

Tagging and Nesting Research of Hawksbill Sea Turtles
(Eretmochelys imbricata) on Buck Island Reef National Monument
U.S. Virgin Islands, 1988.

Final Report to the National
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GENERAL DESCRIPTION

Range

The hawksbill sea turtle (Eretmochelys imbricata) is found in the tropical and sub-tropical waters of the Atlantic, Pacific, and Indian Oceans. It occurs widely in the Caribbean and western Atlantic, ranging from southern Florida southward along the Central American mainland to Brazil, and throughout the Bahamas and the Greater and Lesser Antilles (Meylan, 1984).

Diagnostic Features

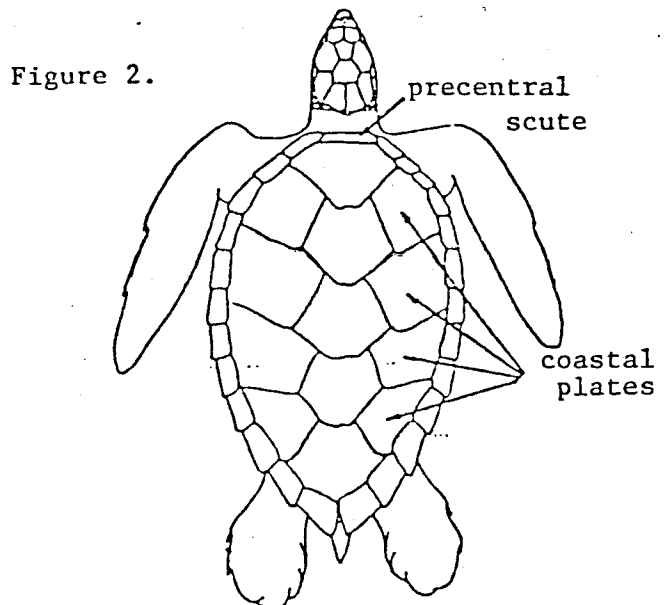
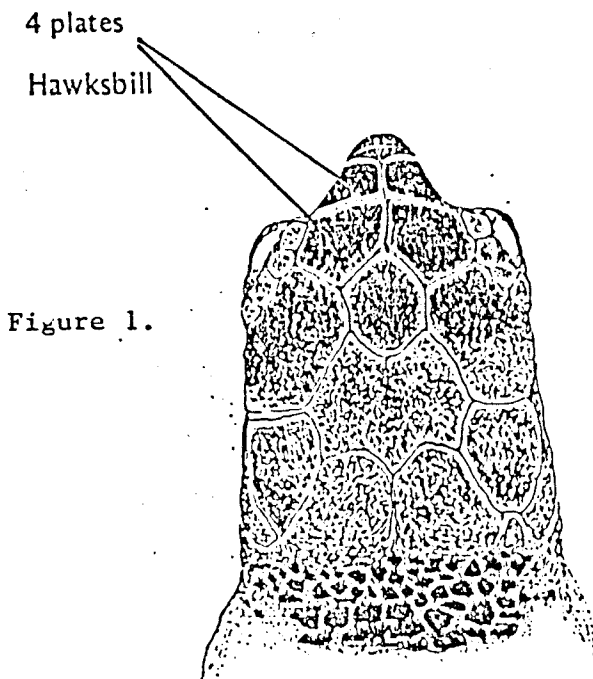
The hawksbill can be identified by the imbricated (overlapping) scutes on the carapace. It also has two pairs of prefrontal scutes on the head (Figure 1). There are four coastal plates on each side of the carapace (Figure 2). General coloration is brown with splashes of yellow and red on the carapace while the plastron is pale yellow. The snout is narrow and 'hawk-like' in appearance.

Habitat

Hawksbills are commonly found in reef and shallow coastal areas.

Feeding Habits

Hawksbills are omnivorous, primarily feeding on sponges, tunicates, sea anemones, jellyfish, and algae.



OBJECTIVES

1. Initiate a population study of nesting hawksbill sea turtles on Buck Island Reef National Monument.
2. Collect specific biological information on nesting individuals.
3. Determine clutch frequency and size, nesting intervals, and site fidelity.
4. Determine and address management concerns such as poaching, predation, and erosion which threaten the population.

METHODS

Study Area Coverage

All night foot patrol of Buck Island commenced on 5 June, 1988. During the first weeks of patrol the entire beach was covered by two people every hour and ten minutes. The study area consists of approximately one mile of beach. The beach is divided into three basic areas; the south shore, the north shore, and west beach. West beach lies between the north and south shores and it does not support a great percentage of overall hawksbill nesting. The majority of nesting occurs in the other two areas. Foot patrol of the entire study area takes forty-five minutes to complete. The patrol is difficult because of cobbles, beach debris such as fallen trees, and low dense vegetation. Therefore, patrol was modified in order to cover the beach more effectively because activities were missed when using the method described above. Thus, the beach was divided between two people for the rest of the night monitoring period. Patrols consisted of twenty minutes of walking and a forty minute rest period. (Refer to Figure 3 and 3A)

Morphometric Parameters

When a turtle was encountered the time, weather and moon phase, and location were recorded (refer to Appendix I for data sheets).

Figure 3 Buck Island Reef National Monument

The map illustrates the Buck Island Reef National Monument. The central feature is the main island, labeled "BUCK ISLAND REEF N.M.". To the west of the main island is a smaller, triangular landmass labeled "Duff's Island". The map shows the "BARRIER REEF" surrounding the main island and "Duff's Island". A "NORTH" arrow points towards the upper right. A "SCALE" bar is located in the lower left corner, with markings for 225', 165', 112', 66', 33', and 16.5'. The map also shows various "reef" features and "reef walls" along the perimeter of the island.

BUCK ISLAND REEF N.M.

SCALE

225' - 1 mi
165' - 3/4 mi
112' - 1/2 mi
66' - 1/4 mi
33' - 1/8 mi
16.5' - 1/16 mi

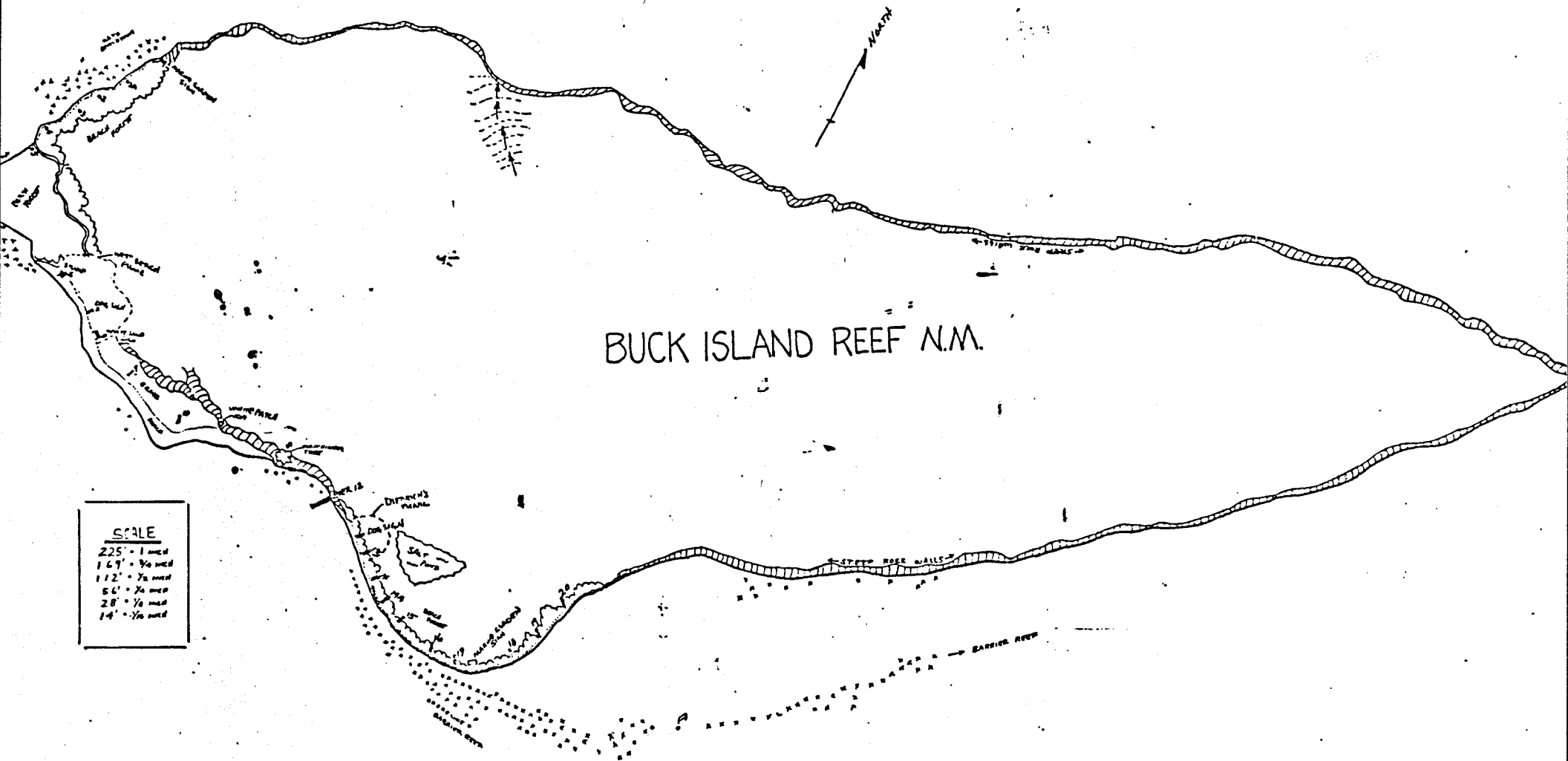
NORTH

BARRIER REEF

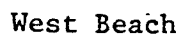
Duff's Island

reef walls

reef



North Shore



SCALE

225' = 1 inch
169' = $\frac{3}{4}$ inch
112' = $\frac{1}{2}$ inch
56' = $\frac{1}{4}$ inch
28' = $\frac{1}{8}$ inch
14' = $\frac{1}{16}$ inch

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South Shore

The turtle's action was also recorded and all subsequent stages of the nesting cycle were timed (i.e. approach, bodypitting, digging, laying, covering, or departure).

Once a turtle was discovered, lights and activity were kept to an absolute minimum until she began laying. Over-the-carapace measurements of the individual were taken after covering had begun. Length measurements were made from the precentral scute (nuchal plate) to the posterior point (notch). Width measurements were made at the widest point of the carapace which lies just behind the front flippers. (Refer to Figure 2)

Nesting

Nest depth measurements and egg counts were not taken even though they appear on the data sheets because of the sensitive nature of hawksbills. Indeed, this is not a well documented subject but a cautious attitude was maintained until the approachability of the animals was assessed.

After all eggs had been deposited, overburden (depth of sand over the eggs) was measured. The measurement was taken from egg level to sand level right below the posterior point of the carapace.

Tagging

The turtle was tagged right after laying was completed, during the initial stage of covering. Inconel tags were inserted in the second scale away from the body on the front left flipper. Only one tag was used as instructed by the National Park Service until reactions were documented and analyzed. This measure is once again a product of the cautious attitude maintained throughout the project.

The first five hawksbills that were observed nesting were also paint-tagged as a temporary measure. This was done during laying while the turtle was still. Lights were kept to a minimum during the procedure. Alcohol was used to remove algae from the carapace and then a single numeral was applied with yellow enamel

paint on the lower portion of the carapace. Clear nail polish was then applied to the number to insure durability. This tagging measure was discontinued after discovering that the individuals were losing the numbers more quickly than expected.

Identifying Characteristics

During covering the turtle was closely examined for tag scars and diagnostic markings. All barnacles were recorded on a diagram included on the data sheet. The diagram allowed for the concise reporting of barnacle location for future reference. Careful notations were also made as to the degree of juxtaposition of the imbricated scutes of the carapace.

Nest Location

The nest location was determined by measuring the distance from the nest to the closest marker. A compass bearing was also taken from the nest to the marker. A detailed crawl and nest diagram was also recorded. In the diagram the nest was drawn in relation to the high tide line, water level, vegetation, and distinguishing landmarks.

Hatchlings

Hatchling emergence was difficult to monitor because tracks are hard to discern in the beach forest and cobbled areas. If an emergence was not recorded for a near term nest within a week of the expected emergence date, it was excavated. Predation by ghost crabs (Ocypode quadratus) and Yellow-crowned Night Herons (Nyctanassa violacea) was closely monitored and recorded.

Nest Excavation

During excavation, all nest contents were removed and recorded. All unhatched eggs were opened in order to determine the size of the embryos that did not reach full term development. After examination, nest contents were reburied.

RESULTS AND DISCUSSION

A. Nesting

1988 season
Prior to the night monitoring period, marine turtle activity was recorded by park rangers and the biological technician. During this period 21 hawksbill sea turtle activities were recorded. Only one of the activities was noted as a confirmed nest while 19 activities were listed as suspected nests. The last activity of the original 21 was recorded as a false crawl. Through careful monitoring of the suspected nests, eight of these activities were confirmed as nests and excavated.

Night monitoring began on 5 June, 1988 and was continued through 20 August, 1988. Monitoring was sporadic due to a lack of boat transportation to and from Buck Island. On several occasions, National Park Service transportation was supplemented by members of the community. All in all, night monitoring was carried out on ⁴⁰38 occasions.

Night monitoring allowed research personnel and volunteers to observe 23 hawksbill activities. Eighteen of these activities resulted in the deposition of eggs. The other 5 observed activities were unsuccessful nesting attempts (false crawls).

Research personnel also recorded another 33 unobserved hawksbill crawls during this period. Of these activities, 7 were confirmed as nests by locating eggs. Sixteen activities were judged as nests and listed as suspected nests and the remaining crawls were noted as false crawls. Suspected nests are continuously monitored for signs of hatchling emergence as a means of confirmation. After at least sixty days, an attempt is made to locate and excavate suspected nests. Thus far, this procedure has confirmed 2 of the 16 suspected nests recorded during the night monitoring period.

Twelve hawksbills were tagged by research personnel during night patrols. The majority of the tagged individuals (8) were only observed once. Two hawksbills were observed twice and another two individuals were observed nesting on three occasions. From these observations, the average internesting interval (the number of days between a successful nesting activity and the next nesting attempt) was 15.5 days. This calculation was derived from only four intervals. The tagged individuals that were

observed three times were seen 30 days after their second successful nest. This interval was not used in calculating average interesting interval because of its extreme length. It was assumed that these individuals were not observed earlier due to the sporadic nature of the night monitoring. It is also felt that the absence of consistent night patrol directly attributed to the high number of tagged individuals that were only observed once.

Average over-the-carapace measurements of observed turtles yielded the following figures (Table 1). Length measurements ranged from 82.5cm to 94.0cm while width measurements ranged from 78.0cm to 90.7cm.

Average clutch size was calculated from nest excavation figures. Egg counts were not made during laying as discussed in METHODS. Table 2 contains 1988 averages as well as averages for 1985, 1986, and 1987. The figures presented were calculated by the author from National Park Service records.

As described in METHODS, all stages of the nesting cycle were timed (Table 2). Laying and covering (initial and secondary) were found to be the longest stages.

The study area, as previously described, is broken into three distinct areas; the north shore, the south shore, and west beach. To date (20 August, 1988), 46 hawksbill crawls have been recorded on the south shore while only 17 crawls have been noted on the north shore. A further breakdown of activity distribution is presented in Table 3 and Table 4. Once again, the author has utilized National Park Service records and provided similar activity distribution profiles for 1985, 1986, and 1987. Unfortunately, sea turtle monitoring records prior to 1987 are sometimes inconsistent and fragmented. Rangers were asked to carry out detailed monitoring of sea turtle activity as well as their other regular duties. Therefore, crawls were not consistently recorded or confirmed. Thus, the author has only included the overall number of recorded crawls (activities) in the tables and figures.

A small amount of information on individual hawksbill site fidelity was collected during the night monitoring period. Evidence exists that hawksbills might be capable of 'homing' to specific sections of nesting areas to nest (Carr and Stanyck, 1957; Diamond, 1976). Yet, the degree to which site fixity is expressed within a population is not well documented (Meylan, 1984). Once again, the sporadic nature of

the night monitoring program makes it difficult to interpret the small amount of information that was gathered on site fixity (Table 5). Only one instance was recorded where a tagged individual nested in more than one of the three designated sections of the study area. A larger sample size is needed before conclusions can be drawn.

B. Hatching

All data presented on hatching success and average hatchling measurements for 1988 are partial records calculated from available results. Nest monitoring will continue throughout the end of the season.

C. Mortality Factors

In past years hawksbill nests on Buck Island were threatened by both mongoose predation and human interference (poaching). Many instances of nest loss due to erosion were also noted in the earlier years of the Buck Island sea turtle monitoring program (National Park Service, 1980-1987). Predation by the exotic mongoose (Herpestes auropunctatus) was one of the greatest threats affecting nest mortality. Now, after extensive trapping programs, mongoose predation has been reduced to almost zero. Human interference is another threat that has been reduced. No poaching has been recorded at Buck Island this season. The increased presence of research personnel on the beach seems to have deterred poaching. The third threat to hawksbill nests, erosion, is a complex problem that warrants further investigation. During the night monitoring period only ^{up to 4 now} two of the confirmed 34 hawksbill nests have been lost to erosion and inundation. Erosion is addressed to a greater extent in the subsequent recommendations.

MANAGEMENT RECOMMENDATIONS

Buck Island Reef National Monument provides nesting habitat for hawksbill sea turtles (Eretmochelys imbricata) as well as leatherback sea turtles (Dermochelys coriacea) and green sea turtles (Chelonia mydas). By far, the majority of sea turtle activity on Buck Island is hawksbill in nature. Other sea turtle activity on Buck Island has not been directly addressed and it should be understood that all sea turtle populations nesting on Buck Island are faced with similar problems. The introduction of a night monitoring program in the 1988 nesting season has created new research and management possibilities. Yet, if night monitoring is to continue in subsequent seasons, certain aspects of the program must be evaluated.

The National Park Service contracted the author on an independent purchase order to monitor hawksbill sea turtles on Buck Island. It was a somewhat difficult project without guidelines. Both communication and management problems hindered effective monitoring throughout the entire season. In order to prevent future problems, the author would like to present and discuss the following problems.

1. An accurate sea turtle study can not be carried out without consistent coverage of the study area. Furthermore, a population study is not possible when night monitoring is sporadic. The beach must be patrolled regularly in order to tag and observe individuals. This season, only four tagged animals were observed more than once. If transportation to and from Buck Island is not available for regular night patrol (7 nights a week) then tagging should not be continued and a new approach should be explored. The beach must be patrolled at least 4-5 nights a week.
2. One of the most difficult problems is the lack of complete records of sea turtle activity on Buck Island. It is imperative that suspected nests be closely monitored and ultimately confirmed and excavated. The only way to gauge nest mortality and success is to first find out how many nests there are. Many of the National Park Service records attribute nest loss to erosion and poaching. Yet, the records are dealing with suspected nests and not confirmed nests.

Therefore, it is difficult to assess threats to the population and without accurate records management is also hindered.

3. The marker system on Buck Island is inadequate and it impedes effective nest confirmation and excavation. There are not enough markers to take measurements to individual nests from two reference points. If there were more markers recording activities would be easier as well as accurate. Then, nest confirmation and excavation would be more successful which would enhance data collection.
4. Nest excavation has traditionally been done 90 days from the observation date by Park Service personnel. By waiting almost 30 days beyond average incubation periods nest excavation becomes more difficult and ambiguous. Nest contents decompose rapidly after hatching which makes it difficult to interpret reasons for low success in certain cases. A more accurate analysis of nest contents is necessary. Furthermore, older National Park Service records show that many nests were not confirmed because the area had been lost to erosion. If those nests had been excavated earlier they might have been confirmed before being washed-out.

CONCLUSIONS

Buck Island Reef National Monument is an important nesting area for three endangered sea turtles. It is especially important due to the fact that it supports hawksbill nesting. The hawksbill population warrants further investigation. Until the population is studied in a more complete manner it is difficult to initiate effective management and protection plans. For instance, erosion must be measured on a regular basis before relocation programs are instituted. There are many unknowns left to be investigated. Continued monitoring is important and it must be done consistently in order to be effective. Furthermore, it is imperative that the National Park Service outline guidelines for future monitoring in order to facilitate good working relationships.

ACKNOWLEDGEMENTS

I would like to express my appreciation to Joel Tutein, Howard Forbes, and Zandy Hillis of the National Park Service for their continued support. They were responsible for transportation to and from Buck Island. I would like to especially thank Joel and Howard for their extreme concern for the project as well as their happy demeanor even though they had to get up at 5AM to make the early morning pick-ups.

I would also like to thank Robert van Dam who worked with me throughout the summer and endured long hours and difficult working conditions without compensation. Without his help it would have been impossible to continue night monitoring. Other volunteers that contributed a great deal of personal time to the project include Cathy French and Barbara Gimlin. I would like to thank them both for their positive contributions.

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Special thanks goes to Fred and Phyllis Sladen for supplementing National Park Service transportation.

Finally, I would like to extend special appreciation to my family, especially my big brother who supported me throughout the project.

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APPENDIX I

Table 1. Carapace measurements of female hawksbill sea turtles nesting on Buck Island Reef National Monument, U.S. Virgin Islands, in 1988.

Dimension	N	$\bar{X}$ (cm)	Range
o.c.*notch to notch	12	87.7	82.5 - 94.0
o.c. width	12	82.2	78.0 - 90.7

* over-the-carapace

Table 2. Average time elapsed during subsequent stages of hawksbill sea turtle nesting. Buck Island Reef National Monument, U.S. Virgin Islands. 1988.

Stage	N	$\bar{X}$ (min)	Range
Approach	3	3	2 - 5
Bodypitting	7	4.7	2 - 11
Digging	5	27.8	20 - 35
Laying	12	17.8	15 - 27
Covering ¹	6	33.0	24 - 42
Initial ²	5	12.8	11 - 15
Secondary ³	4	25.0	16 - 46
Departure	7	4.5	.5 - 12
TOTAL	4	129.9	90.5 - 198

¹Includes both initial and secondary covering.

²Back flippers used exclusively.

³Both front and back flippers utilized.

NOTE: Approach, bodypitting, and digging times used only when they were followed by the successful deposition of eggs (laying).

Table 3. Activity distribution of hawksbill sea turtle crawls 1985-1988
Buck Island Reef National Monument.

Year	South Shore (#of crawls)	North Shore (#of crawls)	West Beach (#of crawls)
1985	69	53	26
1986	50	26	7
1987	44	58	5
1988	46	17	24

Note: 1988 data is not complete since the season was still in progress when this count was made 8/20/88.

Table 4. Activities recorded. Hawksbill sea turtle nesting on Buck Island Reef National Monument. 1985-1987.

Year	Confirmed Nests	Suspected Nests	Aborted Crawls
1985	18	42	86
1986	20	40	25
1987	43	62	8

Table 5. Site selection. Hawksbill sea turtle nesting. Buck Island Reef National Monument. 1988.

Tag Number	Nest site 1	Nest Site 2	Nest site 3
PPW804	17	14	-
PPW807	14	14A	2
PPW808	14A	17A	17A
PPW813	15	17	-

} BUS
marker
numbers

Note: Marker numbers (nest sites) are clearly illustrated in Figure 3/3A.

Table 6. Average clutch size of hawksbill sea turtles. Buck Island Reef National Monument. 1985-1988.

Year	N	$\bar{X}$ (eggs)	Range
1985	7	153.4	110 - 230
1986	14	146.6	106 - 189
1987	11	144.7	59 - 200
1988	20	142.3	111 - 170

HATCHING DATA, 1988

BUCK ISLAND REEF NATIONAL MONUMENT, VI

Female's tag _____ Date laid _____ Species HB LB GR

Location _____ Marker No. _____ Dist. _____ Dir. _____

Weather at emergence

Sky _____ Seas calm moderate heavy

Rain _____ Previous weather _____

Wind direction _____ Velocity 0 L M S VS

Nesting results

Date emerged _____ Incubation _____

Time emerged _____ Date cleaned _____

Nest Contents

live hatchlings _____ Embryos

dead hatchlings _____ 1. midterm _____

hatched deformed _____ 2. fullterm _____

unhatched deformed _____ a. pipped _____

undeveloped _____ b. unpipped _____

hatched shells _____

yolkless _____

Predation

eggs _____

hatchlings _____

Hatchling measurements

length _____

width _____

weight _____

Nest success _____ %

Comments and Notes

LOG ENTRY FORM, 1988
BUCK ISLAND REEF NATIONAL MONUMENT

Date _____

Beach patrol schedule _____

Reason _____

Offshore activity

Boats _____

Lights _____

Further activity _____

Visitors

Authorized _____

Unauthorized _____

Erosion _____

Tides _____

Trash _____

Animal activity _____

Other Observations and notes

Drop - off _____

Pick - up _____