Tagging and Nesting Research on Hawksbill Turtles (*Eretmochelys imbricata*) at Jumby Bay, Long Island, Antigua, West Indies

2004 ANNUAL REPORT

Prepared for the

Jumby Bay Island Company, Ltd.

By

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Wider Caribbean Sea Turtle Conservation Network (WIDECAST)

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ABSTRACT

2004 marked the 18th consecutive year that hawksbill (*Eretmochelys imbricata)* sea turtle nesting research has been conducted on Jumby Bay, Long Island, Antigua, West Indies. Saturation tagging, based on hourly patrols maintained for 154 consecutive nights and the tagging of all nesting hawksbills, remained the cornerstone of the project's research on the reproductive biology and population ecology of this critically endangered species. This season's field research also included genetic sampling for haplotype analysis and potential future studies on inter-relatedness. 2004 Field Directors Seth and Carol Guy Stapleton were responsible for conducting the research and for completing more than 1,300 hours of beach patrols.

The 2004 season began the evening of June 15th and ended the morning of November 16th, consistent with past seasons. Fifty-one nesting hawksbills were observed and tagged during the patrol season, the highest number of individuals documented in a single season. Thirty-six of the 51 turtles were remigrants. Remigration intervals (elapsed time since previous appearance) ranged from 2 to 6 years, with an average remigration interval of 3.0 years. With the addition of 15 neophytes in 2004, a total of 237 hawksbills have been tagged on Jumby Bay since the project's inception in 1987.

A total of 186 nests were deposited on Long Island during the patrol season. The number of clutches per female ranged from 1-6, with an average of 3.7 clutches per turtle. Consistent with previous seasons, activity levels were highest during the months of August and September. Nesting activity peaked during the week beginning August 24th when 15 nests were deposited. The estimated average of number of eggs per clutch was 145. Of the 90 nests analyzed, mean overall release success was 80.2%.

The Jumby Bay Hawksbill Project is an initiative of the Wider Caribbean Sea Turtle Conserva-tion Network (WIDECAST), a region-wide scientific network and Partner Organization to the United Nations Caribbean Environment Programme. WIDECAST embraces the largest network of sea turtle research and conservation projects in the world, providing a unique framework that enables Caribbean nations to collaborate in the collection, sharing and use of research and management information. The Jumby Bay Hawksbill Project has been privately funded since its inception by the homeowners on the island.

2004 Annual Report:
Jumby Bay Hawksbill Project

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15 June – 16 November 2004

I. INTRODUCTION

In addition to their intrinsic value, sea turtles serve as both predator and prey to other marine species and contribute to the diversity and stability of marine ecosystems. They also have well-established cultural significance in the Caribbean as well as throughout the world. Despite an impressive fossil record that dates the earliest modern sea turtle ancestor *Santanachelys* to the Cretaceous period, most modern populations are declining. Sea turtle populations today face colossal obstacles in regards to their survival worldwide, and all six Caribbean species are listed as either "Endangered" or "Critically Endangered" by the World Conservation Union (IUCN 2004).

Not surprisingly, human activities, both legal and illegal, pose a major threat to these reptiles. Decades of over-harvesting large juveniles and adults, collecting eggs for human consumption, accidental deaths through fishery by-catch, and the degradation and loss of suitable nesting habitat through beach development are some of the major factors contributing to the current depleted status of sea turtle populations. In addition to centuries of harvest for its meat and eggs, the hawksbill (*Eretmochelys imbricata*) sea turtle has also been slaughtered for its beautiful carapace (shell), which has traditionally been used to make tortoiseshell jewelry and trinkets. In the Caribbean and across the world, overcoming such threats is complicated by highly migratory sea turtle populations, inadequate management regimes, insufficient political commitment to coastal zone planning, lack of public awareness, and deeply rooted traditions surrounding the use of turtle parts for consumption and trade.

Antigua and Barbuda, like many of its Caribbean neighbors, still permits the seasonal harvesting of hawksbills and other sea turtle species for domestic use. Effective protection of long-lived, migratory species requires the enforcement of international protection policies and a commitment to sea turtle management and conservation at the local level. Continued research, public awareness programs, population monitoring, habitat protection, and law enforcement are all vital components of a successful effort to restore native sea turtle populations.

Research on long-lived species such as sea turtles is most useful if it spans several decades and maintains consistency in data collection, such that the data can be used to assess life-history trends. For 18 consecutive years, hawksbill nesting research has been conducted on Pasture Beach, Long Island, Antigua. This ongoing study has led to advances in understanding life-history characteristics including adult female recruitment and survivorship, annual and lifetime fecundity, and reproductive behavioral patterns. However, even with nearly two decades completed, biologists are just beginning to recognize long-term population trends. Many questions remain and, as research progresses, additional questions arise. The resulting ecological information is critical to management decisions in Antigua and Barbuda and offers a foundation for management and policy decisions made throughout the region as well.

The current status of global sea turtle populations illustrates the necessity of long-term demographic and nesting ecology research. Therefore, the Jumby Bay Hawksbill Project continued its tradition of “saturation tagging” style research, based on nightly patrols and the tagging of all nesting females. This season’s research also included genetic sampling for haplotype analysis and for potential future studies on inter-relatedness. The Project upheld its tradition for public outreach, an essential component of conservation, by hosting Jumby Bay residents and resort guests on the beach, leading educational turtle watches for groups from mainland Antigua, conducting presentations for school children, and hosting a sea turtle research team from Nevis.

The annual report includes a summary of the information collected during the 2004 field season and a list of project recommendations.

II. STUDY SITE

Pasture Bay Beach is an approximately 450 meter long beach located on the northern side of Long Island, a 300 acre privately owned island several kilometers off the northeast coast of Antigua, West Indies (see Appendix I). Long Island is the site of the Jumby Bay Resort and some 30 residential estates. Pasture Bay Beach faces windward, thus collecting sand through natural processes. Hawksbill turtles have probably been nesting at this site for centuries where, historically, thick maritime forest and coastal shrubs covered the beach. Since this species prefers to lay eggs under the shelter of vegetation, such an environment provided prime nesting ground for hawksbills. Although resort development cleared most of the natural vegetation in years past, vegetation islands of Scaevola and seagrape shrubs have been planted specifically to improve conditions for hawksbill nesting.

Numbered markers placed along the vegetation line at 10-15 meter intervals along Pasture Bay Beach divide the beach into 36 sectors. Characterizing the beach into three zones also helps to describe the study area:

The northeast-facing section (stakes 19 to 31) is relatively narrow, with mixed shrubs and sparse mangrove. There are no man made structures on this portion of the beach apart from a road that runs parallel with the coastline on the backside of the vegetation.
The middle, north-facing section (stakes 8 to 18) is characterized by wide expanses of sand. Portions of the natural vegetation have been cleared, but vegetation islands have been planted in recent years to supplement existing nesting habitat. A marsh lies behind the beach between stakes 8-14, separated by a thin line of vegetation.
The northwest facing sector (markers –1 to –5 and 0 to 7) represents a diverse area. The beach between stakes 2 and 7 narrows and contains palm trees and numerous sea grape and Scaevola bushes. Prominent limestone shelves exist at the shoreline between stakes

0 and 2. Markers –5 to 0 include three private residences, with primarily open, sandy beaches and thin rows of vegetation adjoining the properties.

Pasture Bay Beach has been the main focus for the duration of the project. However, nesting activity on nearby peripheral beaches has increased in recent years. Noteworthy beaches include Pond Bay Beach, behind privately owned villas, and those of the estates Doniford House, Carisbrooke and Hawksbill Cove. Pond Bay Beach was patrolled throughout the season, and Doniford and Carisbrooke beaches were patrolled for portions of the year. Additional activity was reported at Hawksbill Cove and Carisbrooke when we were unable to access them.

III. METHODS

Patrols

As in previous seasons, we patrolled Pasture Bay Beach hourly, on foot, from dawn to dusk for 154 consecutive nights during the designated nesting season (15 June through 16 November) to ensure that all turtles nesting on Pasture Beach during this period were observed and identified. Previous observations indicate that the hawksbill nesting process typically occurs within a 1.5-hour time frame. Hourly patrols therefore ensure every nesting turtle is observed. Patrol protocols follow standard guidelines set by previous project staff and adhere to international sea turtle research norms (cf. Eckert et al., 1999).

Pond Bay Beach was patrolled only at sunrise until we recognized an increase in turtle activity and accordingly increased patrols to 3-4 times a night. Towards the end of the season, we patrolled Doniford beach approximately 5 times a night after locating a nesting turtle there by chance. Since we did not obtain permission to patrol Carisbrooke and Hawksbill Cove, we were unable to check those beaches and have no continuous reliable record of turtle activity on those beaches for this season.

Data Collection

Data collection procedures were followed in accordance with the methodology of previous seasons. We made every effort to ensure that all phases of the nesting process remained as natural as possible and typically processed turtles (e.g. tagged, measured, photographed) only during egg-laying. We generally left eggs in situ and allowed hatchlings to emerge and disperse to the water without intervention whenever possible.

In a few instances we handled turtles outside of the egg-laying stage. When necessary, individuals located during the covering or concealing phase of nesting were approached to collect data. We also redirected disoriented turtles and released those hindered by vegetation.

Tagging

We applied tags shortly after the onset of egg-laying, following deposition of 5 or more eggs to ensure that the turtle was fully in the nesting trance. In some instances the turtle flinched mildly, and we continued tag application.

We attached an Inconel tag (size 681, Caribbean Marine Turtle Tagging Center) to the first most proximal scale on the trailing edge of the front flipper of every untagged turtle. We thoroughly investigated untagged turtles for tag scars and remnant drill patterns to differentiate between neophytes (first-time nesters) and remigrants (returning nesters) that had lost tags. We tagged both front flippers of each neophyte and assigned one tag as the turtle's permanent identification number. Remigrants missing tags were identified using any remaining tags and / or the drill pattern and subsequently retagged. In some instances, we were compelled to tag individuals on the second most proximal pad because of tears or other abnormalities on the first pad. Finally, if old tags were not securely attached, we added an additional tag on the adjacent pad.

Drilling

Using a battery powered hand drill, we drilled a unique pattern of holes through the inert posterior marginal edge of the supracaudal scutes of all previously unmarked individuals. Drill patterns served as an additional identification method and frequently permitted identification of an individual outside of egg-laying without disrupting the turtle.

Drill holes "migrate" to the distal edge of the supracaudals as a result of carapace growth and wear. Holes near the edge are also worn down from abrasion. The pattern of holes placed 12-15 mm or more from the posterior marginal edge of the supracaudals will remain readable for a minimum of 4-5 years (Richardson et al. 1999). Therefore, we placed the holes as far anterior as possible while still remaining in inert tissue to maximize the life of the pattern. When remigrants exhibited a drill pattern closer than 12-15mm to the edge, a repeat pattern was re-drilled higher on the supracaudals to ensure the pattern would be legible for as long as possible. Additionally, some patterns were cleaned or enlarged throughout the season to enhance visibility.

Morphology

We recorded curved (over the curve) carapace length and maximum curved carapace width for nesting individuals when possible. Carapace length is defined here as the distance from the nuchal notch along the middle of the carapace to the posterior tip of the longest supracaudal. We recorded and mapped barnacle positions, deformities, injuries, and unique markings (e.g. chips from carapace) and photographed individuals when conditions permitted.

Genetic Sampling

Using a razor blade sterilized with isopropyl alcohol, we cut a small piece of tissue (approximately 5 mm long) from a natural outcropping of skin on the turtle's rear flipper. Turtles sampled in this manner did not show a response to or awareness of the process. The sample was immediately placed in a tube of SED buffer solution labeled with the turtle's original tag number and date. We then gently macerated the tissue to ensure percolation of the preservative and applied pressure to the wound with cotton wool. When we were unable to sample an individual, we sampled her offspring (unhatched embryo or dead hatchling) by slicing off the tip of a flipper and preserving as outlined above during nest excavation.

Nest Location

We mapped nests using the markers and measurements from adjacent landscape features (e.g. distinctive tree trunk, large branches). We also used colored flagging directly over or close to the nest site when it would remain inconspicuous. Labeled flagging was inserted into the nest cavity to confirm nest identity upon excavation. We maintained efforts to conceal the exact location of the nests, minimizing the potential for discovery by poachers. We conducted checks on each nest at least once a week to watch for signs of predation or any other disturbance.

Egg Counts

When time and conditions permitted, we took an exact egg count by tallying eggs as they were deposited into the nest chamber. We took additional egg counts of relocated nests. These counts enabled us to assess how accurately we estimated clutch size from nest contents during post-emergence nest excavations. As in previous seasons, egg counts occurred infrequently (n=9) as the collection of other data (i.e. tagging, measurements, genetic sampling) took precedence.

Emergence and Excavation

We closely monitored nests for several days prior to the expected emergence date. When an emergence occurred successfully, we recorded the date, estimated time of emergence, and number of hatchlings seen, if any. We guided disoriented hatchlings (i.e. those attracted to artificial lighting) and released trapped hatchlings (i.e. those ensnared in roots of the nest chamber). On Jumby Bay, hawksbill nests typically exhibit a 55 to 60 day incubation period between egg-laying and hatchling emergence; however, this year, due to an unusually high amount of rainfall, many nests had a longer incubation period, with several nests hatching after 65 days. With this in mind, nests that showed no sign of activity at approximately 68 days were excavated carefully to assess their status.

We recorded nest depth and noted nest cavity characteristics such as root structure, large rocks, and unusual or hard substrate. Nest contents were categorized to estimate clutch size and hatchling release success rate. Hatched shells were counted, and unhatched eggs were opened to determine stage of development when mortality occurred. We categorized eggs using criteria outlined on the back of the hatchery data sheet (see Appendix II) and recorded the stage of embryonic development (early-, mid-, or late-term) when the stage was evident. We included a separate category for pipped hatchlings (i.e. hatchlings that had begun to break through their shell but had not yet completely emerged). On a few occasions, we encountered hatchlings not ready for release due to excessive lethargy. We kept these individuals in a container filled with moist sand and draped with a damp cloth. The container was then stored in a warm, dark place for one night before we released the hatchlings.

Managed Hatching and Relocated Nests

We relocated the nests deposited below the high water line. Depth and shape of the reburied nests adhered to the approximate dimensions of a natural nest (50 cm average depth). We partially relocated additional nests because the original chambers were not large enough to hold the entire clutch. Finally, if a nest site was susceptible to hatchling disorientation due to artificial lighting or other anthropogenic effects (e.g. close to road), we constructed a barrier around the nest in an attempt to contain the hatchlings until they could be guided in the appropriate direction.

False Crawls

We also recorded false crawls (i.e. unsuccessful nesting attempts). Time of observation, location, behavioral or morphological observations, and potential causes of the failed attempt were noted. Most false crawls could not be associated with an individual. Occasionally, however, we identified false-crawling turtles by discrete observation of the supracaudal drill pattern while the turtle was digging. Otherwise, we did not bother a false-crawling turtle with data measurements.

IV. RESULTS

Recruitment

Fifty-one adult female hawksbills were observed on Long Island during the 2004 nesting season, including 36 remigrants and 15 neophytes (Fig. 1). This is the highest seasonal cohort value on record for the project, surpassing the 2002 season total of 50 individuals and 2003 season total of 49 individuals. Even though the overall number of nesters is very close to the overall number from the 2003 season, the percentage of neophytes nesting this season (29.4 %) differs quite sharply from the percentage of neophytes nesting in 2003 (42.9 %). Similarly, the percentage of remigrants nesting this season also differed quite sharply from the previous season (70.6% in 2004; 57.1% in 2003).

Remigration

Of the 36 remigrants, 2 (5.6 %) had a remigration interval (elapsed time since previous appearance) of six years, 2 had an interval of five years, 4 (11.1%) had an interval of four years, 13 (36.1 %) had an interval of three years, and 15 (41.7 %) had an interval of two years (Fig. 2). The mean remigration interval for the 2004 remigrant cohort was 3.0 years.

Fig. 1 Total Nesting Females, Remigrants and Neophytes from 1987 to 2004
Jumby Bay, Antigua

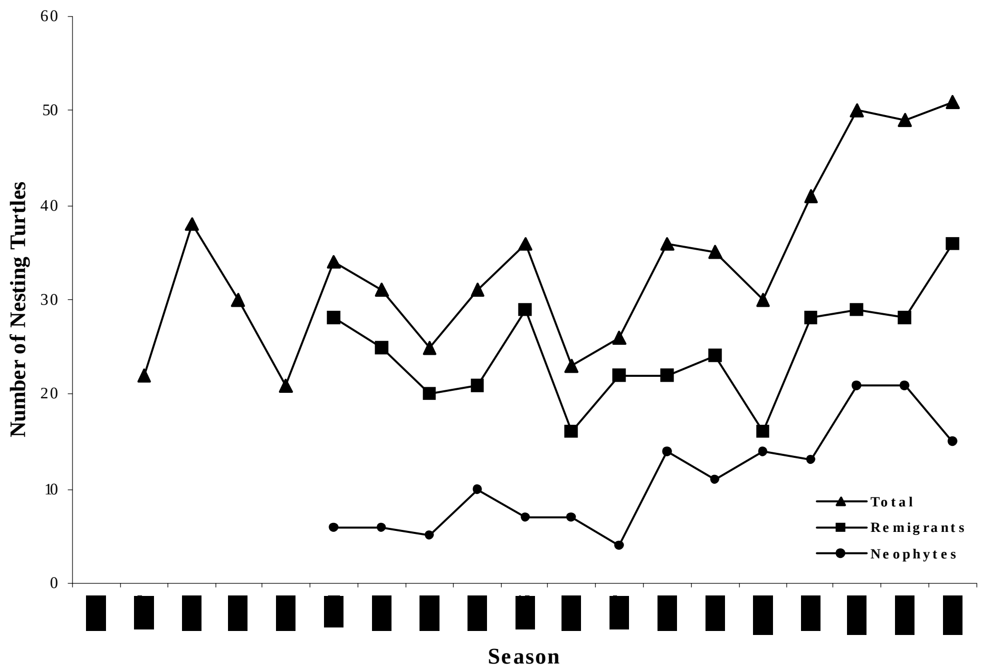
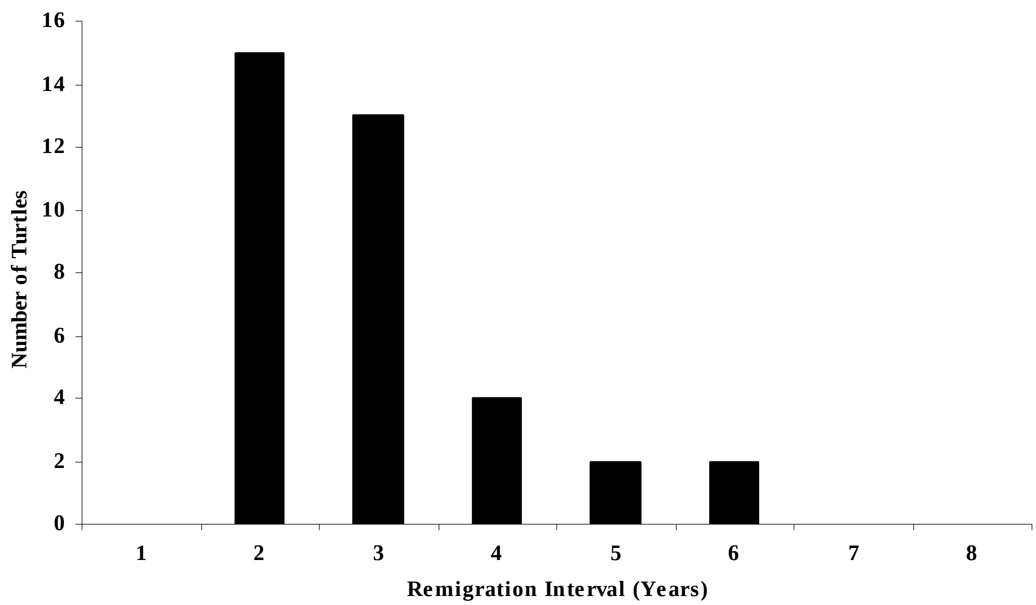


Fig. 2 Frequency Distribution of Remigration Intervals
Jumby Bay, Antigua 2004



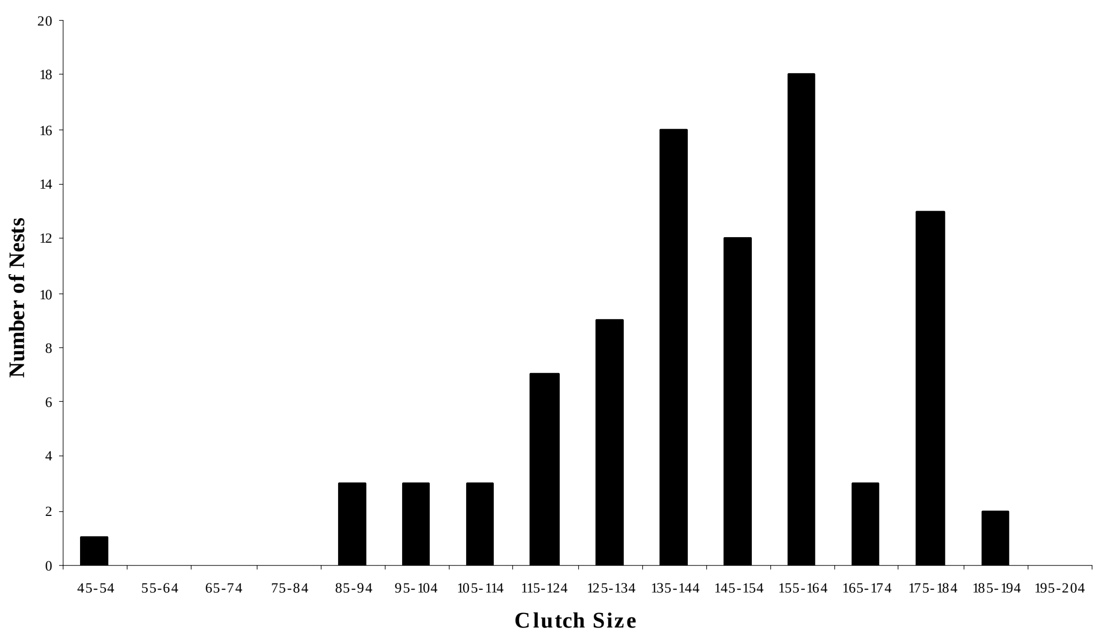
Fecundity-Clutch Size

Between June 15th and November 16th, 186 nests were documented on Long Island. One-hundred and seventy-four nests were laid on Pasture Beach, 8 on Pond Bay Beach, 2 on Doniford Beach and 2 on Carisbrooke Beach. The deposition of two of these nests (one at Pasture Bay, one at Pond Bay) went initially undocumented, even though they were laid during the patrol season. We were unaware of their existence until emergence. Unfortunately, we do not know the identities of the turtles that deposited them or the exact dates of deposition. The unknown nests were thus not included in these analyses. Additionally, we found 7 nests laid prior to June 15th upon emergence and located 2 pre-season nests on Carisbrooke. Data for Doniford and Carisbrooke beaches are incomplete since patrols on these beaches did not span the entire season.

We excavated 98 nests this season. However, because of confounding factors such as partially reburied clutches and difficulties differentiating between clutches from previous seasons and from the nest of interest, we only summarized data from 90 nest excavations. Clutch size ranged from 49 to 187 eggs, with an average of 145 eggs per nest (Fig. 3). Egg count values deviated +/- 5.4 eggs (3.6 %) on average from excavation estimates when comparing clutch size values determined by egg counts at the time of laying or reburying with values determined by nest excavations post emergence.

We suspect that one nest was poached this season. Located between markers 4 and 5, this nest contained only 8 eggshells at the time of excavation. This nest was also excluded from analyses.

Fig. 3 Frequency Distribution of Estimated Clutch Size
Jumby Bay, Antigua 2004

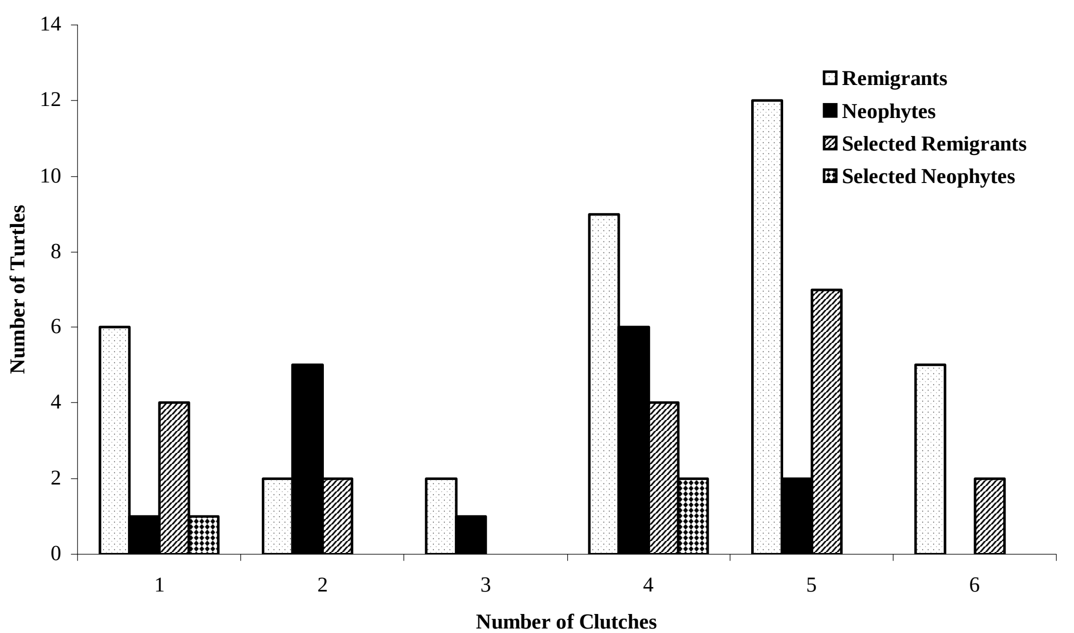


Fecundity-Clutch Number

The number of predicted nests per female deposited between June 15th and November 16th 2004 ranged from 1 - 6, with a mode of 5 and an average of 3.7 nests per turtle. Neophytes deposited 48 nests with an average of 3.2 nests per neophyte. Remigrants deposited 142 nests, averaging 3.7 per remigrant (Fig. 4). These values do not include turtles that may have been at the end of their nesting period when the season began and those at the beginning of their nesting period when the season ended.

To reduce error in determining fecundity and remain consistent with analyses from previous seasons, we also summarized the data for turtles with a documented first visit occurring between July 3 and September 15. Unfortunately, this dramatically reduced the sample size from 15 to 3 neophytes and from 36 to 19 remigrants. The number of clutches deposited by these selected neophytes was 9 with an average of 3.0 nests per neophyte. The number of clutches deposited by the selected remigrants was 71 with an average of 3.7 nests per remigrant.

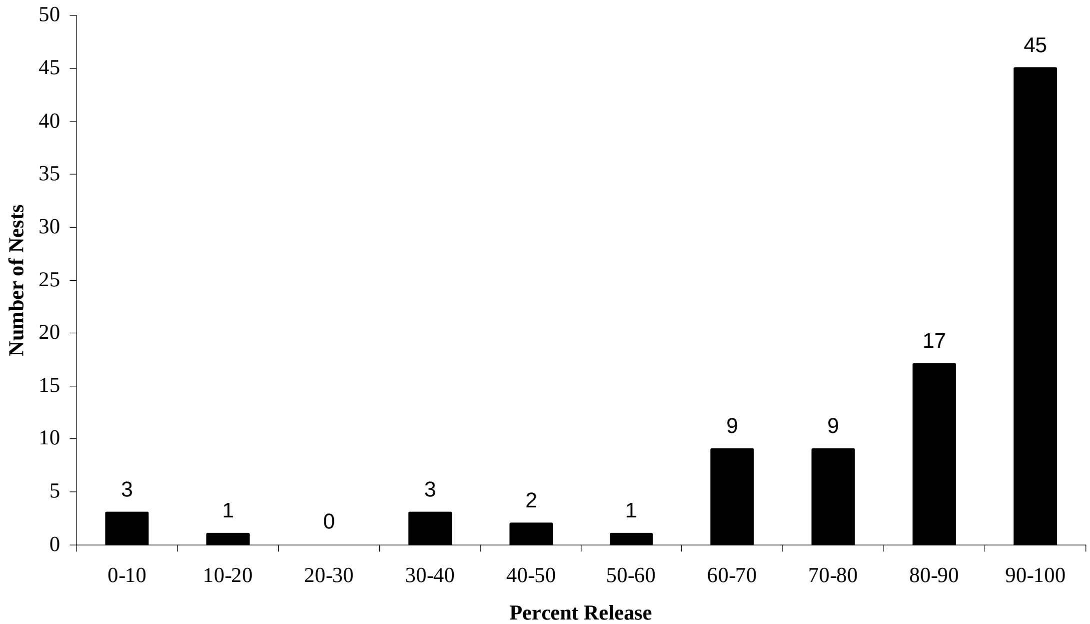
Fig. 4 Frequency Distribution of the Number of Predicted Clutches per Turtle
Jumby Bay, Antigua 2004



Release Success

To estimate the number of hatchlings released from the nests (either naturally or with researcher assistance), we analyzed data from 90 nest excavations. Release success ranged from 0% to 98.1% with an average of 80.2% released (Fig.5). The nest with the highest success had 155 hatchlings released out of a clutch of 158 eggs. Two nests had 0% release success (clutch sizes of 150 and 86), and no embryo development was evident. Excluding these two nests, the nest with the lowest success released only 2 hatchlings out of a clutch of 105 eggs (1.9%).

Fig. 5 Frequency Distribution of Estimated Release per Nest for Pasture Beach
Jumby Bay, Antigua 2004

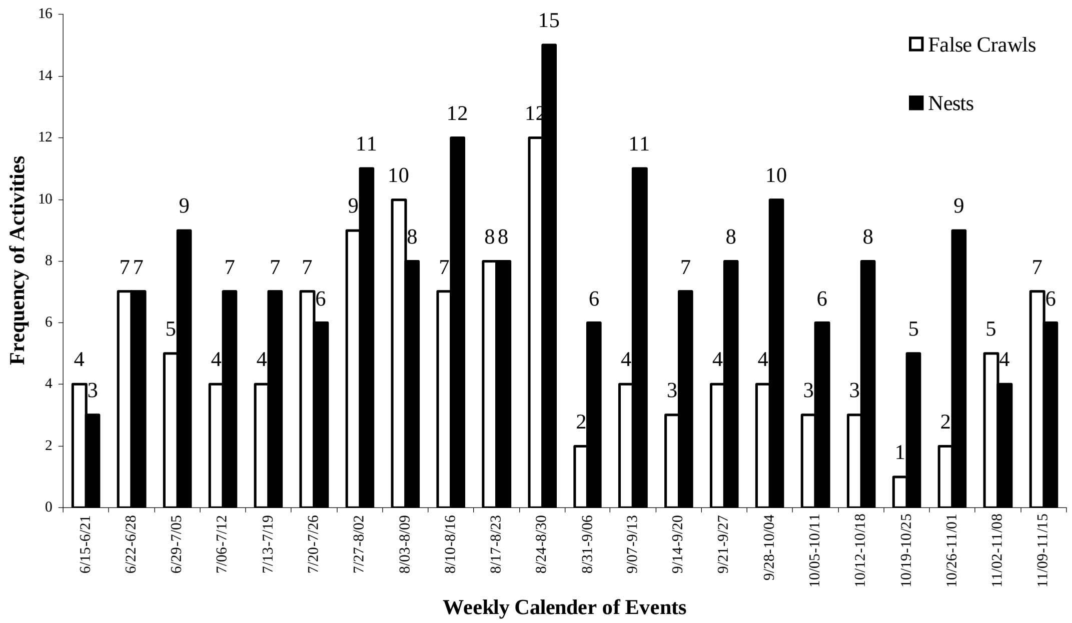


Season Activity Levels

We documented 115 false crawls and the deposition of 173 nests, totaling 288 activities, on Pasture Beach (Fig. 6). Additionally, 39 false crawls and 7 nests, totaling 46 activities, were documented for Pond Bay Beach. Monitoring activity on Pond Bay Beach was complicated by an extremely high water line that, at times, may have erased evidence of nesting turtles.

Nesting activity peaked during the week beginning August 24th on Pasture Beach. We documented 15 nests (8.7%) and 12 false crawls (11.0%) during this week. Six nests and 5 false crawls occurred on the night of August 25th alone. The least amount of activity occurred the first week of the season, beginning June 15th, with only 3 nests (1.7%) and 4 false crawls (3.7%).

Fig. 6 Weekly Activity for Pasture Bay and Pond Bay Beaches, Jumby Bay, Antigua 2004 Season



Nest Density by Beach Section

The highest concentration of nests occurred between markers 27 and 28 with 14 nests (8.1%) deposited in this area (Fig. 7). The areas between markers 5 and 6, 24 and 25, and 28 and 29 followed with 12 (6.9%), 11 (6.4%) and 11 nests respectively. By contrast, the areas between markers –5 and –3, 0 and 2, and between 12 and 13 had no nests.

False Crawls versus Nest Density by Beach Section

The greatest discrepancy between number of nests and false crawls occurred between markers 30 and 31 (Fig. 8). We documented 23 false crawls and only 8 nests in this area. These 23 crawls represent 2.9 times the number of nests in that area and the highest frequency of crawls per section. In contrast, turtles nested successfully each time they emerged between markers 7 and 8 (6 nests) and 17 and 18 (5 nests).

Fig. 7 Nest Density by Beach Sector for Pasture Bay
Jumby Bay, Antigua 2004

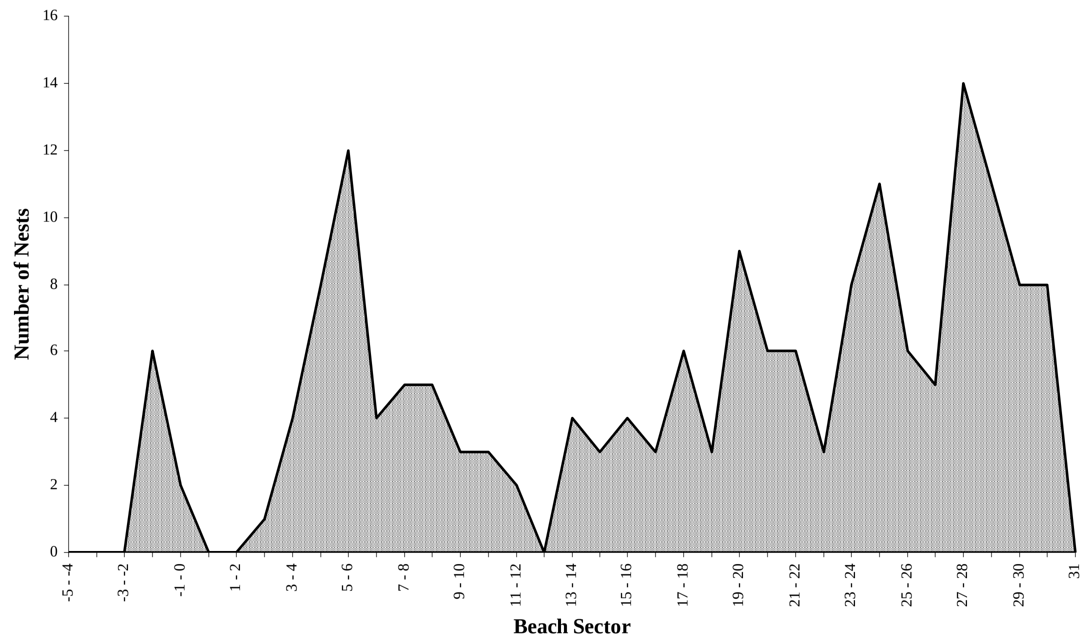
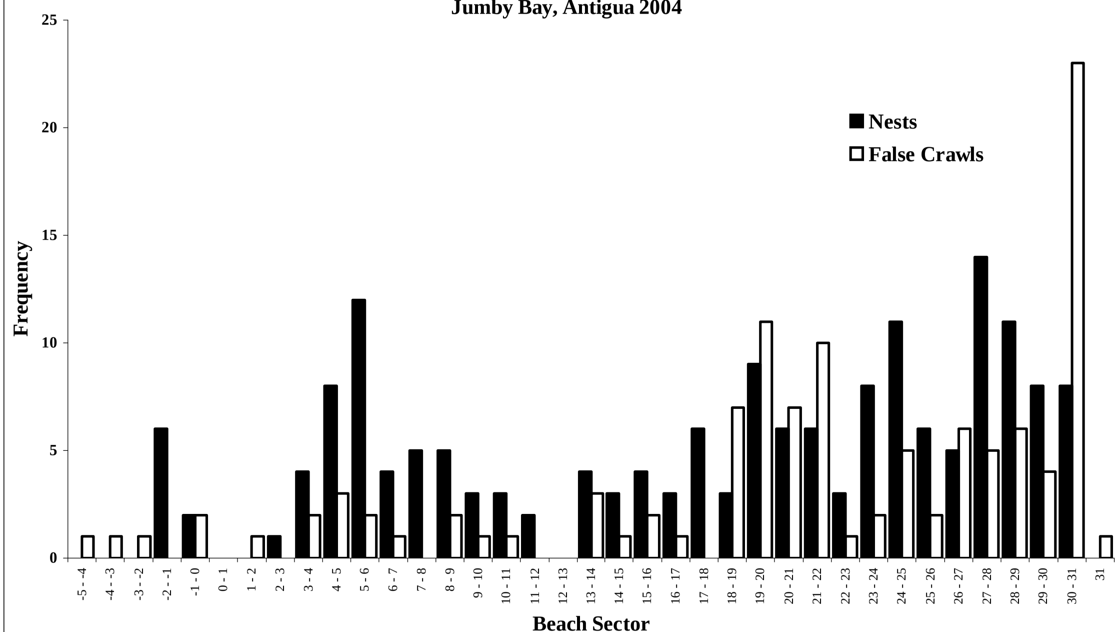


Fig. 8 False Crawl and Nest Density by Beach Sector for Pasture Bay
Jumby Bay, Antigua 2004



Genetic Sampling

We took 39 tissue samples for genetic analysis. Of these, 30 were from adult female nesters, 7 were from unhatched embryos, and 2 were from dead hatchlings. Results from haplotype analysis are pending at this time.

Situations Requiring Researcher Assistance

On five occasions we redirected hatchlings attracted by artificial light. Hatchlings from 2 nests were prevented from entering and rescued from the swimming pool at Tir Na Nog, and hatchlings from 2 more nests were prevented from crossing the path leading to Pasture Point. We also prevented hatchlings from 1 nest from entering the marsh. In total, approximately 370 hatchlings were redirected.

We reburied 374 eggs from 5 nests because the nests were too shallow to accommodate all of the eggs deposited. Only 2 of these nests hatched before the end of the season with total clutch release successes of 90% and 78%.

Turtle XXA280 was redirected towards the ocean on numerous occasions, both before and after nesting took place. We found her in the swimming pool at Doniford House and on the lawn at Pond Bay Villas. Another turtle, QQZ152, was reported in the swimming pool at Doniford House before we began patrolling this beach.

Neophyte WE5031 had a deformed left rear flipper and required assistance with digging.

Unfortunately, after the season had ended and we had left the island, a turtle wandered onto the property at Doniford House and fell into a pit. It was unable to get out and died before being found. No other mortality of nesting females from the Jumby Bay population was noted either on or off the island.

V. DISCUSSION

Season Results

The Jumby Bay hawksbill population continues to show signs of long-term growth (Richardson et al. 2004. in prep.). Natural fluctuations in cohort size and composition are to be expected and have been documented since the inception of the project. Given these cyclic population trends and recent peaks in nesting individuals, we expected a smaller 2004 nesting cohort. However, although neophyte numbers in 2004 were lower than those recorded in 2002 and 2003, overall nesting cohort numbers are almost identical to the previous seasons. Continued long-term research will shed more light on such population trends.

Although the data suggest population growth on Jumby Bay, monitoring efforts on other islands in the region are necessary to assess the broader regional status of hawksbills. It is possible that Jumby Bay is acting as a magnet beach, attracting turtles deferred by development on the mainland and adjacent islands. Alternatively, Jumby Bay might be a source of recruitment to mainland nesting beaches. Again, long-term studies across other local beaches are necessary to test these hypotheses.

Rainfall was unusually high this season and excessive runoff caused widespread erosion on all of the Long Island beaches. We believe that the rainfall may be responsible for the increased incubation periods documented this year. No nests on Pasture Bay Beach were lost to erosion, but a large amount of sand was lost in certain areas including the far northern sector of Pasture Bay and along all of Pond Bay Beach. Over time, ocean currents should replenish sand in those portions of the beach.

In addition to the abnormally high rainfall, two hurricanes, Frances and Ivan, threatened the region. The hurricanes caused higher than normal tide levels and generated concern that a number of nests would be lost as a result of high water. Fortunately, this did not prove to be the case on Pasture Bay. However, Pond Bay's naturally high water line was intensified by the erosion. At least one nest completely failed and another had severely diminished hatch success because of the high waters.

Anecdotally, it appears that when a hurricane was predicted to pass near Long Island within a few days, turtles due back for a midseason nest returned a few days earlier than expected and overall nesting activity increased. When the hurricane was at its closest to Long Island, nesting activity decreased. However, as these are only observational records, we will continue to gather further records.

Interestingly, we noted much more total activity on Pond Bay Beach this year than in 2003 (2004: 8 nests, 39 false crawls; 2003: 1 nest, 8 false crawls). We further believe that additional crawls may have been missed on Pond Bay in 2004 because of the erosion and extremely high water lines highlighted above. Shifts in currents and other factors may be responsible for the altered activity patterns. We presume that this trend and anecdotal evidence from guests and homeowners indicates an increase in turtle use of all peripheral beaches. This evidence underscores the need for future accessibility to all beaches on Jumby Bay (see Recommendations).

We also documented far fewer false crawls on Pasture Bay in 2004 than in 2003 (2004: 115; 2003: 192), though nest numbers between years were nearly identical (2003: 179; 2004: 174). The largest differences occur from markers –5 to 0 (2003: 27 false crawls; 2004: 5), markers 30 to 31 (2003: 10, 2004: 23), and section 31+ (2003: 20; 2004: 1). This discrepancy may result from a lower proportion of less experienced neophytes in 2004, or perhaps there were fewer instances of researcher-induced false crawls this season. Additional factors including nest site suitability and ocean currents may play a role as well. The trend warrants further evaluation and monitoring in the future.

Finally, although every effort is made to prevent poaching, it still occurs on Jumby Bay. The loss of 1 nest out of 186 does not impact the hawksbill population as a whole (Richardson, pers. comm.). The death of 1 reproductively active female, however, is a significant loss. The odds of surviving into adulthood are very small and therefore a reproductive turtle plays a vital role in the continuation of her species.

Public Awareness and Education

More than 300 resort guests visiting Jumby Bay witnessed a hawksbill nesting, nest excavations, hatchling emergences, or came down to the beach in the hopes of seeing a turtle on Pasture Bay Beach this season. Homeowners and their families frequently joined us on the beach as well. We conducted an informal educational presentation for the children of homeowners and resort guests at the Turtle House.

We continued the tradition of hosting turtle watches for groups from mainland Antigua through the Environmental Awareness Group (EAG) from 7:30 PM until 11 PM every Friday night beginning in July. An EAG volunteer accompanied each group of seven visitors, often local children and their parents, each week. Turtle watches are a very important way to educate Antiguans and visitors to Antigua about sea turtles and how to help protect them. Since there are no opportunities to participate in educational turtle watches on the mainland, they are extremely popular. We conducted turtle watches for over 90 guests through the EAG this past season.

We also hosted a special turtle watch for a group of high school students from the United States and Antigua as part of their internships with the EAG. We hope that the project can participate in this internship program on an annual basis.

Unfortunately, we did not get to conduct as many school visits this season as we would have liked due to scheduling difficulties. We did, however, conduct two educational PowerPoint presentations to about 120 children at St. Nicholas Primary School. We had hoped to begin the season with a presentation on the project for the Jumby Bay Resort staff, but were unable to due to scheduling conflicts.

We distributed pamphlets this season containing information on the project and sea turtles in general to Jumby Bay homeowners, resort guests, turtle watch participants, the EAG, students at St. Nicholas Primary School, and resort staff. Additional publicity came from articles by journalist Martha Watkins Gilkes published in LIAT magazine and in a local newspaper.

Visitors

In order for turtle conservation efforts to be successful, it is imperative that researchers from around the world collaborate and interact with each other, dispersing the information acquired on individual projects. The British High Commissioner of Antigua graciously provided funds to WIDECAST to organize a researcher “exchange” to Jumby Bay this season. In August, two young researchers from the year-old Nevis turtle project spent four days and three nights with us, allowing us to share information and experiences from the Jumby Bay Hawksbill Project.

VII. ACKNOWLEDGEMENTS

Project funding was provided by the Jumby Bay Island Company through annual grants to WIDECAST, Inc. (Wider Caribbean Sea Turtle Conservation Network). The JBIC additionally provided a special grant in 2004 to upgrade the database, analyze data for future publications, and develop a project website.

We are first and foremost enormously grateful to the Jumby Bay homeowners and resort for continuing to host and fund the research program. Such support is fundamentally important in any successful ecological research, and it demonstrates the commitment of the homeowners for global conservation efforts. We are very thankful for this opportunity and look forward to completing 2004 analyses and participating in future publications. Special thanks to the homeowners who attended the meeting: Mr and Mrs McNeill, Dr. Peter Swann and Mr. Roland Franklin. Thanks to you, the turtle house was outfitted with several amenities that greatly enhanced our quality of life!

We thank the Jumby Bay Resort and Jumby Bay Island Services for the assistance and logistical support provided this year. Staff helped us on countless occasions, and we are sincerely grateful for their support throughout the season and their concern for our well-being.

We also want to thank all those who helped to make us feel like a valued part of the community at Jumby Bay and in Antigua. Of special mention are Peter and Kathy Bowling, Ron Budacz, John and Sarah Fuller, Martha Gilkes, Dennis and Robin McNeill, the Morgans, Dick and Judy Nelson, Jepson Prince, David Stubbs, Don and Karen Tate, Annie Thorvaldsen, and numerous staff members.

Volunteers have become an important component of the research program. We thank Jepson Prince for his many patrols, Corina Sealy for presentation scheduling, and the EAG volunteers who assisted with outreach programming during the EAG turtle watch programs. We are also grateful for Rachel Steele's assistance with patrols and resort guests this season.

We extend our gratitude to all those who joined us on the beach for our nightly patrols to turtle watch and swap stories. Special thanks to those who generously contributed to the project including the Grays, Hon. Judge Olivetti, Ona, and Julie and Don Longo among numerous others.

Ms. Peri Mason, Dr. Jim Richardson and Dr. Karen Eckert (WIDECAST) provided comments to this manuscript and served as invaluable resources throughout the 2004 research season. In particular, we would not have gotten here without the tireless support, upbeat energy, and friendship of Ms. Peri "Pippen" Mason. 2003 JBHP Field Directors Keri Goodman and Allison Ballentine also provided much-needed assistance along the way.

Finally, we are ever grateful to our families for always encouraging us to follow our dreams, however far away they may take us.

We dedicate this season to Mr. Mark Brace.

VIII. LITERATURE CITED

Eckert, K. L., Bjorndal, K. A., Abreu G., F. A. and Donnelly, M. (Editors). 1999. Research and Management Techniques for the Conservation of Sea Turtles. ICUN/SSC Marine Turtle Specialist Group Publ. No. 4 Washington, D.C. 235 pp.

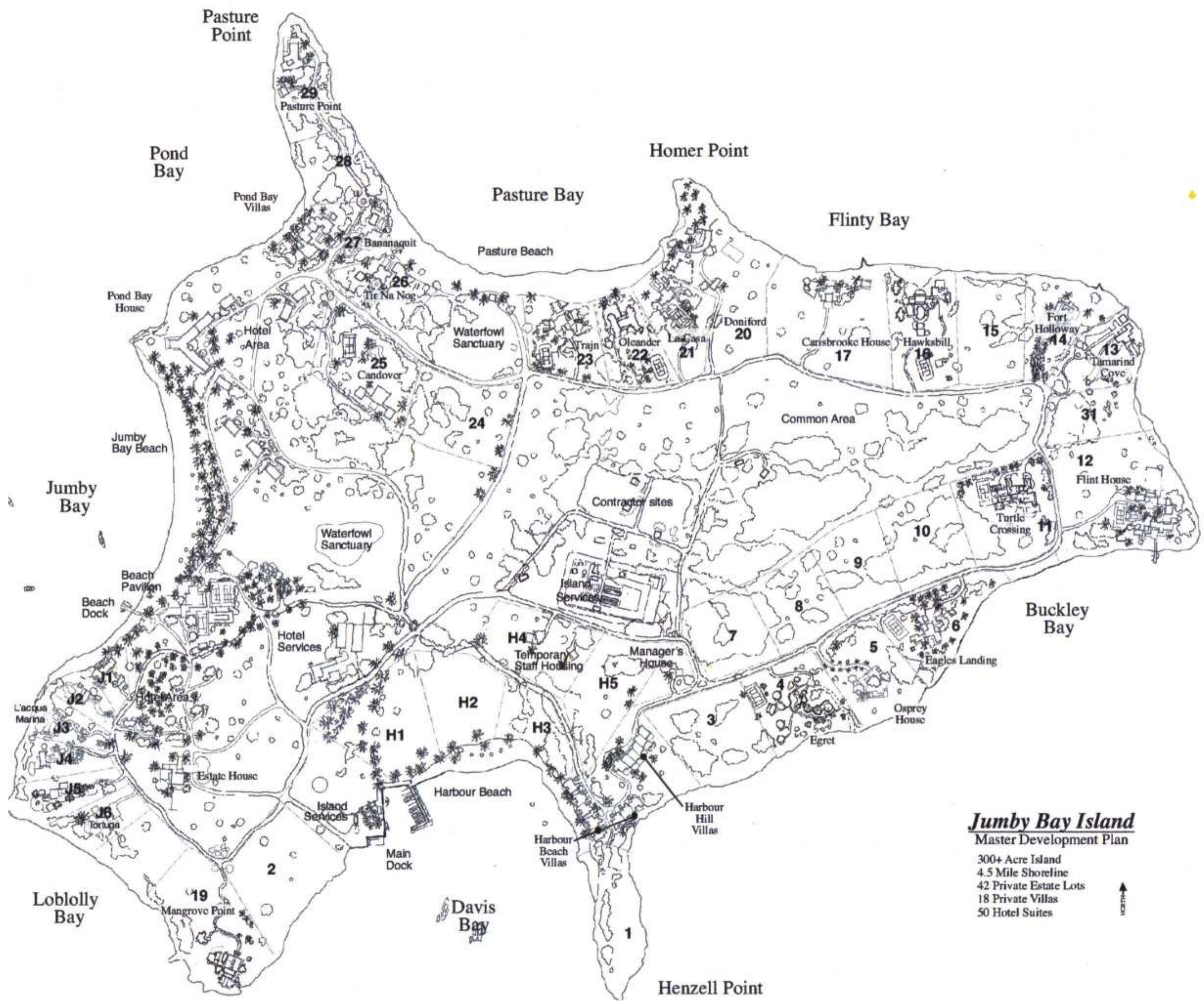
IUCN 2004. *2004 IUCN Red List of Threatened Species*. <www.redlist.org>.

Richardson, J. I., Bell, R., Richardson , T. H. 1999. Population ecology and Demographic implications drawn from an 11-year study of nesting hawksbill turtles, *Eretmochelys imbricata*, at Jumby Bay, Long Island, Antigua, West Indies. *Chelonian Conservation and Biology*. 3(2): 244-250 pp.

Richardson, J. I., et al. 2004. Seventeen years of saturation tagging data reveal a significant increase in nesting hawksbill turtles *Eretmochelys imbricata* on Jumby Bay, Long Island, Antigua, West Indies. In prep.

Witherington, B. E. and R. E. Martin. 2000. Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches (revised edition). Florida Fish and Wildlife Conservation Commission, FMRI Technical Report TR-2. 73 pp.

APPENDIX I



Map of Jumby Bay Island

APPENDIX II

WIDECAST
Wider Caribbean Sea Turtle Conservation Network

"Working together to build a future where all inhabitants of the Wider Caribbean Region, human and sea turtle alike, can live together in balance."

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) is a volunteer expert network and Partner Organization to the U.N. Environment Programme's Caribbean Environment Programme. WIDECAST was founded in 1981 in response to a recommendation by the IUCN/CCA Meeting of Non-Governmental Caribbean Organizations on Living Resources Conservation for Sustainable Development in the Wider Caribbean (Santo Domingo, 2629 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme." Today WIDECAST embraces the largest network of sea turtle research and conservation projects in the world, including the Jumby Bay Hawksbill Project (JBHP) in Antigua, and is a unique model for multilateral marine resource management.

WIDECAST's vision for achieving a regional recovery action plan has focused on bringing the best available science to bear on sea turtle management and conservation, empowering stakeholders to make effective use of that science in the policy-making process, and providing a mechanism and a framework for cooperation within and among nations. By involving stakeholders at all levels and encouraging policy-oriented research, WIDECAST puts science to practical use in conserving biodiversity and advocates for grassroots involvement in decision-making and project implementation.

WIDECAST is all about partnerships - building bridges to the future that facilitate and strengthen conservation action, encourage inclusive management planning, and help to ensure that utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term. Through information exchange and training, WIDECAST promotes strong linkages between science, policy, and public participation in the design and implementation of conservation actions. The network recommends standards for range state adoption, develops pilot projects, provides technical assistance, supports initiatives that build capacity within participating countries and institutions, and promotes coordination among Caribbean countries in the collection, sharing and use of biodiversity data.

With Country Coordinators in nearly 40 Caribbean States and territories, the network has been instrumental in facilitating complementary conservation action across range states, strengthening and harmonizing legislation, encouraging community involvement, and raising public awareness of the endangered status of the region's six species of migratory sea turtles. At the center of WIDECAST's activities are its Country Coordinators. They are drawn from professional governmental and non-governmental sectors, must have sea turtle research and/or management experience and responsibility, and participate in the coalition as volunteers. For more information on the larger context to which data collected by the JBHP contributes, or to contact WIDECAST Country Coordinators in Antigua or elsewhere in the region, please visit us at www.widecast.org.