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TAGGING AND NESTING RESEARCH OF  
LEATHERBACK SEA TURTLE (DERMOCHELYS CORIACEA),  
SANDY POINT, ST. CROIX, U.S. VIRGIN ISLANDS, 1981/82

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Final Report to the U.S. Fish and Wildlife Service

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## ACKNOWLEDGMENTS

We would like to thank Dr. David Olsen and Mr. Billy Hillestad of the Division of Fish and Wildlife (U.S.V.I.) and Dr. Robert Brander of the National Park Service for initiating the project and providing leadership, logistical support, and help in the field. We thank EARTHWATCH and the Center for Field Research for providing volunteers and logistical support. Deep gratitude is extended to the 87 EARTHWATCH volunteers who provided continuous field research assistance. Gratitude is also extended to William Tobias, John Yntema and Eduardo Delerme (Division of Fish and Wildlife, U.S.V.I.), Mike Christian (U.S. Department of Commerce, National Marine Fisheries Service, Law Enforcement Division), Tom Adams (Cruzan Rum Industry), Vonnice Small (National Park Service), and Officers Tranberg, Callwood, Skov, Farchette, and Thomas of the Enforcement Division of the Department of Conservation and Cultural Affairs (U.S.V.I.) for their support and help in the field. Dr. John Ogden and his staff (The West Indies Laboratory of Fairleigh Dickinson University) and the staff of the NOAA Hydro Lab provided access to their St. Croix facilities. Senator Sidney Lee (U.S.V.I.) furnished permission for the use of road access to the study site. Dr. James I. Richardson (Georgia Sea Turtle Cooperative Research Program) provided data sheet design and technical advice. Special appreciation is extended to Tina Hillestad, logistical coordinator, for a job well done; and to Pat and Mac McFee, proprietors, Cottages-by-the-Sea, for enthusiastic assistance with volunteer accommodations.

## INTRODUCTION

The Leatherback sea turtle (Dermochelys coriacea) is the largest and most morphologically divergent of the seven species of sea turtles in the world. The carapace is smooth and leathery with seven longitudinal ridges. The species is mainly pelagic, feeding on jellyfish and tunicates, and only enters shallow water to reach coastal nesting habitats. While the life history of the Leatherback turtle is still relatively unknown, its biology is comprehensively dealt with by Pritchard (1971).

The Leatherback sea turtle was listed as an endangered species by the United States Department of the Interior in 1970. It was listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1975. The estimated number of adult breeding female Leatherbacks in the world is 104,000 (Baker, 1981). Only 13 significant nesting areas remain worldwide (Sternberg, 1981) with six of those located in the Western Atlantic (Carr, et al., 1982).

Sandy Point, St. Croix, Virgin Islands, supports the major concentration of nesting Leatherbacks in the United States; other, limited nesting occurs in Culebra and Vieques, Puerto Rico (Dodd, 1978; Caribbean Conservation Corps, 1980). In September of 1978 the United States Fish and

Wildlife Service designated an area .32 km wide and 3.06 km long on Sandy Point, St. Croix, as Critical Habitat for the species, and in March of 1979 the National Marine Fisheries Service designated the surrounding waters as Critical Habitat as well. Acquisition of Sandy Point by the U.S. Fish and Wildlife Service is anticipated.

The St. Croix population of Leatherback sea turtles was reported by biologists in the mid-1970's. In 1981, the Division of Fish and Wildlife (U.S. Virgin Islands) began a population and movement study of nesting Leatherbacks on Sandy Point as part of a U.S. Fish and Wildlife Service Endangered Species Cooperative Agreement. Prior to 1981 no systematic studies had been conducted there, although a few turtles had been tagged by conservation officers during patrols in previous years.

In 1982 an intensive research effort was conducted under the auspices of the Division of Fish and Wildlife (U.S.V.I.). Funding was provided through Section 6 Endangered Species funds and EARTHWATCH and the Center for Field Research of Belmont, Massachusetts. The project, designed to assess the size, productivity, and management priorities of the Sandy Point Leatherback population, commenced on March 30 and continued through the first week of September, 1982.

Due to the very intensive nature of the 1982 research as compared to the work performed in 1981, this report will

deal primarily with the results of the 1982 work with the 1981 results displayed separately. Various methodological inconsistencies in the 1981 research do not allow valid comparisons to be drawn with the 1982 results.

## METHODS

### A. Study Area Coverage

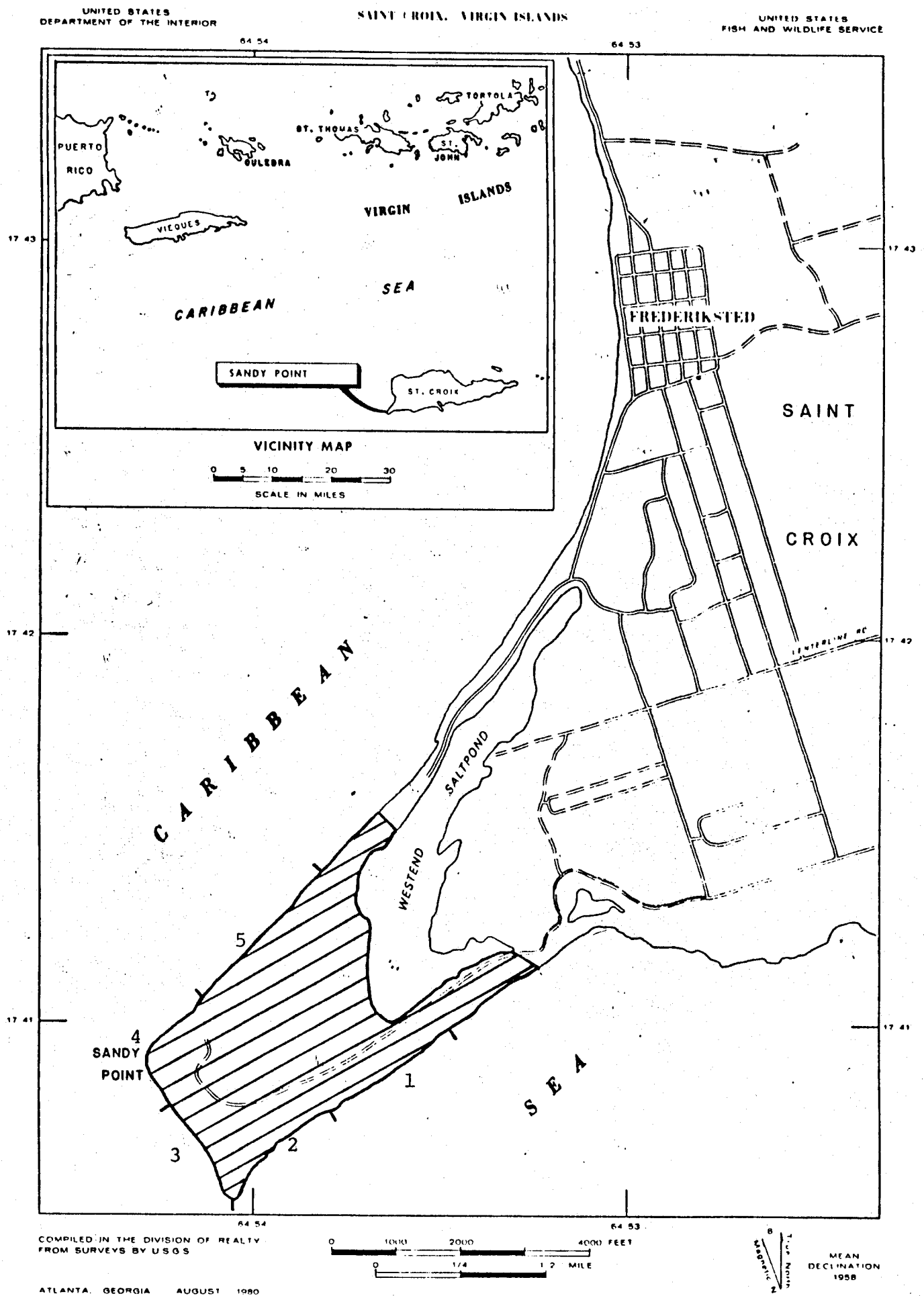
#### 1. 1981

Beach patrols in 1981 commenced in late March and continued through the end of July. Various numbers of people performed the beach walks. Methods were similar to those used in 1982; however, nest location was inadequate and no nests were relocated.

#### 2. 1982

All-night patrol of Sandy Point's 2.4 km nesting beach (Figure 1) began on March 30, 1982. Ten teams of EARTHWATCH volunteers, 5-10 individuals each, assisted the authors in patrolling the nesting beach on foot. Each team of volunteers spent 10 days on the project. Each team was divided into smaller groups to enable hourly coverage of the entire beach. Previous data indicated the majority of turtles required at least one hour to complete the nesting sequence,

Figure 1 . Sandy Point



thus hourly patrols ensured that all turtles were observed and tagged.

Numbered stakes were placed along the beach at 20 m intervals to ascertain exact location of nests using triangulation off the two nearest stakes (distance).

#### B. Morphometric Parameters

When a turtle was encountered the time, location, weather and moon phase were noted (refer to Appendix I for data sheet). Stages in the nesting sequence were recorded (i.e. approach, bodypitting, digging, laying, covering or departing) and timed.

Once a turtle began digging, over-the-carapace (o.c.) and straight-line (s.l.) measurements were recorded. These measurements were taken during each successive emergence for every individual. Over-the-carapace measurements were taken using steel tape measures; 153 cm tree calipers were used for straight-line measurements. Three different carapace dimensions were obtained using each method. Length measurements were made from the posterior point of the carapace alongside the dorsal ridge, and from the posterior point of the carapace to the point over the shoulder. Width was determined by measuring the carapace at its widest point just behind the front flippers.

Lighting was kept to a minimum. Flashlights (D-cell) were used when necessary.

C. Nesting

Nest depth was measured immediately upon completion of excavation prior to oviposition. The points of reference were the bottom of the hole and the base of the posterior point of the carapace. This point generally corresponded to the "firm sand" surface level.

As each clutch was laid, yolked and yolkless eggs were counted. The diameters of 10 yolked eggs/clutch were measured with a pair of small calipers. When all eggs had been deposited, overburden (depth of sand over the eggs) was measured from egg level to the base of the posterior point of the carapace.

If the nest was in an area where erosion or inundation were imminent, the eggs were removed upon deposition and relocated to a more secure area of the beach. The original nest dimensions were duplicated in the relocated nest. These dimensions were recorded.

#### D. Tagging

The turtle was tagged on the trailing edges of the front flippers, approximately 20 cm away from the body, immediately following laying. Three tags were used, one on one flipper and two on the other. Two Monel cattle ear tags (NMFS AAG series) were used with a single yellow plastic Riese tag (OA series). Originally Monels were used alone, but they were observed to cut or abrade the turtle's carapace between successive emergences. The plastic tags, which did not harm the carapace and tended to be better retained by the turtle, were then used in addition to the Monels.

The turtle was examined for diagnostic markings, deformities and ectobiota. These were recorded on the data sheet.

#### E. Nest Location

The nest location was determined by measuring the distance from the nest to each of the two nearest stakes. These distances were recorded. A beach profile was sketched showing the nest in relation to the vegetation line, the current water level and the high tide line.

The turtle was timed on her crawl back to the water and a rate of crawl was determined. Crawl width measurements were obtained in the firm wet sand.

#### F. Hatchlings

Near term nests were monitored for emergence during the patrols to secure accurate emergence times. When an emergence was discovered, the time was noted and the number of crawls or hatchlings counted. The location of the emergence was measured for identification. Hatchlings were followed to make sure they were not captured by predators, such as ghost crabs (Ocypode quadratus) or Yellow-crowned Night Herons (Nyctanassa violacea), or tangled in beach debris. Lighting was kept to a minimum to prevent hatchling disorientation.

#### G. Nest Excavation

Once hatchlings emerged the nest was left for one night to allow any residual hatchlings to emerge before the nest was excavated to determine hatching success. All contents were removed and compared to the original egg count. The contents were recorded and all unhatched eggs opened to determine the size and any obvious deformities in the embryos that did not survive to term. Live residual hatchlings were placed in a cooler and released that night.

## RESULTS AND DISCUSSION

### A. Nesting

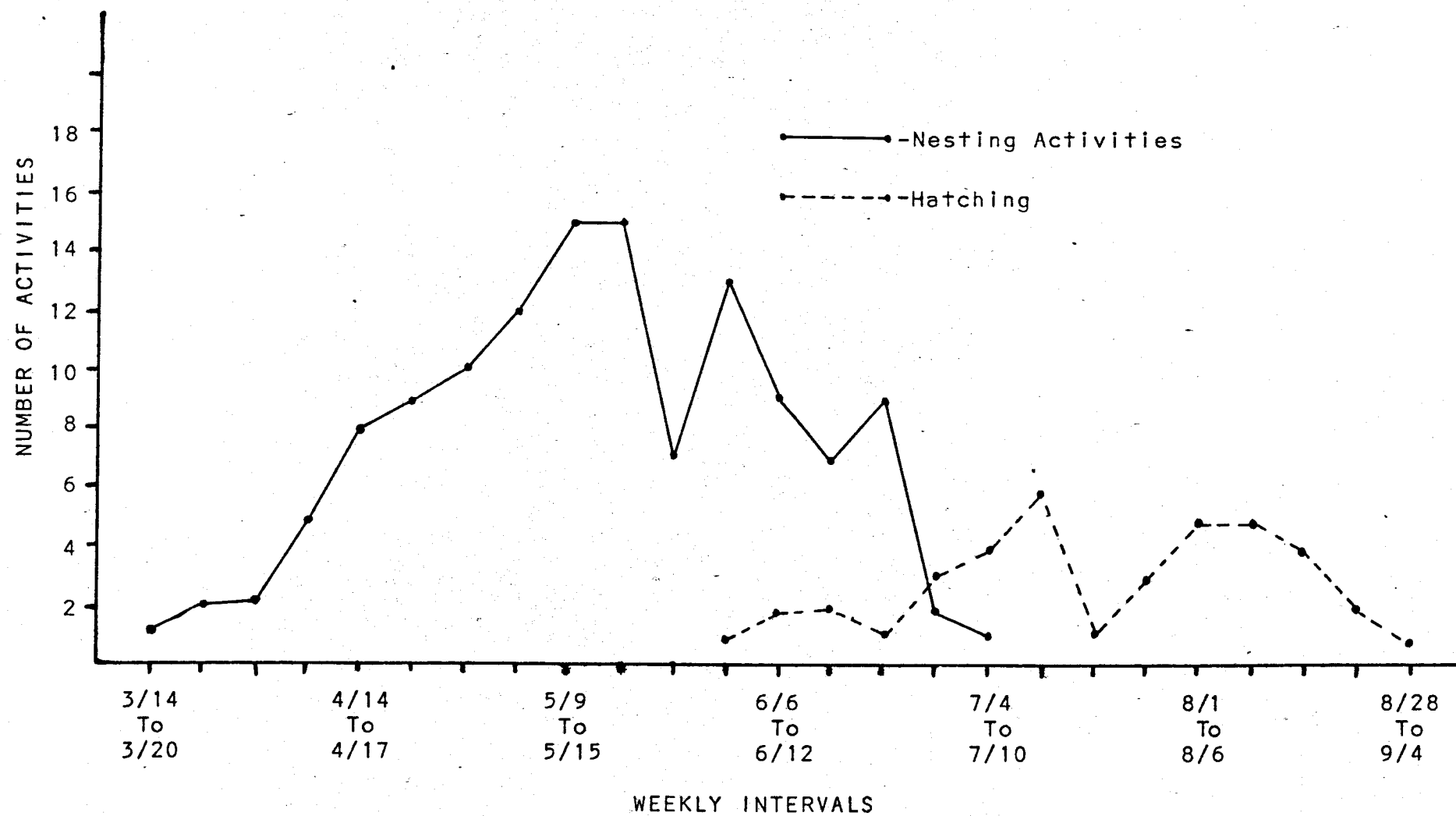
#### 1. 1981

One hundred and twenty-nine crawls were counted during the 1981 nesting season at Sandy Point. Of these, 58 were found on the south shore, 58 on the west shore, and 13 on the north shore of the Point (Figure 1). Partitioning the habitat into five areas of approximate equal length indicates that Area 3 (west shore) was the most frequently used area for nesting and renesting.

Of the 129 crawls made on the Sandy Point beach, 119 showed indications of actual nesting attempts. However, due to the difficulties in differentiating between oviposition and a false crawl, the actual number of nests is unknown. Only 31 nestings were attended by human observers. Females dug one to five pits per crawl, with an average of 1.3. Thirty-two percent of all nestings showed more than one pit dug.

Nesting activity started in the third week of March and continued through to the beginning of July with a very pronounced peak in the first two weeks of May (Figure 2). During this period, 20 individual turtles were observed.

Figure 2. Weekly 1981 Nesting and Hatching Activities on Sandy Point, St. Croix.



Seventeen of these turtles were neophytes (never having been tagged before) and three were tag returns from 1979.

Individual Leatherbacks were observed to renest up to five times during the season. Of the 20 individuals that could be identified by tags, 47% were observed to renest at least once. The average known internesting period was 9.6 days. The hypothesized internesting period for all turtles known to have renested at Sandy Point was 9.2 days (assuming nesting occurred about every nine to ten days but was missed).

The distances of the nest cavities to the mean high-water mark ranged from zero (at the water's edge) to 38.5 meters (above the vegetation line). An average of 9.3 meters from above the mean high-water mark was found for the 31 nest cavities measured.

The depth of the nest cavity ranged from 61 to 99 cm, with the mean of 75 cm. Pits were usually dug straight down, although some nest cavities penetrated the substrate at an angle. Often such asymmetrical holes were the result of a deformed or injured rear flipper.

The fecundity of female Leatherbacks nesting on Sandy Point was extremely variable. Clutch size ranged from a total of 60 to 148 eggs, with a mean of 98.6 eggs ( $S = 21.78$ ). These figures describe total clutch size; however,

approximately 20% of the eggs laid are small and deformed and apparently yolkless. The number of such inviable eggs per nest ranged from six to 50, with a mean of 20.0 ( $S = 10.5$ ). The data on total clutch size and viable egg number is compatible to data reviewed by Pritchard (1971), although the 1981 figures are lower than means recorded from both Caribbean and Pacific nesting populations (Table 1).

Only one long-distance movement record from this population has been recorded; one female tagged on St. Croix and last seen on June 8 was recovered 85 days later on September 1 in Atlantic City, New Jersey. This turtle had traveled 1,680 nautical miles (3,113 km). Death was attributed to blockage of the ileo caecal valve by a large, clay-like mass (enterolith) (R.C. Schoelkopf, personal communication).

## 2. 1982

Leatherback sea turtle activities (false crawls and successful nests) occurred on Sandy Point during 76 (73.5%) of the 104 nights beginning with March 30 (the first patrol by the authors) and ending with July 11, 1982 (the last nesting attempt). Activities totaled 155; 85 (55%) resulted in egg deposition. An 86th nest was reported on March 20 by Conservation Enforcement Officer Otto Tranberg. An additional three nests were recorded outside of the 2.4 km study area.

Table 1. Carapace measurements of female leatherback sea turtles nesting on Sandy Point, St. Croix, in 1982.

| Dimension                    | N  | $\bar{S}$ (CM) | SD  | Range         |
|------------------------------|----|----------------|-----|---------------|
| o.c. <sup>1</sup> tip-to-tip | 19 | 159.6          | 8.4 | 145.5 - 182.6 |
| o.c. notch-to-tip            | 19 | 152.2          | 8.1 | 139.4 - 173.5 |
| o.c. width                   | 19 | 111.3          | 7.3 | 99.4 - 130.8  |
| s.l. <sup>2</sup> tip-to-tip | 17 | 149.4          | 7.7 | 137.7 - 167.2 |
| s.l. notch-to-tip            | 17 | 144.8          | 7.6 | 133.0 - 162.3 |
| s.l. width                   | 17 | 81.3           | 4.5 | 74.1 - 93.8   |

<sup>1</sup> o.c. = over-the-carapace.

<sup>2</sup> s.l. = straight length.

Table 2. Average time elapsed during successive stages of leatherback sea turtle nesting. Sandy Point, St. Croix, 1982.

| Stage           | N  | $\bar{S}$ (min) | SD   | Range   |
|-----------------|----|-----------------|------|---------|
| Approach/Search | 5  | 7.2             | 6.2  | 3 - 18  |
| Bodypitting     | 27 | 9.2             | 3.8  | 2 - 17  |
| Digging         | 35 | 23.3            | 8.8  | 10 - 44 |
| Egg laying      | 59 | 10.8            | 3.9  | 6 - 32  |
| Covering        | 55 | 35.9            | 11.3 | 8 - 69  |
| Departure       | 57 | 5.7             | 5.0  | 1 - 31  |

Note: approach/search, bodypitting and digging times used only in the event that they preceded successful egg laying.

Table 3. Final outcome of leatherback sea turtle nests laid on Sandy Point, St. Croix, in 1982.

|           | Nests | Emerged |      | Percent Success |      |      | Lost to erosion/<br>inundation |      | Mongoose |     | Unknown |     |
|-----------|-------|---------|------|-----------------|------|------|--------------------------------|------|----------|-----|---------|-----|
|           |       | N       | %    | N               | %    | SD   | N                              | %    | N        | %   | N       | %   |
| Relocated | 27    | 25      | 92.6 | 23              | 64.4 | 20.3 | 1                              | 3.7  | 2        | 7.4 | 1       | 3.7 |
| In situ   | 59    | 30      | 50.8 | 22              | 62.3 | 23.4 | 25                             | 42.4 | 2        | 3.4 | 4       | 6.8 |
| Total     | 86    | 55      | 64.0 | 45              | 63.4 | 22.2 | 26                             | 30.2 | 4        | 4.7 | 5       | 5.8 |

One hundred thirty-four activities were observed; 21 were not. Of the latter, 16 were judged to be false crawls either because there had not been sufficient time for completion of a nest (area had been patrolled fewer than 30 minutes earlier), the disturbance had occurred in the surf zone, the crawl indicated beach ascent and departure with no evidence of bodypitting, or the site was monitored and no emergence of hatchlings occurred. The remaining five were judged to be nests -- two were lost to erosion prior to term and three successfully emerged.

Nineteen Leatherbacks nested on Sandy Point in 1982. All were observed and tagged. An average of 4.4 nests per turtle were laid (SD 2.3; range 1-9). The average internesting interval (the number of days between a successful nesting bout and the following nesting attempt) was 9.8 days (SD 1.6). The average internesting interval was calculated using 55 intervals between seven and 15 days; 11 intervals  $\geq$  18 days were omitted. Assuming that nesting occurred elsewhere when a particular turtle did not appear on Sandy Point "on schedule" (but reappeared 2-3 intervals later), the average number of nests laid per turtle can be estimated at 6.3 (SD 3.6; range 1-9).

Nesting activity steadily increased through April and May, peaked during the first week of June, and steadily declined to the last nest on July 10 (Figure 3). An anomaly

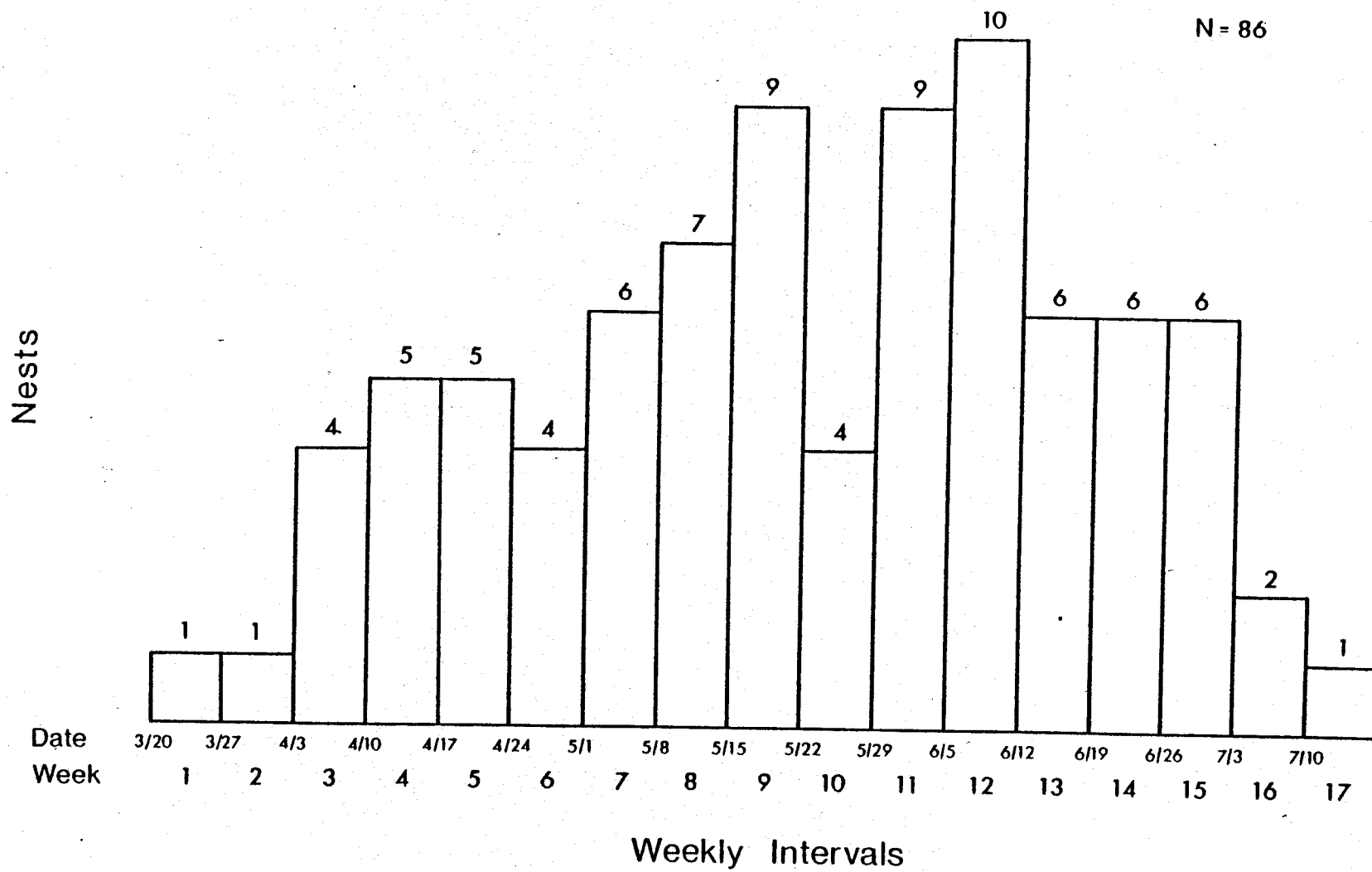


Figure 3. Leatherback nests by week on Sandy Point, St. Croix, 1982.

was recorded in week 10 when an unexplained drop in nesting occurred. Additional data would be required to determine whether the frequency distribution characteristically resembles a bimodal curve as is suggested in Figure 3, or whether a normal curve is more typical.

As a result of the onset of severe erosion in late May and early June, a sharp increase in false crawls was observed in weeks 13 and 14 (Figure 4). Erosion of the beach resulted in a greater percentage of turtles failing to make a successful ascent to a nest site. The combined ratio of nests to false crawls was approximately 1:1 from the last week in May to the season's end. During the first half of the season, the ratio was approximately 3:1.

Three turtles were responsible for the final seven false crawls of the season. For reasons not evident, none of those attempts resulted in egg deposition.

One turtle false crawled 10 times, including seven times in seven days. On the night of April 11, the night following her first appearance on Sandy Point, she laid 11 yolked eggs (no yolkless). No additional eggs were deposited on subsequent visits. Her false crawls were not included in Figure 4.

Over-the-carapace lengths (measured from the posterior tip alongside the dorsal ridge, "notch-to-tip") ranged from

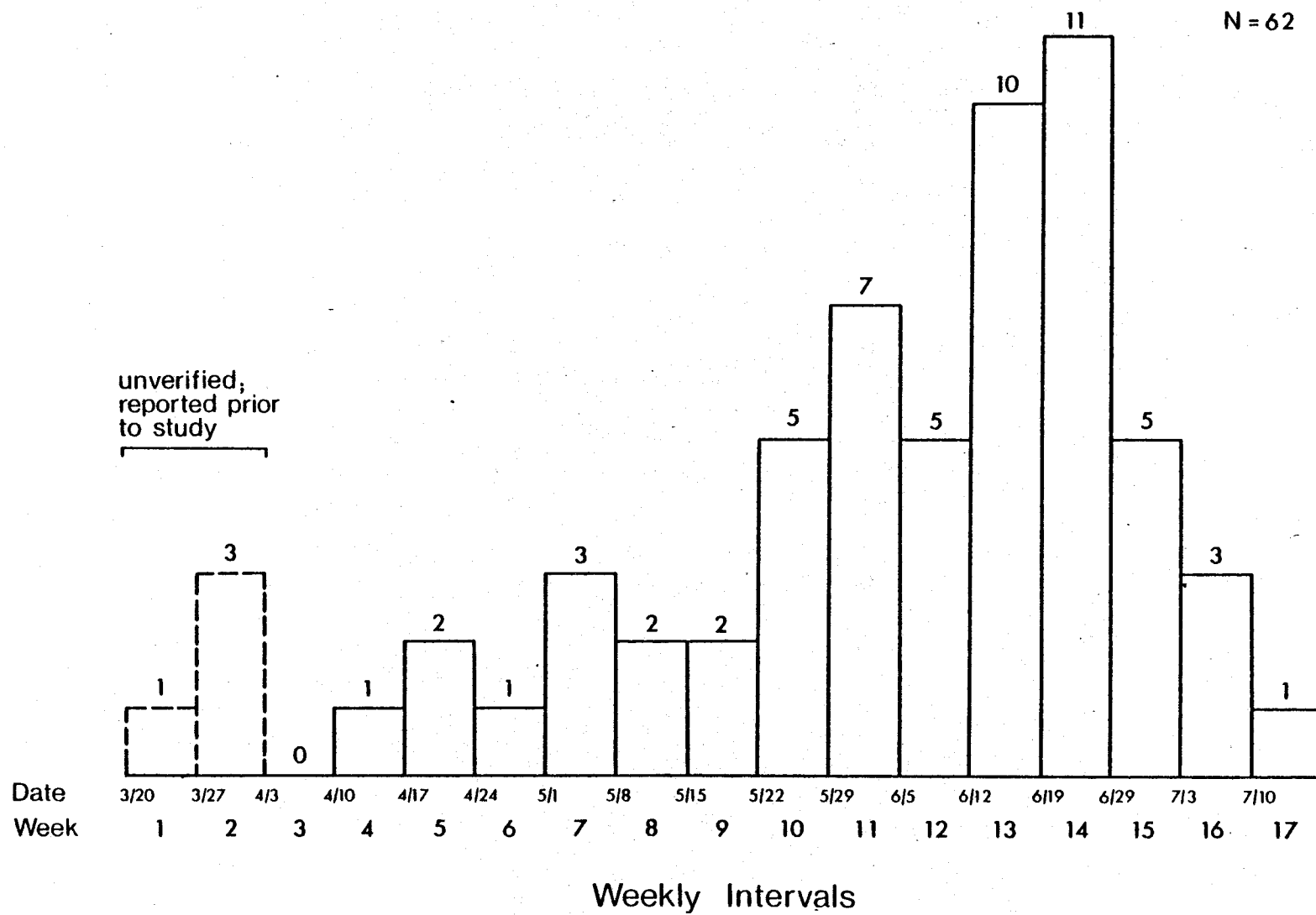


Figure 4. Leatherback false crawls by week on Sandy Point, St. Croix, 1982.

139.4 cm to 173.5 cm (Table 1). Turtles were divided into six size classes based upon over-the-carapace (notch-to-tip) length and no correlation was observed between the size of the turtle and either the number of nests laid or the size of the clutch (Figures 5 and 6). The average clutch size was 112.7 (SD 25.1; range 11-148). Yolked eggs averaged 74 per clutch (SD 17.5) and yolkless eggs 38 (SD 17.3). The greatest number of yolked eggs laid in one nest was 108. The average diameter of yolked eggs was 54.0 mm (SD 2.9; N = 430).

Average nest depth was 63.9 cm (SD 8.5); average overburden was 38.4 cm (SD 8.9). Nest excavation (digging) and covering/camouflaging were observed to be the longest stages in the nesting sequence (Table 2). Rate of crawl was determined upon departure and averaged 3.8 meters/minute (SD 1.4; N = 47).

## B. Hatching

### 1. 1981

Hatching began in the first week of June and continued through the first week in September (Figure 2). Forty-three nests are known to have hatched. No hatching events were witnessed in their entirety, but several nests were observed just after hatchlings emerged. Evidence of hatching was

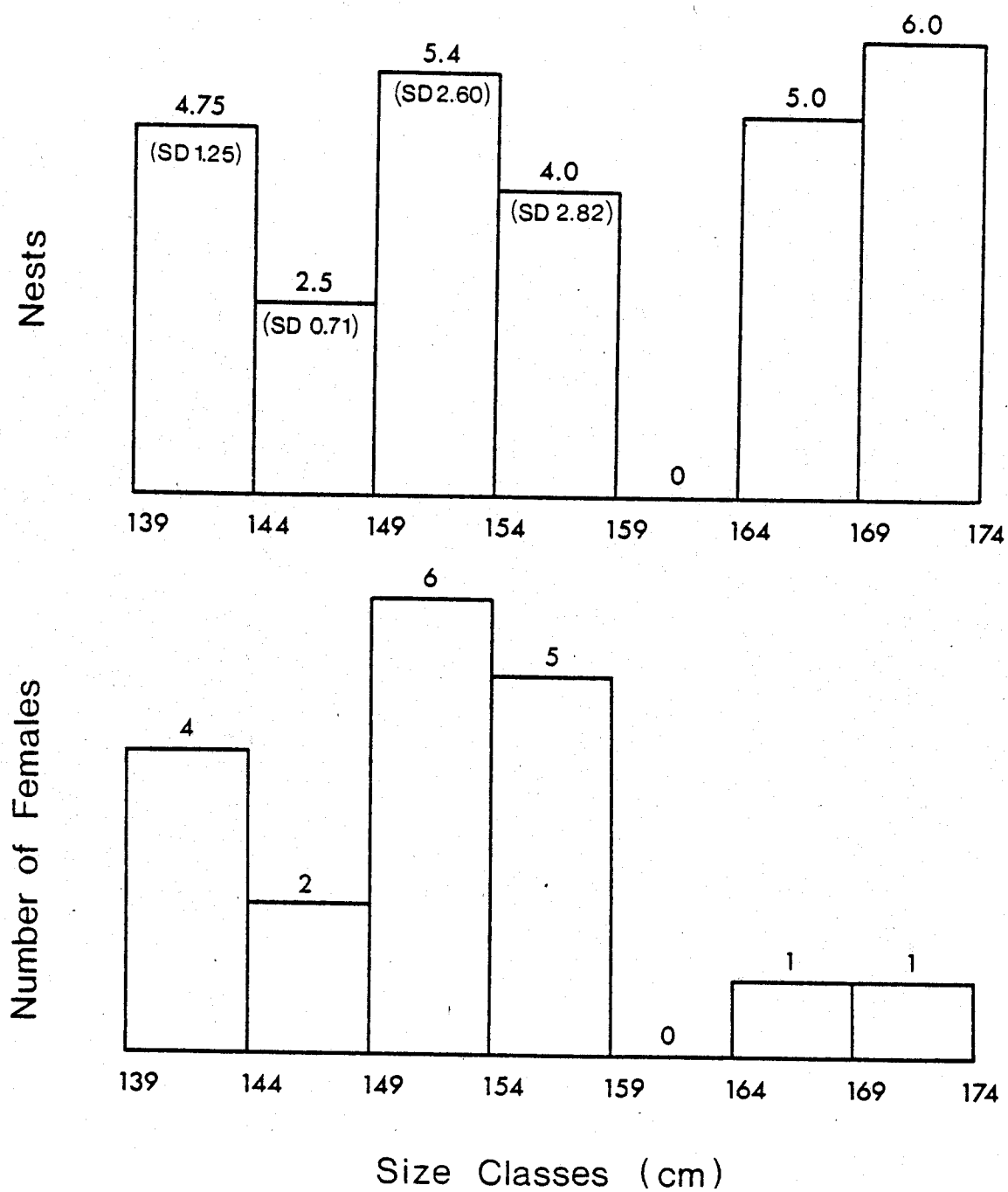


Figure 5. Average number of nests laid by size class (o.c. notch-to-tip), Sandy Point, St. Croix, 1982.

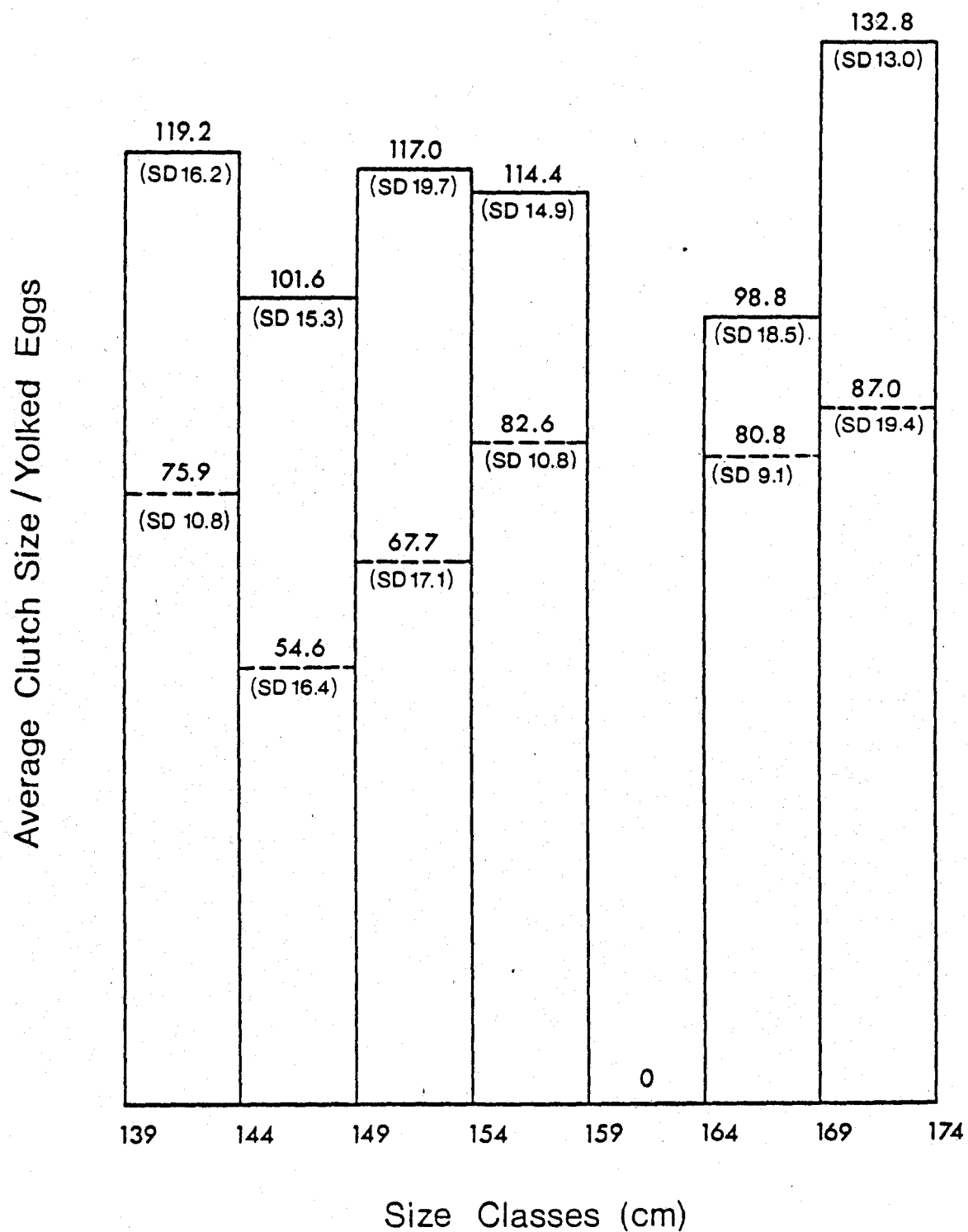


Figure 6. Average clutch size/yolked eggs laid by size class (o.c. notch-to-tip), Sandy Point, St. Croix, 1982.

most often indicated by hatchling tracks in the sand, although stray hatchlings themselves were occasionally seen.

Most hatching events show incomplete hatchings; generally, 40 to 50 tracks were counted. Often stray hatchlings were found in the vegetation, having crawled away from the sea. The reason for their disorientation is not known; however, it may be that the last hatchlings emerging near dawn on the west beach crawled towards the light of the rising sun. All hatchings occurred between dusk and dawn.

An attempt was made to excavate known hatched nests, but as sufficient time had elapsed to erase evidence of hatching none of the nests were able to be located. Therefore, no figures for nest success are available for 1981.

## 2. 1982

The average incubation period was 63.4 days (SD 4.0; range 57-72). The average incubation period declined as the season progressed (Figure 7). Conditions such as temperature and moisture content within the nest cavities were not monitored; thus, it was not possible to determine any correlation between incubation period and any of the various physical parameters known to influence incubation.

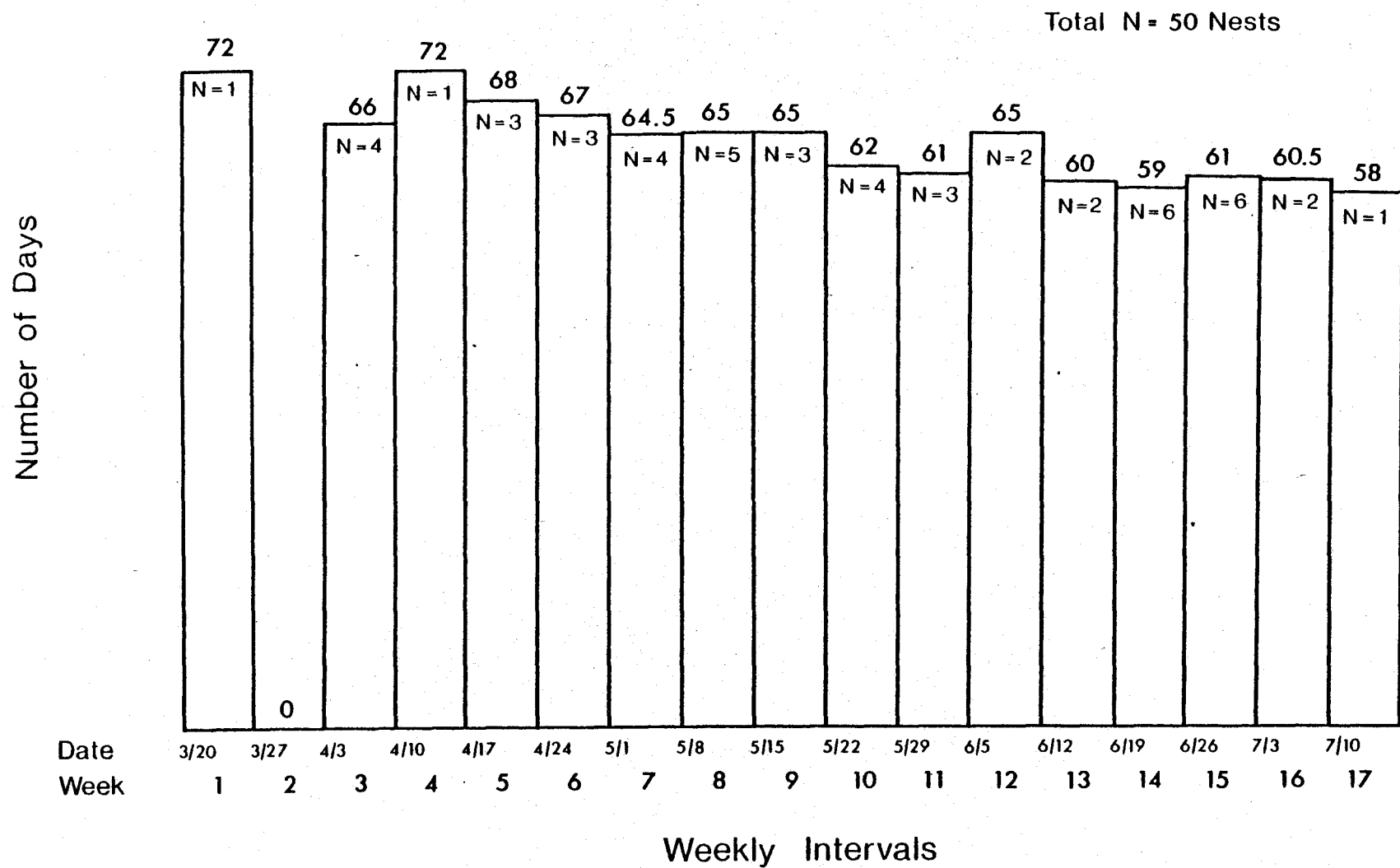


Figure 7 Average incubation periods of leatherback nests on Sandy Point, St. Croix, 1982.

The majority of the hatchlings (73.5%) emerged between 1900 and 2059 hours, 22.5% between 2100-0200 hours, and 4% between 0500-1859 hours.

Nest outcome was broken into three major categories (Table 3); known emergence (64%), loss to erosion/inundation (30.2%) and unknown (5.8%). (Four mongoose-disturbed emergences are discussed later.) A significantly greater percentage of the relocated nests survived in term (92.6%) than those remaining in situ (50.8%).

The nests with known results (either successful emergence or loss to erosion/inundation) represent 94.2% of the total. The average combined hatching success (hatchlings emerged/yolked eggs laid) was 40.2% (SD 35.1; range 9-92). As hatchling success for nests surviving to term averaged 63.4% (slightly higher for relocated nests, slightly lower for in situ nests), the loss of 30.2% of the nests to erosion seriously reduced the season's productivity.

### C. Mortality Factors

#### 1. 1981

Nests: The greatest threat to the nest success of the Leatherback has been the eroding coastline. In 1980 four out of 80 nests survived to hatch following the catastrophic

effects of Hurricane Allen in mid-July (O. Tranberg, personal communication). In 1981 a shift in prevailing wind direction in June caused the washout of 34% of the 119 possible nests. Furthermore, 96% of the 119 possible nests during the 1981 breeding season were inundated by tidewash to some degree.

Human disturbance is also a factor affecting the nesting success of the sea turtles in Sandy Point. Despite regular enforcement patrols, approximately 9% of all nests were disturbed by poachers. Two nests were actually excavated and robbed. The remainder were probed in the search for the nest cavity and presumably suffered no harmful effects to the eggs. Besides poaching, human activity on the beach (including that of the biologists) and lights from nearby developed areas may disturb and confuse nesting females (Pritchard, 1971).

## 2. 1982

Nests: Erosion was the most significant cause of nest loss. Erosion was most extensive during late May and early June when very heavy surf resulted in the loss of an area approximately 600 meters long and 15-35 meters wide along the blunt southwest side of Sandy Point. Large swells routinely inundated the southeast shore (facing Hess Oil refinery). It appeared that when water did not remain in the nest cavity as a result of the frequent washings, embryos

survived and emergence occurred -- but average success was poor. It is highly significant that if no relocation had occurred, 60% of the nests would have been lost to erosion.

Egg predation by terrestrial predators prior to nest emergence was not observed.

Importantly, and perhaps for the first time since the arrival of man on St. Croix, no poaching occurred on Sandy Point in 1982 as a result of the continuous beach patrol by research personnel and officers of the Enforcement Division of the Department of Conservation and Cultural Affairs (U.S.V.I.). In 1982 poaching was known to have occurred on St. Croix other than on Sandy Point. Two men were apprehended by National Marine Fisheries Service Law Enforcement Agents after having poached a Leatherback nest on another St. Croix beach.

### 3. 1981

Hatchlings: Animal tracks on the beach have given an indication of natural predation on the hatchlings. Several hatchling tracks ended in the vicinity of bird tracks, perhaps Black-crowned Night Heron (Nycticorax nycticorax) or Yellow-crowned Night Heron (Nyctanassa violacea). Other turtle tracks ended at the entrance of ghost crab burrows. A few instances of feeding by crabs on dead hatchlings was

observed. No figures are available on hatchling mortality for 1981.

#### 4. 1982

Hatchlings: Mongoose predation occurred on four nests laid near vegetation. Olfactory or visual cues associated with an early dusk (or rare daylight) emergence enhanced their orientation to the nests. Limited excavation of the nests occurred and resident hatchlings near the surface were decapitated or eviscerated. Egg shells were left scattered throughout the immediate area.

Night herons, ghost crabs, vehicle traffic and beach debris (entanglement resulting either in predation or death by exposure to the sun) were additional causes of mortality. In one instance, 29% of the hatchlings were crushed and killed when a jeep drove over the nest. The majority of surviving hatchlings were not able to emerge through the crushed hatchlings and compacted sand and began tunnelling parallel to the surface and were removed by hand. In several instances, vehicle traffic missed nest sites by inches.

Fewer than 10 hatchling deaths were attributed to ghost crabs and night herons as a result of the presence of research personnel. Debris consisted of sea grasses, shrubs, coral and large branches left by storm swells and would have

presented a major problem in some areas if research personnel had not cleared limited areas surrounding nest sites. A common beach vine (Ipomoea spp.) also entangled hatchlings.

### CONCLUSIONS

The Sandy Point Leatherback population is indeed small and probably constitutes a relic population which has been declining for many years due to both biotic and abiotic factors. The Leatherback almost certainly has been exploited to extirpation from St. Thomas and St. John Islands. On St. Croix human depredation has been severe for generations, but has become acute within the last two generations as population levels have increased dramatically on the island.

Development of St. Croix has caused the loss of some nesting beaches and thus further aggravates the survival status of the Leatherback.

Presently, the Sandy Point Leatherback population carries perhaps an inordinate responsibility for the survival of the species in Caribbean waters. Therefore, conservationists and the Division of Fish and Wildlife (U.S.V.I.) are seeking to maximize reproductive success and to ascertain limiting factors on the population.

The basic biology of nesting for the St. Croix population is comparable to Leatherbacks elsewhere. Total population size, recruitment and mortality, however, are not yet ascertained for the population and until the parameters are determined, management of the species will be difficult. Therefore, conservation efforts must maximize production for the Leatherbacks at Sandy Point.

To accomplish this objective will require temporal commitments of manpower to conducting beach patrols on Sandy Point for the removal and relocation of in situ nests and the subsequent monitoring and protection of the beach environment to insure hatching success.

The Leatherback has chosen for its last stand in the Virgin Islands a very unstable beach environment. In 1981, 34% of the in situ nests were known to have been lost to erosion. In 1982, 30.4% were lost to erosion and inundation (wave wash) with a strong effort made for relocation. After June 15, 1982, 78% of the nests were relocated, all of which would have been lost to erosion. It is intuitive, therefore, that delineation of Sandy Point as Critical Habitat and its eventual acquisition must be accompanied by yearly nest relocation and protection to permit any significant reproductive success.

The Division of Fish and Wildlife (U.S.V.I.) will seek to enhance nesting success in 1983 through relocation of nests threatened with erosion. Tagging of gravid females will continue, and previously tagged individuals returning to nest will be determined for an assessment of potential adult mortality or emigration from the Sandy Point beaches. Data from subsequent seasons will allow more accurate evaluation of population productivity as well as remigration and recruitment rates necessary to assess population stability.

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## APPENDIX I

1982 ST. CROIX LEATHERBACK PROJECT

1. Old tag(s) \_\_\_\_\_ Date \_\_\_\_\_
2. New tag(s) \_\_\_\_\_ Tagged Before: YES NO  
(untagged turtles only)
3. Removed tag(s) \_\_\_\_\_ Beach \_\_\_\_\_
4. Action \_\_\_\_\_ Time \_\_\_\_\_ Crawl Number \_\_\_\_\_
5. Result: LAY <sup>FALSE</sup>CRAWL Reason: \_\_\_\_\_
6. Observations on turtle \_\_\_\_\_
7. \_\_\_\_\_
8. Carapace measurements: Condition of carapace GOOD BAD
9. length (o.c.) tip to tip \_\_\_\_\_ cm length (s.l.) tip to tip \_\_\_\_\_ cm
10. length (o.c.) notch to tip \_\_\_\_\_ cm length (s.l.) notch to tip \_\_\_\_\_ cm
11. width (o.c.) maximum \_\_\_\_\_ cm width (s.l.) maximum \_\_\_\_\_ cm
12. Nest and crawl diagram:
13. \_\_\_\_\_
14. \_\_\_\_\_
15. \_\_\_\_\_
16. Observations on nest \_\_\_\_\_
17. Yoked eggs layed \_\_\_\_\_ Yokeless eggs layed \_\_\_\_\_ Yoked eggs reburied \_\_\_\_\_
18. Nest depth(cm) \_\_\_\_\_ Overburden(cm) \_\_\_\_\_ Hatchery No. \_\_\_\_\_
19. \* \* \* \* \*
20. Sky \_\_\_\_\_ Wind direction \_\_\_\_\_ Wind velocity \_\_\_\_\_ Air temp. \_\_\_\_\_
21. Precipitation \_\_\_\_\_ Water temp. \_\_\_\_\_ Seas: \_\_\_\_\_
22. Previous weather \_\_\_\_\_
23. Crawl location: \_\_\_\_\_
24. Observer(s): \_\_\_\_\_
25. ADDITIONAL COMMENTS:

Additional Information (time permitting)

1. Timed laying sequence: Elapsed time on beach \_\_\_\_\_

Approach crawl: start \_\_\_\_\_ finish \_\_\_\_\_ rate (m/min) \_\_\_\_\_

Body pit(s): start \_\_\_\_\_ finish \_\_\_\_\_ number \_\_\_\_\_

Nest hole: start \_\_\_\_\_ finish \_\_\_\_\_

Lay: start \_\_\_\_\_ finish \_\_\_\_\_

Cover: start \_\_\_\_\_ finish \_\_\_\_\_

Department: start \_\_\_\_\_ finish \_\_\_\_\_ rate (m/min) \_\_\_\_\_

2. Turtle observations:

Diagnostic marks \_\_\_\_\_

Deformities \_\_\_\_\_

Ectoparasites \_\_\_\_\_

3. Crawl measurements: width (cm) \_\_\_\_\_

water's edge to H.W.M. (m) \_\_\_\_\_ H.W.M. to nest site (m) \_\_\_\_\_

4. Hatchery: nest depth (cm) \_\_\_\_\_ overburden (cm) \_\_\_\_\_

time layed (completion) \_\_\_\_\_ time removed \_\_\_\_\_ time reburied \_\_\_\_\_

5. Nesting results: Nest type- IN SITU HATCHERY RELOCATED

Date emerged \_\_\_\_\_ Time emerged \_\_\_\_\_ Incubation (days) \_\_\_\_\_

Hatchlings released \_\_\_\_\_ Nesting success (%) \_\_\_\_\_

Nest contents: Date cleaned \_\_\_\_\_

live hatchlings \_\_\_\_\_ embryos (midterm) \_\_\_\_\_

dead hatchlings \_\_\_\_\_ hatched deformed \_\_\_\_\_

hatched shells \_\_\_\_\_ unhatched deformed \_\_\_\_\_

rotten/undeveloped \_\_\_\_\_ other \_\_\_\_\_

Predation \_\_\_\_\_

Other causes for poor hatch: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## DATA SHEET INSTRUCTIONS:

- i. Original tag: To be filled in by project leader at a later date.
- ii. Map/page: All data sheets must be sequentially numbered from beginning to end of season. Data sheets for a given night are organized and numbered the following day. Crawl number on map corresponds to page number.

1. Old tag(s): All tags on a turtle when she emerges this visit are considered old tags. This includes tags put on same night on earlier visit, on previous night's visit, and tags from previous years. All tags on turtle must be read, verified and recorded on every visit, regardless of the number of visits made by an individual turtle. Don't goof on reading tag numbers! If a turtle has already departed when the crawl is discovered, mark "GONE" in this location.

Date: Use a split date which defines a given night. Thus, a turtle may crawl before or after midnight, but the split date stays the same. For example, April 15 at 2200 and April 16 at 0100 would both be recorded as IV 15/16, since both crawls occurred on the same night.

2. New tag(s): All tags placed on the turtle on this visit are recorded as new tags. By definition, a given tag will never be recorded as new except once, on the visit during which it was applied to the turtle. DOUBLE TAG OR TRIPLE TAG ALL TURTLES!

Tagged Before: In terms of population ecology, this may be the most important observation you make, so BE CAREFUL! If a turtle emerges from the ocean without a tag (or with a tag which is broken, eroded or otherwise unreadable), inspect the animal for evidence of previous tagging. If there are no tag fragments, tag holes, characteristic swellings on the trailing edge of flipper (callouses) or other diagnostic marks which would indicate a history of previous tagging, circle "NO" at this point. If the turtle has such marks, circle "YES" at this point. Ask your team leader for instruction on how to identify tag scars, and have each member of the team verify your observation (conclusion) on this matter. Make the best decision you can, even if you are not absolutely sure. If impossible to determine, so indicate on the data sheet. If the turtle is carrying a readable tag, do not mark anything in this space.

3. Removed tag(s): If a tag is removed on this visit, it should be recorded here and saved in an envelope for future reference. Any tag that is hard to read, is broken, eroded or deformed, shows evidence that it may fall off, or appears to be from some distant tagging location should be removed for the record. If the tag hole is clean and not swollen, a new tag should be placed in the hole. Reference each removed tag to another tag number currently on the turtle and save the old tag in an envelope properly identified.

Beach: Refers to general location. For instance, Sandy Point South or Sandy Point West would be typical entrees.

4. Action: This refers to what the turtle is doing when she is discovered. The computer will calculate estimated time of emergence by comparing the action entree to the time entree.

Time: This refers to the exact time that the turtle is discovered on the beach, regardless of what she is doing when discovered. If the turtle has already departed (a "GONE" on line 1 above), give best estimate of when you think she arrived on the beach, and write "ETA" after your estimate.

Crawl No.: Every crawl should be assigned a temporary number on the night it is found and should be located on a map accordingly. The crawl will be assigned a permanent map number on the following day, corresponding to the permanent data page number (see line number ii above).

5. Result: LAY <sup>FALSE</sup> CRAWL: Circle appropriate entry. If the turtle should cease laying and depart without covering the nest, this is called an "Abort Lay" and should be written in above the word "LAY".

Reason: Try to give the best reason you can for why the turtle false crawled or did an abort lay. Discuss possible reasons with your team leader. If you cannot determine a reason, write "I DON'T KNOW".

6. Observation on Turtle: Enter here anything that catches your imagination, including physical or behavioral attributes of the turtle, unusual marks, etc. Specific observations on the turtle are also entered on back of data sheet at location 2.

7. (continued comments from above line)

8. Carapace measurements: If you think the carapace is broken, notched or otherwise mis-shaped so as to cause an aberrant measurement, circle "BAD" at this point; otherwise, circle "GOOD". Check posterior promontory at carapace for integrity and circle "BAD" if it looks broken or shortened.

- 9-10. "O.C." refers to over-the-curve measurement, while "S.L." refers to straight line. O.C. measurements are taken with a tape measure; S.L. measurements are taken with calipers. An O.C. carapace length is taken with tape lying adjacent to central carapace ridge and not on top of it. Front of carapace is either its most anterior point (TIP) lateral to midline or the exact midline (NOTCH).

11. Carapace width is defined as the widest point, wherever that point, may be located.

NOTE: Measure a turtle every time you see her. Multiple measurements of the same turtle provide valuable information on the variance of the measurements. Don't copy measurements from one data sheet to another.

- 12-15. Nest and crawl diagram: This is a diagrammatic vertical relief (profile) of the beach at the point of the crawl. The diagram must be carefully structured and consistent from observer to observer to be useful for computer coding. Work carefully with your team leader and check your art work with other team members for accuracy.
- a) - water level marked with double slash (//),  
- high water mark (HWM) located with single slash (/),  
- landward extent of crawl indicated with curved arrow (↩),  
- body pit or nest hole marked with (O),  
- clutch of eggs marked with circled cross (X).
  - b) - indicate beach relief, including hollows, dunes, escarpments, erosion banks, etc. Carefully indicate location of body pits (O) or nest (X) relative to this relief.
  - c) indicate vegetation and its proximity to the nest. Establish unique symbols to identify principle types of vegetation (grass, railroad vine, beach plum, etc.).
  - d) add whatever additional marks you think appropriate to define nest environment. For instance, wrack lines or beach trash can be so indicated if you think its presence is noticeable or affects the turtle.
16. Observations on nest: Enter here whatever strikes your fancy. Items might include shape of nest, beach material, presence of moisture, standing water or roots in nest hole, ants or crabs or other predators in vicinity, unusual amounts of organics or dirt in sand, etc.
17. Yoked eggs layed: This entry is only possible if the eggs are removed to the hatchery or if an observer has carefully counted each egg as it drops into the nest cavity. Don't guess and don't excavate natural nests if they are to be left in situ. Don't count yokeless eggs here; they are usually identified as being 1 inch in diameter or less.
- Yokeless eggs layed: If a natural nest is relocated, count the number of small, yokeless eggs and indicate the number here. Do not rebury yokeless eggs.
- Yoked eggs reburied: If the nest is relocated or placed in hatcher, one or more eggs may break in handling. Indicate final number here, even if same as number of yoked eggs layed.
18. Nest depth (cm): If a natural nest is relocated, measure distance from surface of beach to bottom of cavity of the natural nest.
- Overburden (cm): If a natural nest is relocated, measure distance from surface of beach to estimated location of top egg of the natural nest.

Hatchery No.: Each nest is numbered and located as such in hatchery and on the data sheet. Check with team leader.

19. \* \* \* \* \*

20. Sky: Use aeronautical terminology. CLEAR is what it says, SCATTERED is cloud covering less than 50% of sky, BROKEN is cloud covering more than 50% but less than 100%, OVERCAST is 100% cloud cover, FOG, DISTANT LIGHTNING, etc.

Wind direction: Use a compass.

Wind velocity: Use a wind gauge (MPH) or Beaufort Scale, but be consistent.

Air temperature: Use thermometer.

21. Precipitation: This refers to immediate time of crawl. If rain earlier in evening, indicate in "previous weather" (line 22).

Water temperature: Use thermometer.

Seas: Develop a relative index of surf. For instance, NONE, LIGHT, MOD, HEAVY, VERY HEAVY might be used.

22. Previous weather: Enter here any weather preceeding the crawl time (previous 24 hours) which, in your opinion, might affect the nesting behavior of the turtle. Previous rain and/or high winds is particularly important. If quantity of rain (previous 24 hours) can be measured, so indicate.

23. Crawl location: This is the place to temporarily note a crawl location ("50' east of old broken tree", etc.) until it can be properly transferred to the map.

24. Observer(s): Indicate all people in party. This is useful. If the data keeper has to go back and check discrepancies with particular team members during the following days.

NOTE: If you try to answer a question on the data sheet and cannot do so, say "I don't know" or "I can't tell". If you leave an entry blank, it means you did not try to answer it.

PRIORITIES: If a turtle is carrying a tag, make every effort to read it. Never send a turtle back to the water with an unreadable tag; take it off and replace with a new tag.

If a turtle has no tag, get one on her. Add more if time permits, up to three if she carries no old tags.

If a turtle carries old tags, make sure you add at least two new tags, regardless of how many old tags she is wearing.

All other measurements or entries on the data sheet are secondary to the above.