggerhead turtles nesting on these shores.

Marine Corps Base Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The Base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). ~~This was accomplished by designing a cage (Photo 2, page 3) to be placed over each nest which would keep the predators away from the nests.~~ This method of protection has <sup>proven</sup> ~~been~~ highly successful, since the only nest damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered Species List as threatened in August of 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the US Fish and Wildlife Service to determine if a conflict existed as a result

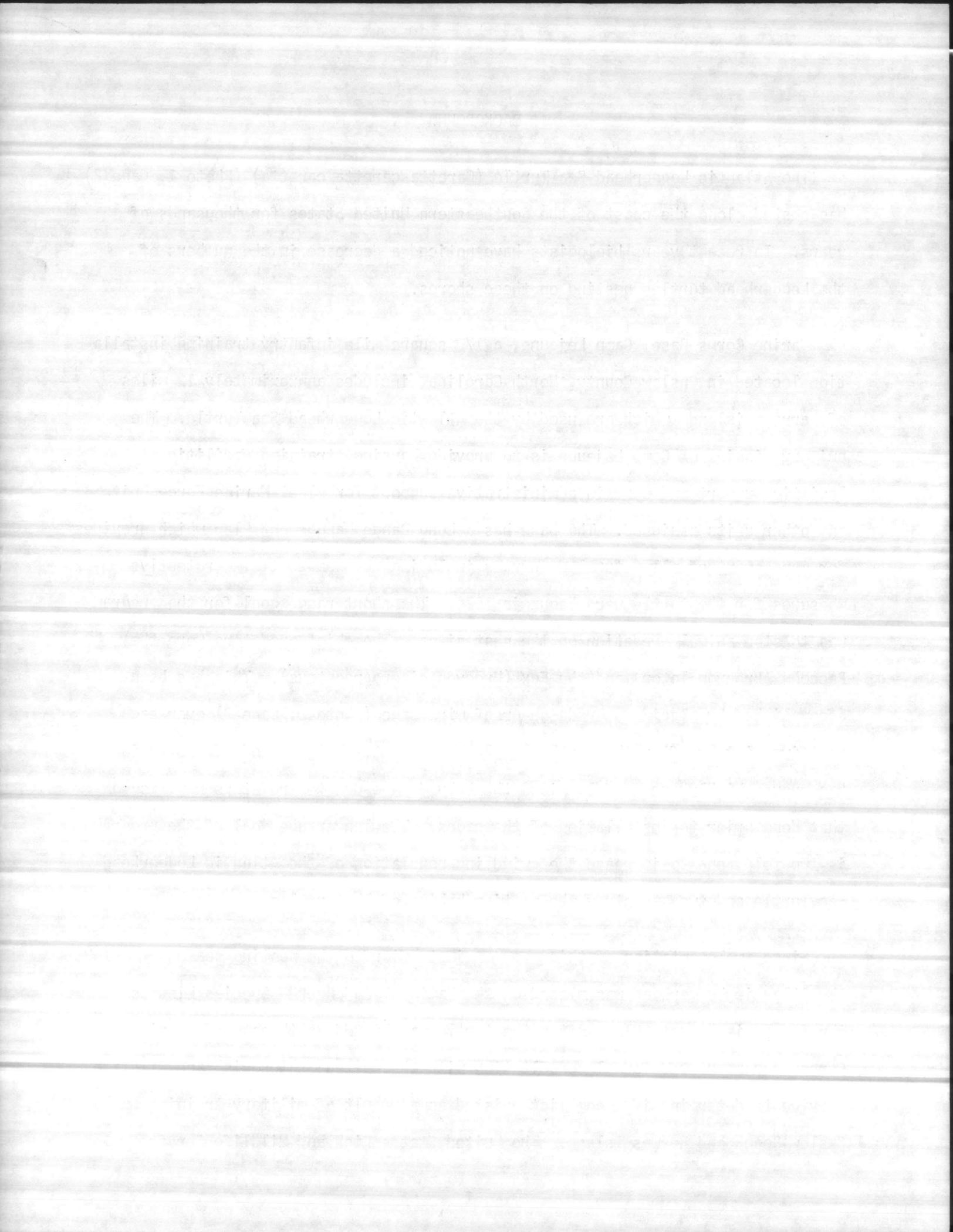


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Marine Corps Base, Camp Lejeune, a 170 square mile infantry training installation located in Onslow County, North Carolina, includes approximately 12 miles of barrier islands which are used by the Atlantic Loggerhead Sea Turtle. The primary mission of Camp Lejeune is to provide housing, training facilities, logistic support and certain administrative support for Fleet Marine Force Units and other units assigned. The base has a Long Range Management Plan which provides for management of all natural resources including the sea turtle. Protective measures for the turtle were begun in 1974. The short range goal for the program was to stop animal predation on the nest sites. The chief predators were the Raccoon (*Procyon lotor*) and the Fox (*Urocyon cinereoargenteus*). This has been accomplished by placing a predator-proof wire cage (Photo 2, page 3) over each nest immediately after the turtle has left the nest. This method of protection has proven highly successful, since the only damage due to predators now, is that done prior to installation of the cages. The long range goal of the program is two-fold, one to increase the dwindling population of the Atlantic Loggerhead Sea Turtle and two, to study the nesting habits of the turtles.

Since implementation of this program just prior to the nesting season of 1974, the Atlantic Loggerhead was placed on the National Endangered Species List as threatened in August 1978. After the turtle was listed as threatened, Marine Corps Base requested formal consultation with the United States Fish and Wildlife Service to determine if a conflict existed as a result of military training on Onslow Beach and Borwns Island. The United States Fish and Wildlife Service



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The second phase of the study consisted of aerial surveys. This segment of the program was accomplished with the aid of the Marine Corps. Helicopters and crew were dispatched from the Marine Corps Air Station (Helicopter), New River to assist in making sightings and counts of turtle crawls and apparent nest sights along the beach strands of the coastal islands involved in the survey. Flights were not always over the entire coastal area, but were divided into a northern section and a southern section. The northern section included the barrier islands from Onslow Beach to Cape Lookout. The southern section included the barrier islands from Onslow Beach to Smith's "Baldhead" Island. There were nine flights total; four during June and five during July. All flights were made during the prime nesting period before, during and after the full moon for each month (Table II). The data from the aerial surveys was compared to other aerial surveys conducted by Dr. Schwartz of IMS.

### RESULTS

During the nesting season, from June to August of 1979, a total of one hundred thirty eight attempts to nest were made by sea turtles. Of these attempts, sixty-three clutches were laid of which forty-seven were protected. (Table I). Four nests were entered by predators, before they could be protected, with a loss of approximately fifty eggs. Eggs from fourteen nests totaling 1,595 eggs were sent to IMS. Of these 1,595 eggs, 912 hatched for a success rate of 57.2%. Eggs from an additional nine nests were removed and sent to IMS when the coolness of the weather ruled out any chance of hatch-out of 378 for a success rate of 36.2%. The remaining forty nests contained 4,439 eggs, of which 2,747 eggs hatched for a 61.8% rate of success. Six nests were destroyed by Hurricane David. The most

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Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, page 19. The areas at two miles north and south appear to have the greatest utilization. The beach contour from one to three miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, is as far as 150 yards. The area from .5 to 2.5 miles south has a high berm with no more than 30 yards of flat beach to the water line at low water. Also, in the section from 1 to 1.5 miles south, the beach composition is largely shell fragments and sand stone. With this information in mind, and a visual examination of map 1, there seems to be no preferred types of beach contour.

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TABLE I

## GROUND SURVEY ONSLOW BEACH

	<u>Crawls</u>	<u>Nests</u>	<u>Nest Protected</u>	<u>Nest Removed For Headstart</u>	<u>Turtles Tagged</u>
May	0	0	0	0	0
June	32	16	14	2	2
July	31	26	19	7*	12**
August	9	21	15	5***	12****

Note: \* - (7-17-79) Remove 1 double yolk egg from protected nest for H. S.

\*\* - Two of the 12 were returns

\*\*\* - (8-6-79) removed, triple yolk egg from protected nest

\*\*\*\* - Three of these turtles previously tagged July 79 on Only Beach - 1 turtle previously tagged by University of Georgia, Athens (#NC0020)

119

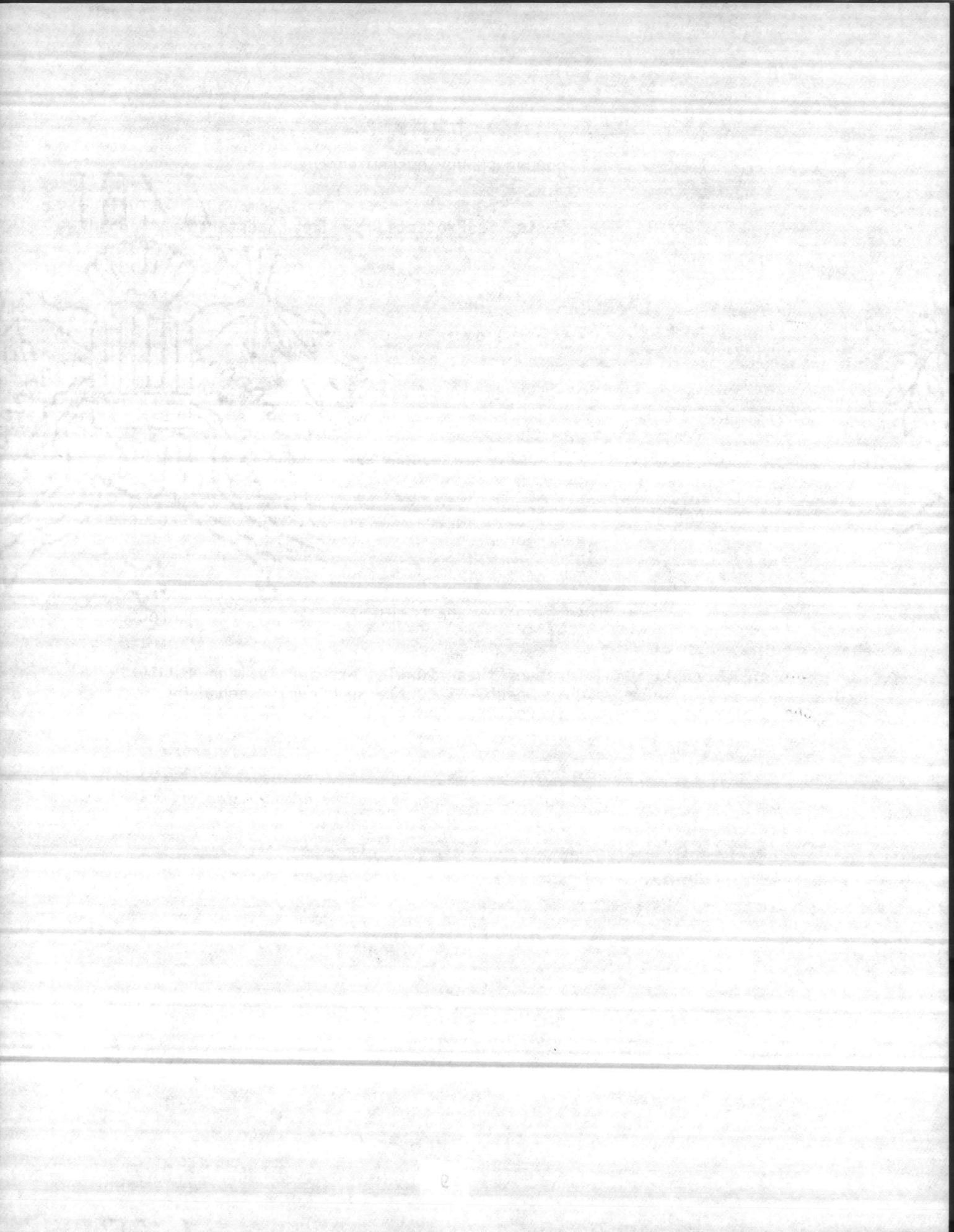


TABLE III

## SUMMARY OF NESTING ACTIVITIES AND SUCCESS

<u>Month/Day</u>	<u>Note</u>	<u>No. Eggs</u>	<u>No. Hatchlings</u>	<u>Percent of Success</u>
Aug 7	(8)	156	8	5.3
8	(1)	104	36	34.6
9	(8)	116	22	18.9
9	(1)	110		
9	(1)	110	18	8.2
9	(2) (8)	130	1	0.8
11	(1)	125	63	50.2
14	(8)	125	92	73.6
16	(9)	100	- -	- -
16	(2) (8)	92	43	47.5
16	(2) (8)	99	85	84.8
16	(1)	98	75	76.5
17	(9)	100	- -	- -
63	(10)	7077	4037	57
40	(11)	4439	2747	61.8
14	(1)	1595	912	57.2
9	(8)	1043	378	36.2

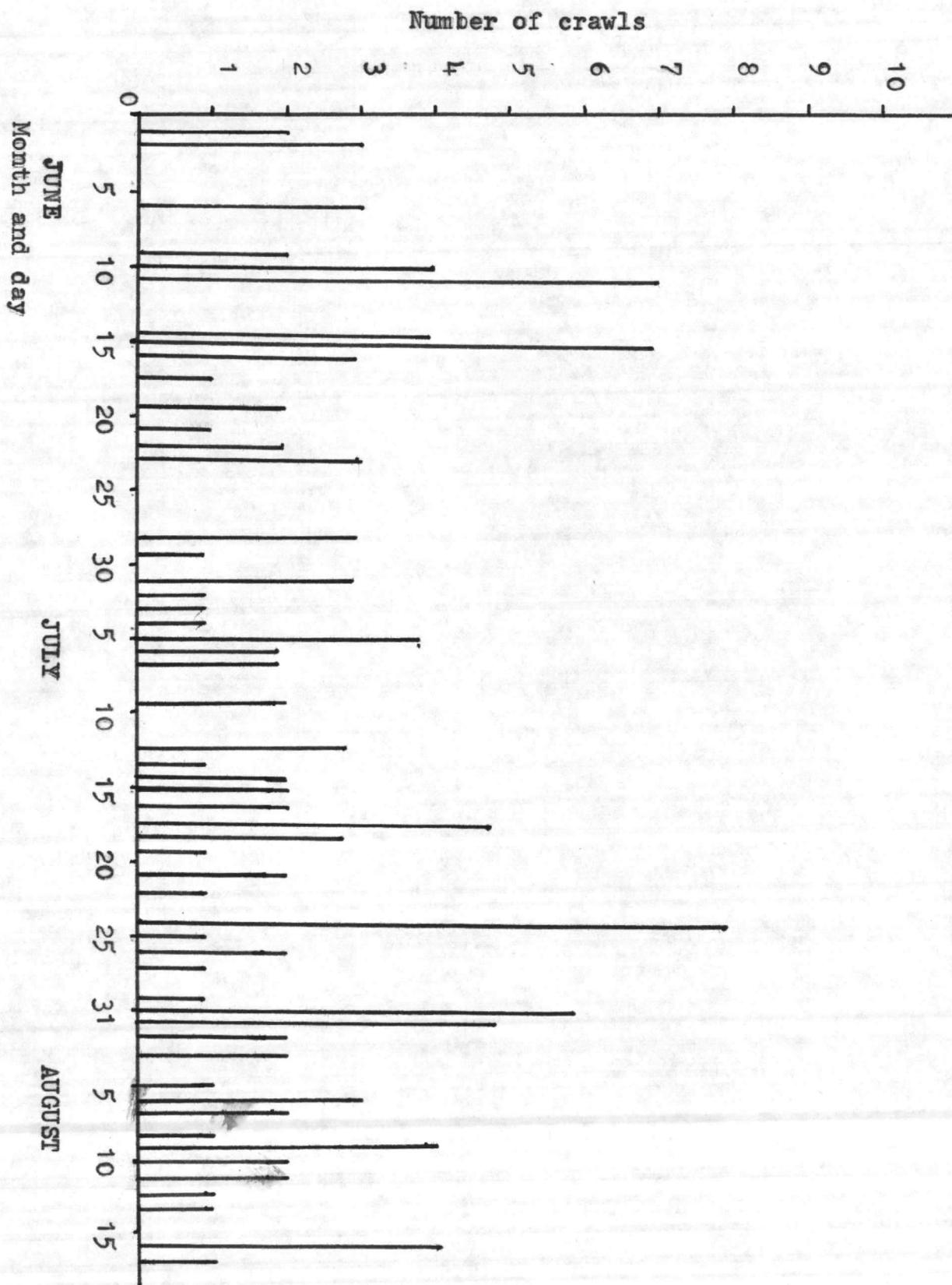
## Note:

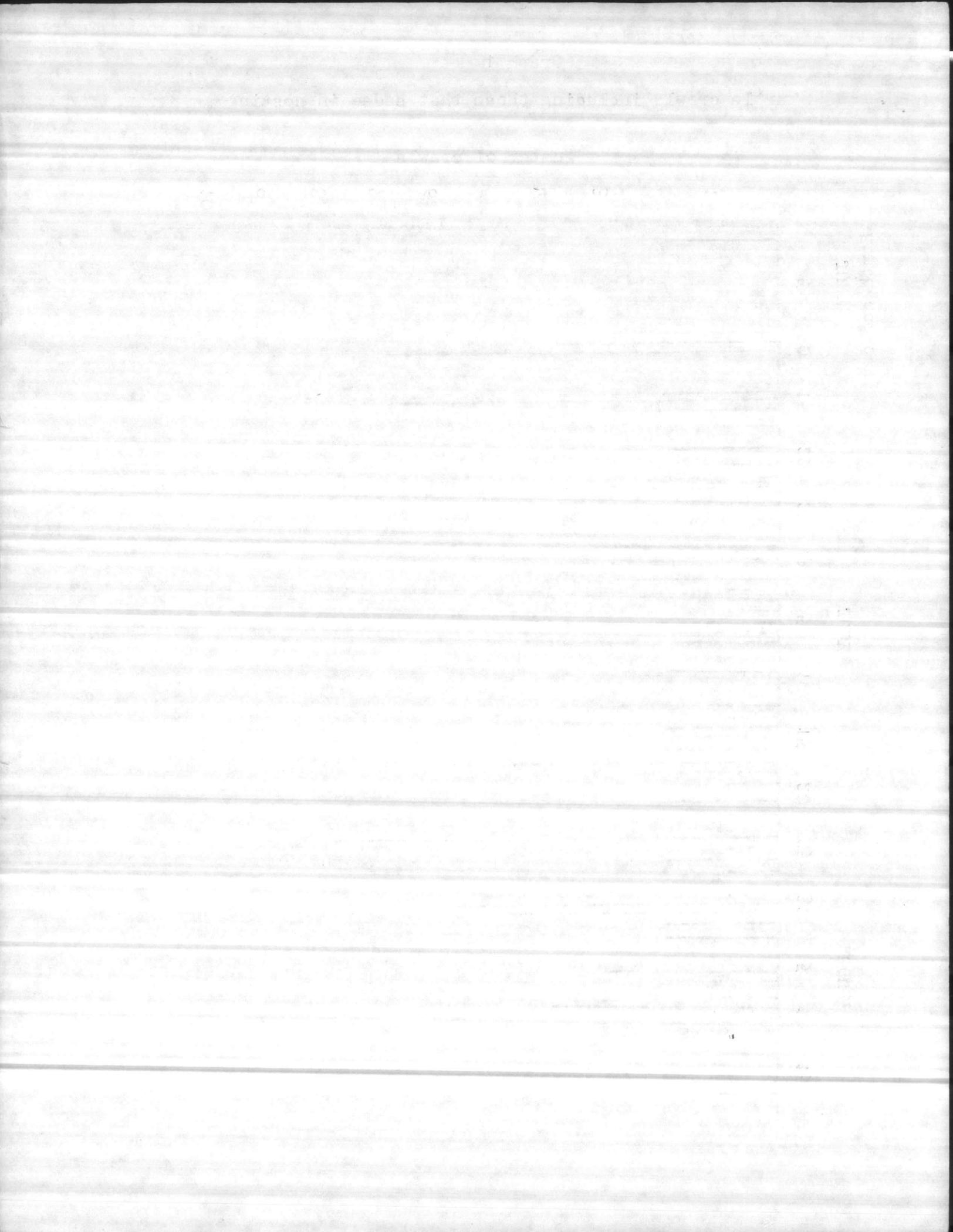
- (1) - Removed for Headstart
- (2) - Redeposited Eggs
- (3) - Nest opened by Raccoons
- (4) - Inundated by tide at full moon or David
- (5) - Released all Hatchlings
- (6) - Destroyed by David
- (7) - Double Yolk
- (8) - Late nests taken up after 60 days and sent to IMS
- (9) - Unprotected or not counted
- (10) - 1979 Totals
- (11) - 1979 total minus all nests removed for IMS (Notes 1 & 8)



Graph 1

Turtle crawls including those that ended in nesting





2  
12 | 29  
    24  
    ---  
     5

SEA TURTLE INVENTORY  
(Nesting Data)

Marine Corps Base  
Camp Lejeune, North Carolina

Date Female Nested 8-2-79 Nest No. 113 Tag No. 32 Time 2145  
Date Eggs Hatched \_\_\_\_\_ Nest Location (Miles/tenths from Risley Pier) 2.1 (5)  
Visibility Good 25-30 mi Weather Conditions Fair 0% cloud  
Wind Speed and direction 5-10 SW Air Temperature 26°C  
Water Temperature 25°C Time Ashore (Known or estimated) 1.5 hr  
Carapace Length 2' 10" Carapace width unable to obtain  
Carapace condition (Damages/barnacle infestation, etc.) Barnacles Good  
Head length/width 7" Right front flipper length 1' 4"  
Right rear flipper length 1' 1" Estimated weight 200-225 lbs  
Flipper condition (cuts, missing portions, etc.) all complete  
Body pit length/width 4 x 4 Depth to egg chamber 12"  
Time of nearest low \_\_\_\_\_ or high tide 0145  
Distance of nest below \_\_\_\_\_ or above high tide line 11 M  
Comments: Turtle in H<sub>2</sub>O when taking carapace measurements 94 Eggs Redeposited to site beside nest 112

Summary of Instructions: Conduct tagging and collection of pertinent nesting data during peak nesting periods beginning approximately two nights prior to each full moon, June through August. Begin survey one-half hour after high tide. Attempt to tag nesting turtles after they have begun depositing eggs in egg chamber. Use lights only sparingly in accomplishing the operation.

8-5-01 113 35 2142

Grid station  
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2000

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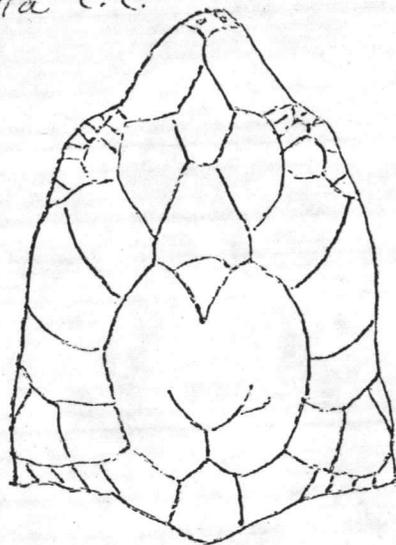
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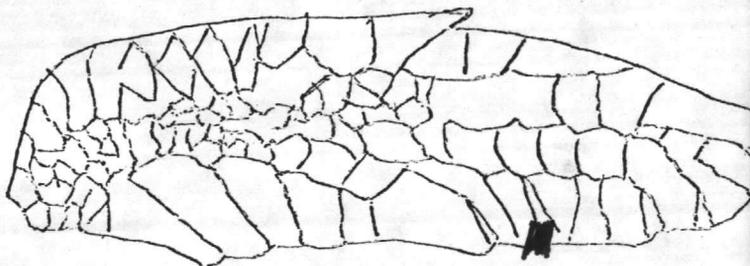
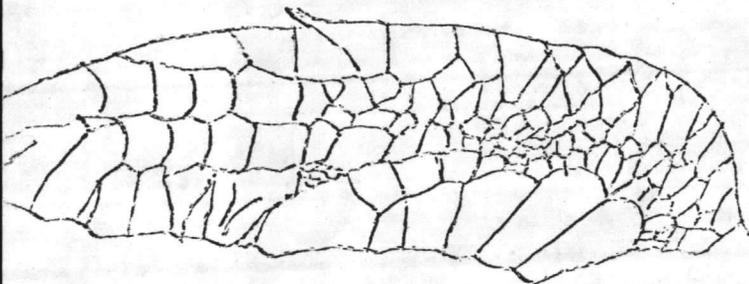
1000 2000

Upper head Caretta c.c.  
5 or 2 more costals

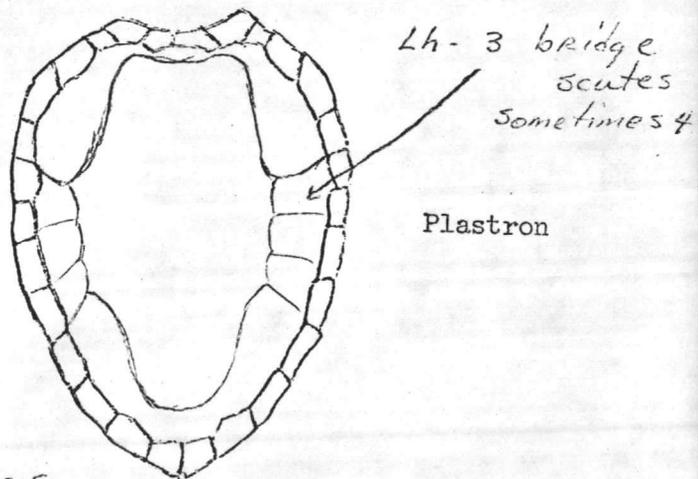
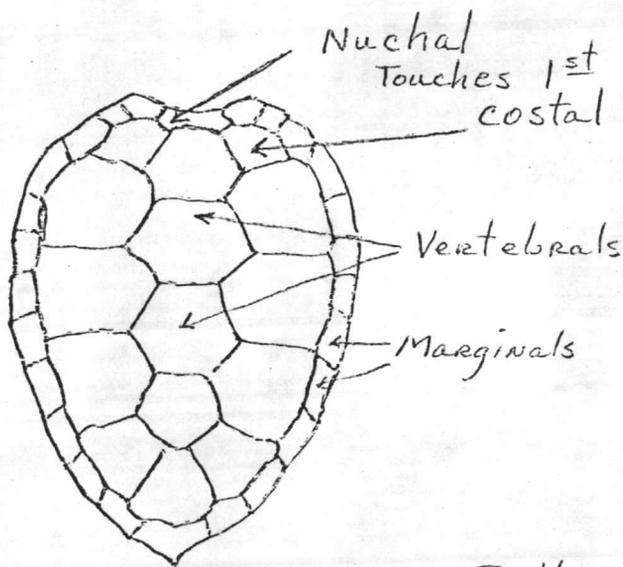


Left Front Flipper

Right Front Flipper



Tag # 32

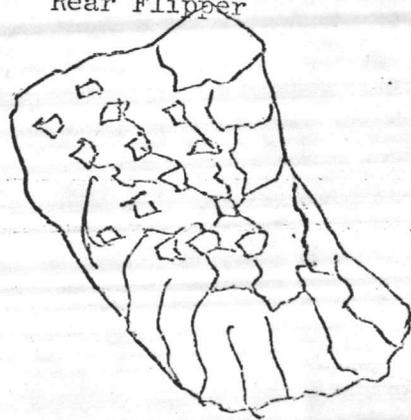


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Left Rear Flipper

Ridley has interanal scute

Right Rear Flipper



N

55 11 101

## DISCUSSION

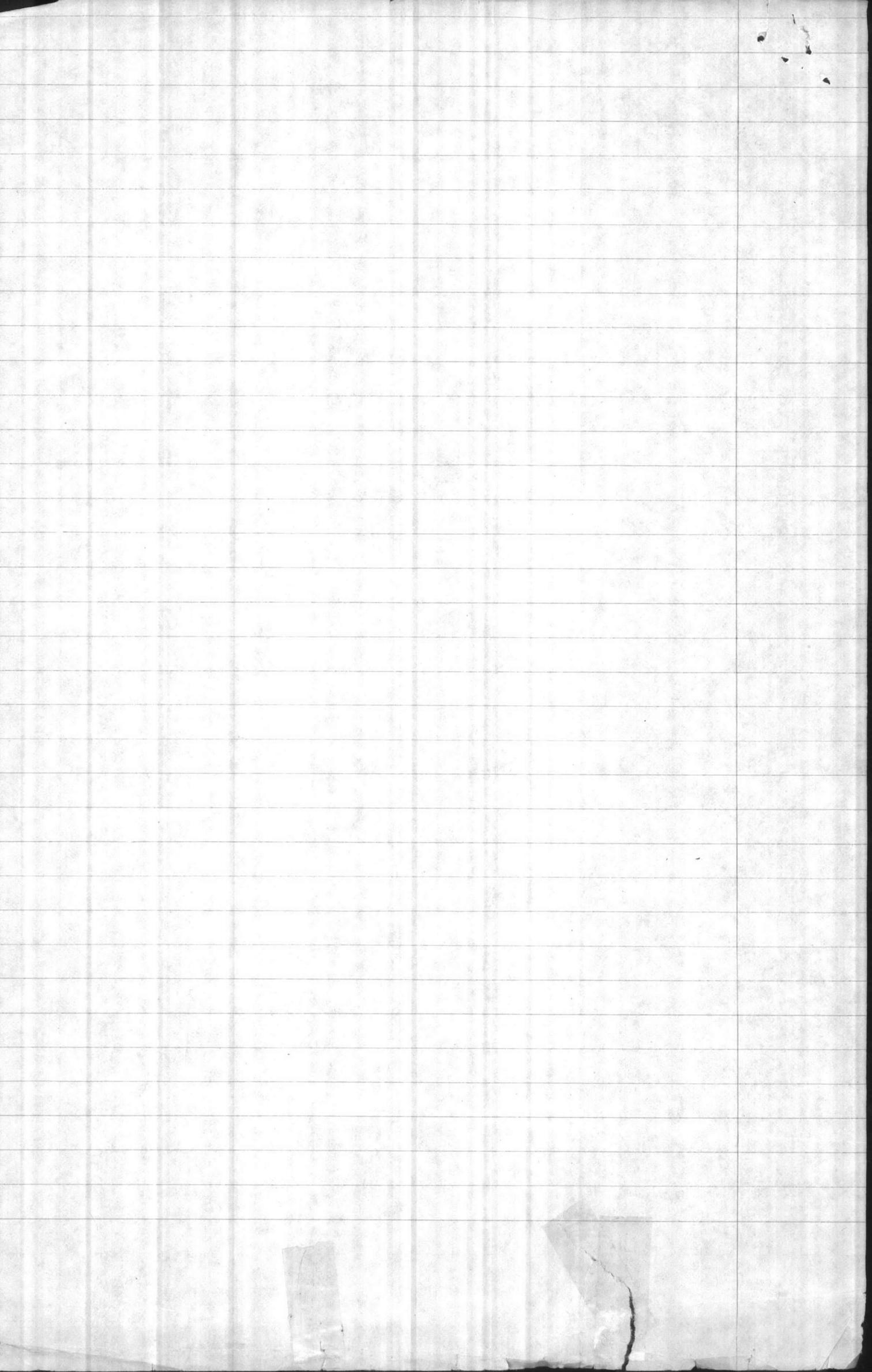
### (I) addition

Recent studies done in Canada have indicated that nest tampering of any kind could be detrimental to hatching success. This was of particular interest to the Lejeune biologists since clutch size was to be an integral part of their management program. A deadline of <sup>forty</sup> forty-eight hours was adhered to for any egg handling by the Lejeune group. The Canadian theory was given a severe test inadvertently by the Lejeune technician when an entire clutch of eggs ~~were~~ <sup>was</sup> dropped. Pro Clutch number 92 of July 24, which ~~were~~ <sup>was</sup> being removed for head-start (IMS), was dropped from four feet when the containers they were in collapsed. This clutch was artificially incubated at IMS with excellent results. Of 133 eggs (2 broke in the fall) 113 hatched for an 84.9% success. From this experience the Lejeune biologists gained more confidence in their 48 hour deadline for moving nests.

### (II) addition

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should be followed



## Hurricane

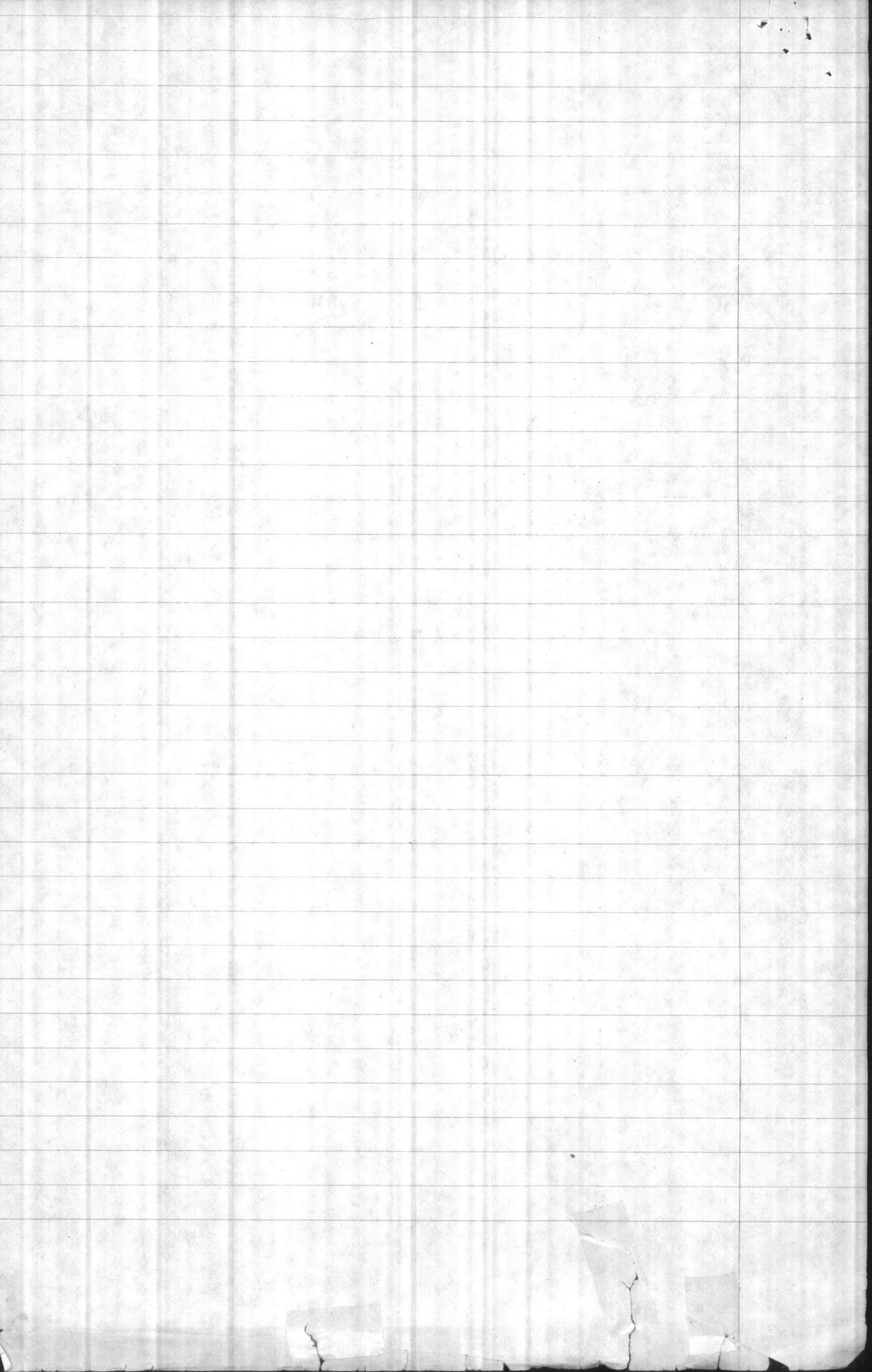
The destroyed nests were completely washed away. Some of the partially developed eggs were found in the debris of the high water mark. The nests that were barely reached by wave wash seemed to be unaffected by this light inundation. One nest of July 24 had 123 eggs hatch for 100% hatch out. Another nest however, under nearly identical conditions and <sup>laid</sup> on the same day had only 48% hatch-out (76 of 159 eggs hatched). Since the nests were not opened immediately after the storm no clear conclusions can be drawn.

The nests that had sand deposited over them by the storm would have failed completely without human intervention. One ~~nest~~ <sup>out of 150 eggs laid on 5 July 79 produced</sup> as an example, nest ~~of~~

~~July 5 150 eggs~~ 101 hatchlings for 67.3% success". When entered about eighteen inches of sand and matted sargassum weed were removed from over the hatchlings. It was the opinion of the technician that the hatchlings were not capable of making the ascent to the surface.

## Redone section -

Nesting activity seemed to be determined by individual turtle cycles, not the moon phase or weather. Evidence for this was the return of previously tagged turtle number 33-796 later tagged IMS 26 flipper tag. This turtle returned to the beach after 14 days (July 12 & July 26). The



first clutch was <sup>laid</sup> ~~laged~~ on a rainy night at 2215 hours and contained 149 eggs. The second nest was <sup>laid</sup> ~~laged~~ on a Fair night with good visibility but no moon and at 2230 hours. This nest contained 157 eggs. The time ashore was about the same each time and for each nesting the tide was near high.

<sup>addition</sup>  
III Correlation of beach contour to turtle utilization on Onslow Beach was attempted using map 1, Page <sup>? map 1 on page 1 of 100</sup>. The areas at 2 miles north and south appear to have the greatest utilization. The beach contour from 1 to 3 miles north is a very flat wide beach. At low water, from the base of the dunes to the water line, <sup>the beach extends for</sup> ~~is as far as~~ 150 yds. The area from .5 to 2.5 south has a high beach with no more than 30 yards of flat beach to the water line at low water. Also in the section from 1 to 1.5 miles south, the beach composition is very largely shell fragments and sand stone. With this information in mind and a visual examination of map 1 there seems to be no preferred beach types of beach contour. Maybe offshore food supplies dictate where turtles will use the beach.

