

Caroline Rogers

NPS/VHS

~~Research Report on~~

Nesting and Tagging of Hawksbill sea turtle

(Eretmochelys imbricata)

at Buck Island Reef National Monument

U. S. Virgin Islands

1987 - 1988.

by

&

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January, 1989

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BUCK ISLAND REEF NATIONAL MONUMENT
Division of Natural Resource Management
Christiansted, St. Croix, U.S. Virgin Islands

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on nocturnal project -
clarity -

ABSTRACT

Hawksbill sea turtle nesting at Buck Island Reef National Monument, U. S. Virgin Islands during a 3 month nocturnal monitoring project is described. Historical records of sea turtle monitoring at Buck Island are summarized. Twelve female hawksbill turtles were tagged. The average female measured 87.7 cm in carapace length and 81.8 cm in carapace width. Average clutch size was 140.5 eggs. The average hatchling weighed 15.1 grams. Nesting behavior is discussed. Site fidelity and activity distribution around Buck Island is reviewed. Management concerns including erosion, predation, recreation, and poaching, ~~are~~ addressed.

— when possible, try to avoid phrases like "is discussed", "is reviewed", "is described" — I know it's not always easy!

Zandy — it would strengthen the report overall if you could put Buck Island's significance as a nesting site in perspective — e.g., indicate how it compares (# activities per mile of beach) with other sites — really, get across the fact that this little island is IMPORTANT!

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INTRODUCTION

Buck Island Reef National Monument ^(BUIR) ^{provides} is well documented as a nesting area for three endangered species of sea turtle; the leatherback (Dermochelys coriacea), the green (Chelonia mydas), and the hawksbill (Eretmochelys imbricata) (NPS 1965-1988; Rainey, 1976; Seaman and Randall, 1962; Shabica, 1979; Small, 1980-82; Towle, et al., 1978). In 1980, Buck Island Reef National Monument's rangers began participating in the National Park Service's, Southeast Region's "sea turtle monitoring program". The rangers were trained ⁱⁿ for field-identification of turtle crawls and nests and they made observations in the course of their other duties ^{from 1980 to 1986} (Small, 1980-82) (Appendix VI - IX). ~~Data on sea turtle activities was collected in this manner for 1980 through 1986 nesting season~~ (BUIR/NPS Rangers, pers. comm.; Small, 1980-82). However, the importance of Buck Island Reef NM for nesting sea turtles has not yet been fully assessed by park management.

^{The National Park Service's} ~~Park management's~~ interest and concern for endangered sea turtles mirrors that of other conservation agencies, especially in light of the increased destruction of ~~viable~~ sea turtle nesting habitat and the continued overexploitation of sea turtles in the Caribbean (Rainey and Pritchard, ____).

Of special concern is the hawksbill sea turtle. Its population has reached low levels, ^{and} before its ecology has ^{not} been adequately investigated (Carr & Stancyk, 1975; Diamond, 1976; Witzell, 1983). The Caribbean hawksbill population has continued to

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decline due to the harvest of the shell for jewelry. This is a low bulk, high-value product easily targeted for illegal exploitation (Rainey and Pritchard, ____). ~~[Due to its economic importance worldwide,]~~ Several Caribbean nations refuse to comply with CITES and continue to harvest hawksbill. This emphasizes the immediate need for further research on the habitat and nesting requirements of this animal (Buitrago, 1985; Carr and Stancyk, 1975; Meylan and Mack, 1983; Witzell; 1983).

~~In review of past and current sea turtle nesting records for Buck Island Reef NM,~~ ^{few} leatherback and green-sea turtle activities have ^{were} ~~always been recorded in low numbers~~ ^{on BuIs from 1982 - 1988} (Appendix I & II). However, ^{more numerous} hawksbill nesting activities have been ~~proportionately higher in~~ number. The 1987 Buck Island sea turtle nesting season was ^{- probably OK to put this in NPS report but not in manuscript for publication elsewhere} closely monitored ^{for example - - -} [by the park's new biological technician]. All other on-going sea turtle monitoring programs ^{elaborate on this here elsewhere} [Results of 1987 were highlighted by the significant amount of hawksbill nesting]. Managers of Buck Island Reef NM, conscious that few undeveloped and protected areas remain where hawksbills could be studied, agreed to expand the sea turtle monitoring program. Characteristically, hawksbills are diffuse nesters, with an extended nesting season, making them difficult to study ^{probably should move elsewhere} (Bjorndal, et al., 1985; Lund, 1984). ~~It has been observed on~~ Buck Island Reef NM, ^{that} the hawksbill turtle is present in significant enough numbers to warrant a long-term study.

In 1988 a three month nocturnal monitoring program was instituted

in addition to the expanded day monitoring program which continued year round. The objectives of ~~the new program to study~~ the ~~hawksbill~~ included the collection of basic biological data, the initiation of a tagging program, and the introduction of an effective management plan for Buck Island Reef NM nesting sea turtles. The program also addressed management concerns such as the effects of recreation, poaching, predation, and erosion.

GENERAL DESCRIPTION

Distribution

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 (Limpus, et al., 1983; Lund, 1984; Meylan, 1984; Witzell, 1983) (Figure 1).

Morphology

The hawksbill can be identified by the imbricated (overlapping) scutes on the carapace and two pairs of prefrontal scales on the head (Figure 2). There are coastal scutes on each side of the carapace (Figure 2). General coloration is brown with splotches of yellow and red on the carapace; the plastron is pale yellow. The beak is narrow and 'hawk-like' in appearance (Meylan, 1984; Nelson, 1988).

probably preferable to cite earlier refs. on this — morphol. characteristics have been known for a long time

Habitat

Hawksbills are commonly found in shallow coral reef and coastal

make it clear to the reader that this summarizes results of day & night program

plan not developed yet — the study helps provide a basis for a plan

areas (FAO Species Identification Sheet, 1977).

→ Either expand
this section or
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Diet

Hawksbills are omnivorous primarily feeding on sponges, algae, tunicates, sea anemones, and jellyfish (Meylan, 1984 and 1988).

Consider putting a section here on basic biology —
ave. clutch size, carapace size, etc. —

GENERAL DESCRIPTION OF STUDY SITE

Buck Island Reef National Monument is located 1.5 miles north of the island of St. Croix, U.S. Virgin Islands. It is a 176 acre tropical dry forest island surrounded by approximately 600 acres of ocean and coral reef system (Figure 3).

Since 1961 Buck Island Reef NM has been under the jurisdiction of the National Park Service. The park provides for conservation of the island's natural resources and supports daily recreational activities such as picnicking, boating, snorkeling, diving, and hiking. There is no overnight camping on the island; however, overnight anchorage is permitted off West Beach (Figure 4).

The sea turtle nesting habitats are located on the south, west and northwest sides of the island. The nesting areas are approximately 1460 meters of the island coastline which varies in width seasonally (5 to 45 meters). ^[Reference needed] These nesting habitats range from the sheltered south shore, with low beach forest vegetation and cobbled beaches, and near offshore coral reefs to the southwest shoreline comprised of rock walls and open beach/dune grass (West Beach). This beach area seasonally shifts with winds, waves, and currents (Gladfelter and Gladfelter, 1980). On the north shore the beach forest gradually slopes down to the water

explain
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and frequently areas of this beach are obstructed by fallen trees and root masses. Offshore, the barrier reef breaks up into a maze of patch reefs extending out to the "drop-off" ~~well~~ north of St. Croix (Figure 4).

The beach forest vegetation is comprised primarily of manchineel (Hippomane mancinella), purple sage (Lantana involucrata) and sea grape (Coccoloba uvifera) (Woodbury and Little, 1976).

METHODS

STUDY AREA COVERAGE

All night foot patrols of Buck Island commenced on 5 June, 1988. Throughout the ~~nocturnal~~⁹ monitoring period, researchers kept an ongoing log of night activities at Buck Island, i.e. boating activity, animal sitings, erosion^{7?}, visitors, and unusual events (Appendix III). During the first weeks of patrol the entire beach was covered by two people, patrolling together, at (70) minute intervals. Foot patrol is hindered by coral cobbles and beach debris (i.e. fallen trees, low and dense thorny vegetation). Patrol of the entire study area requires forty-five minutes. Therefore, in order to cover the beach more effectively and avoid missing nesting activities, the patrol was subsequently ^{why?} ~~← when?~~ divided between two people, and patrols were made alone or with volunteer assistants [^{probably could omit this ~} provided by Buck Island's Volunteer-in-the-Park Program.]

MORPHOMETRIC PARAMETERS

When a turtle was encountered, the time, location, weather, and

moon phase, were recorded (Appendix IV). The turtle's action at the time of discovery was noted and all subsequent stages of the nesting cycle were timed and logged (i.e. approach, bodypitting, digging, laying, covering, or departure).

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

NESTING

A cautious attitude was maintained until the approachability of the nesting animals was assessed. Nest depth measurements and egg counts were not obtained due to ~~the sensitive nature of the hawksbill;~~ the potential ^{for} of disrupting nesting ~~was great~~ (Carr and Stancyk, 1975; Witzell, 1983). Following oviposition, the overburden (depth of sand over the eggs) was measured when possible. The measurements were taken from egg level to sand level right below the posterior point of the carapace. The presence of water, roots, and/or debris in the nest cavity was also carefully recorded.

TAGGING

Each nesting turtle was tagged after egg-laying was completed during the initial stages of covering. Inconel tags and tagging tools provided by the National Marine Fisheries Service were used

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(tag series PPW 801-899). A single tag was inserted in the second scale out from the body on the trailing edge of the front left flipper (Figure 2). Only one tag was used until individual reactions were documented and analyzed.

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The first six hawksbill turtles observed nesting were also paint-tagged, as a temporary visual tag. This was done during egg-laying while the turtle was still. Lights were kept to a minimum during this procedure. Alcohol on a soft scrub pad was used to remove algae from the carapace in preparation for painting. A single number was painted on the posterior portion of the carapace with yellow enamel paint. Clear nail polish was then applied to the number to increase durability.

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 back of each data sheet (Appendix IV). This diagram allowed for the concise reporting of ectobiota and location on the carapace, such as goose barnacles (Lepas anatifera), and fragile star barnacles (Chthamalus fragilis), and various algae (Kaplan, 1988). Photographs were taken of each nesting hawksbill as a further record of ectobiota and distinguishing features. Careful notations were also made as to the degree of juxtaposition of the imbricated scutes of the carapace; written descriptions were made on each animal, e.g. smooth to highly overlapping. Since animals were only single-tagged extra care was taken in these descriptions to insure accurate documentation of individual characteristics for future

reference.

NEST LOCATION

During nocturnal patrol, location of nesting animals was facilitated by "knockdown" stakes. Knockdowns, wire survey markers flagged with 3-M reflective tape, were placed on the top of the berm along nesting areas with cobble beaches. In these areas crawls are not visible and the knockdowns pushed over by an emerging turtle enabled researchers to locate nesting animals and their entry and/or exit from the beach (Dr. James Richardson, pers. comm). Knockdowns were left in place throughout the nesting season and were also used effectively to locate activities during day monitoring.

← incorrect way to reference the method put barrier any work ref. this

Nest location was recorded ~~and logged~~ ^{and compass bearing} by measuring the distance from the nest site to the closest marker. These "markers" are wood stakes and/or naturally occurring trees located at approximately 200-meter intervals along the beach berm. Each marker is painted with a corresponding number (Small, 1980-82). The markers begin at number 1 at the ~~furthest~~ northwest edge of the nesting areas and extend around to West Beach, down the south shore, and end in Turtle Bay at number 20 (Figure 5).

the pers. comm. doesn't refer exactly to Beach Is. area (call me if this doesn't make sense)

~~A compass bearing was taken from the nest site to the closest marker. This was used to locate the nesting area for nest success determination post-hatching.~~ A detailed crawl and nest diagram was drawn to show each nest in relation to vegetation, high tide line, water level, and other distinguishing natural features or landmarks (Appendix IV). ^{Using these methods, we were able to relocate}

HATCHLINGS

Hatchling emergence was difficult to monitor because hatchling tracks were lost in the beach forest and the coral cobbled areas. If an emergence was not recorded for a near-term nest within a week of the expected emergence date, 70 days, the nest was located and excavated for inspection.

Predation by ghost crabs (Ocypode quadratus), the great land crab (Cardisoma guanhumi), and yellow-crowned night herons (Nyctanassa violacea) was closely monitored and recorded.

NEST EXCAVATION

how many
Nest excavations were performed approximately 70 days post-hatching. *Nests were* The ~~nesting activity~~ was located and all nest contents were removed. Live hatchlings, found trapped in the nest, were counted, measured with dial calipers, weighed, and subsequently released. (There are no hatchery facilities available on Buck Island Reef NM.)

Nest contents were further sorted into the following ~~general~~ categories: hatched shells, undeveloped eggs, dead hatchlings, and full-term pipped and un-pipped (Appendix V). All unhatched eggs were opened to determine the size of the embryos that did not reach full term development. All irregularities were recorded, and after examination, nest contents were reburied in the original nest cavity.

RESULTS AND DISCUSSION

NESTING

Prior to and following the nocturnal monitoring period, sea

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turtle activity was recorded^{omit} [by the biological technician and Buck Island park rangers.] Nocturnal beach monitoring was conducted on 40 nights between June and August of 1988. Monitoring was sporadic due to extreme weather conditions and frequent lack of boat transportation to or from Buck Island. [On several occasions, National Park Service transportation was supplemented by members of the St. Croix community.] ^{omit}

this actually belongs in the methods section

~~During the nocturnal monitoring period,~~ 23 hawksbill activities were ^{actually} observed. ^{at night} Eighteen of these activities resulted in the deposition of eggs and two were unsuccessful nesting attempts (false crawls). On three occasions hawksbills were observed on approach. These individuals moved along the shoreline within the surf zone in a scallop pattern. Researchers did not interfere or approach the animal, on these occasions. One individual ^{of these 3?} was tagged. (PPW 820) during departure after an unsuccessful nesting attempt and subsequently nested an hour later. The second recorded false crawl involved a previously tagged individual (PPW 808) who nested the following night (Table 1).

Research personnel recorded an additional 33 unobserved hawksbill crawls during this period. The majority of these activities were ~~judged as nests and listed as suspected nests.~~ ~~Suspected nests~~ ^{and} were continuously monitored for indications of hatchling emergence as a means of confirmation. In all cases, after a minimum of 70 days, an attempt was made to locate and excavate suspected nests.
Describe the results of these excavations here -

Twelve hawksbills were tagged with inconel tags during the

nocturnal monitoring period. Six of these individuals were also paint tagged (Table 1). Paint tagging was discontinued when researchers discovered that the paint^{ed} tag numbers ~~were~~ remaining legible for less than one nesting interval, approximately 15 days.

The majority of the tagged individuals (8) were only observed nesting on one occasion. Two hawksbills were observed twice and two were observed nesting on three occasions (Table 1). Only one individual was observed nesting during the day. She was observed prior to the nocturnal monitoring period [~~by park service personnel~~] and never tagged or observed again.

From these ^{limited} observations the average internesting interval (the number of days between a successful nesting activity and next nesting attempt) was 15.8 days ($SD = 0.83$, $n = 4$ intervals). The tagged individuals observed a third time were seen thirty days after their second successful nest. This interval was not used in calculating average internesting interval because it is likely that these individuals nested unobserved in the interim. In the absence of consistent nocturnal patrols, it is not surprising that nesting activities were missed and that a large number of tagged individuals were only observed once.

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Over-the-carapace measurements ranged from 83.5 cm to 94.0 cm, while width measurements ranged from 76.3 cm to 90.0 cm (Table 2). If measurements were taken more than once, the figures were averaged.

compare
to data
from other
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Average clutch size was calculated from nest excavation figures

because egg counts were not obtained during laying. Table 4 summarizes average clutch size (1985 - 1988). The figures presented for 1985 and 1986 are from Buck Island Reef ranger sea turtle monitoring logs. Average clutch size for the Caribbean hawksbill ranges from 101 - 161 eggs (Meylan, 1984). In 1988, Buck Island data show an average clutch size of 140.3 eggs (SD = 24.0, n = 75). This figure is comparable to the reported 142 eggs per clutch recorded for the U.S. Virgin Islands in 1982 (Small, 1982). Successive clutches laid by tagged hawksbills did not change appreciably in size throughout the season (Table 5).

As described in METHODS, All stages of the nesting cycle were timed (Table 6). The longest stage of the nesting cycle was covering (33.2 minutes). Only four animals were observed from the time of approach through departure. On the average, these animals spent 129.9 minutes on the beach.

The nesting season in the U.S. Virgin Islands has been documented to range from May through November (Boulon and Olsen, 1982) and June through November (Witzell, 1983). On Buck Island Reef NM nesting occurs from late April through December, but more often nesting occurs from May through November as reported by Boulon and Olsen (Figures 6A - G). Also recorded for Buck Island Reef are isolated and sporadic nesting activities in January, February, and March (NPS sea turtle monitoring logs, 1980 - 1988).

Boulon and Olsen, as well as the material presented in Witzell does not cite a peak nesting interval. As stated earlier,

doesn't [Zullo] provide info. on this at all

aw/kward reunite inclu dates ref.

hawksbills are found to be diffuse nesters with an extended nesting season. Hawksbill nesting on Buck Island has been recorded to peak during the months from July to October (Figure 6A - G). These figures show monthly hawksbill sea turtle activity for 1982 through 1988. From these figures the majority of nesting took place from July to October. The most active month of the year varies among the figures; the highest number of activities occurred twice in July (1984, 1987), three times in September (1982, 1985, 1988), and twice in October (1983, 1986). [Note that every three years the same month serves as the peak month.]

redunda.

probably omit unless you're confident in from all year

~~The study area, as previously described, is broken into three segments; the south shore, the north shore, and West Beach (Figure 4).~~ Of the 155 hawksbill activities recorded for the 1988 season, 73 were documented on the south shore, 63 on the north shore, and 19 at West Beach. ^(Figure 4) ~~A monthly distribution of these activities is shown in Figure 10.~~ Consistently, each nesting beach has its own peak marked by a distinct rise and fall in the number of activities. ^(Figure 10) Historically, the north and south shore nesting areas have had the highest number of hawksbill nesting activities (Figure 7, 9, & 10). These two areas collectively represent 80 to 90 percent of the hawksbill activities. ~~Figure 7 illustrates that West Beach~~ characteristically supports as little as 5 percent and no more than 19 percent of the nesting activities (1982 to 1988). ^(Figure 7) The north and the south shores are typical hawksbill nesting habitat with isolated areas of beach forest, low berms, and cobble

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beaches. ^{However,} ~~On the contrary,~~ West Beach is an open beach with low dune grass and deep offshore water where most visitor recreation occurs.

Sea turtle monitoring records prior to 1987 were often inconsistent and fragmented. Records from as early as 1965 have been reviewed and are summarized in Table 7. Prior to 1982, records did not accurately delineate species. For several years the loggerhead sea turtle (Caretta caretta) was included in monitoring records (Appendix VI). It was difficult for park rangers to obtain consistent data because they were asked to carry out detailed sea turtle monitoring in addition to other regular duties. Nest confirmation was rarely obtained. Figure 8 clearly shows an increase in the number of confirmed hawksbill sea turtle nests over the years. In 1985, only 20 nests were confirmed, while in 1988, 88 nests were confirmed showing a dramatic increase in nest confirmation at Buck Island (Figure 8).

^{redundant}
In 1988, a small amount of information on individual hawksbill site fidelity was collected during the nocturnal monitoring period. Evidence exists that hawksbills might be capable of 'homing' to specific sections of nesting beaches (Carr and Stancyk, 1975). 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 Buck Island nocturnal monitoring program makes it difficult to interpret the small amount of information that was gathered on site fixity (Table 8). Only one instance was recorded where a tagged individual (PPW 807) nested in more than one of the three

say something about what the summary shows - # of recorded activities from to

Although they did manage to document a lot of activity

designated nesting areas (Figure 4). A larger sample size is needed before conclusions can be made.

HATCHING

In 1988, 88 nests were confirmed and approximately 6,800 hawksbill hatchlings were released from Buck Island. Nest excavation, in conjunction with nest monitoring, provided this estimate. Average incubation periods were not calculated because emergences were often unobserved and nests were excavated one or two weeks post hatching. Mean hatchling length (straightline carapace) was 4.1 cm ($n = 20$, $SD = 0.10$) while mean width was 2.9 cm ($n = 20$, $SD = 0.13$). Hatchling weights ranged from 14.0 to 17.5 grams (Table 3). These figures are comparable to figures presented for other hawksbill populations throughout the world (Witzell, 1983). A small percentage of unusual and abnormal occurrences were observed in hatchlings including scute deformities, albinism, and a set of twins. ← identical or fraternal (5)

Nest outcomes are presented only for confirmed nests in 1987 and 1988. Of the 88 confirmed nests in 1988, 68 nests (77 %) survived to term without recorded predation, erosion, or poaching. The mean hatching success for these nests (hatchlings/yolked eggs laid) was 80.9 percent ($SD = 16.1$, range 17.0 to 100 %). No count was available for 5 (6 %) of the 88 confirmed nests. The remaining 15 nests were either partially or totally destroyed by predation or erosion. There were no recorded cases of poaching during the 1988 season even though poaching has been previously recorded on Buck Island (Christian, NPS letter & pers. comm., 1981; Small, 1980-1982). Seven nests (8 %) were

lost to predation in 1988. All seven of the nests were located in the north shore nesting area (Markers 2A - 4) within a 200 meter stretch of beach (Figure 5). Suspected predators are the black rat (Rattus rattus) and the great land crab (Cardisoma guanhumi). After 2 nests were invaded by an unknown predator, the bio tech and NPS rangers set out 10 live traps. Twenty-five rats and 1 land crab were trapped over a two week period. Eight nests (9 %) were lost to erosion. The loss of three of these nests was directly attributed to Tropical Storm Gilbert which passed to the south of Buck Island on September 10, 1988. The remaining 5 nests were laid in wash zones. Including the 15 nests partially or totally destroyed, the mean hatching success was 67.9 percent (SD = 31.9, range 0 to 50 %, n = 83).

In 1987, 46 nests were confirmed and 39 (84.7 %) of these survived to term. Mean hatching success was 83.5 percent (SD = 17.6, range 12 to 98%). There was no count available for 2 (4%) nests. Poaching contributed to the loss of 1 (2 %) nest, while both predation and erosion were responsible for the loss of 2 nests respectively. Mean hatching success for 1987, including these nests, was 75.8 percent (SD = 28.0, range 0 to 50%, n = 44).

The hatching success of nests surviving to term in 1987 and 1988 was high (83.5 % and 80.9 % respectively) in contrast to the mean success of all nests (67.9 % and 75.8 % resp.). Yet, it is low in comparison to success levels of undisturbed nests in other areas. ~~Vannie~~ Small recorded a hatching success of 90.1 percent for undisturbed nests on St. John, U.S. Virgin Islands, over a

two year period ($SD = 14.6$, $n = 29$). Similar results were reported at Tortuguero, Costa Rica (91.6% , $SD = 4.1$) (Bjorndal, et al., 1985). Buck Island hatching success was lowered by poor success in four nests (range 17 to 49 %) which was not attributed to predation, erosion, or poaching. All of these nests had a large percentage of undeveloped eggs and midterm embryos. There was no correlation between nest location and success and nest contents were found dry and compact at excavation. One of these nests was laid by the only recorded diurnal nester.

MANAGEMENT CONCERNS

Nesting Sea Turtles

Harassment Lighting, noise, and physical contact will disturb nesting females. During the nocturnal monitoring program there was no record of unauthorized visitors or activities on the beach. The park is closed at night and camping is prohibited. Nocturnal monitoring and increased ranger presence will enforce already existing park regulations which protect nesting sea turtles.

Disorientation There is no artificial lighting on the island to cause disorientation. Furthermore, other light sources, such as camera strobes, flashlights, and camp fires are prohibited by park regulations and controlled by nocturnal monitoring. Overnight anchorage is permitted off West Beach (Figure 4) and could potentially disorient nesting females and was closely monitored during the nocturnal program.

Beach Debris Both manmade and naturally occurring obstructions

along the nesting beaches have been observed hindering nesting females during approach, body pitting, and departure. On several occasions, individuals were unable to reach suitable nesting ground due to logs, root masses, fallen trees, automobile tires, bouys, and planks. During nocturnal patrols researchers picked up portable debris and ranger/volunteer groups participated in beach 'clean-up' walks.

Eggs

Poaching Poaching has historically occurred on Buck Island. Recently, due to increased monitoring efforts, and public volunteer involvement and local conservation programs, poaching has been effectively reduced.

Erosion This is a multi-faceted problem which needs to be addressed. Due to the natural movement of the beaches, erosion in nesting areas occurs seasonally. Erosion profiles and detailed documentation of nest losses are imperative if this problem is going to be fully addressed.

Beach Traffic Vehicle traffic, which threatens other mainland nesting areas, is not a concern on Buck Island. Other traffic such as visitors, beached boats, game poles, and beach umbrellas could impact nests but are prohibited during the nesting season. Furthermore, most of this activity takes place on West Beach which does not support a large percentage of overall nesting.

Predators Extensive trapping programs have eliminated the ^{primary} ~~number one~~ historical threat to eggs, ^(and hatching) the exotic mongoose (Herpestes auropunctatus).

Beach fires Beach fires are prohibited and beach grills are provided for cooking during the day.

Hatchlings

Disorientation Due to the limited number of nocturnal activities on Buck Island disorientation by lighting is minimal. However, one instance of hatchling disorientation was recorded on West Beach where overnight anchorage is allowed. Hatchlings were attracted in large numbers to the lights ^{of} a sailboat anchored at West Beach (Figure 4).

Entanglement Hatchlings were frequently found trapped in roots lining the nest cavity. Entanglement also occurred in beach debris such as monofilament fishing line, root masses, and plastic refuse.

Predators Predation by endemic species was closely monitored. ???

CONCLUSIONS

Buck Island Reef National Monument has historically supported hawksbill sea turtle nesting. Yet, it was not until 1987, when comprehensive monitoring began, that Buck Island's importance as hawksbill nesting habitat was fully realized.

In 1988, the Buck Island sea turtle monitoring program was further intensified by the introduction of a nocturnal monitoring program. The primary objectives of this program included the collection of biological data, the initiation of a tagging program, and the introduction of an effective management plan for sea turtles nesting on Buck Island.

The primary objectives of the program have been ^{achieved} initiated and a management plan can now be accurately addressed. The biological data collected during the 1988 season has established a baseline of information on the hawksbill nesting population at Buck Island. The tagging program ^{provides a basis for} has insured the continued collection of data which will provide information on site tenacity, remigration, and tag recovery for this endangered and poorly documented species.

Buck Island Reef National Monument is a protected, undeveloped offshore island which provides stable nesting habitat for the hawksbill turtle. In light of the continued loss of nesting habitat to development in the Caribbean, Buck Island's role in the conservation of the hawksbill is even more significant. The results of the 1988 nocturnal monitoring program indicate that a long-term monitoring program is not only feasible but ^{critical} warranted.

— Can you say something here about the continuation of the monitoring program? —

*** This is a ~~very~~ important point which you should elaborate on —
put Buck Island in perspective
* how do the number of
activities per beach mile
compare to other sites in
the Caribbean? —

TABLES AND FIGURES

Table 1. Tagging information on female hawksbill sea turtles nesting on Buck Island Reef NM, U.S. Virgin Islands, 1988.

Temporary Paint	NMFS Tag*	Date Tagged	Tagging Location**	Other Dates Observed
1^	804	6/21/88	SS/14A	6/5
2	805	6/12/88	SS/14A	-
3	806	6/13/88	NS/02	-
4	807 817	6/13/88 6/28/88	SS/14 SS/14A	7/28
5	808	6/13/88	SS/14A	6/28, 7/28 7/29
6^^	809	6/16/88	SS/13	-
-	810	6/17/88	WB/11	-
-	813	8/02/88	SS/15	8/18
-	814	8/04/88	SS/17	-
-	818	8/04/88	SS/19	-
-	820	7/20/88	NS/04	-
-	822	7/26/88	NS/03	-

* National Marine Fisheries Service, Inconel Tags, Series PPW.

** Nesting area (SS = South shore; NS = North shore; WB = West Beach) and corresponding "Marker" Number (Figure 5).

^ Paint tag applied prior to inconel tag, which was applied upon subsequent nesting.

^^ Number "6" was the last paint tag applied during nocturnal monitoring period due to unsuccessful results.

Table 2. Carapace measurements of female hawksbill sea turtles nesting on Buck Island Reef NM, U.S. Virgin Islands, 1988.

DIMENSION	N	$\bar{X}$ (cm)	SD	RANGE
o.c.* notch to notch	12	87.7	3.8	83.5 - 94.0
o.c. width	12	81.8	4.0	76.3 - 90.0

* over-the-carapace.

Table 3. Carapace and weight measurements of hawksbill hatchlings. Buck Island Reef NM, U.S. Virgin Islands, 1988.

DIMENSION	N	$\bar{X}$	SD	RANGE
s.l.* notch to notch	20	4.1 cm	0.10	3.9 - 4.3
s.l. width	20	2.9 cm	0.13	2.6 - 3.2
weight	20	15.1 g	0.97	14.0 - 17.5

* straightline.

Table 4. Average clutch size of hawksbill sea turtles. Buck Island Reef NM, U.S. Virgin Islands, 1985 - 1988.

YEAR	N	$\bar{X}$ (eggs)	SD	RANGE
1985	7	153.4	41.3	110 - 230
1986	12	140.9	19.9	107 - 166
1987	42	137.3	29.6	59 - 201
1988	74	140.5	23.5	91 - 198

Table 5. Successive clutch size of tagged hawksbills nesting on Buck Island Reef NM, U.S. Virgin Islands, 1988.

Individual Tag #	NUMBER OF EGGS/CLUTCH			$\bar{X}$	SD
	Nest 1	Nest 2	Nest 3		
PPW 804	165	165	-	165.0	0
PPW 807	126	140	115	127.0	10.2
PPW 808	155	160	176	163.7	9.0

Table 6. Average time elapsed during subsequent stages of hawksbill sea turtle nesting. Buck Island Reef NM, U.S. Virgin Islands, 1988.

STAGE	N	$\bar{X}$ (min)	SD	RANGE
Approach	3	3.0	1.7	2.0 - 5.0
Bodypitting	4	6.5	4.7	2.0 - 11.0
Digging	6	25.7	8.2	15.0 - 35.0
Laying	13	18.4	4.1	14.0 - 24.0
Covering*	6	33.2	11.3	15.0 - 50.0
Initial**	6	13.3	2.3	10.0 - 16.0
Secondary***	4	25.0	14.1	16.0 - 46.0
Departure	8	4.0	3.9	0.5 - 12.0
TOTAL^	4	129.9	47.6	90.5 - 198.0

* Includes both initial and secondary covering.

** Rear flippers used exclusively.

*** Both front and rear flippers utilized.

^ Total time elapsed on beach.

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

Table 7. Summary of hawksbill sea turtle monitoring. Buck Island Reef NM, U.S. Virgin Islands, 1978 - 1988.

Season	Total Number of Recorded Hawksbill Activities	Source
1965	*80	Ranger Patrols
1966	*36	Ranger Patrols
1967-69	-	Records Not Available
1970	*21	Ranger Patrols
1971	*4	Ranger Patrols
1972-77	-	No Monitoring Records
1978	*50	(Shabica, 1979)
1979	-	No Monitoring Records
1980	*56	Ranger Patrols
1981	*36	Ranger Patrols
1982	58	Ranger Patrols
1983	71	Ranger Patrols
1984	69	Ranger Patrols
1985	149	Ranger Patrols
1986	85	Ranger Patrols^
1987	113	Biological Technician
1988	158	Biological Technician Nocturnal Monitoring

* Records did not delineate species.

^ Data sheets used by rangers (1980 - 1986) in the field included in Appendix VI - IX.

Table 8. Site selection. Hawksbill sea turtle nesting. Buck Island Reef NM, U. S. Virgin Islands, 1988.

Tag Number	Nest Site 1	Distance (meters)*	Nest Site 2	Distance (meters)*	Nest Site 3
PPW 804	17	176	14	-	-
PPW 807**	14	42	14A	807	2
PPW 808	14A	172	17A	30	17A
PPW 813	15	150	18	-	-

* Distance between respective nest sites.

** This individual nested on both the south shore and north shore.

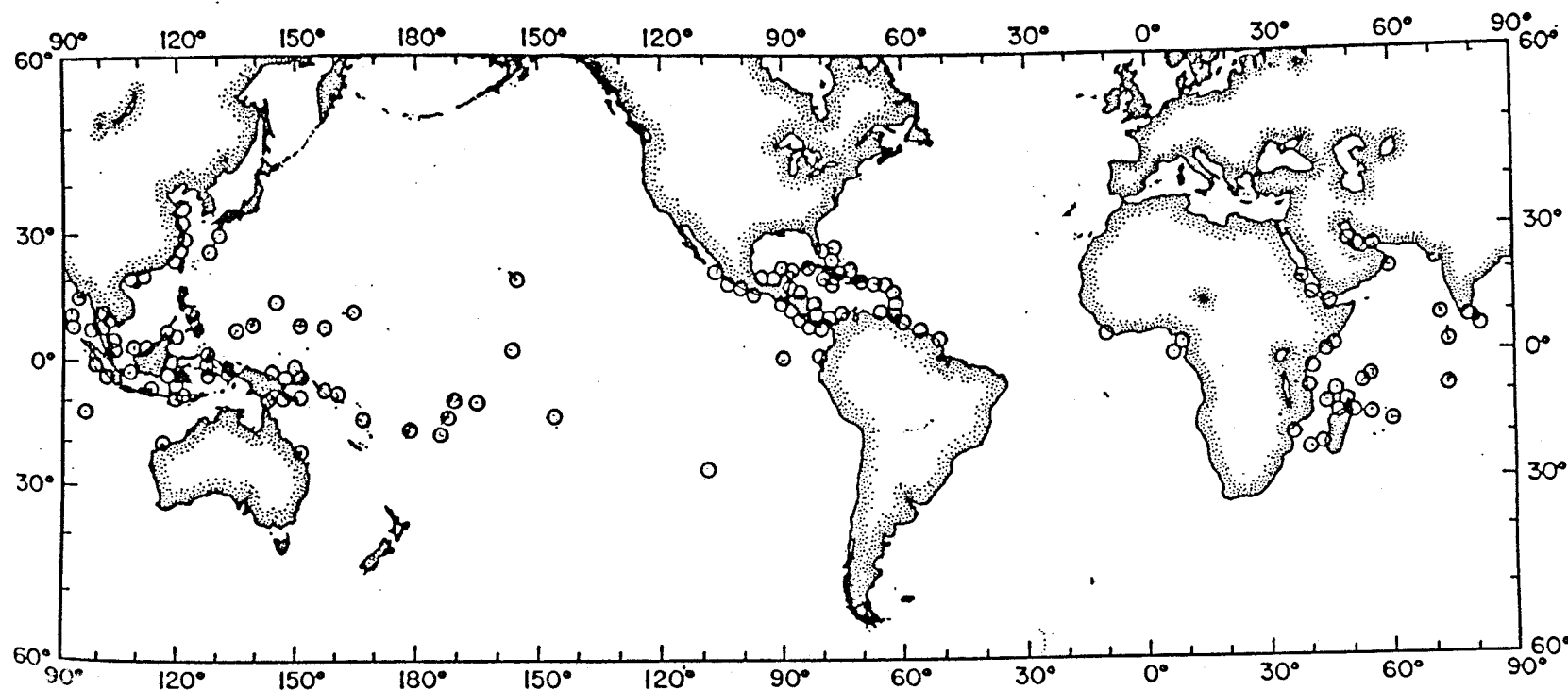


Figure 1. Documented nesting location of the hawksbill sea turtle worldwide. (Adapted from Witzell, 1983).

DORSAL

VENTRAL

Tag location

Imbricated scutes

Carapace

2 Pairs prefrontal scutes

marginal
scutes

claws

"BEAK"

Precentral scute

central
scutes

costal
scutes

Posterior notch

ventral
scutes

inframarginal
scutes

tail

Figure 2. Hawksbill sea turtle (*Eretmochelys imbricata*).

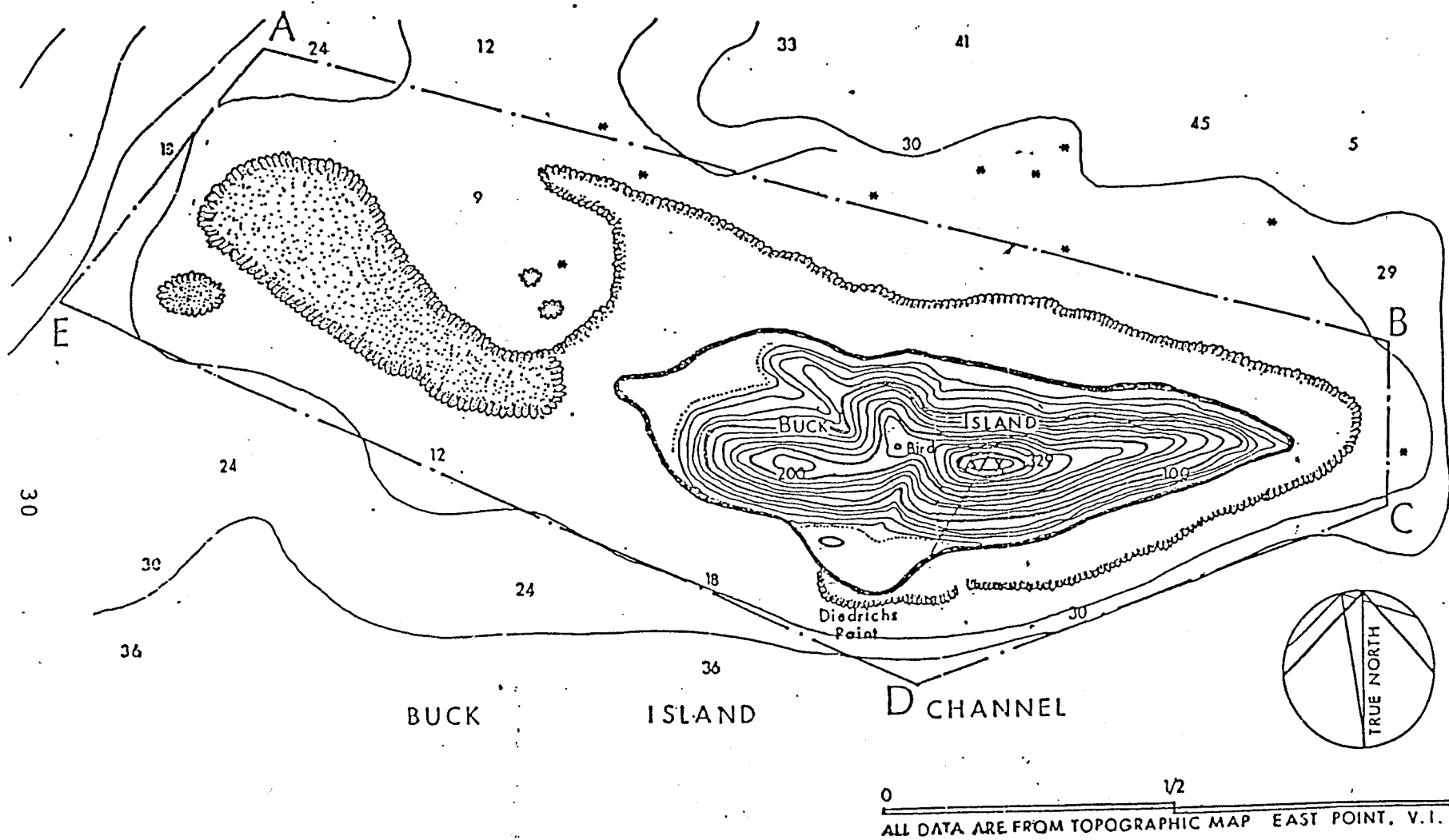


Figure 3. Buck Island Reef NM. Boundaries showing area around 176 acre island and 600 acres of park waters. Natural Resources Mangement Plan Drawing, 1982.

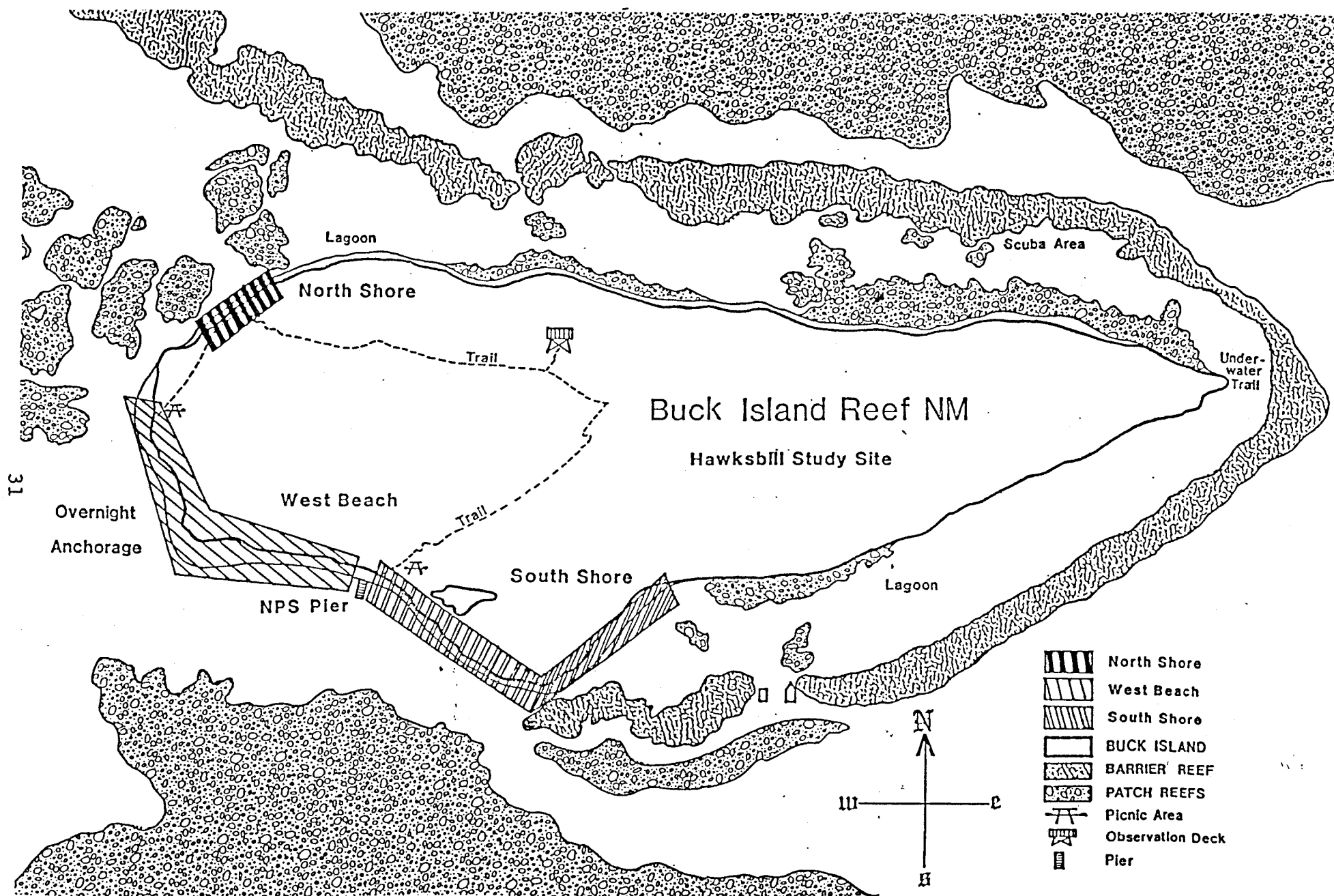


Figure 4. Buck Island Reef NM Study Site. Predominant sea turtle nesting area; North shore, West Beach, and South shore. 1988.

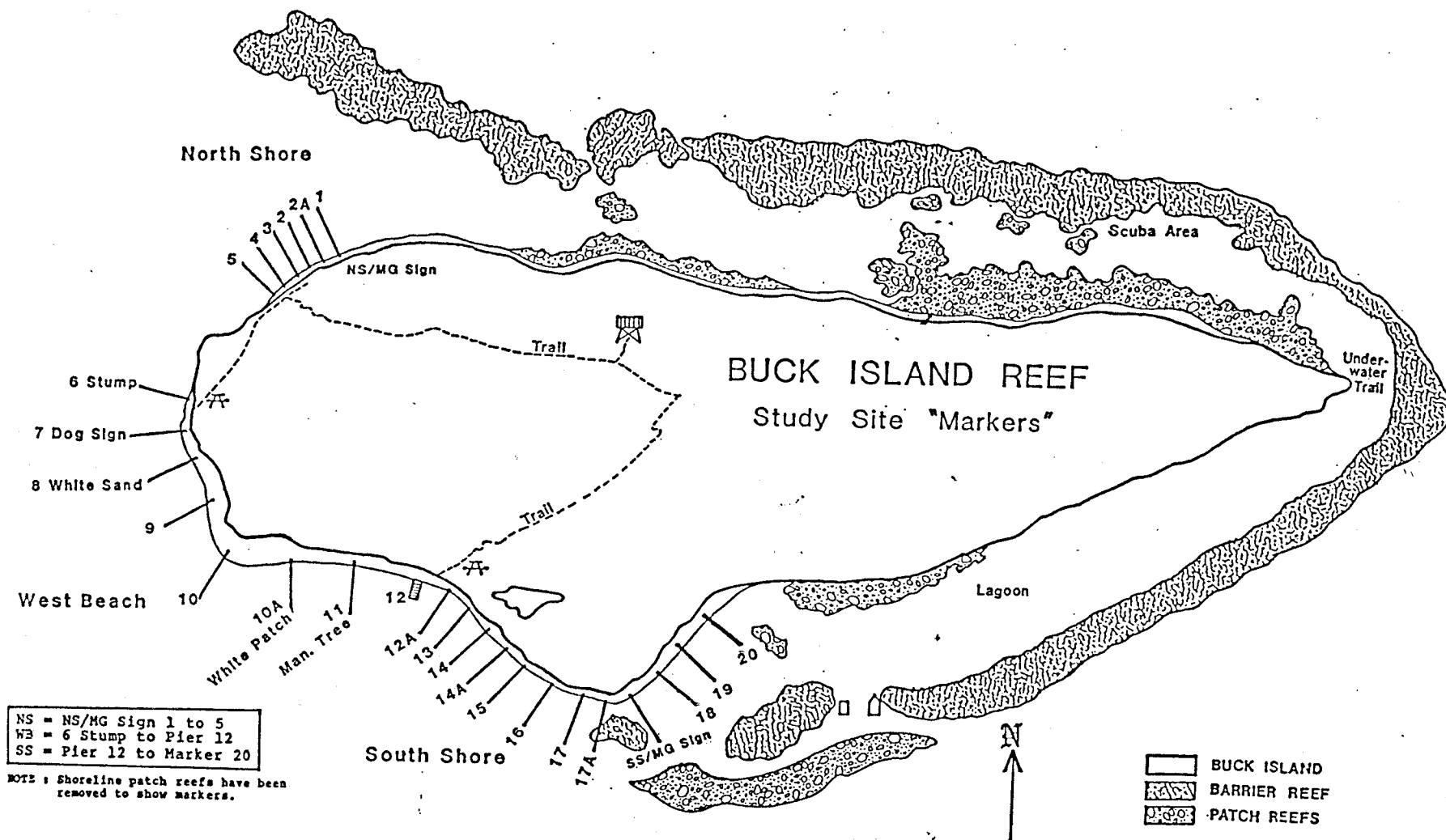


Figure 5. Buck Island Reef NM, Study Site. Location of Nesting-Area Markers. 1987 - 1988.

HAWKSBILL SEA TURTLE ACTIVITY

BUCK ISLAND REEF NM, 1982 MONTHLY

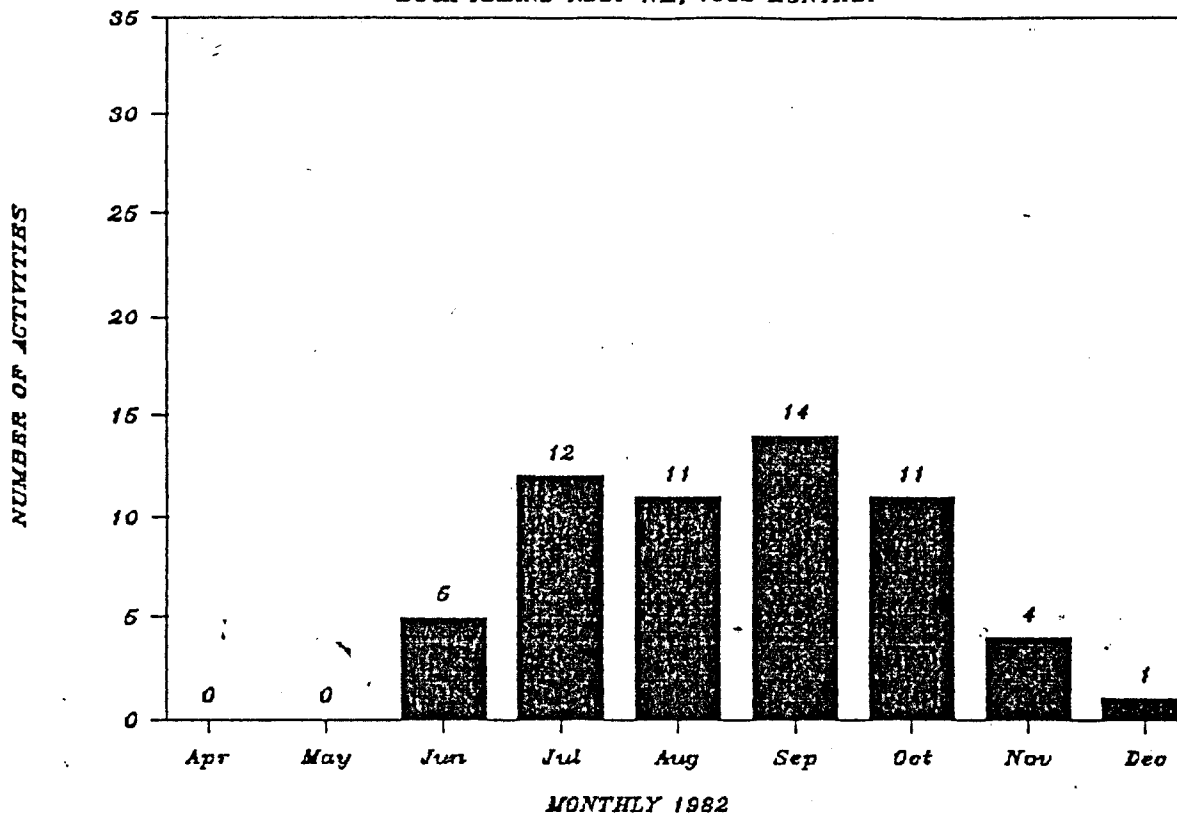


Figure 6A.

HAWKSBILL SEA TURTLE ACTIVITY

BUCK ISLAND REEF NM, 1983 MONTHLY

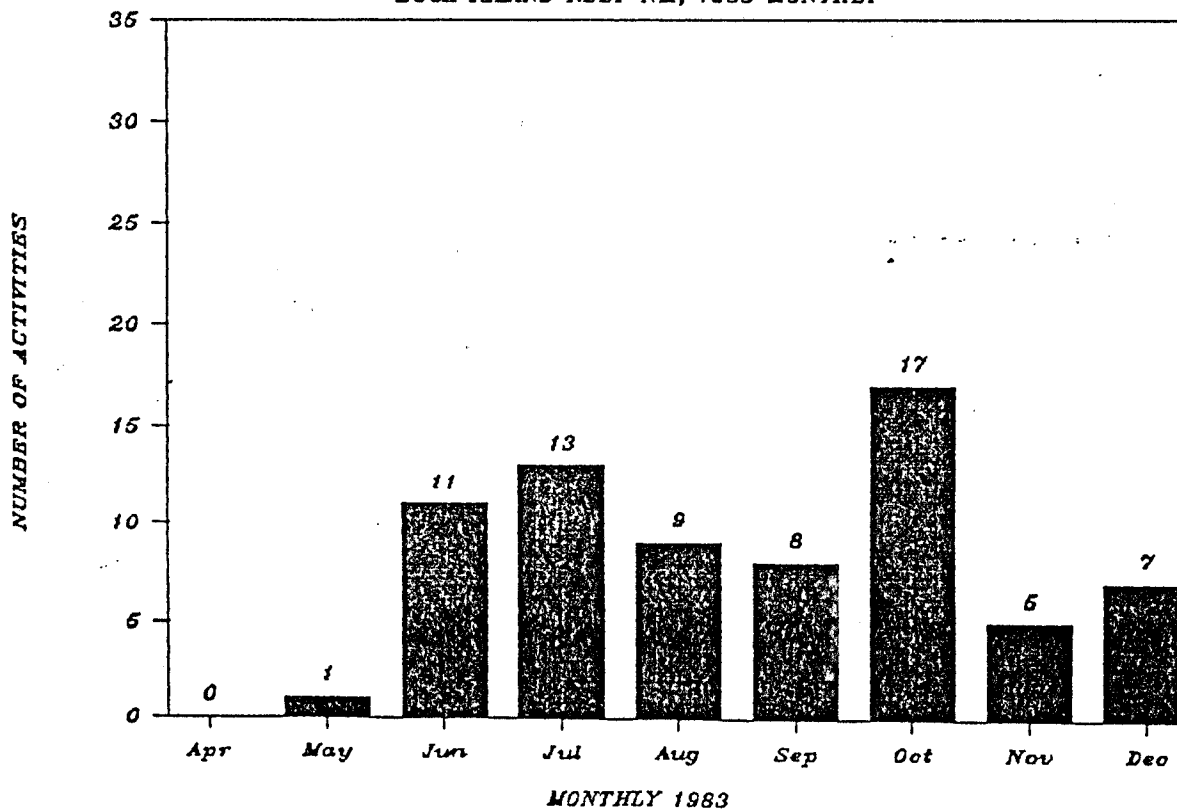
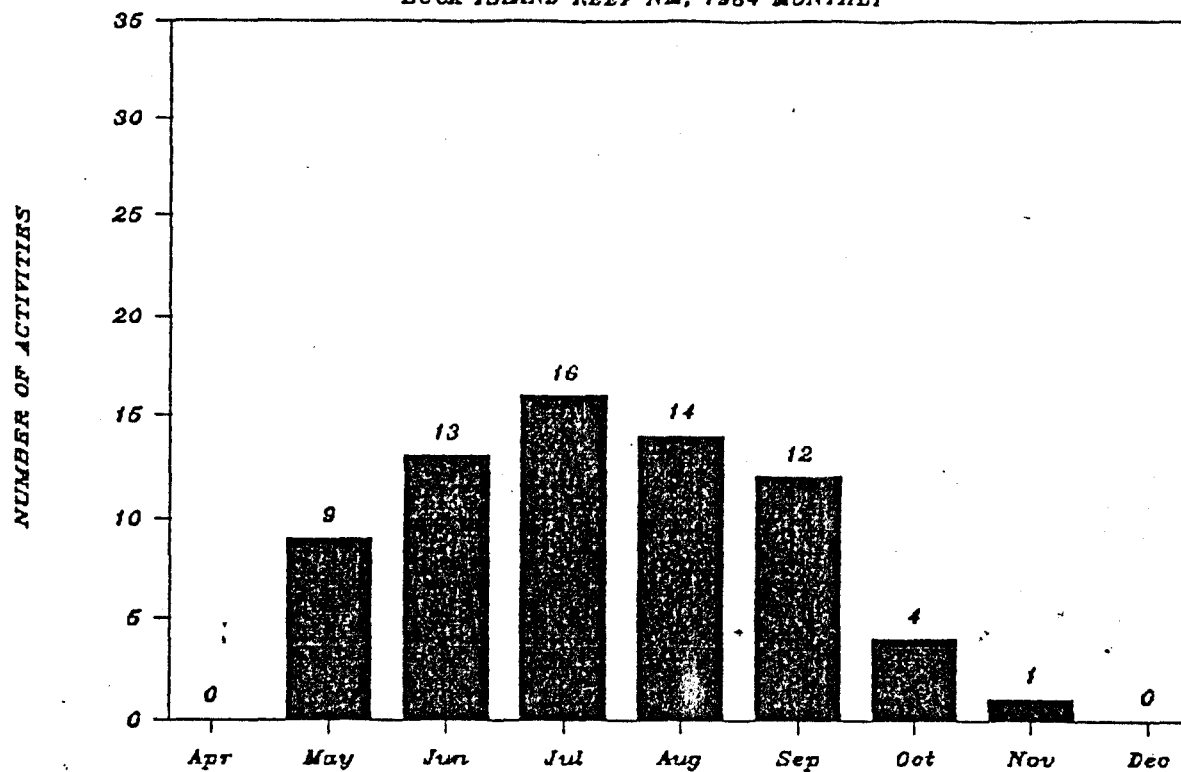


Figure 6B.

HAWKSBILL SEA TURTLE ACTIVITY

BUCK ISLAND REEF NM, 1984 MONTHLY

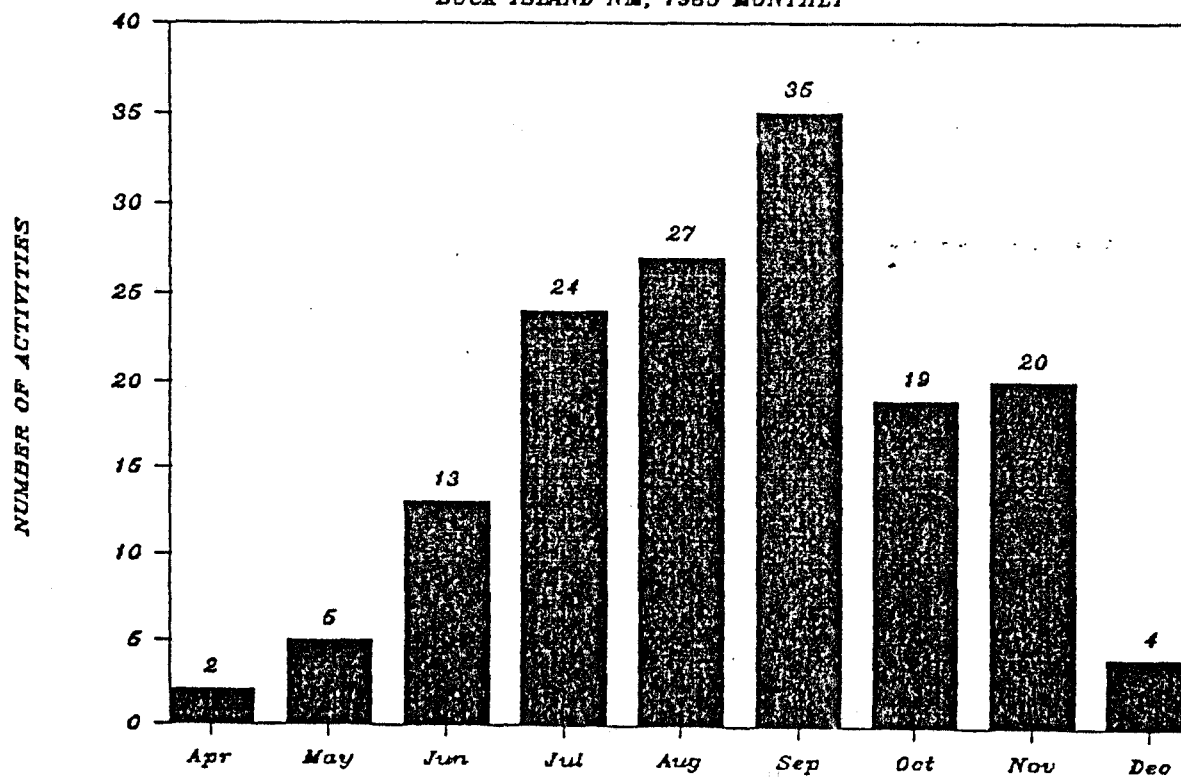


MONTHLY 1984

Figure 6C.

HAWKSBILL SEA TURTLE ACTIVITY

BUCK ISLAND NM, 1985 MONTHLY

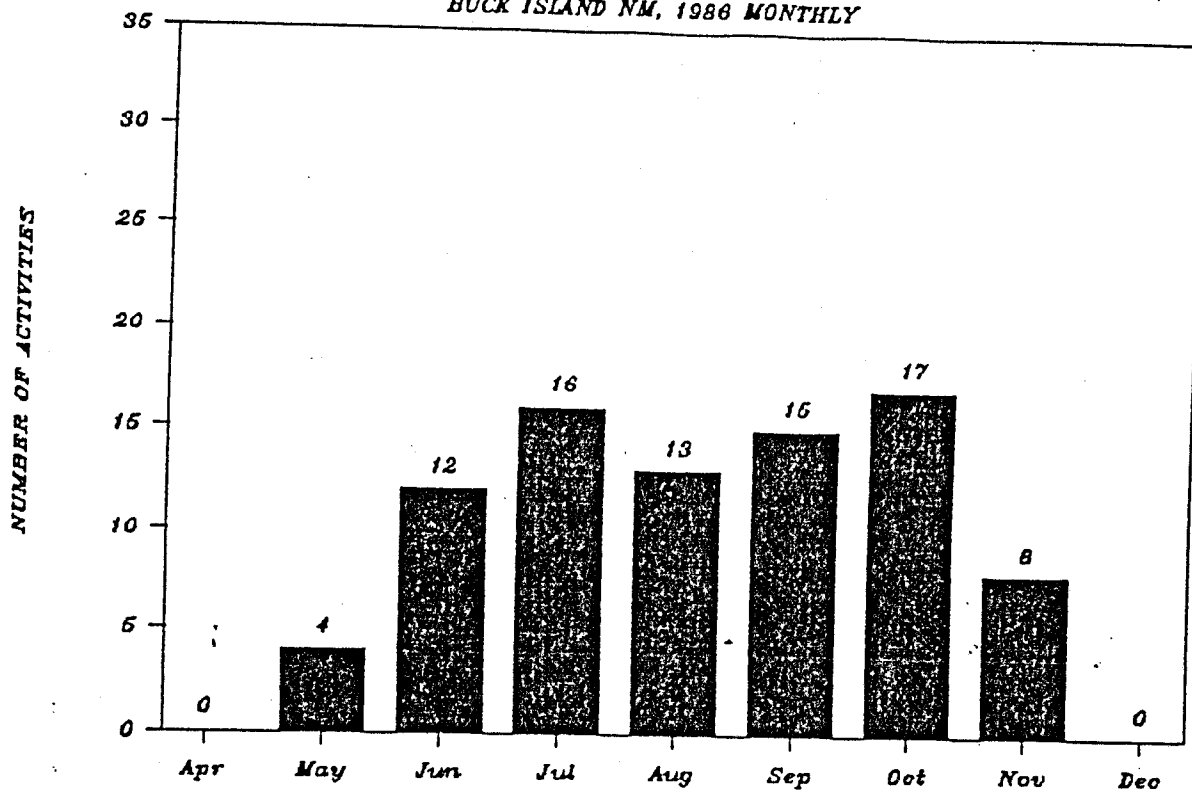


MONTHLY 1985

Figure 6D.

HAWKSBILL SEA TURTLE ACTIVITY

BUCK ISLAND NM, 1986 MONTHLY



MONTHLY 1986

Figure 6E.

HAWKSBILL SEA TURTLE ACTIVITY

DUCK ISLAND REEF NM, 1987 MONTHLY

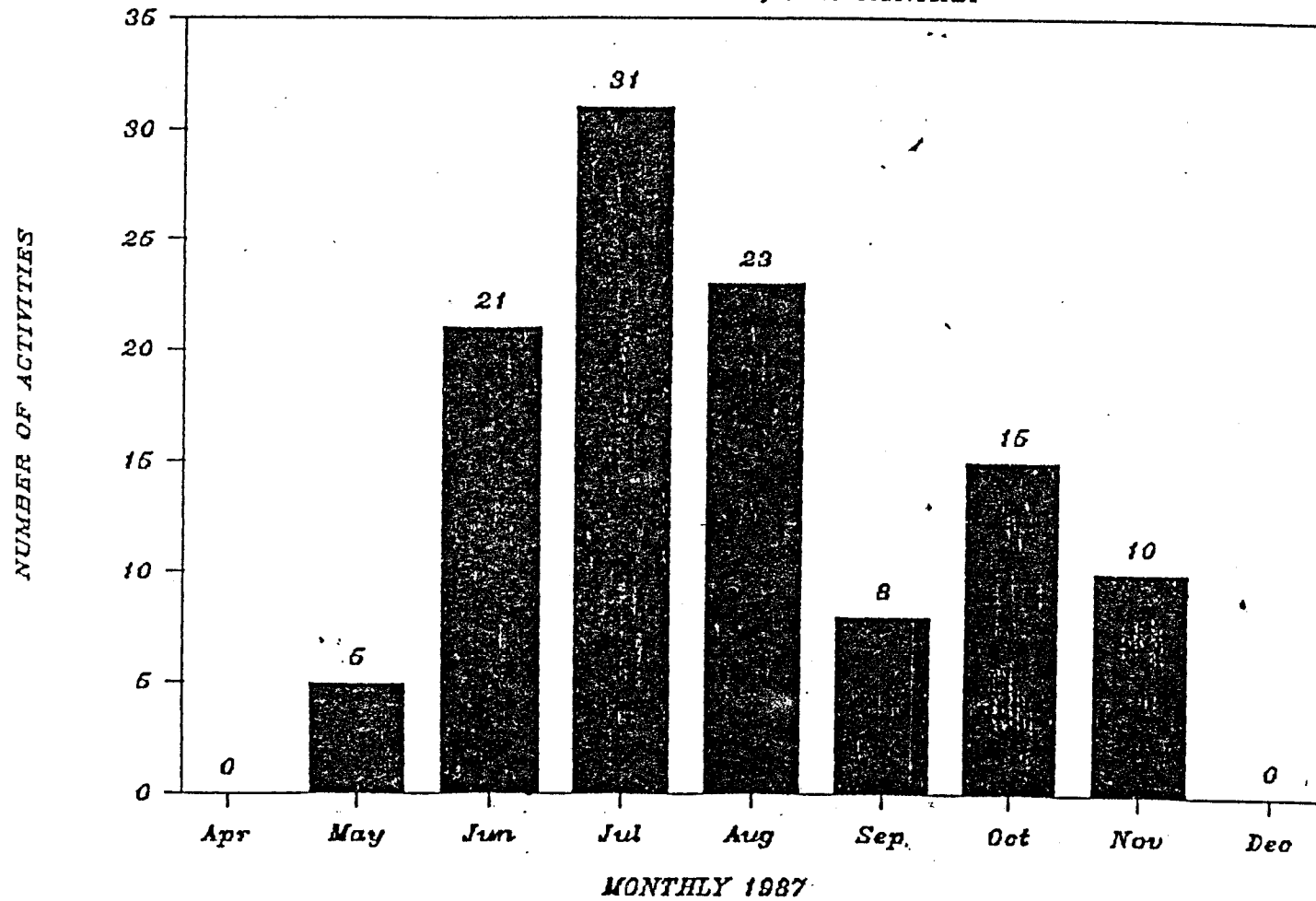


Figure 6F.

HAWKSBILL SEA TURTLE ACTIVITY

BUCK ISLAND REEF NM, 1988 MONTHLY

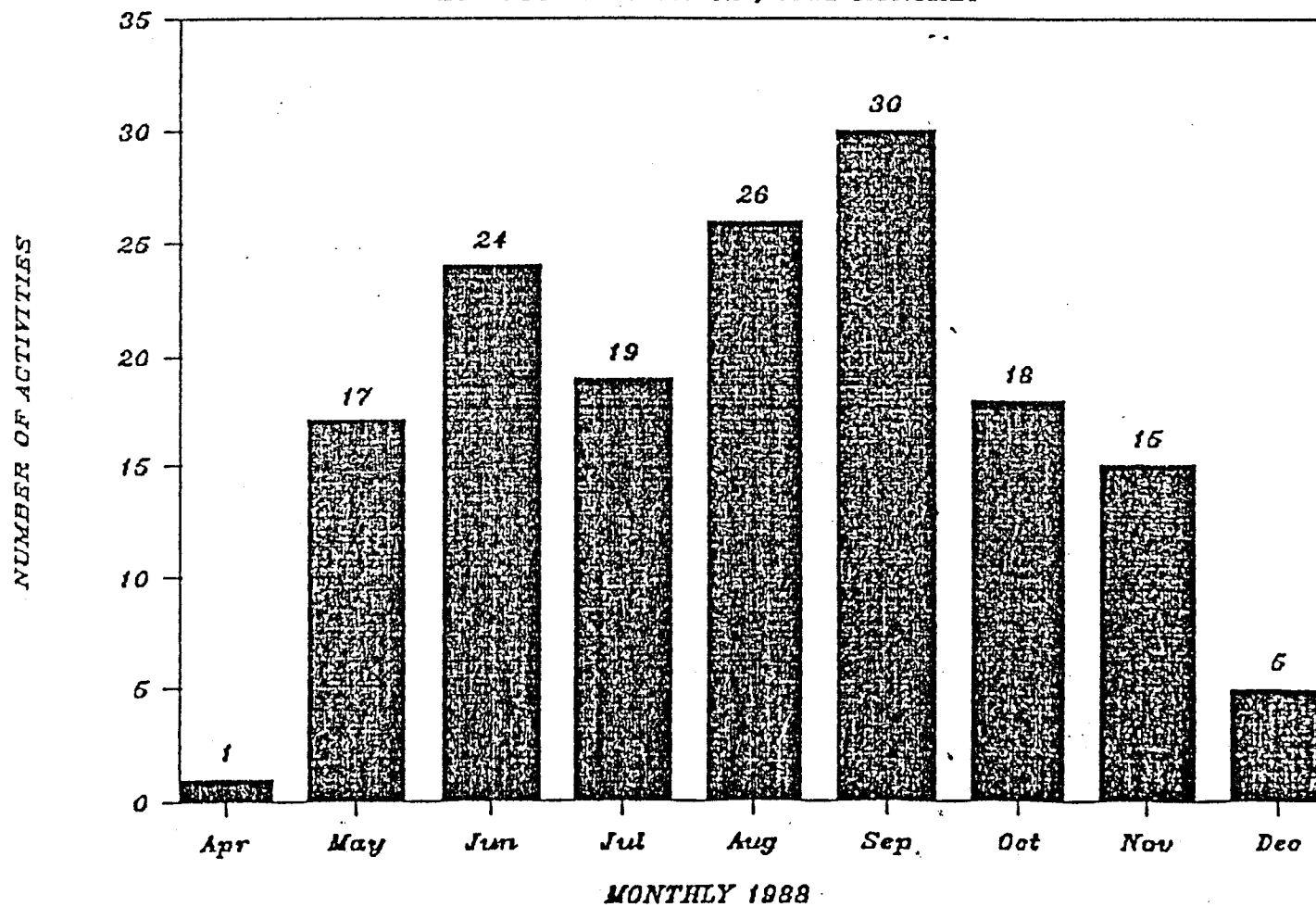


Figure 6G.

HAWKSBILL ACTIVITY DISTRIBUTION

BUCK ISLAND REEF NM 1982 THRU 1988

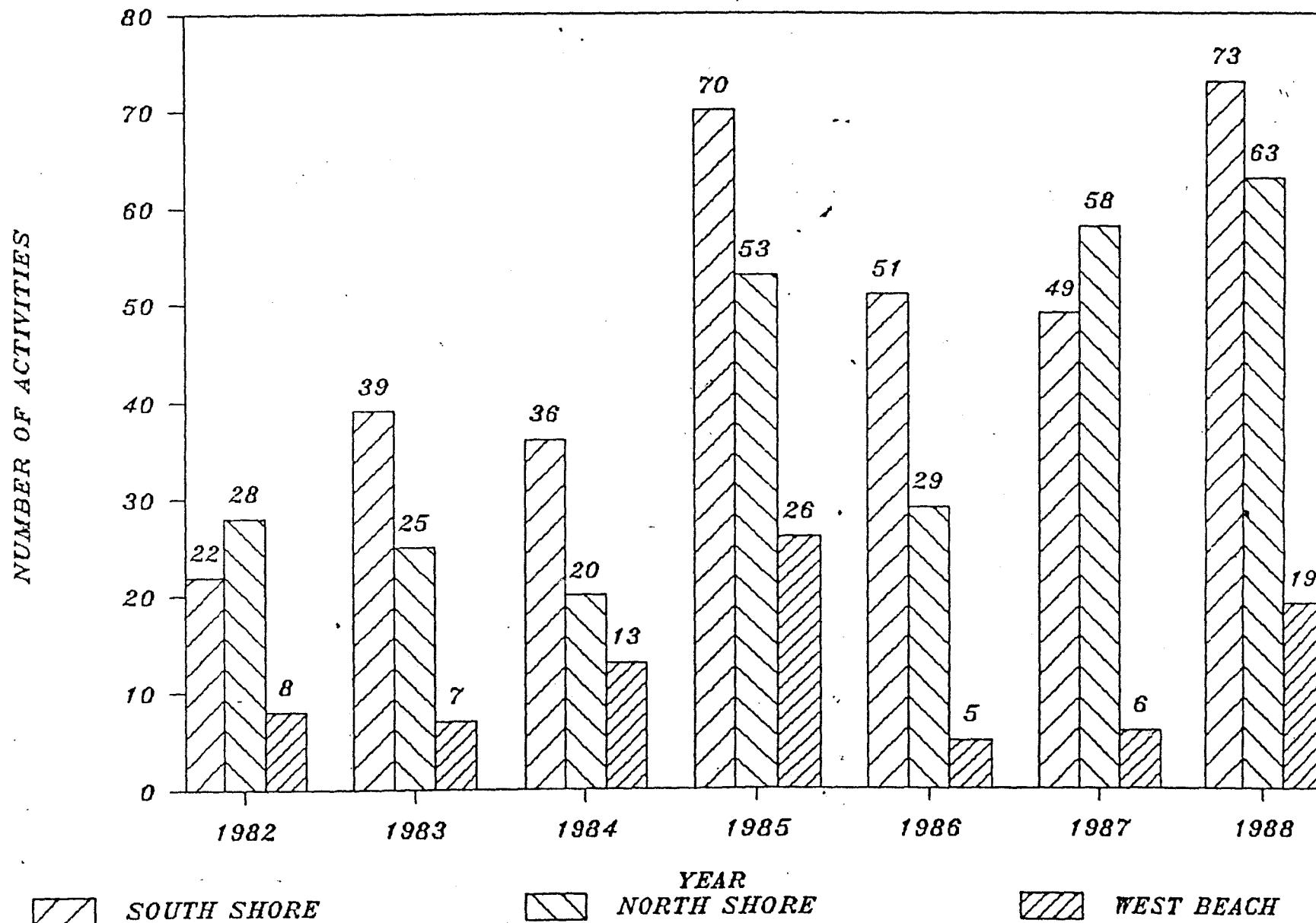


Figure 7.

HAWKSBILL NESTING ACTIVITIES

BUCK ISLAND REEF NM, 1985 THRU 1988

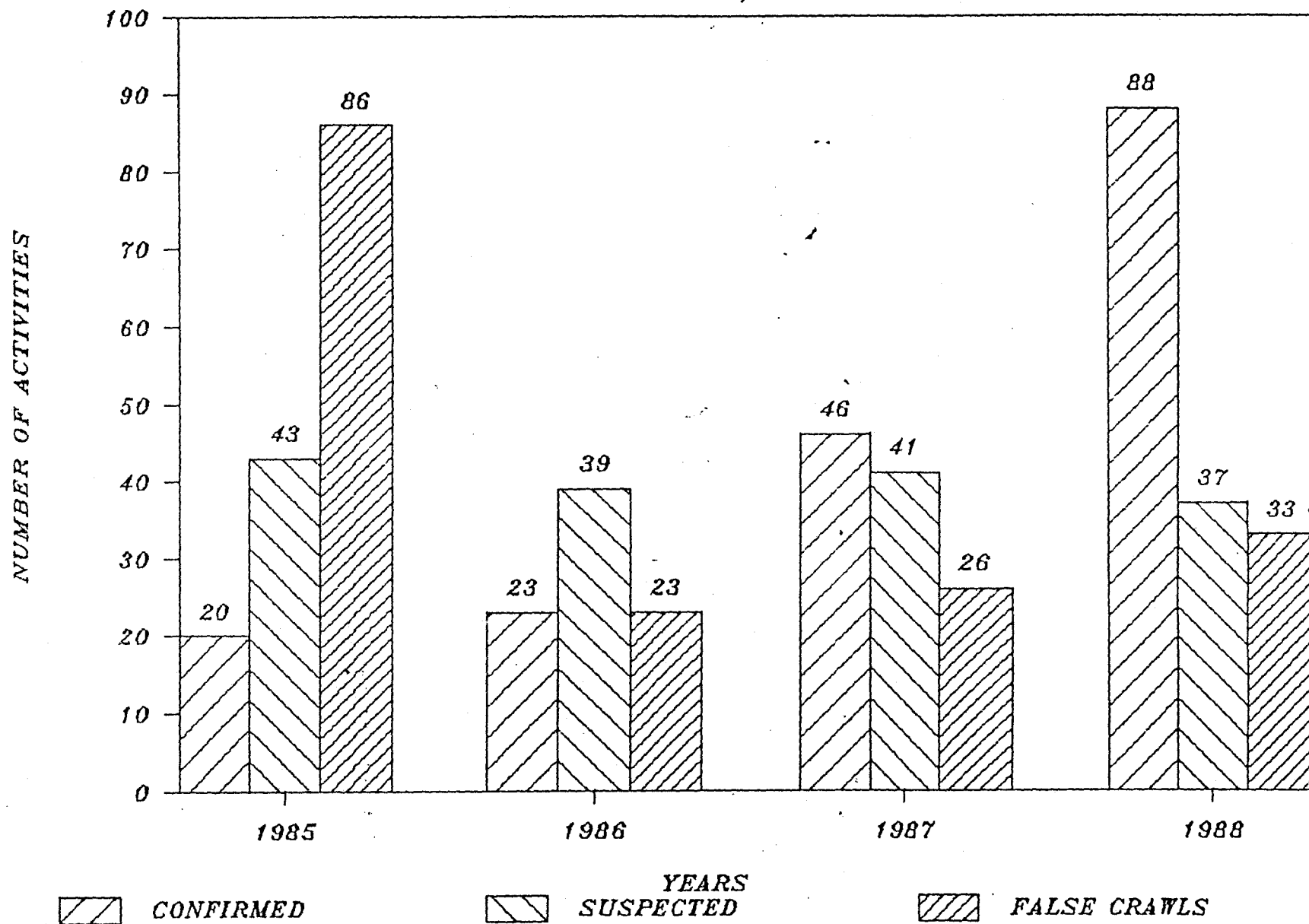


Figure 8.

HAWKSBILL ACTIVITY DISTRIBUTION

BUCK ISLAND REEF NM, 1988 MONTHLY

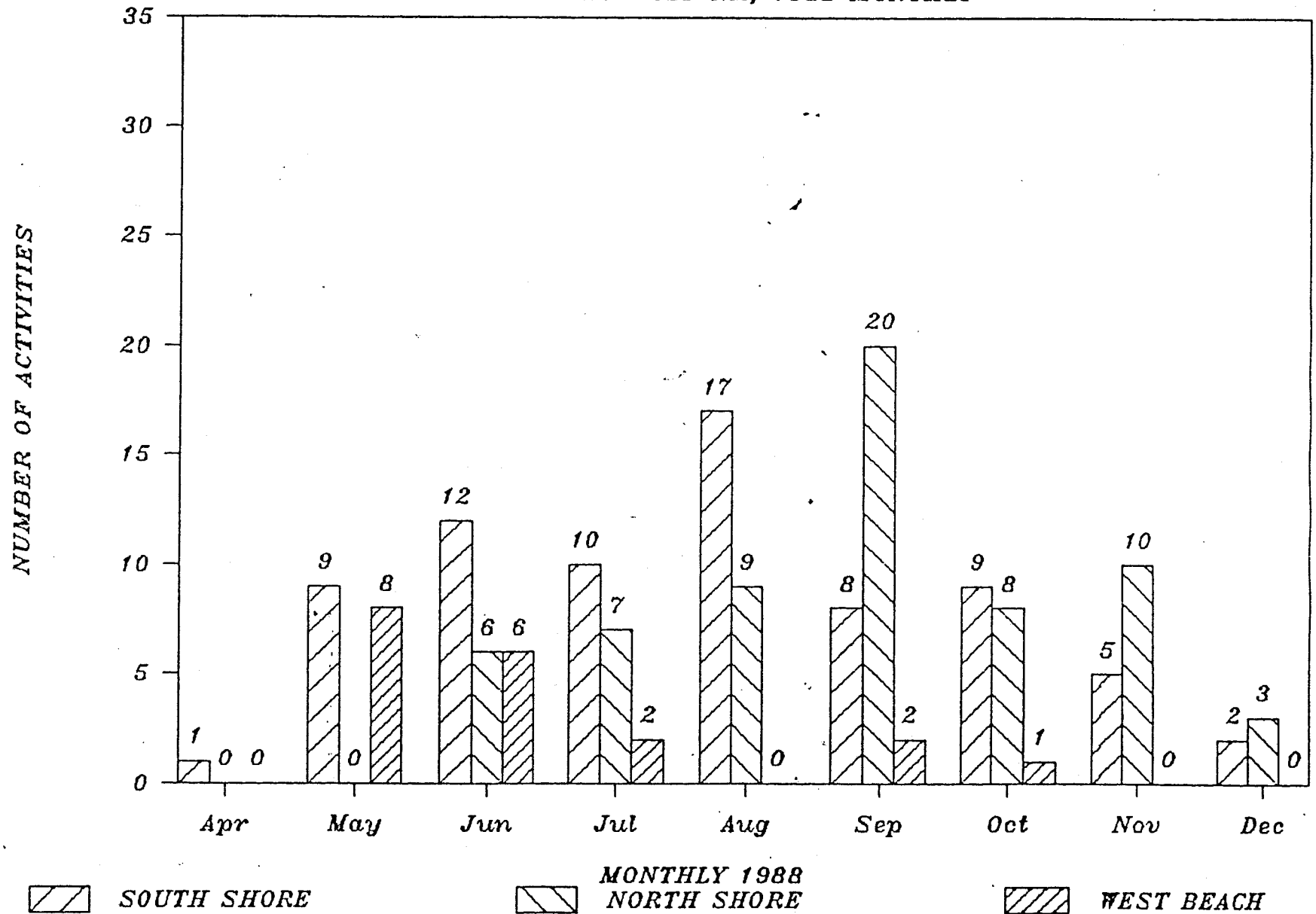


Figure 9.

HAWKSBILL ACTIVITY DISTRIBUTION

BUCK ISLAND REEF NM, 1987 MONTHLY

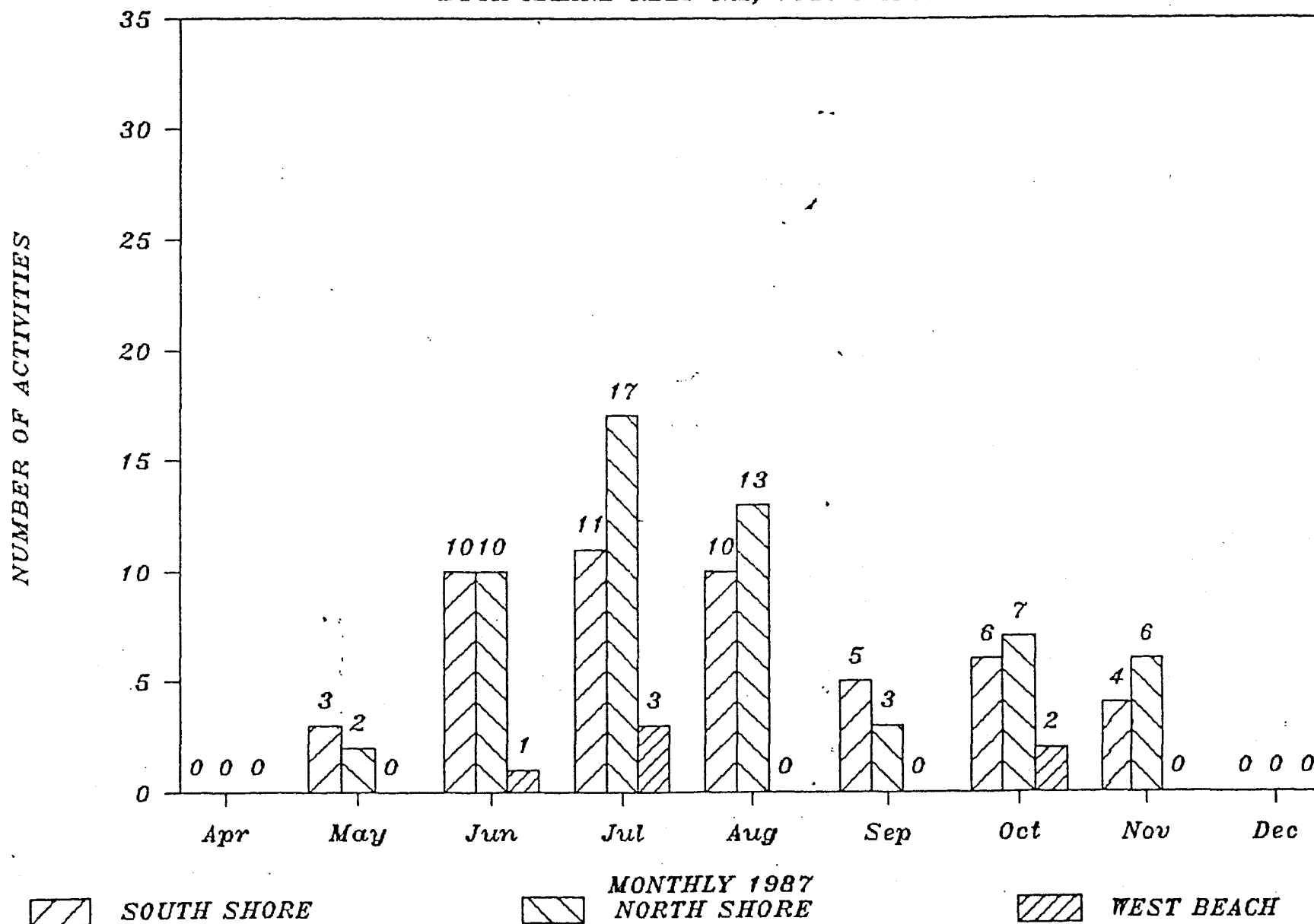


Figure 10.

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APPENDIX

Appendix I. Leatherback sea turtle (Dermochelys coriacea) nesting activities on Buck Island Reef NM, U.S. Virgin Islands, 1988.

There were 18 recorded leatherback activities in 1988. Only one of these was observed but this individual was not tagged. All the activities occurred on West Beach. Fourteen of the activities were confirmed nests while 3 were suspected nests and one was a false crawl.

Nine of the confirmed nests survived to term without recorded erosion. The mean hatching success for these nests was 74.1 percent (SD = 25.0, n = 9, range 4 to 86 %). Three of the confirmed nests were lost to erosion. Including these nests, the mean hatching success dropped to 55.6 percent (SD = 38.7, n = 12). In the last two nests no count was available.

The results from previous records are presented in the table below:

Leatherback activities recorded on Buck Island Reef NM, from 1982 - 1988.

Year	Confirmed Nests	Suspected Nests	Aborted Crawls
1982	3	1	-
1983	2	1	-
1984	1	6	-
1985	No activities recorded for leatherback.		
1986	2	4	1
1987	1	1	-
1988	14	3	1

Appendix II. Green sea turtle (*Chelonia mydas*) nesting activities recorded on Buck Island Reef NM, U.S. Virgin Islands, 1988.

There were 19 recorded activities. Four of these activities were observed during the nocturnal monitoring period. These observations resulted in the tagging of one individual (PPW 823). Another green turtle was observed on 2 occasions. This individual was unable to successfully excavate a nest due to the absence of the left rear flipper. This individual was not tagged.

Five of the recorded activities were confirmed nests while four were judged as nests. The other 10 activities were unsuccessful nesting attempts (false crawls). Green turtles nested on both West Beach and the south shore. Nesting between markers 18 - 20 proved difficult (Figure 5). Nine of the ten false crawls occurred in this area. One individual (PPW 823), spent over 6 hours trying to nest in this area. There are numerous open pits on this stretch of beach and nesting green turtles had difficulty excavating a nest due to dense roots and rocks.

The mean hatching success for 4 of the 5 confirmed nests was 69.0 percent (SD = 30.1, range 27.0 to 96.0 %). No count was available for the fifth nest.

The results from previous records are presented in the Table below:

Green sea turtle activities recorded on Buck Island Reef NM, from 1982 - 1988.

Year	Confirmed Nests	Suspected Nests	Aborted Crawls
1982	3	4	1
1983	2	3	2
1984	-	6	3
1985	-	3	4
1986	1	10	2
1987	-	9	1
1988	5	4	10

LOG ENTRY FORM, 1988
BUCK ISLAND REEF NATIONAL MONUMENT

Appendix III. 1988.

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 _____

SEA TURTLE ACTIVITY LOG
BUCK ISLAND REEF NATIONAL MONUMENT, USVI

Appendix IV. 1988

Sky _____ Moon _____
Seas: calm moderate heavy
in _____ Previous Weather _____
wind Direction _____ Velocity 0 L M S VS

Date ____/____/88
Daily Record _____
Activity No. _____

Species HB GR LB

Action _____ Time Observed _____
Observations on Turtle _____

New Tag No. _____ Paint Tag No. _____ Photo _____
Previous Tag No. _____ / Tag Scar _____
Tagging Observations _____

Crawl & Nesting Diagram:

Observations on the Nest _____
Nest depth _____ cm. Overburden _____ cm.

Timed laying sequence:
Approach crawl : start _____ finish _____
Body pit (s) : st _____ fin _____ st _____ fin _____
Nest hole (s) : st _____ fin _____ st _____ fin _____
Laying : st _____ fin _____
Covering : st _____ fin _____
Departure : st _____ fin _____
Elapsed time on beach _____ min.

RESULTS: LAY FALSE CRAWL Reason: _____

Carapace Measurements: Length o.c. notch/notch _____ cm.
Width o.c. maximum _____ cm.

Yolked egg diameter: _____ mm.
egg weight : _____ mm.
_____ gr.
_____ gr.

Location _____ Marker No. _____ Dist. _____ Dir. _____
Distance of nest: to HWM _____ to seaward vegetation _____

Nested in : Open Beach Beach Forest Shore Line Vegetation

Observers : _____

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

TURTLE MONITORING DATA SHEET

Appendix VI. 1980 & 1981.

Data Sheet Number _____

Park Name _____

Location Data:

Grid Location Number _____

River _____

Marsh _____

Estuary _____

Beach _____

Species: Loggerhead _____

Adult _____

Green _____

Juvenile _____

Ridley _____

Hawksbill _____

Leatherback _____

Did the turtle nest Yes _____ No _____

Date _____

Time _____

Was the nest predated Yes _____ No _____ Date of Observation _____

If yes, was the predator a: raccoon _____

feral swine _____

ghost crab _____

other _____

Did the nest hatch: Yes _____ No _____

If yes: give date: _____ number of hatchlings _____

Dead turtles: Date observed _____

Adult _____

Cause of death:

Juvenile _____

Appendix VII. 1982, 1983, & 1984

Sea Turtle Nesting Activity log
Buck Island Reef National Monument
1982 Season

Date: _____ Activity No.: _____ Observer: _____ Species: HB _____
GR _____
LB _____

Nest: _____ Aborted Crawl: _____ No. false holes dug: _____

Beach: North shore _____ Landmark: _____

Diedrich's _____ Direction: _____

West End _____ Distance: _____

Turtle
Distance of nest to mean high water mark _____ Lunar Phase: _____
(1 = new moon)

Weather Condition: Wind: _____ knots N S E W NE NW SE SW (circle direction)
(Night of nesting) Cloud cover: _____ % Rain: _____

Beach Condition: Easy incline; no obstacles _____

Climbed eroded ledge _____ ft in height _____

Nested in woody vegetation _____

Nested in open beach _____

Predation: Date _____ Mongoose _____ No. eggs destroyed _____
Man _____ Total clutch destroyed _____
Partial clutch destroyed _____

Hatchling Emergence Date: _____ Age of Nest: _____ days

Nest Cavity Contents: No. hatched eggs _____
No. yolkless eggs _____
No. developed but unhatched eggs _____
No. dead: in shell _____
out of shell _____
No. live hatchlings _____
Total _____

Deepest depth that eggs were found: _____ inches

Nest opened by: _____ Date opened: _____

Notes:

SEA TURTLE NESTING ACTIVITY LOG
 VIRGIN ISLANDS NATIONAL PARK
 1985 Season

Observer: _____
 Activity No.: _____

Date observed: _____ Date Nested: _____ Date to check for hatching _____

Nest: _____ Aborted Crawl: _____ Species: HB _____ LB _____ GR _____
 No. false holes dug: _____

Beach: _____ Landmark: _____
 Direction: _____ Distance: _____

Distance of nest to mean high water mark: _____ Nested in open beach: _____
 Distance of nest to seaward vegetation line: _____ Nested in: _____

CRAWL DIAGRAM:

Beach
 Ocean

Notes: (include any abnormal weather, sea conditions etc. night of nesting)

OUTCOME OF NEST: Hatched successfully: _____ Date: _____ Age of Nest: _____

predation: Date: _____ Mongoose: _____ No. eggs destroyed: _____
 Age of nest: _____ days Dogs: _____ No. hatchlings destroyed: _____
 Man: _____ Total clutch destroyed: _____
 Partial clutch destroyed: _____

Sea Swell Activity: Date: _____ Nest inundated: Yes _____ No _____ ? _____

otes:

Observer _____

Activity No. _____

Date observed: _____ Species: HB _____ GB _____ LB _____

Suspected Nest _____ Aborted crawl _____ Cause: Steep bank _____ Rocky soil _____ Heavy rooting _____

Confirmed Nest _____ Shoreline obstructed _____

Beach _____ Marker No. _____ Distance _____ Direction _____

Distance of nest to mean high water _____ Nested in: Open Beach _____ Beach Forest _____
Shoreline Veg. _____

Distance of nest to seaward vegetation _____

(Diagram)

BEACH
OCEAN

Shoreline condition: eroded ledge---angle _____ height _____ easy incline _____
rocky shore _____ trees/roots _____

Outcome of nest: Hatched _____ Date _____ Hatched eggs _____ Unhatched eggs _____
Dead hatchlings _____

Age of nest _____ days

Predation: Date _____ Age of nest _____ days Predator: _____

Destroyed eggs _____ Destroyed hatchlings _____

Clutch destroyed: Total _____ Partial _____

Environmental conditions: Rain _____ Swells _____ Other _____

Notes: