

Tagging and Nesting Research on Leatherback Sea Turtles (*Dermochelys coriacea*) on Sandy Point, St. Croix, U.S. Virgin Islands, 2004.

Annual Report to Fish and Wildlife Service

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Tagging and Nesting Research on Leatherback Turtles (*Dermochelys coriacea*) on Sandy Point, St. Croix, U.S. Virgin Islands, 2004

ABSTRACT

The Sandy Point National Wildlife Refuge in St. Croix, U.S. Virgin Islands supports the largest continuously studied population of nesting leatherback sea turtles in the world. Flipper tagging began in 1977, and since 1981 saturation tagging and consistent night patrols during the nesting season have yielded a comprehensive database of information on each female nesting at Sandy Point. The 2004 nesting season began with a nest discovered during U.S. Fish and Wildlife surveys on February 17th, and ended with a final activity on July 17th. Activity was highest during the weeks of April 19th and May 25th. One hundred turtles laid a total of 444 nests with an average of 78.05 ± 15.74 yolked eggs per clutch. Of nests laid in 2004, 166 (37.4%) were relocated to protect them from inundation or erosion. The number of documented nests per female ranged from 0 - 10 with an average of 4.6. Sixty two of the turtles were remigrants, with remigration intervals of 2 - 5 years. Of the 354 nests analyzed, mean overall hatch success was $54.15 \pm 24.78\%$. Like most previous years, emergence success of *in situ* nests was significantly higher than that of relocated nests ($p < 0.01$). We estimate that 3.6% of the nests were lost to erosion. With the addition of 38 untagged turtles in 2004, a total of 749 leatherbacks have been tagged since 1979. Nightly patrols and a concerted relocation effort have reduced the major historical threats of poaching and erosion, although there is still poaching of both eggs and adults of green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles after nightly patrols cease.

INTRODUCTION

For the twenty fourth consecutive season research has continued on the nesting ecology and population biology of the endangered leatherback turtle (*Dermochelys coriacea*) at the Sandy Point National Wildlife Refuge (SPNWR), St. Croix, U.S. Virgin Islands. The objectives of this project are to assess the size, productivity, and management priorities of this population (by documenting and tagging all nesting females), to protect adults, nests and hatchlings from predators and poachers, and to protect nests from erosion and inundation. The leatherback is the largest and most morphologically divergent species of sea turtle. The biology of this little-known reptile is reviewed in Marquez (1990). Pelagic in nature, it is rarely encountered except on the nesting beaches, where virtually all of the information on this species has been collected. The SPNWR supports the largest and best-studied nesting population of endangered leatherback turtles in the United States and northern Caribbean. As recently as a decade ago, there were only 13 significant nesting sites worldwide (Sternberg 1981), including six in the western Atlantic (Carr *et al.* 1982). However, leatherbacks have been virtually eliminated from some of these nesting sites, and have declined on almost all beaches where they are known to nest (Betz and Welch 1992, Chan and Liew 1996, Sarti *et al.* 1996, Spotila *et al.* 1996). In contrast, numbers are increasing on Sandy Point and on Culebra, Puerto Rico, where a similar project has been ongoing since 1984 (McDonald Dutton and Soler 1997). This could be due to intensive long-term conservation efforts on these beaches. This project provides a unique opportunity to study recruitment into a population that appears to be recovering from previously declining numbers. The Sandy Point beach and surrounding waters have been designated as critical habitat by the National Marine Fisheries Service, and in 1984 became part of the U.S. Fish and Wildlife Service's Caribbean Islands National Wildlife Refuge System. This study began in 1981 under the auspices of the U.S. Virgin Islands, Department of Planning and Natural Resources, Division of Fish and Wildlife. Funding is provided through USFWS Section 6 Endangered Species grants of the U.S. Endangered Species Act and, since 1982, by Earthwatch and the Center for Field Research, Watertown, Massachusetts. Further information on the history of Sandy Point and the development of the present study can be found in Eckert and Eckert (1985).

The following is a summary of the results of the 2004 data, including comparisons with previous years. Detailed information from those years can be found in Eckert *et al.* (1982, 1984), Eckert and Eckert (1983, 1985), Basford *et al.* (1986, 1988, 1990), Brandner *et al.* (1987, 1989), Boulon (1992), McDonald *et al.* (1991, 1993, 1995, 1996, 1997, 1998, 1999, 2000, 2001), Dutton *et al.* (1992, 1994), and Alexander *et al.* (2002, 2003).

Sandy Point National Wildlife Refuge, St. Croix

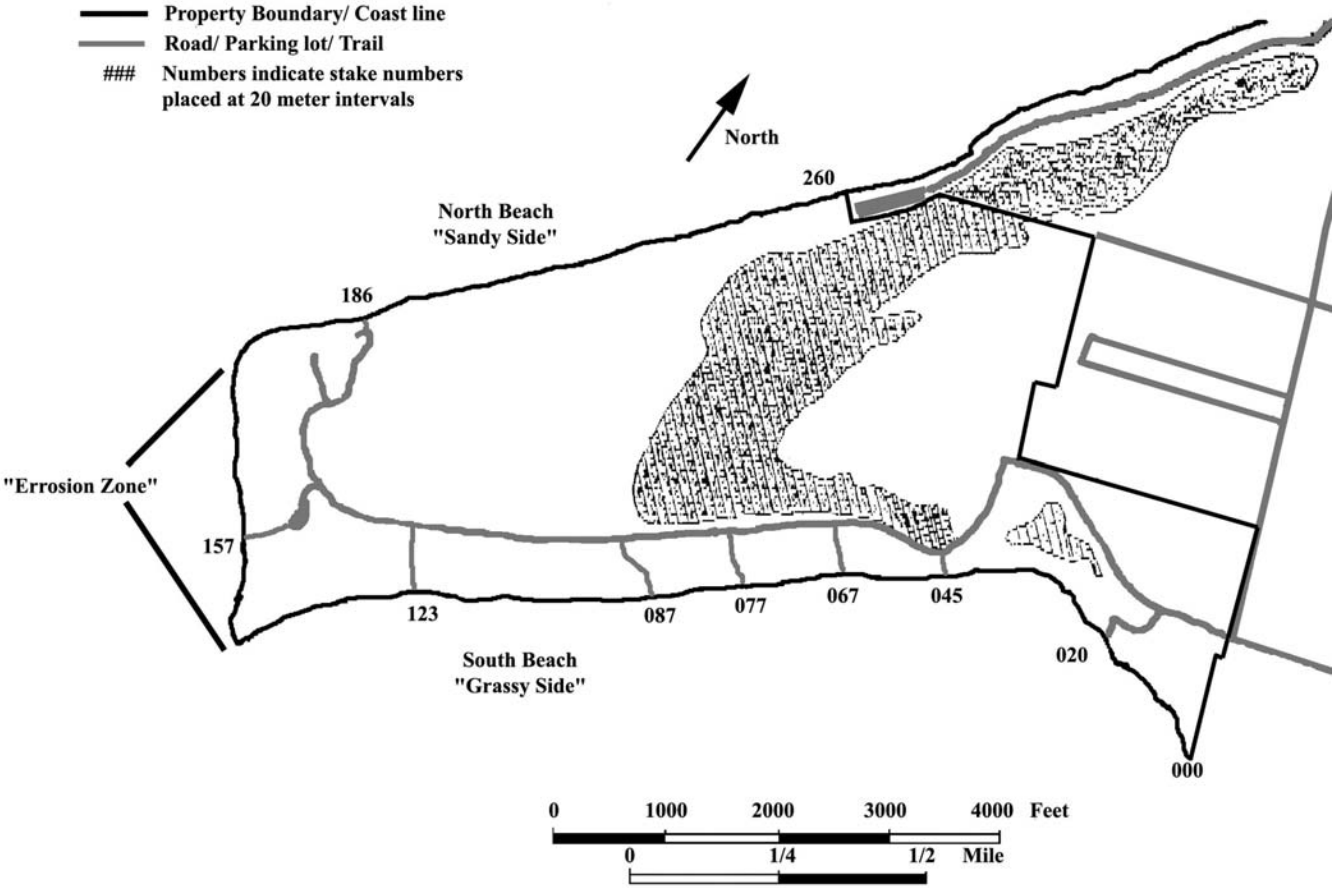


Figure 1 Schematic of Sandy Point National Wildlife Refuge. The drawing shows boundaries, coastline, roads, trails and stake numbers. The stippled areas represent salt ponds, which may be seasonally filled with water.

Study Area

The study area at Sandy Point National Wildlife Refuge (Figure 1) is 3.0 km long, with numbered stakes marking the entire length of the study area. Stakes, placed along the vegetation line at 20m intervals, enable us to obtain exact measurements on nest locations within the Refuge. The beach is divided up into 2 sections, the “grassy” side and the “sandy” side. The sandy side covers stakes 210 to 140 (the point). This half of the beach faces North and West, on the leeward side of St. Croix. It is relatively wide and contains very little vegetation extending out onto the sand, thus the label “sandy” side. The Western portion of the beach on this side erodes away during the nesting season from approximately stake 140 to stake 169. Erosion patterns result in extensive loss of beach so that at times, less than 2 meters of sand remain on the beach. This area of sandy side beach is referred to as the “erosion zone”. The sand, which erodes away from this area re-deposits itself along the area from 170 to 186 on the North side of the beach during the nesting season. This area is called the accretion zone. The process reverses itself during the winter months when the erosion zone refills with sand. This is an annual occurrence and is an indication of the dynamic forces driving the sand transport on Sandy Point.

The grassy side of the beach faces south and is located on the windward side of the island. As a result, the beach is covered with windblown seaweed and debris. Additionally, the beach is covered with an overgrowth of vegetation (grass and sea grape), which occurs naturally on this side of the beach. Due to the extensive ground cover, this side is referred to as the “grassy” side. The stakes patrolled on the grassy side are numbered 45 to 139. Stakes 0 to 66 have little or no sand available for suitable leatherback nesting habitat.

In 2001, sand accretion occurred north of stake #195, covering rocks and providing an additional area for leatherbacks to emerge and nest north of the traditional study area. However, as in 2002 and 2003, there was no accretion in this area in 2004, therefore, the study area only extended to stake #198. The area further north into the 200's was exposed rock and coral, thus preventing nesting activity. Additionally, in 2004, the normal cyclic loss of beach in the “erosion zone” was decelerated, allowing available nesting area to remain throughout the season. This is unprecedented. With the lack of erosion, the accretion zone provided less nesting habitat than normal. Eventually, late in the season (July), the beach finally started to erode and accrete, although to a lesser degree than normal. In 2004, the area from stakes 180 to 190 also provided less nesting habitat due to extremely steep berm with little beach width. Regular patrols were still conducted in the accretion zone and north of stake 186, in spite of the lack of suitable nesting habitat. Occasionally, the area was patrolled further north into the 220's. The grassy side was patrolled regularly to stake 66, and occasionally to stake 45.

METHODS

Study Area Coverage

Historically, nightly beach patrols on Sandy Point begin starting April 1st. However, in 2004, the beach was patrolled beginning March 1st. The beach was patrolled nightly on foot, starting at 2000 hours and continuing until either 0500 hours, or until the last female finished nesting. Starting on April 6th the researchers were assisted by 9 teams of up to 10 Earthwatch volunteers per team, each participating for a period of 10 days, until the teams ended July 14th. The teams of volunteers were divided into groups, each organized and led on patrols of the beach sections by a qualified Field

Leader. Each group walked their respective study area at 45 minute intervals. It has been previously determined that leatherbacks require at least 1 ½ hours to complete the nesting process, therefore, patrolling the beach at 45 minute intervals ensured that all nesting turtles were observed, tagged, and recorded.

Data Collection

Every time a turtle was encountered on the beach a separate nesting data sheet was completed (Appendix I). All data regarding nesting, identification, morphology, location, nest parameters, and behavior were recorded. Time and date of every encounter were also recorded. Date of emergence and excavation were recorded once hatchlings emerged and nests were excavated. Upon excavation, all nest contents were categorized to determine nest success, and all un-hatched eggs were opened to determine stage of development. This information was recorded on a hatchling data sheet. Basic data collection remained the same as for previous years. Green and hawksbill activities were also documented during the period of leatherback research.

Methods used to collect data were as follows:

A. Morphology

Over the Carapace (o.c.) length and width were recorded once a turtle successfully nested. Carapace length was recorded in centimeters using a standard metal measuring tape. The carapace was measured from the nuchal notch, alongside the vertebral ridge, to the posterior tip of the peduncle at the longest point. Width was measured from each side ridge, across the widest point of the carapace, just posterior to the front flippers. Individuals were measured every time they were encountered, and the measurements averaged at the end of the season.

B. Nesting

Whenever possible nesting behavior and technique were observed and any anomalies recorded. Abnormalities in digging, condition of rear flippers, nest cavity structure, and condition of the sand in the nest were noted.

C. Relocated Nests

Any nests that appeared to be in imminent danger of erosion or inundation were relocated. All nests in the area previously designated as the erosion zone, in addition to those with standing water in the nest cavity were also relocated. Eggs from these “doomed” nests were collected upon deposition, before they contacted the sand in the nest cavity, and placed in a plastic Hefty™ cinch sac bag. The eggs were then transported to a safer, stable area of the beach, where they were relocated in nests constructed by either Field Leaders or Fish and Wildlife Refuge staff. Nests were constructed (generally in the accretion zone) to specified shape and dimensions (Dutton *et al.* 1992), similar to natural nests. The locations of all relocated nests were recorded, along with the number of yolked and yolkless eggs deposited.

Average depth, width and overburden (depth of sand over the eggs, measured from the top of the egg mass to the sand surface) were also documented for each nest.

D. Marginal Nests

Nests that were deemed to have a reasonable chance of survival, in spite of their location relatively close to the high water mark, or inside the erosion zone, were left *in situ* and recorded as “marginal”. Nests were left *in situ* to minimize the potential of skewing the hatchling sex ratios. Moving nests, such as marginal nests, which likely incubate at cooler temperatures due to wave washover, would inhibit the production of male hatchlings.

E. Nest Location

The location of each nest was determined by measuring the distance from the center of the nest cavity to each of the two nearest marker stakes. A Keson fiberglass metric 50m tape was utilized and the distance recorded. The distance of each nest to the vegetation line and high water mark was also recorded.

F. Tagging

Inconel tags were attached to the inguinal skin flap between the rear flipper and the tail of every untagged turtle. In previous seasons Monel tags were applied, however, Monel tags are no longer produced and therefore the smaller Inconel tags were utilized. Traditional tagging pliers were used to attach the flipper tags. No tags were applied to the front flippers of leatherbacks due to decreased retention rates. Flipper tags were applied to both front and rear flippers of hawksbill and green turtles.

Turtles were also tagged with a small (14 mm long x 2 mm diam.) glass-encased electromagnetically encoded microchip, or Passive Integrated Transponder (PIT) tag (AVID, Inc., Norco, CA). The tags were injected using a plastic applicator gun, directly into the left or right shoulder muscle of each turtle using the sterile techniques described in McDonald and Dutton (1996). The tags were detected using hand held scanners (AVID Power Tracker II and IV) which when passed over the shoulder area, displayed the I.D. number on a digital scanner screen. The numbers of all applied and detected PIT tags were recorded on the nesting data sheets. All tagging procedures were designed to cause minimal disturbance to the turtles. No PIT tags were applied unless the turtle commenced laying eggs (for approximately 5 minutes), was motionless, and had entered the nesting trance. No PIT tags were applied if the turtle had finished laying or started the disguising phase.

G. Emergence and Excavation

Nests were monitored nightly, three days before the expected emergence date. After emergence, the location, date, time and number of hatchlings seen were recorded. A wooden stick, with a piece of tape denoting the location and identification number of the nest, was placed behind the emergence area to mark the spot for future excavation. Live hatchlings were guarded from potential predators until they entered the water. Disoriented hatchlings, those wandering the beach, going away from or parallel to the water, or hatchlings trapped in vegetation, were assisted to the waters edge. If a nest did not emerge within the expected time frame it was excavated to ensure that no hatchlings were trapped inside, and to reduce the high full-term pipped mortality often seen in relocated nests.

After emergence, the nests were excavated and the nest contents categorized to determine hatching success. All un-hatched eggs were opened to determine stage of development, using criteria described by Whitmore and Dutton (1985) (Appendix II). Additional sub-categories of development were added during the 2002 nesting season. All abnormalities were described. The condition of the nest cavity was noted to help determine possible causes for poor hatch success. This included extremely wet or dry sand, as well as the presence of mold, roots, and other vegetation. Live hatchlings found within the nest cavity were counted and released. Hatchlings were dispersed along the beach where they emerged, as well as on grassy side. Any eggs or live hatchlings that were not ready for release were brought back to Cottages by the Sea and incubated in Styrofoam coolers until they were ready to be re-released at Sandy point.

H. Blood and Tissue Samples

Blood and/or tissue samples were taken from adult turtles for genetic analysis. Blood samples were taken from veins in the rear flipper using a 21 gauge needle following methods described in Dutton (1996), without disturbing or harming the turtles.

Alternatively, small skin samples (6mm diameter) were taken using a sterile biopsy tool (Dutton and Balazs 1995) or a razor blade. All sampling was carried out during or shortly after the turtle laid her eggs, to ensure the least disturbance to the nesting process.

Skin samples were placed in a salt DMSO solution, labeled and frozen. Blood samples were refrigerated for 1 day. Once the blood separated out it was spun down using a centrifuge, red blood cells were placed in a labeled vial containing anti-lysis solution, and frozen. Plasma samples were placed in empty cryo-vials, labeled and frozen. After clotting, serum samples were also placed in cryo-vials, labeled and frozen for further analysis.

Trample Zone

No trample zone experiment was conducted in 2004, since there was no viable study area. Unlike previous years, the trample zone did begin accreting sand until mid-August, so nests could not be laid or relocated to this area.

Dataloggers

Electronic dataloggers were used to conduct a dual experiment to determine the possibility of a lethal temperature for relocated nests and to determine if sex ratios were modified by relocating nests.

A datalogger, recording temperature at 15 minute intervals, was placed in 6 *in situ* and 6 relocated nests. The dataloggers were placed in the middle of the nest after approximately half the eggs were already in the chamber. Nest locations were recorded and the dataloggers removed upon excavation, once the nest had fully emerged. If a significant difference in temperature was found prior to, or slightly after hatching, it may help explain the high mortality of relocated versus *in situ* nests.

Additionally, any full term pipped or dead emerged hatchlings were collected and placed in glass jars filled with formalin for preservation. The hatchlings will be sexed to determine if there is any difference in sexes produced between the *in situ* and relocated nests. In addition, the data will be examined to determine if there is any correlation between hatch success and the associated temperature profiles.

ANNUAL NUMBER OF FEMALES ENCOUNTERED 1982-2004

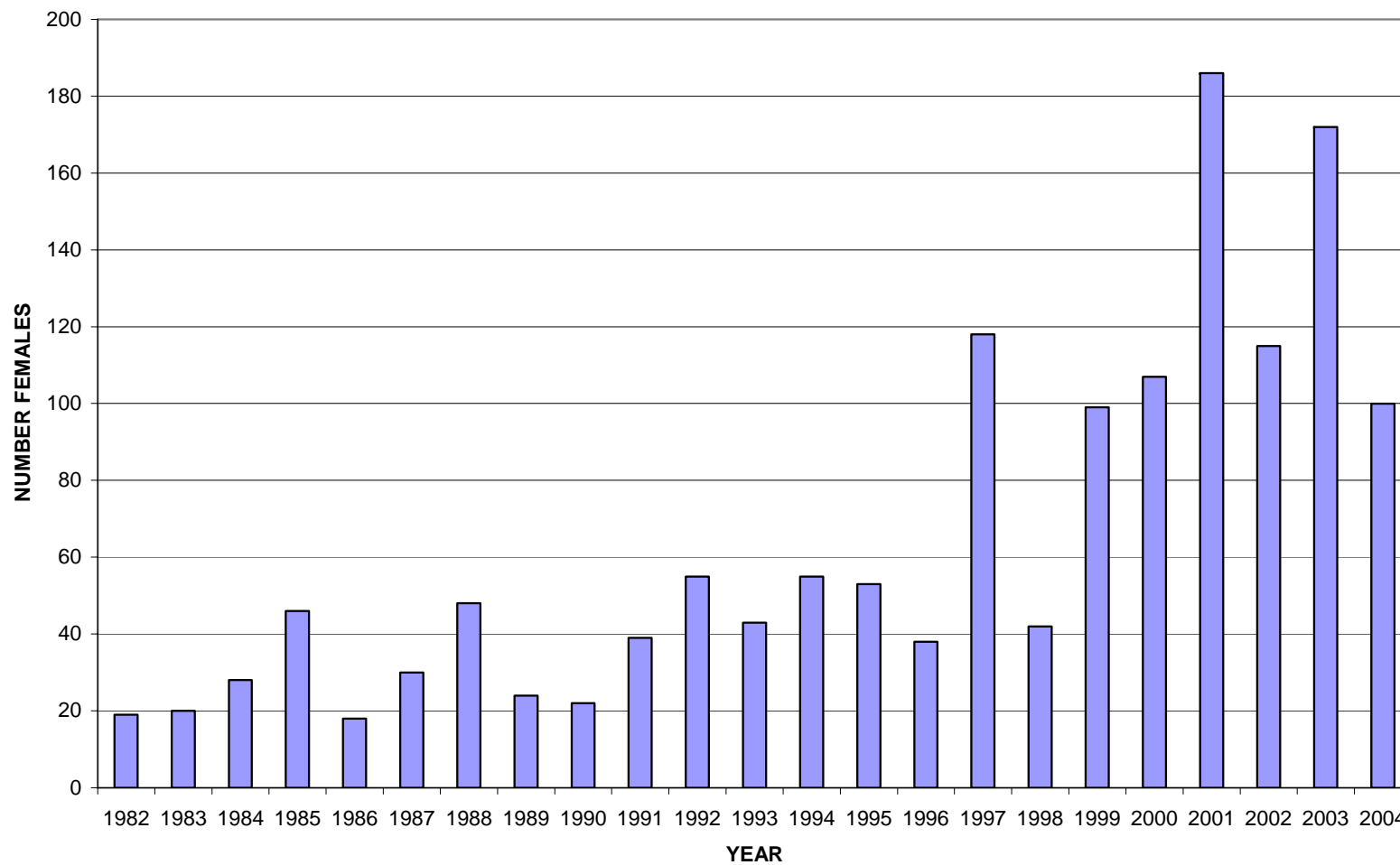


Figure 2 Graph showing the annual number of nesting turtles encountered from 1982 through 2004 nesting seasons.

Table I. Leatherback remigrations to Sandy Point from 1977 to 2004 (population not monitored 1978 and 1980).

Season	Total Turtles Encountered	Remigration Interval						Tag Scarred	Total Remigrant
		1	2	3	4	5	>5		
1977	10	0	0	0	0	0	0	0	0
1979	6	0	0	0	0	0	0	0	0
1981	20	0	3	0	0	0	0	0	3 (15.0%) ³
1982	19	0	0	0	0	0	0	1	1 (5.3%) ³
1983	20	0	7	0	0	0	0	2	9 (45.0%)
1984	28	0	4	0	0	0	0	0	4 (14.3%)
1985	46	1	10	3	0	0	0	2	16 (34.8%)
1986	18	0	1	2	0	0	0	0	3 (16.7%)
1987	30	0	9	5	0	0	0	0	14 (48.3%)
1988	48	0	5	7	1	0	0	4	17 (35.4%)
1989	24	0	7	0	0	0	0	0	7 (29.2%)
1990	22	0	2	3	1	0	0	0	6 (27.3%)
1991	39	0	8	8	0	0	0	14	16 (41.0%)
1992	55	0	6	4	7	0	0	44	17 (30.9%)
1993	43	0	13	4	0	0	0	74	17 (39.5%)
1994	55	0	14	8	1	1	0	144	24 (43.6%)
1995	53	0	16	7	5	0	0	N/A ⁵	28 (52.8%)
1996	38	0	13	5	4	2	0	N/A ⁵	24 (63.2%)
1997	118	0	27	22	5	3	0	N/A ⁵	57 (48.3%)
1998	42	0	15	6	3	1	0	N/A ⁵	25 (59.5%)
1999	99	1	32	9	4	2	26	N/A ⁵	50 (50.5%)
2000	107	0	10	28	2	3	2	N/A ⁵	45 (42.1%)
2001	186	1	45	12	26	1	27	N/A ⁵	96 (51.6%) ⁸
2002	115	1	35	23	5	3	1	N/A ⁵	70 (60.9%) ⁹
2003	172	0	84	12	6	3	3	N/A ⁵	114 (66.3%) ¹
2004	100	0	37	13	8	4	0	N/A ⁵	62 (62%)
Totals		4	403	179	78	23	59	35+ ⁵	

- ¹ Does not represent total number of turtles nesting.
- ² May or may not represent total number of turtles nesting.
- ³ Not accurate due to incomplete tagging in previous years; proportions in later years are more accurate but still not complete.
- ⁴ We do not include tag-scarred turtles in the count of remigrants, as we cannot determine if they were tagged at Sandy Point.
- ⁵ Photoidentification and PIT tags have identified many tag-scarred turtles as remigrants.
- ⁶ 7 year remigration interval
- ⁷ One (1) six year, 1 nine year remigration interval
- ⁸ Nine (9) turtles were originally tagged in Puerto Rico; we have no information on remigration intervals
- ⁹ Two (2) of the three (3) turtles that were originally tagged in Puerto Rico; we have no information on remigration intervals
- ¹⁰ Two (2) unidentified, previously tagged turtles, we have no information on remigrations intervals, additionally we have no information on the remigration intervals of the 4 turtles originally tagged in Puerto Rico.

RESULTS

Adults

During the 2004 nesting season 100 adult leatherback sea turtles were observed at Sandy Point (Figure 2), consisting of 38 previously untagged turtles and 62 remigrants. Of the 62 remigrants, 1 turtle was originally tagged in Culebra, an island off the coast of Puerto Rico, and 1 turtle was originally tagged in the British Virgin Islands. The remigration interval for all turtles ranged from 2 to 5 years with an average remigration interval of 2.66 years (Table 1). Information has not been obtained on the remigration intervals of the Culebran or BVI turtles so an interval of 3 years assumed for the statistic purposes. Remigration intervals were similar to previous years. The carapace lengths of the recorded turtles ranged from 136.2 to 172.7 cm with an average of $152.1 \text{ cm} \pm 6.17 \text{ cm}$. Carapace widths ranged from 100.0 to 137.5 cm, with an average width of $111.3 \text{ cm} \pm 5.67 \text{ cm}$. Size class distribution among new and remigrant turtles is depicted in Figure 3. The average size (length and width) of the 2004 nesting population is consistent with that of the population in past years (Figure 4).

The average number of nests laid per individual female ranged from 0-10, with an average number of 4.64 ± 2.31 nests laid per female during the 2004 nesting season. Some nests, such as those laid prior to March 1 were deposited by unidentified turtles. In addition to early season nests, probable lays, and nesting on beaches other than Sandy Point result in an underestimate of the number of nests laid per turtle. As an alternative method of determining the average number of nests laid per turtle, the number of total nesting activities (444) may be divided by the number of individual turtles (100). The average number of nests laid, when calculated in this manner, is 4.44. This is slightly lower than the 2002 and 2001 nesting seasons which averaged 5.1 and 5.4 nests/turtle respectively, as well as previous nesting seasons.

The average number of dry runs per adult was also determined for the 2004 nesting season. A dry run is defined as an unsuccessful attempt at egg deposition. A dry run is not a track only, and must consist of the turtle attempting to body pit, and/or dig a nest cavity before returning to the water. There were 157 documented dry runs during the 2004 nesting season, with the number of dry runs per turtle ranging from 1 to 10. The average number of dry runs was 2.30 ± 1.91 , which is similar to the 2003 season, (with 1.7 ± 2.85 per turtle), and the 2002 season when there was an average 1.8 ± 3.01 dry runs per turtle.

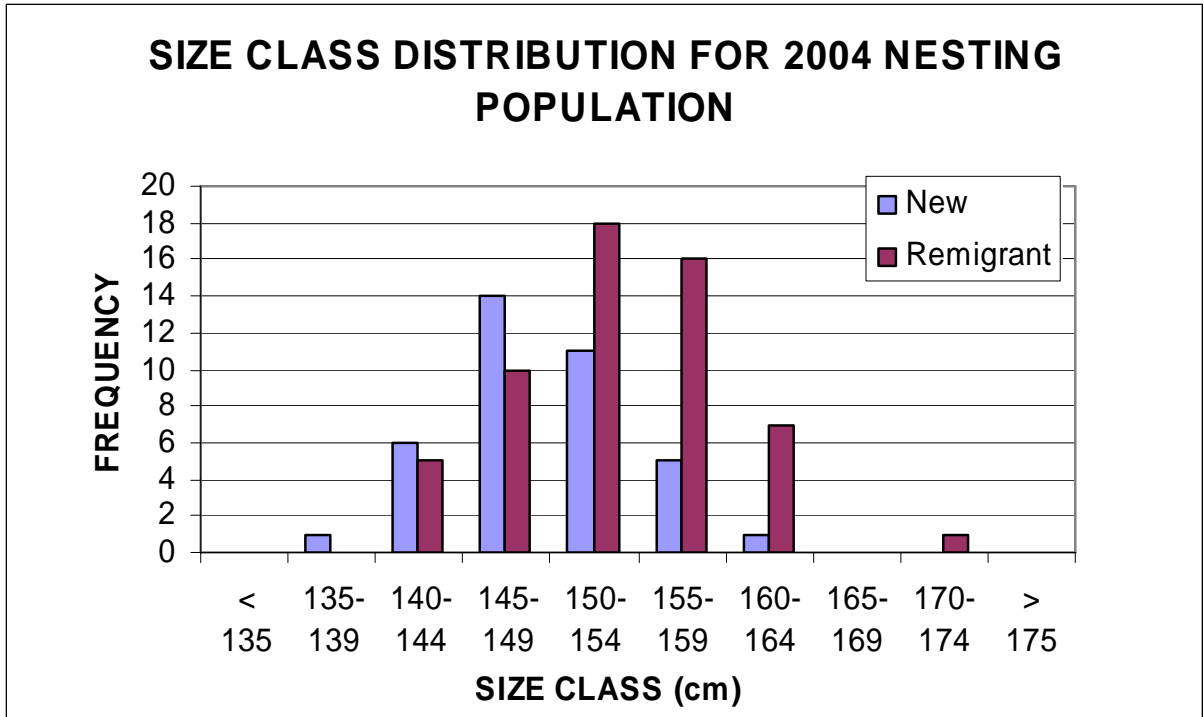


Figure 3 Size class distribution of nesting leatherbacks for the 2004 season

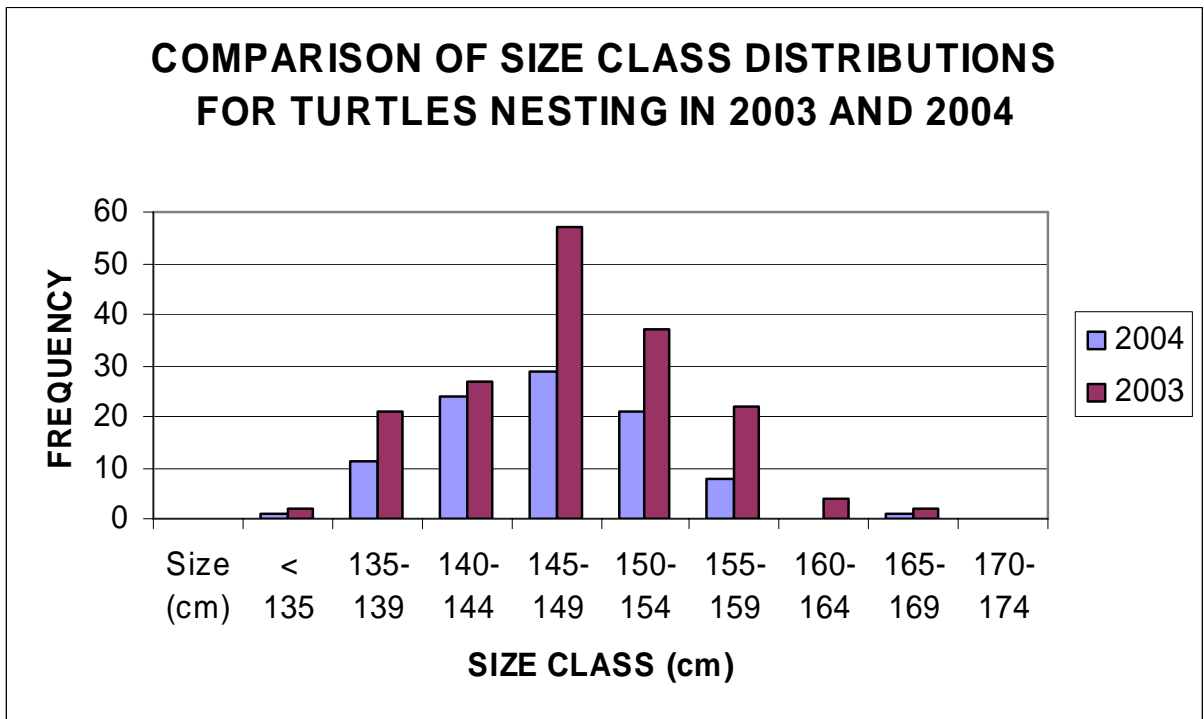


Figure 4 Comparison of size classes for nesting leatherbacks during the 2003 and 2004 seasons.

Inconel tags were applied to all turtles without flipper tags. This includes those that were not previously tagged, as well as turtles that had been previously tagged, but lost their tags. We also retagged turtles after removing tags that were damaged or detaching. As a result, 81 flipper tags were applied this season, with 38 new turtles tagged. PIT tags were also applied to the new turtles, as well as remigrant turtles, as needed. Many remigrant turtles had detectable pit tags, but were tagged with AVID encrypted PIT tags only readable by AVID scanners. Therefore, unencrypted “Focava” code PIT tags, readable by scanners from various manufacturers, were additionally applied to the opposite shoulder of remigrants with only one PIT tag. As a result, 59 PIT tags were applied to both new and remigrant turtles during the 2004 season. Of the 40 new turtles in 2004, 35 were PIT tagged, with 5 new turtles left without PIT tags.

Saturation tagging at Sandy Point almost makes the need for pink spot photos obsolete. This fact, along with time restrictions on the beach resulted in a decreased need and ability to obtain pink spot photos in recent years. There were 7 wound photos taken in 2004. The percent of the population with serious injuries was minimal in 2004. This is similar to 2003, when turtles with major wounds accounted for 4% of the nesting population. Both the 2003 and 2004 seasons had dramatically lower percentages of wounded turtles than the 2002 nesting population, which had 115 turtles, and a larger percentage of the population injured (32%). Injuries appeared to be caused by interactions with boats, fishing tackle, nets, ropes and lines.

In 2004, one turtle came ashore with line and lure still attached. The hook was imbedded in her left front shoulder. The line was cut and principal investigators were able to successfully remove the hook. The wound was disinfected with Betadine before the turtle returned to the ocean. Note: A recreational fisherman reported this incident prior to her arrival on the beach. He had “hooked” here while trolling at about 30’ of depth around 5 miles off the west coast of St. Croix. The fisherman cut the line and left about 50’ of monofilament line attached.

All ectobiota was documented throughout the season and as in past years three main types of barnacles were found. These included the *Stomatolepas dermochelys*, *Conchoderma sp.*, and *Platylepas hexastylus*. Barnacles were found primarily attached to the shoulders, neck, carapace and wounds of adult leatherback turtles. The fish *Remora remora* was encountered attached to 3 turtles in 2004. This number is similar to the 2003 and 2002 seasons (when 5 and 2 turtles were observed with remora, respectively). This, however, is fewer than in 2001, when at least 8 turtles with remora were observed.

Blood and skin samples were collected for genetic and biochemical analysis. Blood samples were collected from 87 turtles (including 31 neophytes), while 102 skin samples were collected (including samples from 31 neophytes). Plasma and serum samples were also collected for further analysis of physiological parameters (such as parathyroid and thyroid hormones, calcium levels, and more). Plasma and serum will be analyzed by Jeanne Alexander and faculty at Texas A&M University, College Station, Texas, as part of the Wildlife and Fisheries Science, PhD program. Genetic analysis is

currently being conducted by Dr. Peter Dutton at the NOAA-NMFS Southwest Science Center's, La Jolla Laboratory.

Nesting Activities

During the period of monitoring (March 1 – September 1, 2002) a total of 705 activities were recorded at Sandy Point. This number is lower than the previous seasons, (2003 with 1,458 activities, 2002 with 912 activities, and 2001 which boasted 1,289 activities). The first nest was recorded on February 17th (Mike Evans and Claudia Lombard, USFWS). Between March 1st and April 1st there were 38 recorded activities, with all activities from remigrants. Of these 38 activities, 30 of them were after March 14th. No neophytes were recorded during this time. Known egg deposition occurred in 62.3% (444) of the nesting activities, while 22.3% (157) of all activities were dry runs. Only 9.5% (67) of the activities were probable lays, with another 6.8% (48) of the activities recorded as track only. Of the 444 known nests deposited on the beach this season, 62.6% (278) remained *in situ*, while 37.4% (166) were relocated. Of the 166 nests relocated this year, it is estimated that 100% of them would have been lost to erosion or inundation had they not been removed and relocated to a different area of the beach.

Figure 6 represents the breakdown of turtle activity during each week of the study period, starting March 1st. Peak activity occurred during the month of May, with the greatest activity recorded during the week of May 25th. Activity slowed greatly starting the week of June 10th. The last activity was recorded on July 17th. This data is similar to the 2003 season, which showed greatest activity during the weeks of May 6th and May 27th. The last activity was earlier in the 2004 season than in the 2003 season, which had the last activity on August 10th.

In order to illustrate the distribution of activities on the beach, the monitored area at Sandy Point was divided into 5 sections. The grassy side was divided into 2 sections, from stake 66 to the entrance around 122 and from stake 123 to the point (stake 139). The sandy side was divided into 3 sections, with section 1 starting from stake 140 around the point, and encompassing the entire erosion zone to stake 168. The remaining 2 sections include the accretion zone, from stake 169 to the entrance at stake 186, as well as from stake 187 to stake 200 at the end of the patrol area. The distribution of *in situ* nesting activities within these given areas (represented in Figure 7) show that a majority of the *in situ* nests, 41.5% were laid in the accretion zone from stakes 170 to 186, followed by the erosion zone with 31.2% of *in situ* nests between stakes 141 and 169. Additionally, 17.4% were laid on the grassy side between stakes 66 and 122. The accretion zone had the greatest amount of dry runs (36.3%), followed closely by the erosion zone with 31.2% (Figure 8). Another 17.2% of the dry runs occurred on the grassy side between stakes 66 and 122. Stakes 123 to 139 on the grassy side (to the point) had very little activity of any kind (only 3% of total activity).

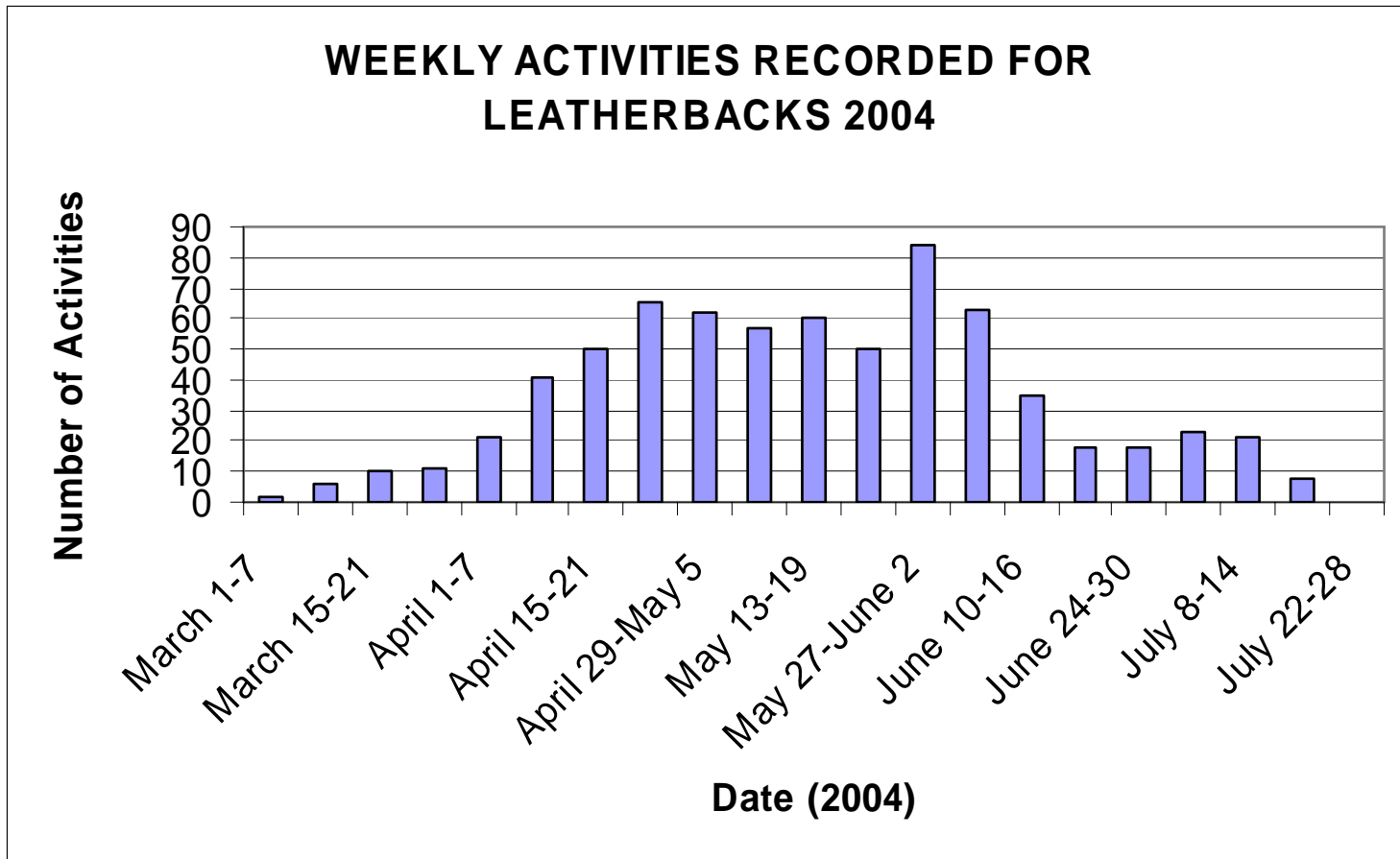


Figure 5 Graph showing the overall number of activities of leatherbacks on the beach by week from the 1st of March to the 28th of July 2004.

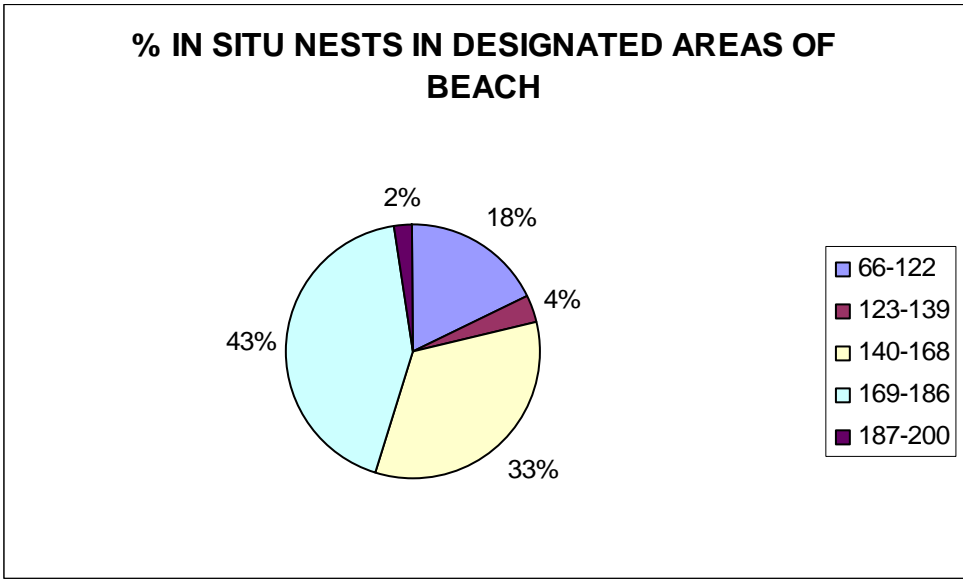


Figure 6 Percent of nests left naturally in different sections of the beach (by Stake #'s).

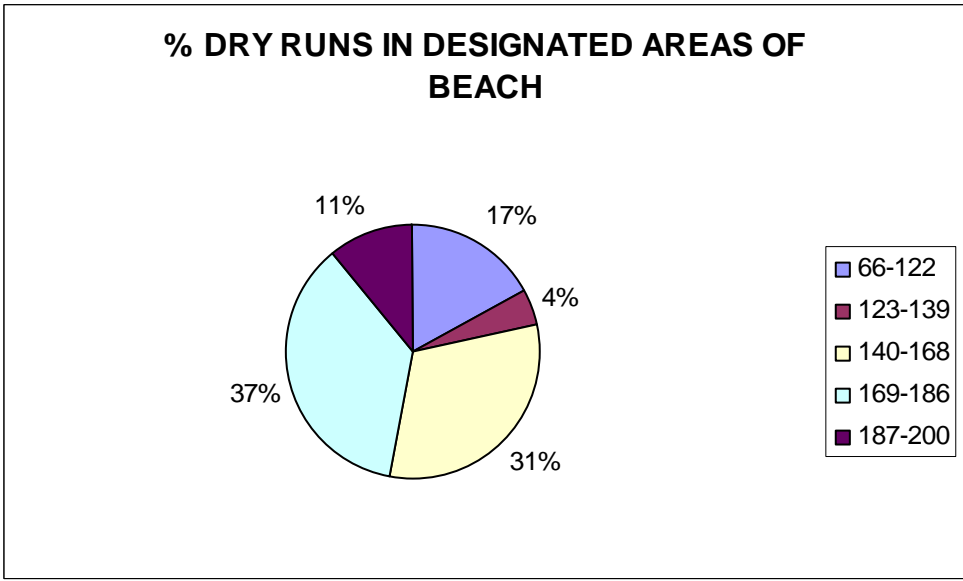


Figure 7 Percent of dry runs occurring in different sections of the beach (by Stake #'s).

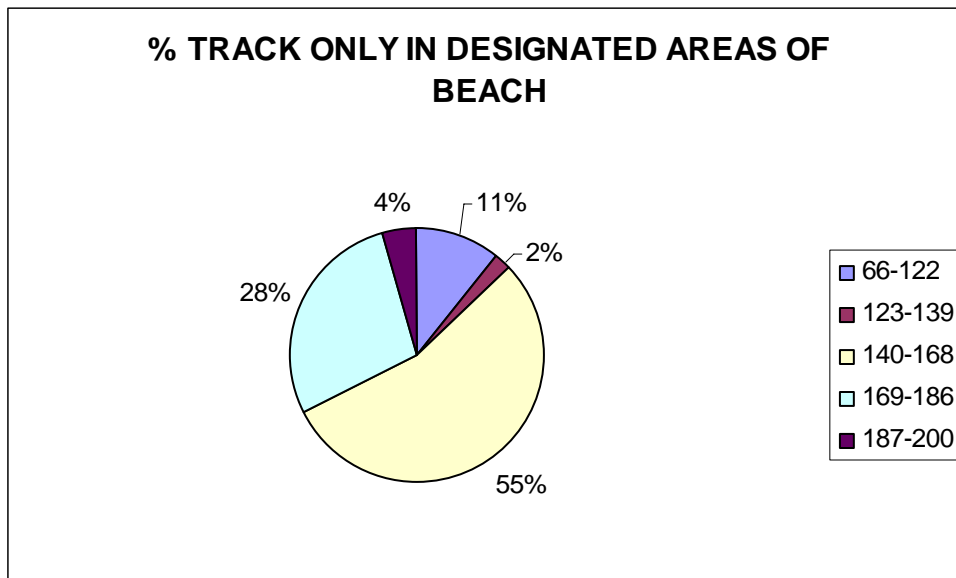


Figure 8 Percent of track only activities recorded in different sections of the beach (by Stake #'s).

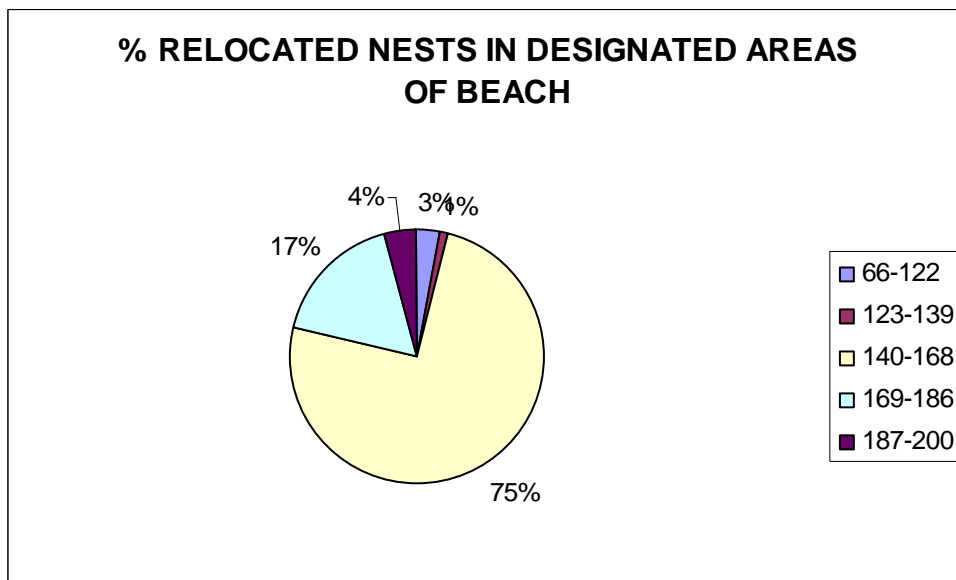


Figure 9 Percent of nests relocated to different sections of the beach (by Stake #'s).

Beach use by leatherbacks during the 2004 nesting season differed from the 2003 and 2002 nesting seasons. There was a major decrease in the use of the northern section of the sandy side of the beach from stakes 187-200. Ten percent of the activities occurred in this section in 2002, 23% in 2003, and this decreased dramatically to only 5.01% in 2004. Beach use in the area from stakes 170-186 remained similar to 2003, while number of *in situ* nests in the erosion zone increased from 25% in 2003 to 31.2% in 2004. Use of the grassy side was also greater (increasing from 13% to 17.4%) during the 2004 season.

The overall use of Sandy Point for actual nest activities remained the same as 2003 and 2002, with most *in situ* nests occurring within the accretion zone and a smaller percentage of activities occurring on the grassy side. The accretion zone had the greatest number of dry runs in 2004 (37%), followed closely by the erosion zone (with 31%). This differs from previous years when the erosion zone showed the greatest number of dry runs, followed by the accretion zone. The erosion zone, however, had almost twice as many track only activities as the accretion zone (55% versus 28% respectively) (Figure 9).

The concentration of relocated nests on various sections of the beach are also illustrated (Figure 10), with 75% of the nests relocated in the upper level of the erosion zone throughout the season (since predicted erosion did not occur), and another 4% relocated on the grassy side throughout the season. Unlike past seasons, a majority of the nests were not relocated in the normal designated zone on the sandy side (which normally extends from the 200's South to stake 170 at the beginning of the accretion zone). This area of beach was unusable for most of the season, so nests were relocated in the erosion zone. As a result, only 17% of the nests were relocated between stakes 170 and 186 (down from 62% on 2003), with only 4% relocated between stakes 187 and 198 (down from 21% on 2003).

Of the total 265 *in situ* nests, as well as the 67 potential nests, it is estimated that 15 washed away. An additional 2 marginal nests were found in the process of being washed away. The eggs were collected and incubated with excellent success. With 16 complete nests documented as washouts, 4.5% of the nests were definitely lost due to erosion. However, since it is likely that more nests washed out than were documented, it is estimated that 6% of the nests were lost due to erosion, which is similar to previous years.

The number of yolked eggs per clutch varied from 9 to 112 eggs, with a mean of 78.05 ± 15.74 eggs. This is very similar to 2003, which had an average of 79.9 ± 19.8 eggs, as well as 2001, which had a mean of 81.6 ± 16.85 yolked eggs. It is, however, slightly higher than the 2002 season when the mean number of eggs laid was 75.4 ± 1.09 . The number of yolkless eggs varied from 0 to 95, with a mean of 36.36 ± 15.87 yolkless eggs. This is similar to the 2002 and 2001 seasons, which had an average of 37.6 ± 1.00 and 35.64 ± 16.78 yolkless eggs respectively. Accurate counts of the number of yolked and yolkless eggs were obtained by utilizing information solely from the relocated nests.

Hatchlings

The incubation period for nests throughout the season ranged from 58 to 89 days with an average incubation period of 65.18 ± 3.73 days. This is similar to the 2002 season, which had an average incubation period of 62.4 ± 2.99 days, as well as the 2001 season, which had an incubation of 63.8 days.

Of the 444 total nests laid in 2004, 354 were excavated, 16 were washed out, 41 were not found, and 33 nests were left alone. The 354 excavated nests were therefore utilized to determine hatch and emergence success. Approximately 93% of total nests were excavated or excavation was attempted in 2004, including 91% of the *in situ* (with 82% successfully found) and 95% of the relocated (with 93% successfully found). Mean overall hatch success (hatched shells/yolked eggs) of all excavated nests ranged from 0 to 96.43, with a mean of $54.15\% \pm 24.78$. (n= 354, range = 0 to 96.43). This is down approximately 5% from the 2001 and 2003 seasons, which had an overall hatch success

of $58.81 \pm 19.62\%$ and $59.6 \pm 23.38\%$ respectively. It is, however, very similar to 2002, when mean overall hatch success was $53.05 \pm 23.35\%$. Actual mean emergence success (hatched shells-dead hatchlings/yolked eggs) was $51.81\% \pm 24.48$. This is also down slightly from the 2003 and 2001 seasons, which showed mean emergence success of $56.7 \pm 23.29\%$ and $55.22 \pm 19.52\%$ respectively. Again, it is very similar to the 2002 season which had $50.01 \pm 22.99\%$. This data shows an oscillation in mean overall hatch and emergence success over the last four years (Figure 11). Hatch success was significantly lower ($p < 0.01$, t-test) in relocated nests ($47.22 \pm 22.23\%$, $n = 147$, range = 0 to 90.57%), than in known *in situ* nests ($59.06 \pm 25.36\%$, $n = 207$, range = 0 to 96.43%). Corresponding mean emergence success was 44.54 ± 21.65 and $56.98 \pm 25.10\%$ ($p < 0.01$, t-test) (Table 2).

Most of the mortality in both relocated and *in situ* nests was due to hatchlings dying during pipping, or shortly after. Using the average emergence success (known nests only) of 44.54% and 56.98% for relocated and *in situ* nests, respectively, it is estimated that 16,004 hatchlings emerged at Sandy Point in 2004 (Figure 12). This takes into account an estimated 6% (27 nests) that may have washed away. Relocated nests produced 36 % of total.

Aberrations

In the 354 nests utilized to determine hatch success, 17 deformities were found including 9 hatchlings and 8 in unhatched eggs. The majority of deformities were found to be abnormal shaped heads and eyes, twins, albinos, and cyclopes. Only one particular turtle produced deformities in more than one nest. This is down from 55 deformities in 2003.

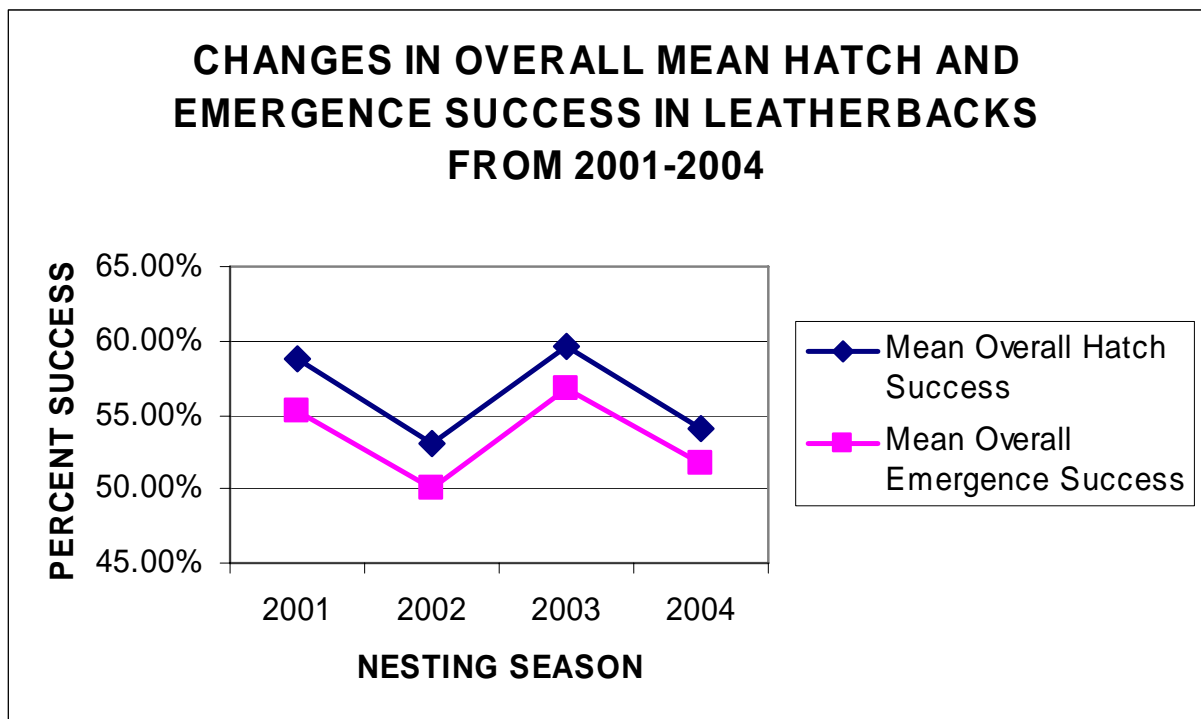


Figure 10 Comparison of mean overall hatch success among 2001 to 2004 nesting seasons.

Table 2. Final outcome of leatherback nests on Sandy Point from 1982 to 2004.

Year	Known				Not Excavated	Total
	Survive to term		Lost			
	N	% hatch success ()	erosion	poaching		
2004						
relocated	147	47.2	1	0	8	
<i>in situ</i>	207	59.1	15	0	25	
not found ⁸	41					
total	395	54.2	16	0	33	444
2003						
relocated	167	50.4	0	0		
<i>in situ</i>	273	65.1	11	0		
not found ⁸	50					
total	490	59.5	11	0	484	974
2002						
relocated	145	46.9	0	0		237
<i>in situ</i>	201	57.5	8	0		346
Unknown ⁷	28					
total	374	53.1	8	0	209	583
2001						
relocated	61	54.3	0	0		
<i>in situ</i>	165	60.8	0	0		276
unknown ⁷	68		30	0		732
total	294	58.8	30	0	684	1008
2000						
relocated	151	53.7	1	0	9	161
<i>in situ</i>	290	64.1	26	0	71	387
total	441	60.6	27	0	80	548
1999						
relocated	100	56.6	0	0	51	151
<i>in situ</i>	250	61.4	27	0	152	429
total	350	60.1	27	0	203	580
1998						
relocated	44	36.9	0	0	18	
<i>in situ</i>	117	46.8	4	0	72	251
total	161	44.1	4	0	90 (36%) ⁶	
1997						
relocated	126	46.9	0	0	112	
<i>in situ</i>	178	53	23	0	281	
total	304	50.4	23	0	393 (55%) ⁶	720
1996						
relocated	57	57.4	2	0	11	
<i>in situ</i>	103	68.6	6	0	61	
total	160	64.5	8	0	72 (30%) ⁵	240

Year	Known				Not Excavated	Total
	Survive to term		Lost			
		% hatch				
1995						
relocated	67	52.4	0	0	52	
boxes	17	66.2	0	0	0	
<i>in situ</i>	45	64	6	0	138	
total	129	57.9	6(1.8%)	0	190 (58%)	325
1994						
relocated	99	60.6	0	0	35	
<i>in situ</i>	107	66.8	12	0	102	
total	206	63.8	12(3.4%)	0	137 (39%) ⁴	355
1993						
relocated	81	64.5	0	0	11	92
<i>in situ</i>	122	69.3	6	0	44	172
total	203	67.4	6(2.3%) ¹	0	55 (21%) ²	264
1992						
relocated	123	61.3		0	22	145
<i>in situ</i>	108	72.2	21	0	71	200
total	231	66.3	21(6.1%)	0	93 (27%) ³	345
1991						
relocated	99	62	0	0	10	109
<i>in situ</i>	122	72.3	13	0	16	151
total	221	67.8	13(5.0%)	0	26 (10%)	260
1990						
relocated	54	61.1	0	0	0	54
<i>in situ</i>	75	70.5	1	0	13	89
total	129	66.7	1(0.7%)	0	13 (9.1%)	143
1989						
relocated	72	63	0	0	2	74
<i>in situ</i>	49	76.4	4	0	10	63
total	121	67.8	4(2.9%)	0	12 (8.8%)	137
1988						
relocated	141	58.53	1	0	3	145
<i>in situ</i>	89	56.86	3	0	5	97
total	230	58.23	4(1.7%)	0	8 (3.31%)	242
1987						
relocated	91	62.78	3	0	1	95
<i>in situ</i>	63	67.41	3	0	10	76
total	154	66.55	6 (3.5%)	0	11 (6.4%)	171
1986						
relocated	30	68.97	2	0	5	37

Year	Known				Not Excavated	Total
	Survive to term		Lost			
		% hatch				
<i>in situ</i>	25	64.61	6	0	14	45
total	55	66.79	8 (9.8%)	0	19 (23.1%)	82
1985						
relocated	110	53.2	1	1	8	120
<i>in situ</i>	90	62.8	16	2	14	122
total	200	57.6	17 (7.0%)	3 (1.2%)	22 (9.1%)	242
1984						
relocated	82	54.8	0	0	6	88
<i>in situ</i>	41	67.7	7	1	4	53
total	123	59.1	7 (4.9%)	1 (0.7%)	10 (7.1%)	141
1983						
relocated	69	50.5	3	0	5	77
<i>in situ</i>	28	64.4	6	2	0	36
total	97	54.5	9 (7.9%)	2 (1.8%)	5 (4.4%)	113
1982						
relocated	23	64.4	1	0	3	27
<i>in situ</i>	22	61.4	25	0	12	59
total	45	62.9	26(30.2%)	0 (0.0%)	15 (17.4%)	86

- 1 This number may have been higher, since early season activities recorded as "dry runs" may actually have been nests that subsequently washed away; these would not have been recorded as nests since there was no evidence of emergence.
- 2 33 of these nests emerged (22 *in situ*, 11 relocated), as evidenced by hatchling tracks, but were not excavated. This number includes three nests that were not excavated prior to our departure.
- 3 Most of these nests emerged, as evidenced by hatchling tracks. This number includes 17 nests that were not excavated prior to our departure.
- 4 At least 60 of these nests emerged (52 *in situ*, 8 relocated). Thirteen nests had not emerged prior to our departure.
- 5 Includes nests for which there was some success, but some eggs were washed out.
- 6 A large portion of these hatched.
- 7 Due to extremely high nest densities in 2001, some of the excavated nests could not be identified to female.
- 8 These are nests that we went to excavate, but could not find

ANNUAL NUMBER OF HATCHLINGS PRODUCED AT SANDY POINT 1982-2003

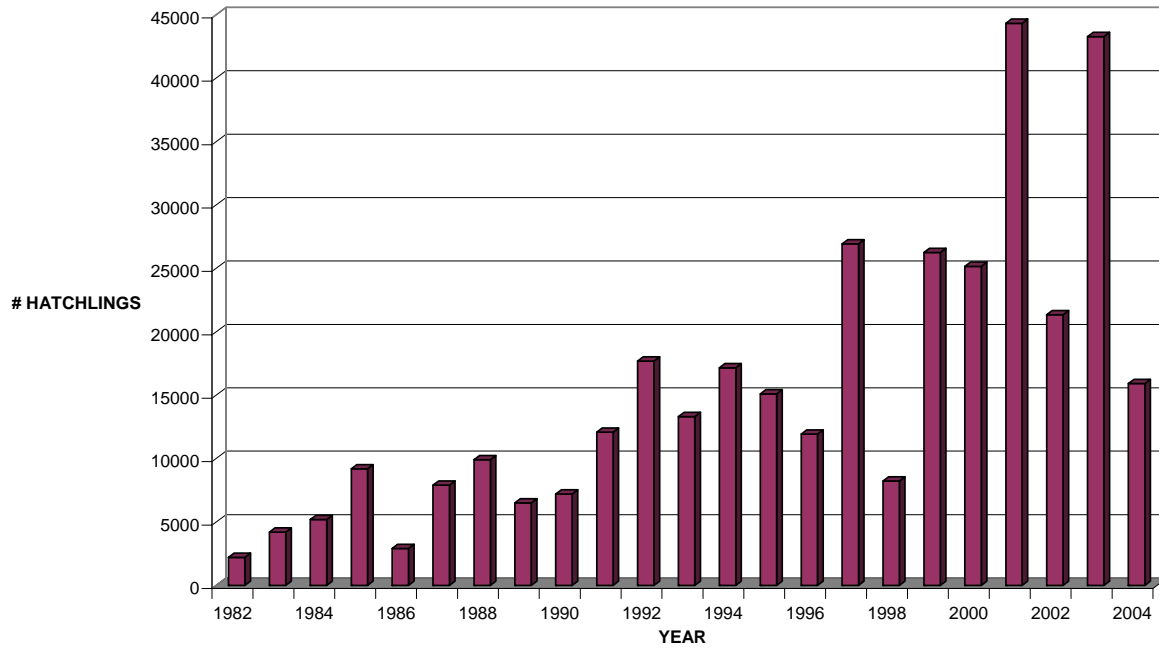


Figure 11 Graph of the number of hatchlings produced by year from 1982 to 2004.

Mortality

There was no adult leatherback mortality documented during the 2004 nesting season. After the leatherback season, however, a hawksbill turtle was killed by dogs on refuge property, north of stake 200. Additionally, two green turtles were killed by dogs just outside of the main town of Frederiksted. Feral dogs are becoming an increasing threat to adult turtles on the nesting beach, in addition to the threat that they currently pose to unhatched eggs, and emerging hatchlings.

Eggs

As in past years the major threat to eggs on Sandy Point continues to be erosion. The seasonal beach erosion on Sandy Point follows a distinctive pattern, which results in the loss of an entire stretch of beach from the point (Stake 140) through to stake 170. Since a majority of nests are laid in this zone, the relocation effort prevents the loss of 30-65% of nests annually. The erosion in 2004 did not follow typical historical patterns, thus reducing the number of nests relocated from the “traditional” erosion zone and increasing the number of nests relocated from other areas of the beach. In 2004, approximately 38% of the total nests were relocated. This is slightly higher than in 2003, when 34% of known nests were relocated. Relocation procedures prevented the loss of a large percentage of nests, reducing nest loss to less than 6%, as in past seasons.

Although poaching was considered a problem at Sandy Point prior to the initiation of this program and the presence of Refuge personnel, it is no longer a serious threat to

leatherback eggs. There was no evidence of poaching during the 2004 nesting season. There were also no attempts during the 2003, 2002 and 2001 seasons. Overall, the frequency of poaching attempts has dropped dramatically since 1985, to virtually no poaching attempts on the refuge property.

Hatchlings

During the 2004 season, the most significant terrestrial predators of leatherback hatchlings at Sandy Point were feral dogs, cats, yellow-crowned night herons (*Nyctanassa violacea*) and ghost crabs (*Ocypode quadrata*). This is similar to past years' results. The mongoose (*Herpestes arropunctatus*) has been an increasing problem, and its presence was documented as a significant threat on the beach again this season. There was evidence of mongoose digging into and destroying unhatched eggs, as well as emerging nests near the vegetation line and along the side of berms. Trapping by U.S. Fish and Wildlife personnel reduced the threat of mongoose predation. Personnel removed at least 20 individual mongoose prior to the main hatchling season, in order to reduce threats to emerging leatherbacks. Another serious and increasing threat is the presence of feral cats and dogs on the beach. Cats were documented numerous times this year patrolling the vegetation line for emerging hatchlings. There was also evidence of cats digging into nests and taking hatchlings before they had a chance to emerge. This threat was first noticed during the 2001 season, and appears to have increased significantly since the 2002 nesting season. Although there was little or no evidence of canine predation during the 2001 and 2002 seasons, dogs have historically been a problem at Sandy Point, and this problem resurfaced in 2003 and continued to be a substantial threat in 2004. A large pack of up to 8 dogs routinely patrolled the beach during hatchling season, destroying innumerable nests.

Beach vegetation poses a threat of entanglement to emerging hatchlings, as well as to eggs and hatchlings in the nest cavity. The roots of various species of beach vines, such as (*Opmea*, *Canavalia*, and *Cassythe filiformis*) may infiltrate the nest cavity, and/or sprawl across the sand surface trapping hatchlings in the nest cavity, as well as on the surface during their "frenzy" to reach the water. Failure of eggs to successfully develop has also been observed when eggs are subjected to root growth in the nest cavity (the eggs are desiccated). The beach vegetation was able to proliferate in the erosion zone in 2004 (since the sand did not wash away as normal) and was extremely detrimental to eggs left to develop in this area. Over a 6 month period vegetation thrived in this area, (growing to over 5 feet tall), and removed the sand of moisture necessary for proper development of eggs. In addition, excess vegetation made locating nests (via triangulation) at times impossible. This significantly increased the number of nests not found for excavation.

A few nests this season showed fatalities when some hatchlings remained on the surface too long and either died of dehydration or attack by fire ants. Ants appeared to be a greater problem on the grassy side of the beach, where vegetation is thicker, than on the sandy side.

Other Turtle Species

Greens

No green turtles were observed to nest successfully by research personnel in 2004. There were, however, a total of 15 green activities observed by research personnel, including 6 probable lays, 6 dry runs, and 3 track only during the 2004 nesting season.

Hawksbills

There were a total of 18 hawksbill activities observed in 2004, including 2 dry runs, 4 successful nests, 6 probable lays, and 5 tracks. No nests were relocated in 2004.

There were a total of 4 turtles, including 3 new and 1 remigrant turtle. Flipper tags were applied to all new turtles, and applied as needed to remigrants. New turtles were also PIT tagged.

The lengths of recorded hawksbill turtles ranged from 84.0 cm to 87.8 cm, with an average length of 85.80 ± 1.88 cm.

Mortality

The threats that are experienced by both the hatchlings and eggs of leatherback turtles are also threats that affect green and hawksbill hatchlings and eggs as well. The threat of poaching, however, is much greater for these two species. Although poaching of eggs is minimal while Sandy Point is patrolled nightly during leatherback season, once patrols stop, the threat increases dramatically. An additional threat to these species is the value of the adult. In the USVI adult green and hawksbill turtles are poached primarily for their meat and eggs. Traditionally, both eggs and adults are taken after the leatherback season ends at Sandy Point, and year round throughout the rest of St. Croix.

DISCUSSION

The 2004 season certainly presented challenges for the research team. Even though we had 100 leatherback turtles and 448 nests, activity was considerably lower than in recent years. Hatch success decreased, while bad weather and vegetation growth increased.

At a critical juncture in worldwide leatherback populations and fluctuations in our own regional population, we must capitalize on the knowledge that this world renowned project can give us. In order to properly manage these populations, it is imperative that we not only understand our own turtle population, hatch success concerns, and mortality rates, but we must prepare ourselves and our team to handle these issues in the future.

Turtle Population

The total of 100 nesting turtles in 2004 was considerably lower than expected as there were 93 turtles from 2001 (remigration interval of 3) and 114 turtles from 2002 (remigration level of 2) that had not returned to nest. Even though 2004 was the 6th highest total in the history of the project, it was well below the average of 136 turtles for the previous 5 years.

Weather patterns, other nesting sites, or mortality are possible explanation for this decline. However, we hope to see these “missing” turtles in 2005. Cooperative efforts between Puerto Rico, the BVI, and surrounding islands as well as identification of other beaches on St. Croix may help to account for some of these turtles in the future.

With the addition of 38 new animals in 2004, a total of 749 individuals have been tagged since 1981. This number likely overestimates the population size, since some untagged turtles are remigrants that lost their tags from previous years. However, comparing PIT Tag returns with photo identification (McDonald and Dutton, 1996) is continuing to make this estimate more accurate. Although, use of photo identification will still be used for unrecognized turtles, and turtles with tag scars, PIT tags have almost made this tool obsolete.

As in past years, several turtles (three in 2002, four in 2003, 2 in 2004) were originally tagged on beaches (1 from Culebra, and 1 from the BVI in 2004) other than Sandy Point. This fact, combined with results of genetic studies, continues to suggest that St. Croix, Puerto Rico and BVI leatherbacks are part of a larger, regional population, rather than distinct groups. Genetic analyses using mitochondrial DNA and nuclear (microsatellite) markers are still being conducted by Dr. Peter Dutton at the Southwest Fisheries Science Center in La Jolla, California. Preliminary results suggest that some of the new nesting females are offspring of at least two of the long-term remigrants (Dutton et al., *In press*). Additional information supporting this theory was provided during the 2003 season when a turtle originally tagged while nesting at Sandy Point also nested at Culebra. While nesting at Culebra, Dr.’s Molly Lutcavage and Sam Sadove fitted this individual with a satellite transmitter. Information from the transmitter suggested the turtle was returning to Sandy Point after spending multiple nesting cycles at Culebra. The turtle did indeed return to Sandy Point and completed her nesting season there.

Unless something unforeseen has happened to the population, we expect the 2005 season to be a record year. Figures 13 and 14 show the trend analysis based upon the project history and the last 10-year history respectively. There are 80 turtles from 2001

(remigration interval = 4), 77 turtles from 2002 (remigration interval = 3), and 170 turtles from 2003 (remigration interval = 2) that we could potentially see in 2005.

Recommendation: In addition to continuing the present research objectives, additional research, as well as cooperation with outside scientists and the researchers in Puerto Rico is advised. Use of remote sensing technology, dataloggers, satellite tagging, evaluation of sand properties, and further projects to increase the body of knowledge regarding this species and the nesting beach are encouraged. This includes studies tailored to the effects and implications of an expanding population. Continuation of the survivorship, mortality, and injury studies are all important aspects that should not be ignored. The outcome of such studies may provide further insight into recommendations and procedures for future management of the growing population.

Hatchlings and Hatch Success

The 2004 season produced an estimated 16,569 hatchlings. Even though we had the 6th highest number of nesting turtles, we only had the 9th highest number of estimated hatchling production. We believe that this is due to a couple of reasons. We had the 4th lowest hatch success (54.2%) of any season since 1982 and the least amount of nests laid (444 total nests, 4.6 per turtle) since 1998.

Hatch Success

Like most past years, hatch success for relocated clutches was significantly lower than that of *in situ* nests. Data from 1992 suggested that nest design has a significant influence on hatch rate, and that the lower hatch rates are avoided in nests where eggs are stacked into a slanting bowl (the "natural" design, Dutton *et al.*, 1992). Relocated nests were constructed using this "natural" design as a guide.

The overall hatch success of both relocated and *in situ* nests (54.2%) was the 4th lowest rate since 1982 and on par with the 2002 season. Higher hatch successes in other years, but particularly in 2003 and 2001 seasons, may be due in part to natural fluctuation, but may also result from the increase in available nesting habitat during these seasons. In 2003, the beach was wider, extended further North, and had a more gradual berm, thus allowing the turtles to utilize a greater area of fresh, regenerated, sandy beach. During 2002 there was a steep berm, and little or no available nesting habitat north of stake 195.

The decreased density of nests in 2002 may also have resulted in a decrease in the amount of bacteria present in the sand from the previous season, and thus healthier nesting habitat in 2003. The 2004 season was unique, with the lack of nesting habitat North of stake 169. The effects of nest density, properties of the sand, and bacterial load on hatch success bear further investigation in the future. This may help us better predict hatch success, as well as assist in finding innovative ways to increase it.

We also had 37 nests (16 *in situ*, 21 relocated) that had a hatch success that was less than 20%. Sixteen (16) of these nests were found saturated in water (14 nests between stakes 162 and 170) and seventeen (17) of these had almost no moisture in them due to vegetation issues (10 in the 150's, 7 in the 180's). This may have significantly affected hatch success, and statistics.

SPNWR Leatherback Trend Analysis

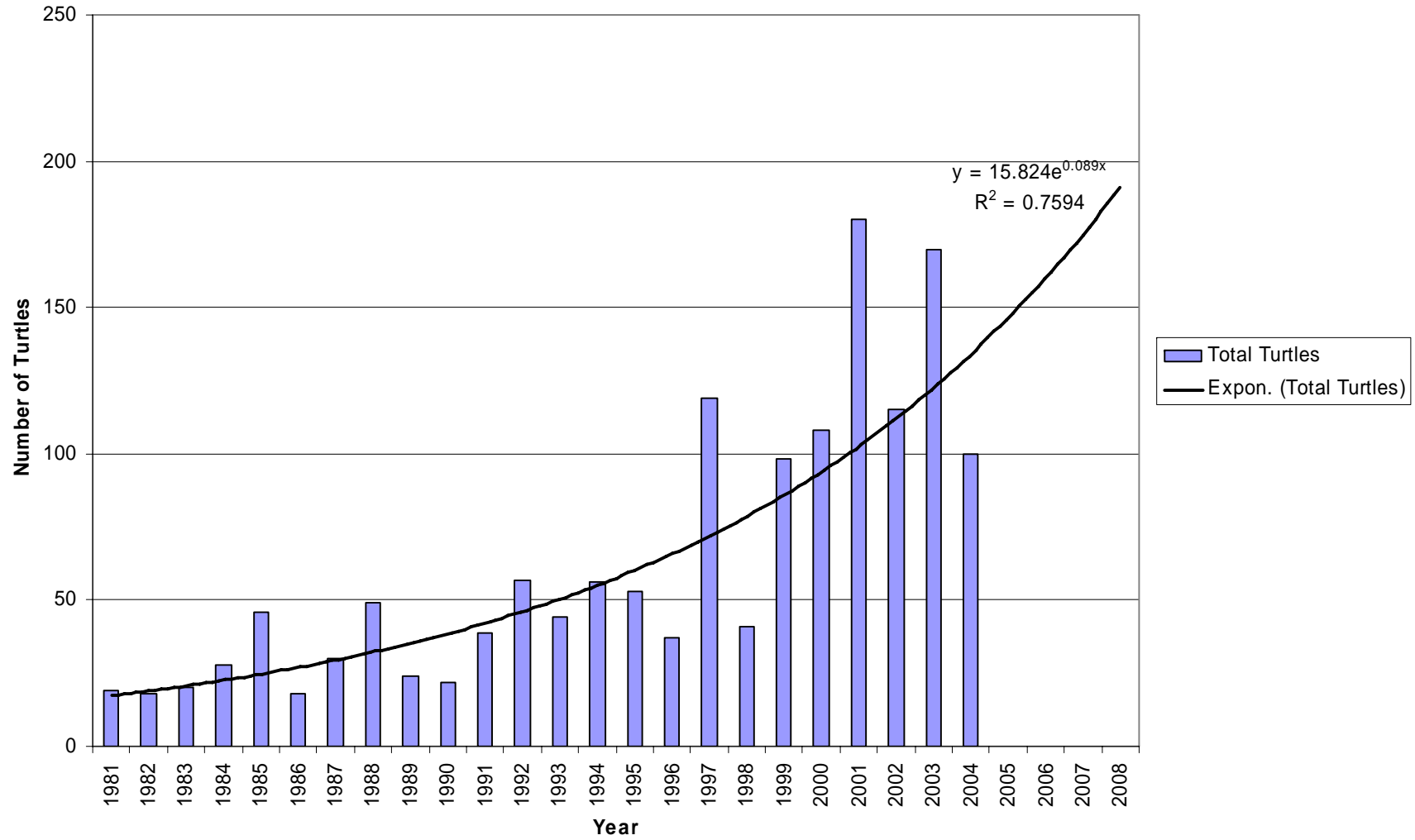


Figure 12 Leatherback Trend (Project History)

SPNWR Leatherback Trend Analysis

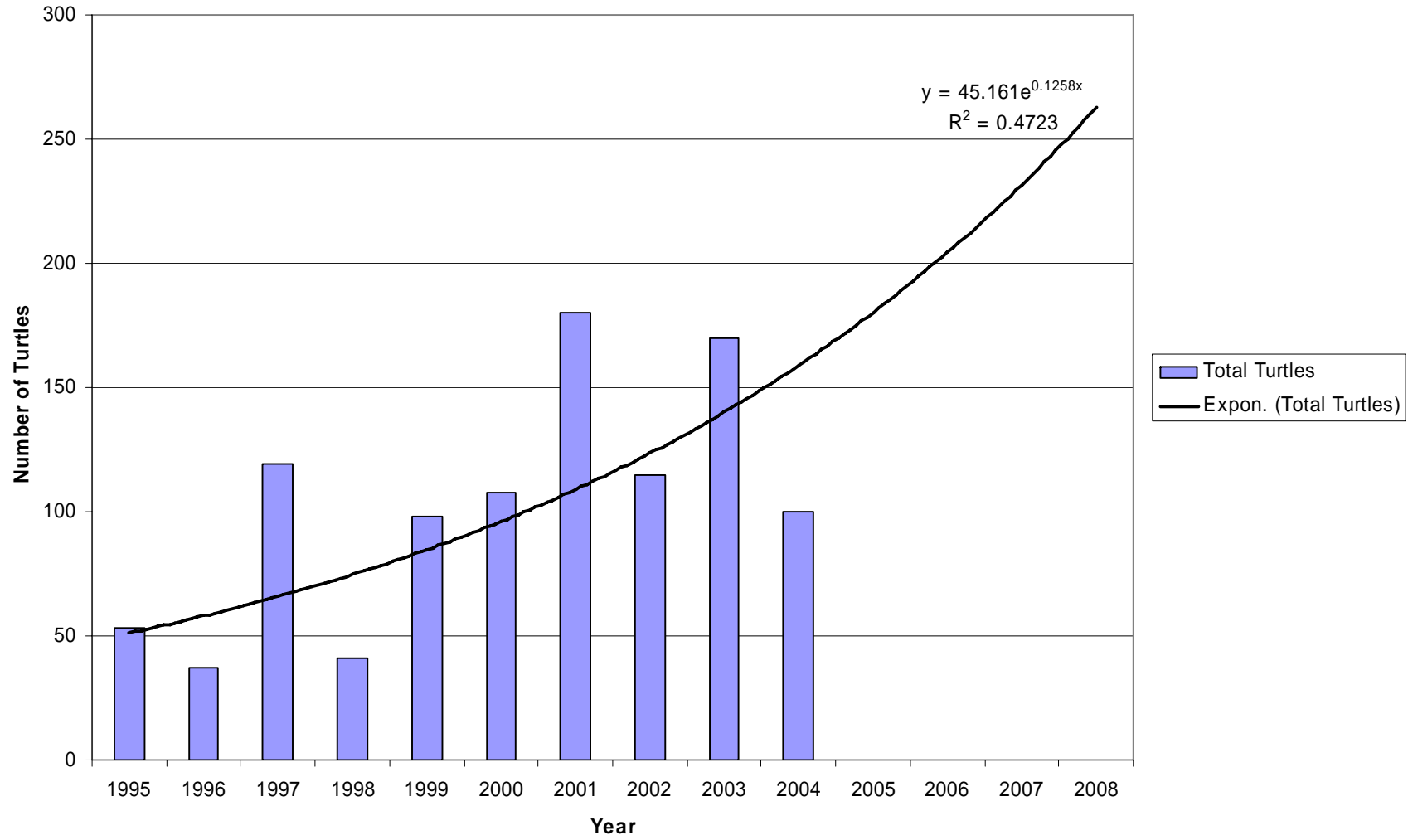


Figure 13 Leatherback Trend (Last 10 Years)

Another notable statistic was the high number of full term pipped (FTP) dead hatchlings and undeveloped eggs per nest. There were an average of 9.84 FTPs (*In situ*: 6.78, Relocated: 14.14) and 13.06 undeveloped eggs (*In Situ*: 12.55, Relocated: 13.84) per nest. Table 3 shows these averages for each nesting month.

Table 3. 2004 Average Mortality per Nest

Nest Month	In Situ			Relocated		
	N	FTP	Undeveloped	N	FTP	Undeveloped
April	78	5.94	14.93	44	9.95	18.20
May	89	6.60	12.34	70	14.86	13.36
June	39	9.10	12.05	31	19.29	8.45
July	1	0.00	14.00	2	1.5	18.0

The full term pipped mortality seems to coincide with the rainiest weather and what appears to be the highest water table level on the beach, particularly from Stakes 160 to 170. The undeveloped eggs are most likely a result of the same water issues with the exception of June and July which is mainly due to lack of moisture in the nests (i.e. vegetation).

Information from nest temperature dataloggers were downloaded and analyzed by Kendra Garrett (WIMARCS), and will be correlated with dead hatchlings, to investigate sex ratios of relocated versus *in situ* nests. This preliminary information, in association with previous temperature data, and associated nest hatch successes, may also provide insight into the high mortality present in relocated nests.

Jeremy Conrad is currently analyzing nest hatch success data from individual turtles. Nest success was tracked throughout the season for a pre-determined group of neophyte and remigrant turtles. This information may provide insight into the fecundity of individual turtles, as well as trends in fecundity over time, and with increased age.

Recommendation: Real time water table evaluation and early or pre-season vegetation management must be implemented for 2005. Continuing the current temperature and clutch comparison experiments may lead us to some answers as to the cause of mortality in nests. We must focus and increase our efforts in 2005 to increase hatch success. These efforts should be combined with the recommendations listed under nest relocation issues discussed later.

Nests Laid

The low 4.6 nests per turtle average may correlate to the seemingly early departure of turtles in 2004. Even though our activity dramatically decreased in July (similar to the 2002 season), we still didn't have the usually high activity in May that other years have seen.

The 38 neophytes averaged 3.1 nests per turtle while our remigrants averaged 5.3 nests per turtle. We also had a significant number of "internesting periods" skipped. Some of these periods can be explained by the unknown (i.e. '999999') activities, but not all. For example, our four (4) 5-year remigrant turtles had 12 recorded nests for the

season. One of the turtles did not have any recorded nests and the other three skipped 4 of their interesting periods. This may imply that they nested elsewhere. Due to increasing communication within the community, there is a growing thought that our leatherbacks are beginning to lay more nests around the island and possibly on other islands. At this point, this is pure speculation and we look forward to analyzing this possibility with satellite telemetry experiments in the future.

We had one turtle (AAV 949) that did not have a recorded nest and there were 15 turtles that had only one recorded nest. Removing these 15 nests and 16 turtles from the statistics, bring the average number of nests per turtle to a 5.1 nest average.

Blood samples taken from nesting females during past seasons are also being used for endocrinological studies in order to learn more about reproductive physiology in leatherbacks. Blood value analysis related to endocrinology and nutritional status will be conducted by Jeanne Alexander (Ph.D. Program, Texas A&M University) in order to provide additional insight into the ability for specific turtles to lay nests and their associated hatch success rates.

Recommendation: Further data analysis based upon the history of the project needs to continue in order to determine any patterns. Additionally, attaching satellite geo-location transmitters to turtles in conjunction with cooperation from surrounding islands and local St. Croix community groups (see www.wimarc.org) will give us a more accurate picture of number of nests laid by our turtle population.

Project Operation

After analyzing the 2002 and 2003 seasons, the 2004 season demanded some changes to project management. With the increase in turtle population, research being conducted, nest relocations, and reported turtle activity throughout St. Croix, we added a full time staff member and we began the formation of the West Indies Marine Animal Research and Conservation Service (WIMARCS). This non-government agency would allow us to put a more rigid management structure in place and would allow us to seek funding from additional resources. The project has moved well beyond the original scope and cannot be handled by two or even three staff.

Patrols

Due to the early turtle activity in 2003, VIDPNR provided additional funding to begin night patrolling on March 5th of this year. Our March patrols recorded the following activities:

Table 4. 2004 March Leatherback Nesting Activity

Date Range	Track Only	Dry Run	Probable Lay	In Situ	Total
3/5/04 to 3/13/04		2	4	2	8
3/14/04 to 3/20/04	1		6	3	10
3/21/04 to 3/27/04	1	2	6	2	11
3/28/04 to 3/31/04		2	5	1	8

Two staff members completed this patrol schedule. Due to safety concerns, the

Refuge manager insisted that these staff members stay together (i.e. no split patrols). Unfortunately, trying to cover a 3km beach with two people is impossible and resulted in the high number of “probable lays”.

Recommendation: The 2004 season did not have the activity seen in previous years. This early patrol schedule may be beneficial in future years. However, to be cost effective, patrols should start March 15th instead March 5th.

Saturation Tagging

Since 1981, saturation tagging and consistent night patrols during the nesting season have yielded a comprehensive database of information on each female nesting at Sandy Point. This tagging, particularly PIT tagging, has almost made the need for photo identification obsolete.

Long term saturation tagging not only allows this project to have an accurate estimate of the turtle population, but makes all statistics such as hatch success, turtle fecundity, and beach preference much more accurate and meaningful. Eliminating saturation tagging, even for a single year, would compromise the integrity of two decades of consistent monitoring and tagging information. This effort will only come to fruition if consistency is maintained.

Recommendation: In order to continue our data analysis, assist our ability to analyze and improve hatch success, and in the interest of the discovery of potential scientific breakthroughs, saturation tagging should definitely be continued.

Nest Relocation

Along with effectively eliminating poaching and providing long term saturation tagging data, perhaps the single most important contribution that the project provides is relocating nests from a threatened area to a stable area of the beach. Areas are considered threatened if a nest appears susceptible to imminent erosion or inundation, is situated in a previously identified erosion zone, or if there is standing water in the nest at the time of laying.

Even though this effort saved thousands of potential hatchlings, relocated nests had a disappointing (44.54%) emergence success in 2004. Although hatch and emergence success of relocated nests are typically lower than *in situ* nests, the 2004 season resembled the substandard 2002 nest emergence season.

On a high energy beach such as Sandy Point, nest relocations usually represent a significant contribution to hatchling production. In 2004, relocations represented 37.4% of all nests, but only 33.9% of the hatchlings. Increasing emergence success to 50% would produce an additional 666 hatchlings, while an increase to 55% would have produced another 1,277 hatchlings.

In accordance with earlier experimental results (Dutton *et al.*, 1992), we currently attempt to duplicate the dimensions and shapes of the original nest as much as possible. However, in addition to this, we need to re-visit all possibilities of increasing hatch

success. Factors such as temperature, moisture, oxygen, carbon dioxide levels, and bacteria all need to be investigated.

Recommendation: Create a more controlled environment for nest relocation. Having this controlled environment will not only allow hatch/emergence success experiments to be more effective, it will also prevent water saturation and desiccation. We propose six (6) 40m by 15m areas on the beach located near the stake line. Each area will be tilled and filtered to remove any debris or vegetation. Once the area is clean, vertical silt screens will be installed to ensure roots do not enter the relocation area. We also recommend either creating six (6) more areas for 2006 or if feasible using only 50% of the area one year and using the other 50% the next year. This would reduce the previous year's bacteria impact. It should also be noted that with these areas located mostly at or in the vegetation line, predator trapping early in the season will be an absolute must.

Education

The key to any successful conservation and recovery project is to create a sustainable environment for the resource (i.e. sea turtles) and the local community. The USFWS operates the sea turtle education program at Sandy Point. Visitors are limited almost exclusively to students and community groups. Lectures are presented to the visitors prior to entering the refuge, and observing the turtles. Numbers and compositions of groups may be obtained from USFWS.

This is a very productive program that is most effective when used in conjunction with classroom activities and presentations. USFWS does have the ability to conduct these classroom activities, but often lacks the funding or staff required. WIMARCS is currently organizing a "Friends of Sandy Point" group to assist the refuge with this endeavor. WIMARCS also currently holds local community presentations to increase public awareness of sea turtle issues, particularly what to do in the event that a turtle, hatchling, or poacher is encountered.

Recommendation: Continue with the USFWS education program and find financial support for the classroom activities. USFWS, VIDPNR, and WIMARCS should "partner" to provide local community presentations and training. See <http://www.wimarc.org> for additional information.

Staffing and Finances

General management recommendations and priorities have already been described in McDonald-Dutton (1997). These staffing recommendations and requirements certainly still hold true today. There has been a 560% increase in the number of turtles over the last four years compared to the first four years. Unfortunately, funding and personnel have not increased proportionately.

The fact is that both the 2003 and 2004 seasons required 4 full time staff and 1 part time staff to meet the demands and requirements of the project. These requirements not only include managing the turtles, but nest relocations, research projects, an ever increasing data set, and Earthwatch volunteers. In 1997, the project was financed with two full time staff to handle an average of 50 turtles. We are currently averaging 144

turtles and believe it is well within the possibility of having 200 turtles during the 2005 season.

With current financing, only three (3) of the staff were able to be paid in 2004. The other two were on a volunteer basis. Finding full time (12 to 14 hours days), knowledgeable, and skillful volunteers is not a realistic management goal. Even the paid staff is at very unacceptable pay scale levels (conservatively around \$3 / hr).

In order to understand the staff impact, it must be emphasized that this project is an unbelievable strain on project personnel. Each full time staff member begins their “day” at 6:00 pm. They come back from the beach somewhere around 4:30 to 5:00 am and then sleep until 11:00am or 12:00pm. Data entry and analysis, blood and tissue processing, and volunteer management take another 2 to 4 hours. This is the typical day from April 29th through July 15th. When the volunteers leave, staff are then required to pickup the workload on the beach. As one might imagine, this schedule over a 5-month period is very draining. Of course, being eaten by “no-see-ums” and working in adverse weather conditions only add to the “experience”.

In order to maintain the same level of intensity as originally conceived for this project, it is important to have adequate funding and staff support. This lack of funding has already cost the project a principal field researcher for 2005 and will most likely cost us another.

Recommendation: In order to meet the goals of this project, we need five (5) full time qualified project staff members for 2005. Please note, that full time staff requires a 24-hour a day commitment; not 8 hours. We recommend that the project be staffed with the following WIMARCS personnel.

- 1) Project Manager (PM): The PM is responsible for Staff management, project scheduling, financial planning, daily logistical coordination, data management, volunteer management, local and federal government liaison, and monthly status reports. The PM is also available to fill in for field leaders when necessary and to assist and coordinate research projects.
- 2) Principal Investigator (PI): The PI is responsible for directing and implementing field research, technical training of volunteers, beach and patrol management, data collection, saturation tagging, data analysis, volunteer management, and annual reports. The PI is also available to fill in for the project manager when necessary.
- 3) Principal Field Leader (PFL): The PFL is responsible for data collection and entry, blood and tissue sample processing, patrol management, nest relocations, saturation tagging, training of volunteers, and daily logistical coordination. Leading a research project is also highly encouraged. This position may also be called upon to fill in for the principal investigator.
- 4) Field Leader (FL): The FL is responsible for data collection and entry, blood and tissue sample processing, patrol management, nest relocations, saturation tagging, and training of volunteers.

- 5) Field Leader (FL): The FL is responsible for data collection and entry, blood and tissue sample processing, patrol management, nest relocations, saturation tagging, and training of volunteers.

Any reduction in this staff will require a reduction in the scope of work. Of course, as concerned and dedicated scientists and conservationists, we would not like to see a reduction in this scope. Obviously, to provide for this staff, additional funding will be required. A proposed budget is available upon request.

CONCLUSIONS

The number of females nesting at Sandy Point has been increasing steadily since 1991, and has showed dramatic increases in 1997, 1999, 2000, 2002, and particularly 2001 and 2003 (Figure 2). This trend is very encouraging, since the leatherback continues to decline globally at an alarming rate. Even though this project has been very successful, we have so much more to do. Results from this project suggest that a long-term commitment of at least ten years is needed before the effects of recovery efforts can be measured. This project serves as a model for successful recovery efforts, and for answering questions about leatherback behavior, reproductive biology and physiology.

Our findings have profound management implications for this species; if it is true that adults return to their natal beaches then we should expect a continued increase in the nesting population at Sandy Point as the hatchlings saved over the years begin to mature. Results from genetic analysis support this theory, as does the dramatic growth of the population in the last few years. One explanation for this increase could be that hatchlings released in the first years of the project are now maturing and returning to nest at Sandy Point. If so, the upward trend in the numbers of females nesting each year should continue. If it does, this suggests an age at maturity of 10 - 15 years for leatherbacks. Genetic studies (Dutton et al. 1999) have shown that the St. Croix population is genetically distinct from others in the Caribbean outside the immediate region of the U.S. Virgin Islands and Puerto Rico, and this is also consistent with the natal homing hypothesis. Further genetic work will determine whether new turtles that nest are the offspring of females tagged in previous years.

This intensive research and conservation effort would not have been possible without the assistance of 1,284 Earthwatch volunteers who over the past twenty-three years have contributed over 105,892 hours patrolling over 103,000 miles of beach. Continued commitment by the Earthwatch Institute and by the USVI Division of Fish and Wildlife, as well as WIMARCS, is necessary to help protect the leatherback as well as add to our knowledge of its reproductive and population biology. This is essential to the evaluation and modification of recovery and management plans to ensure the survival of this endangered species.

A valid argument could be made that this is the most significant wildlife project for USFWS in the southeast region and the most significant endangered species project for VIDPNR. It has world-wide resource management implications and it would be a travesty to not continue this project with the same intensity and comprehensiveness of the past years. With increasing turtle populations, research objectives, and volunteer management requirements, it is time to reevaluate the support, management, and funding of this project.

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APPENDIX I: Adult Sea Turtle Data Sheet

APPENDIX II: Nest Excavation Data Sheet

