MINISTRY OF ENVIRONMENT, HONDURAS

ACTIVITIES OF THE TURTLE AWARENESS AND PROTECTIVE STUDIES (TAPS) PROGRAM, PROTECTIVE TURTLE ECOLOGY CENTER FOR TRAINING, OUTREACH, AND RESEARCH, INC. (ProTECTOR) IN ROATAN, HONDURAS

2007 – 2008 ANNUAL REPORT

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ACTIVITIES OF THE TURTLE AWARENESS AND PROTECTION STUDIES (TAPS) PROGRAM UNDER THE PROTECTIVE TURTLE ECOLOGY CENTER FOR TRAINING, OUTREACH, AND RESEARCH, INC (ProTECTOR) IN ROATÁN, HONDURAS

ANNUAL REPORT OF THE 2007 – 2008 SEASON

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PREFACE

This report represents the ongoing work of the Protective Turtle Ecology center for Training, Outreach, and Research, Inc. (ProTECTOR) in the Bay Islands of Honduras. The report covers activities of ProTECTOR up to and including the 2008 calendar year and is provided in partial fulfillment of the permit agreement provided to ProTECTOR from 2006 to the end of 2008 by the Secretariat for Agriculture and Ranching (SAG).

ACKNOWLEDGEMENTS

ProTECTOR and TAPS recognize that without the financial and logistical assistance of the "Escuela de Buceo Reef House," this project would not have been initiated. We thank the owners and staff of that facility for their interest in sea turtle conservation and their invaluable efforts on behalf of the sea turtles of Honduras. We also extend our appreciation to ESRI for their funding support in terms of GIS software and training. We thank Karla Ventura, Edwin Cruz, the staff of PMAIB and Romeo Silvestri for their constant assistance in sharing data and logistical arrangements for the TAPS program. Numerous volunteers have also assisted in the collection of data, including Lyndsey Kelly, David Kirkwood and Leonardo Rodriguez. I thank Joe Breman for his input in planning, data collection, the development of the project database and GIS analyses.
For Submission to: The Secretariat for Agriculture and Ranching (SAG), the Ministry of Environment (SERNA), Fisheries (DIGEPESCA), and the Department of Biodiversity (DiBio)

August 25, 2009

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INTRODUCTION AND BACKGROUND

A comprehensive background regarding the current status of hawksbill (*Eretmochelys imbricate*) and green (*Chelonia mydas*) sea turtles, and the need for continuing research on their status and plight in Honduran waters, has been provided in a previous report to SAG, SERNA, DIGEPESCA, and DiBio (Dunbar, 2006). That report provided details on methods carried out by the Turtle Awareness and Protection Studies (TAPS) program under interim permits **# DGPA/005/2006 and # DGPA/245/2006,** and provided preliminary results obtained up to November, 2006.

The following is an annual report on the activities of the TAPS program under the ProTECTOR organization carried on between March, 2007 and October, 2008. The TAPS program was officially granted a permit to carry on research on sea turtles of Honduras in March, 2007 by the Secretariat of Agriculture and Ranching (SAG), under permit **#DGPA/5428/2007**, and subsequently began conducting the research for which the permit had been granted. These studies are the first of their kind to be conducted in Honduras with the aim of tagging and tracking juvenile sea turtles, as well as assessing the health of wild-caught, temporarily-captive sea turtles throughout the area of the Bay Islands. The TAPS program is coordinated out of the “Escuela de Busceo Reef House” (RHR) located on the south-east coast of Roatán in the Bay Islands, Honduras (N16°23'23.34", W086°20'57.43") (Figure 1).

In addition to the initial tagging program initiated by ProTECTOR under the Turtle Awareness and Protection Studies (TAPS) program in March, 2007, other projects have been initiated and continue. These projects include an investigation undertaken by Loma Linda University graduate student, Melissa Berube, under supervision by Dr. Stephen G. Dunbar, estimating the size of home ranges for juvenile hawksbills along the southeastern coast of Roatán. This project is also investigating the abundance of hawksbill prey items both within and outside home ranges. Other projects launched under the TAPS program were a hawksbill nesting beach reconnaissance, a sea turtle monitoring program through the dive operators on Roatán, and a Turtle Nesting Hotline Art and Jungle Challenge.

Detailed methods, results and discussions for each project are provided in the following report. At the conclusion of the report, a series of recommendations is provided for consideration by decision-makers in the various Ministries of the Government of Honduras to which the report has been provided.

This report has been furnished to all appropriate Secretariats, Ministries, and Departments of the Honduran Government in both Spanish and English languages.

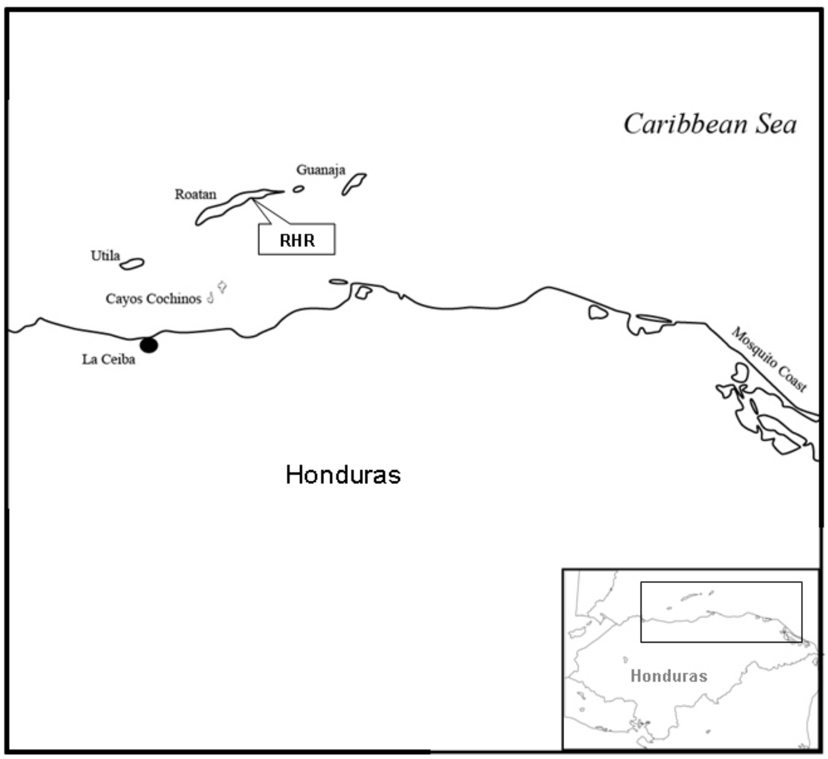


Figure 1. Map showing location of the Escuela de Busceo Reef House (RHR) on Roatan in the Bay Islands. The position of the Bay Islands in reference to the coast of Honduras is shown inset.

Measuring, Weighing, Tagging and Tissue Sampling

The collection of data on measures, weights and tag recovery in sea turtle research are recognized as of great value in determining aspects of life history, growth, habitat sufficiency, population dynamics, and ecology.

Measurements of individuals over time (mark-recapture studies) provide important information about growth rates in individual animals. Absolute growth rates are defined as a change in size over time intervals of various lengths. Most studies utilize absolute, rather than specific, growth rates, especially when the objective of the study is to estimate a size-based growth function above a size-specific growth within a single numeric measure (Chaloupka and Musick, 1997).

Flipper tags provide a primary means by which to identify individuals. For adult turtles, tag returns from captured turtles may provide critical information regarding distant foraging or nesting grounds, as well as migration pathways. For juvenile turtles that may remain within a local, relatively small home range area, flipper tags may provide more data regarding local foraging areas and recruitment, especially if saturation tagging can be achieved.

Tissue sampling provides DNA for genetic analyses. DNA in each cell can allow the identification of individuals, populations, and species. Furthermore, comparisons of DNA sequences can shed light on aspects of reproductive behavior and ecology. A maternal marker, such as mitochondrial DNA (mtDNA) provides an appropriate mechanism for tracing the dispersal of an individual female’s offspring. The application of molecular genetics to various aspects of sea turtle biology can help to bridge gaps in our current knowledge.

Radio Tracking and Home Range Analyses of Hawksbills

Home range is the area used by an animal during its daily activities, but excludes erratic movements or migrations (Bailey, 1984). Determining the home range of an animal requires repeated sightings of that animal over time (White and Garrott, 1990). Estimations of home range are dependent on the amount of time an animal spends in a particular habitat (White and Garrott, 1990).

Sea turtles are migratory animals, however not much is known about this behavior. It is thought that home ranges of adults are dependent on currents and water depth (Horrocks et al., 2001; Seminoff et al.). It is known that nesting turtles both remain close to the beach and may migrate long distances (Horrocks et al., 2001; Troëng et al., 2005). Migration of nesting turtles occurs mostly in shallow waters as long as it is not against large currents (Horrocks et al., 2001). There is less information about the home ranges of juvenile sea turtles. It is thought that juvenile home ranges rely on water depth and food availability (Horrocks et al., 2001; Seminoff et al.).

Home ranges of sea turtles are determined by three main methods: by satellite tags, sonic tags, and radio telemetry. Radio telemetry studies on loggerheads suggest that transmitters may be dislodged after a couple of days (Avens et al., 2003), however, they are useful in determining home ranges. Juveniles that were released after capture often headed back to areas close to their site of capture (Avens et al. 2003). The main problem with radio telemetry is that it only transmits signals at the surface, which may make tracking more difficult (Addison et al., 2002). Most home range studies have been conducted on adult turtles, while studies on juvenile home ranges have been few and far between.

Hawksbill Prey Species Analyses

Hawksbills are primarily spongivores, but may also ingest other organisms such as polychaetes, hydroids, zoanthids, urochordates and gastropods (Bjorndal et al., 1985; Carr and Stancyk, 1975; Hartog, 1980; Horrocks, 1992; Mayor et al., 1998; Pemberton et al., 2000). Meylan (1988)discovered that approximately 95.3% of the hawksbill's diet consists of sponges. Hawksbills, and in particular juvenile hawksbills, spend their time closely associated with reefs, and play a critical role in the reef ecosystem making both conservation of the turtle and its habitat important (Baillie et al., 2004; Cuevas et al., 2007; Diez et al., 2002; Leon and Bjorndal, 2002; Lopez-Mendilaharsui et al., 2008). By understanding the characteristics of the hawksbills preferred habitat, and by looking at the distribution of coral reefs worldwide, potential habitats can be predicted (Buitrago and Guada, 2002; Meylan et al., 1997).

The distribution of hawksbills among the reef is thought to be associated with the types of sponge and other food sources present. Hawksbills establish their habitat around certain species according to abundance, nutrient content and their type of chemical defense, showing a preference for *Chondrilla sp.*, *Geodia sp.*, *Pseudoptergorgia sp.*, and *Spirastrella sp.* (Cuevas et al., 2007; Diez et al., 2002; Leon and Bjorndal, 2002; Leon and Diez, 1999). For hawksbills, species such as *Chrondrilla nucula* are selected for when abundant because this species has a high protein content (Meylan 1988; Leon and Bjorndal 2002). Meylan (1988), highlighted that despite the high spicule content and high toxicity of *Chondrilla nucula* and other species such as *Suberites domuncula* to other marine organisms such as reef fish, these species are commonly consumed by hawksbills. Other more commonly ingested species that have a low protein content are selected for when abundant because they may have a low spicule content (Meylan 1988; Leon and Bjorndal 2002). Leon and Bjorndal (2002), determined that species such as *Spirastrella coccinea* are also highly consumed but are typically less abundant, with lower protein content, and with a greater chemical defense system. It is thought that these sponges are selected because they contain a vital nutrient that is not obtainable from other sponges (Leon and Bjorndal, 2002).

Hawksbill Nesting Beach Reconnaissence

This project was funded by the United States Fish and Wildlife Services – Marine Turtle Conservation Fund (USFWS-MTCF). Details can be found in the final report to USFWS (Dunbar and Berube, 2008).

Caribbean populations of hawksbills are in critical danger of continued decline over the next several decades, although some populations of this species are currently on the rise in areas of their distributions (Richardson *et al.*, 2006). Despite active advances in research on marine turtles and reports of increased nestings in some regions, other areas of the Caribbean have not taken large steps toward integrating beach monitoring and sea turtle management.

Despite historical references to large numbers of hawksbills along the north coast and Bay Islands of Honduras (Roberts, 1827, in Meylan 1999; Carr *et al*., 1982; Cruz & Espinal, 1987) and to the Bay Islands as a major nesting area for this species (Dampier, 1968; de Rochefort, 1666; Long, 1774), little effort has been made to investigate potential recovery of hawksbills in these waters.

This project was an initial investigation into the potential for recovery efforts of hawksbill (*Eretmochelys imbricata*) populations around the island of Roatán, Honduras through a reconnaissance of prospective nesting beaches. The project operated through the use of personal interviews, concentrated beach monitoring, aerial surveys, and preliminary community monitoring efforts. Personal interviews were conducted with local residents to determine where sea turtles have historically (over the past 50 years) nested, and where local community members have most recently confirmed nesting turtles. These interviews were also used to investigate the issue of egg harvesting on the island.

Hawksbill Aerial and Dive Monitoring

Aerial surveys have been utilized for estimating sea turtle population numbers in previous studies. The advantage to aerial studies is that opportunity to cover large areas rapidly. Aerial surveys have not previously been reported as a method for surveying sea turtle abundances in Honduras.

Dive monitoring has also proved useful in establishing influxes of turtles, and resident turtles in a given area. This method does have the disadvantage of requiring the training of inexperienced surveyors. However, with some training of potential spotters, the method may provide important data over large areas, especially where divers consistently operate over the long-term.

Turtle Nesting Hotline Art and Jingle Challenge

This project was supported, in part, by a SWOT Outreach grant.

Turtles in the Bay Islands are under threat from loss of habitat, coastal pollution, commercial and artisanal fisheries, and the taking of turtles and eggs for consumptive uses (Bräutigam and Eckert, 2006; McClenachan et al., 2006). Along with historical references to large numbers of sea turtles along the north coast and Bay Islands of Honduras (Carr et al., 1982; Cruz and Espinal, 1987; Meylan, 1999), the Bay Islands have also been historically recognized as a major nesting area for hawksbills (Dampier, 1968; de Rochefort, 1666; Long, 1774). Still, little effort has been made to establish a nesting beach monitoring system for sea turtles in Honduras.

A major factor hampering nesting turtle monitoring is that no system of communication exists for reporting nest sightings to specific personnel or a dedicated location. This means that even if nesting or hatching turtles are sighted, there is no designated recipient to accept the information and activate a response. Threats at nesting beaches could be mitigated if a coordinated system of monitoring females and nests was established. Furthermore, if the public (both local communities and tourist visitors) were made more aware of the plight of sea turtles in the region, an effective campaign of beach protection could be established. From a series of successful SWOT-supported workshops in 2007 (Dunbar et al., 2007; SWOT, 2007-2008), it is evident that local communities on Roatán are eager to seek ways to sustain marine environments, yet there have been few opportunities in the past to develop new initiatives. Since school-aged children can have a strong influence on family units and the wider community, the Protective Turtle Ecology Center for Training, Outreach and Research, Inc. (ProTECTOR) launched an island-wide educational outreach initiative involving school children on Roatán, ages 6 - 15. This initiative integrates the need for a Turtle Nesting Hotline with the need to involve school-aged children around the island in awareness about the status and plight of sea turtles in the Bay Islands.

DETAILED METHODS

Measuring, Weighing, Tagging and Tissue Sampling

We collected initial data in Phase T1 from February 28 - March 9, 2006 (Interim permit # DGPA/005/2006) on a group of 20 juvenile hawksbills and four green sea turtles that were 'reclaimed' on the island of Roatán. In Phase T2 (June 17 – July 1, 2006), we again recorded morphoetrics for comparison to Phase 1A measurements. From these measurements we previously calculated and reported short-term estimates of growth rates (Dunbar, 2006).

Juvenile *E. imbricata* were incidentilly captured by hand by local fishermen during artisinal fisheries for lobster (*Panulirus argus*) and conch (*Strombus gigas*). In response to the offer of reward, several local fishermen have agreed to bring captured turtles to the "Escuela de Buceo Reef House" (RHR) in Oak Ridge, Roatán. Under guidance of Dr. Stephen G. Dunbar (SGD), personnel at the RHR have received training on measurement proceedures, flipper tagging, and the temporary care of turtles at the facility. Once purchased from local fishermen, turtles temporarily reside in the protective turtle pool at the RHR. Turtles brought in were housed in the protective turtle pool for periods of between 2 weeks and 3 months. We made an effort to release turtles as soon as possible. However, at times it was necessary to hold them for extended periods before they could be tagged and released. Each turtle was given a name, and a temporary identification. The number was etched into the shell with a high-speed dremel tool. Care was taken not to etch the number so deeply that it penetrated the scute. After etching, the number was filled in with White Out™ and covered over with a commercial, non-reactive silicone to extend the life of the White Out™ so the individual could be identified both while in the protective turtle pool, as well as at the time of release (Figure 2). This has provided a non-invasive means for immediate, short-term identification while the turtles remain in the protection of RHR. All animals have also been checked for general health, ectoparisites (barnacles, mites) and for Fibropapilomas. Several non-invasive morphometrics, such as Straight Carapace Length (SCL), Straight Carapace Width (SCW), Curved Carapace Length (CCL), Curved Carapace Width (CCW), weight to the nearest 0.1 kg and the notation of identifiable distinguishing marks were recorded. Curved carapace length was recorded with a vinyl tape measure in two ways. The first was to measure minimum value, from the nuchal notch at the anterior of the carapace, to the notch made by the two supracaudal scutes. The second method was to measure the maximum value, from the nuchal notch to the tip of the supracaudal scute. Straight carapace length was measured with a 127 cm Haglöf tree caliper (Forestry Suppliers, Inc.) from the nuchal notch to both the notch made by the two supracaudal scutes and to the tip of the supracaudal scute. All turtles were placed in a weighing bucket (Figure 3), and weighed on an NC-1 Series Crane scale (American Weigh, suppliers) to ± 0.1 kg.

Figure 2. A small juvenile *E. imbricata* demonstrating the position of the identification number etched into the shell.

The bucket was then removed from the scale and lowered to the ground where all other measurements were taken. Upon completion of all data collection, each turtle was digitally photographed from different views (dorsal, ventral, lateral) to produce a digital catalogue of all study animals. These have been linked to the database for subsequent tagging and tracking projects.

Figure 3. Steve Dunbar is assisted in the process of weighing a juvenile *E. imbricata* by a guest at the Escuela Busceo de Reef House.

Furthermore, each turtle received two inconel flipper tags (681 style) to increase the odds of correctly identifying an individual at a later date. A tag was placed on the first scute proximal to the body on the front, right and back, right flippers (Figure 4). Prior to tagging, each tagging site was cleaned and rubbed with Betadine, and the piercing tooth of each tag was coated with Polysporine™ to reduce the potential for infection at the tag site. Turtles were held for monitoring for at least 24 hours after tagging to ensure there were no ill effects of the tagging procedure.

Figure 4. Inconel 681 style flipper tags were applied to both the front and back flippers at the site of the first scale proximal to the body.

To assess the genetic structure of the juvenile population in the study area, two to three small samples of tissue were taken from the necks of many of the tagged turtles. Samples were excised from the neck skin of the turtles by using a clean razor blade. Tissue samples have been stored in NaCl at the RHR and will be exported to Loma Linda University on receipt of the appropriate CITES permit from the Honduras government.

Radio Tracking and Home Range Analyses of Hawksbills

Study Area

This is an ongoing study that began in June 2007 and will run to June 2009, in Roatán, Honduras. Hawksbills were captured by local fisherman, and kept in a natural pool at the Escuela Busceod Reef House. All six turtles used in this study were released between June 2007 and August 2008 at Port Royal, Roatán.

Radio Tracking and Home Range Determination

Six turtles were selected to receive radio transmitters for tracking in the area of Port Royal, Roatán. All sea turtles selected were of weights great enough that the transmitter (approximately 20 g) was less than the recommended 5 % of total body weight. Transmitters were attached by drilling two small holes that aligned with the flanges atached to the transmitter body, at the 9th and 10th right marginal scutes. Transmitters were then secured with rubber rings underneath the flanges, by two zip-ties then covered over with Powers PowerFast, two-part marine epoxy. Rubber rings reduced the likelyhood of the transmitter wearing on the marginal scutes from direct contact (see Figure 5).

Drying time for the epoxy was between two and three hours, depending on weather conditions. The transmitter antenna was fastened so that it pointed posteriorly and stood upright aproximately 34 – 40 cm., (Figure 6). Upon release, the antenna remained in the upright position and could be observed from a distance (Figure 7). Upon release of the turtles, tracking commenced using a portable antenna and receiver. When turtles were sighted their location was recorded using a Global Positioning System (GPS). Home ranges are currently being analyzed using minimum convex polygons (MCP) and fixed kernel density (FKD) with Home Range Extension (HRE) software for ArcGIS.

Figure 5. Position of the radio transmitter on the 9th and 10th right marginal scutes. Note the rubber rings to eliminate direct contact ware of the shell and the zip-tie through the right flange.

Figure 6. A full view of the radio transmitter position on the shell of a juvenile *E. imbricate*. Note the antenna is curled around during the epoxy drying phase.

Figure 7. A released *E. imbricate* with deployed radio transmitter for tracking.

Hawksbill Prey Species Analyses

Survey Transects

The transect in this study was made using 30 meters of one quarter inch nylon rope weighted down at each end with 1.82 kilograms of lead weight. As in Dunbar (2006), the transect was placed at random in each survey, site and Universal Transverse Mercator (UTM) readings were obtained for both the start and end point of each transect using a Global Positioning System (GPS), and a two meter wide swath on each side of the transect was surveyed (Figure 8) for abundance of each species. Species surveyed were selected based on literature of commonly consumed species by hawksbills (Table 1), and were obtained primarily from Meylan (1988), Leon and Bjorndal (2002), and Cuevas et al. (2007). A total of 48 transects in 14 sites were surveyed.

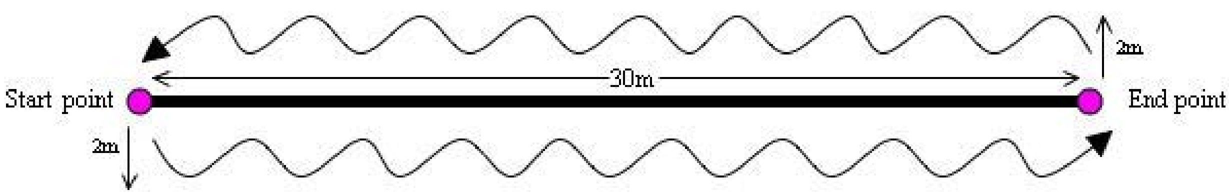


Figure 8. The transect survey method showing the transect and the swath on either side.

Table 1: The species of sponge, soft coral, zoanthid, and anemone surveyed in this study, based on the most commonly consumed species by hawksbills. Reproduced from Meylan (1988), Leon and Bjorndal (2002), and Cuevas et al. (2007).

Type	Order	Family	Species
Anemone	Actiniaria	Actiniidae	*Anemonia sulcata*
Soft Coral	Alcyonacea	Pseudogorgiidae	*Pseudoptergorgia elisabethi*
			Pseudoptergorgia sp.
Sponge	Astrophorida	Chrondrosiidae	*Chondrilla nucula*
			Chondrosia reniformis
		Geodiidae	*Geodia gibberosa*
			Geodia neptuni
		Stellettidae	*Acorina sp.*
	Hadromerida	Spirastrellidae	*Spirastrella coccinea*
		Suberitidae	*Suberites domuncula*
			Suberites ficus
Zoanthid	Zoanthidea	Zoanthidae	*Palythoa caribaeorum*

Statistical Analysis

The total abundance of each species for each site were collected and the mean and density for each species in both non-turtle and turtle sites (Figure 9) were calculated for comparison. Independent t-tests were conducted for all twelve species to determine if there was a significant difference in mean abundance and density between non-turtle and turtle sites.

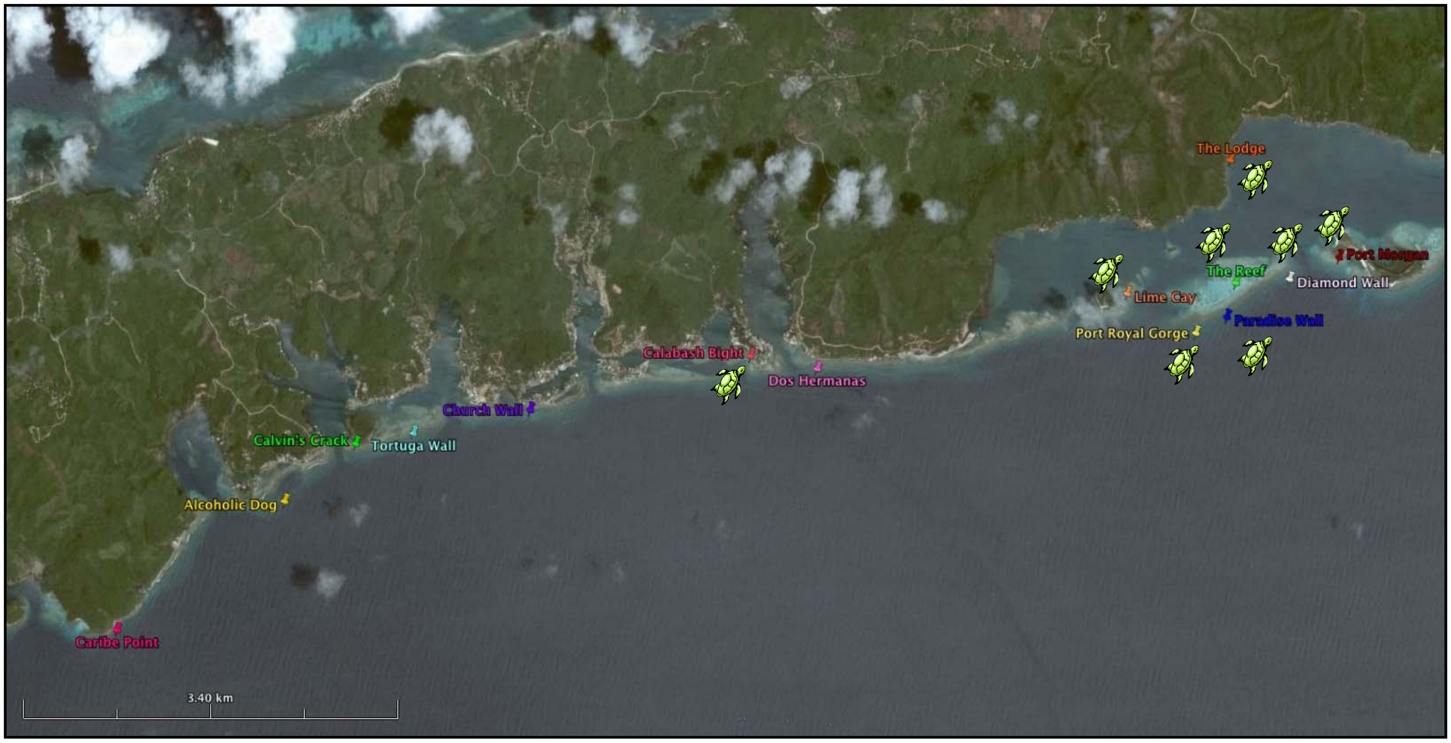
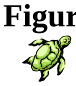


Figure 9. A map of the survey area on the south coast of Roatán showing both the turtle and non-turtle sites.  denote turtle sites.

Hawksbill Nesting Beach Reconnaissence

Prior to receiving funding from USFWS-MTCF, initial efforts to locate hawksbill nesting beaches on Roatán were accomplished by interviews of local fishermen in 2006. These included people in the communities of West Bay, West Bay Beach, Flower's Bay, Marbella Beach, Punta Pimienta, Turquoise Bay, Punta Gorda, Paya Bay, Camp Bay, Oak Ridge, French Harbour, and French Caye. After interviews were conducted, we visited beaches corresponding to these communities. Additional interviews were conducted with people living on the beaches to ascertain the most recent times when nesting turtles were seen on their beaches. On completion of interviews with beach residents, SGD and associates, Irma Brady from the Bay Islands Conservation Association (BICA-Roatán), and Joe Breman (ESRI), walked the beaches to investigate evidences for nesting turtles during the 2006 nesting season (June through November). We searched for crawls, indications of potential nests, the remains of hatchlings and eggs as evidence that nesting had taken place on the beaches visited. These data have been incorporated into this report (See Results section).

In 2007, a beach monitoring protocol was developed and provided to volunteers during a two hour training session over the project period of June to September. The protocol included a data collection sheet for both nesting females (Appendix 1A) and hatchlings (Appendix 1B), as well as a laminated sheet providing distinguishing features of species likely to be encountered on Roatán for identification (Appendix 2B). If SGD or MB were available, straight carapace lengths (SCL-minimum and maximum) and straight carapace width (SCW) were also recorded. Volunteers were trained in how to record curved carapace lengths (CCL -minimum and maximum) and curved carapace width (CCW) and were provided with a soft tape measure. Volunteers mainly consisted of two groups of "Outlook Expeditions" participants. These groups were organized by Mr. Edward Stones from the company head office in Scotland. The first group of 12 participants, under the direction of Ms. Cara Allison, monitored Camp Bay Beach (N16°25'44.7", W086°17'26.8") from July 17 – 21, 2007, and Paya Bay Beach East (N16°25'38.0", W086°18'39.4") July 18 and 20, 2007. The second group of 11 participants, under the direction of Mr. Tom Allen, monitored Camp Bay Beach from August 14 – 17, 2007, and Paya Bay Beach East on August 15, 2007 (Figures 10 and 11).

Figure 10. Members of the first monitoring group from Outlook Expeditions camping at Camp Bay Beach.

Figure 11. A volunteer shows young community members how to use a GPS.

Participants patrolled the beaches throughout the night with two teams of two people. These teams were switched with fresh teams every 2 to 3 hours. Teams stayed in contact with each other and the base camp by two-way radios, and were provided a cell phone to contact SGD or MB in case a turtle was sighted. In this case, volunteers were instructed to restrict the turtle from returning to the water after nesting. On the arrival of SGD or MB, the turtle species was to be confirmed, and the turtle was to be further measured, flipper tagged with Inconel (681 style) tags, photographed, and released.

Additionally, Dunbar and Berube monitored beaches personally, during periods of the 2007 – 2008 nesting season. These are indicated by initials SGD and MB under "Monitoring Group" in the results under Table 9. We undertook beach walks irregularly from July 29, 2007 – September 6, 2008. In all, 291,039 m^2 of local beach area were surveyed for evidence of nesting hawksbills, and is currently being mapped in a GIS database.

The beach walk and data collection protocols were standardized and are now being used on a nesting beach monitoring project in another area of Honduras, although equipment available to volunteers may vary.

Hawksbill Aerial and Dive Monitoring

Preliminary aerial surveys of beach areas and outer reef areas around Roatán were undertaken between July 16, 2007 and August 22, 2008. We contracted with Bay Islands Airways to fly us at an altitude of approximately 120 m above sea level with airspeed of approximately 40 - 43 knots to survey for sea turtles along the outer reef areas around Roatán. The plane is a fixed wing, open cockpit Aircam (Lockwood Aviation, Canada), three-seat float plane (Figure 12). Both the pilot and passenger acted as observers. An example of the view from the cockpit to the water surface is shown in Figure 13 and approximate flights paths over the island are shown in Figure 14.

In addition to aerial sightings, dive sightings of adult hawksbills were logged by trained dive staff at the Reef House Resort, CoCo View Resort, and Fantasy Island Resort on the southeast coast of Roatan. We provided dive masters with data collection sheets (in both hard copy and digital formats) for recording details of the sightings (Appendix 2A), and laminated sea turtle identification cards (Appendix 2B) to be kept onboard the dive boats. Before each dive, dive masters briefed tourist divers on identifying features of the three species of turtles likely to be encountered. As much as possible, dive masters confirmed the sighting and species identification during the dive. After each dive, sightings were discussed and data collected on the location (dive site), depth at which the turtle was seen, species, life stage (juvenile or adult) and sex (if possible). Because dive boats from these resorts do not typically carry GPS equipment, dive operators do not have a list of latitudes and longitudes for the dive sites they use. To specify dive locations, we used a dive guide produced by Mar Dive Guides (Gonzalez, 2007) that has published latitudes and longitudes for many dive sites along the northwest and south coasts of Roatan.

Turtle Nesting Hotline Art and Jingle Challenge

Planning for the school presentations began in June, 2008 with several visits to schools to arrange presentation dates and introduce ProTECTOR and the main presenter, Stephen G. Dunbar to school administrators. School visits proceeded as arranged with teachers and Principals as outlined in Table 2. School presentations began on July 9, 2008 and continued through to October 31, 2008.

ProTECTOR has been assisted in presenting the “Turtle Nesting Hotline’s Turtle Art and Jingle Challenge” to schools across the island by Loma Linda University graduate student, Ms. Melissa Berube, and staff from the Roatán Marine Park headed by Ms. Grazzia Matamoros.

After a 20 – 25 minute presentation about sea turtle ecology and threats to their survival, students were introduced to the ProTECTOR organization and to the Turtle Awareness and Protection Studies (TAPS) program carried out by ProTECTOR in the Bay Islands. During the presentations, students were encouraged to suggest ways they could become involved in helping sea turtles, including shading beach lighting, beach clean-ups, and picking up litter from local streets and fields. Students were then challenged to partner with ProTECTOR in sea turtle conservation by drawing, coloring, or painting 11 × 14 inch artwork featuring sea turtles on the beach, and/or recording a 15 – 20 second jingle about turtles on the beach. Competition entries were submitted to their school office, with the student's name, age, phone number, and school provided with the submission by November 5, 2008. At each presentation venue, three SWOT II and three SWOT III Reports were provided to the school as reference materials. Students were directed through the reports and made aware that the SWOT Reports and website would be valuable reference materials for information and ideas related to their artwork and jingles. At the conclusion of each session, SWOT Reports were provided to the sponsoring teacher or administrator to be placed in the school library, or kept in the room's bookshelf. We were also able to distribute over 30 Conservation International Sea Turtle posters to the schools (some receiving up to two copies, depending on school size).

During the majority of presentations, both photographs and video were taken. The video taken has been edited into a 3 - minute video and is used on the SWOT website. Several of these photographs and video clips will also be used as updates at the ProTECTOR website (see: www.turtleprotector.org).

Figure 12. SGD talks with Mr. Clay Donnelly, pilot of the Aircam open cockpit plane used for aerial surveys for sea turtles around Roatan.

Figure 13. View from the aerial survey plane to the water surface. Sea turtles are easily distinguishable near the surface from a height of 300 – 400 feet above sea level.

Figure 14. Approximate flight paths of aerial surveys between July, 2007 and August, 2008. Flight date color codes: Black = July 16, 2007; Blue = July 19, 2007; Green = August 19, 2008; Orange = August 22, 2008.

Table 2. Schools, dates and grades addressed by the presentation of the "Turtle Nesting Hotline's Turtle Art and Jingle Challenge" in Roatán, Honduras.

School	Date	Grades
Arnold Bilingual School	July 9, 2008	4 - 7
Church of God Bilingual School	July 9, 2008	4 - 7
Church of God Bilingual School	July 9, 2008	8 - 12
Jonesville SDA School	July 11, 2008	K - 6
Jean Isablle School	July 18, 2008	4 - 12
Escuela Dionisio de Herrera	August 21, 2008	5 - 7
Pandy Will Community School	August 21, 2008	4 - 6
Pandy Will Community School	August 22, 2008	4 - 8
French Harbour SDA School	August 22, 2008	4 - 8
French Harbour SDA School	August 22, 2008	9 - 12
Children's Palace	September 19, 2008	4 - 6
Children's Palace	September 19, 2008	7 - 8
Children's Palace	September 19, 2008	9 - 11
Punta Gorda School	September 26, 2008	4 - 12
Escuela Roberto Stanley	October 13, 2008	5
Escuela Roberto Stanley	October 16, 2008	4 - 6
Alternative School	October 17, 2008	4
Escuela Miguel Paz Barahona	October 27, 2008	2,4,6
Escuela Miguel Paz Barahona	October 28, 2008	1,3,5

RESULTS

Measuring, Weighing, Tagging and Tissue Sampling

As of the preparation of this report, we have tagged 64 *E. imbricata*, and 12 *C. mydas* through the TAPS program on Roatán. Although we measured minimum and maximum straight and curved carapace lenths (SCLn-n, SCLn-t, CCLn-n, CCLn-t, respectively), as well as straight and curved carapace width (SCW, CCW, respectively), we mainly report CCL and CCW (Figures 15 and 16) because turtles in the early stage of the project were unable to be measured for SCL and SCW. Recaptured turtles were re-measured and re-weighed. Table 3 provides weights and CCLs for recaptured turtles.

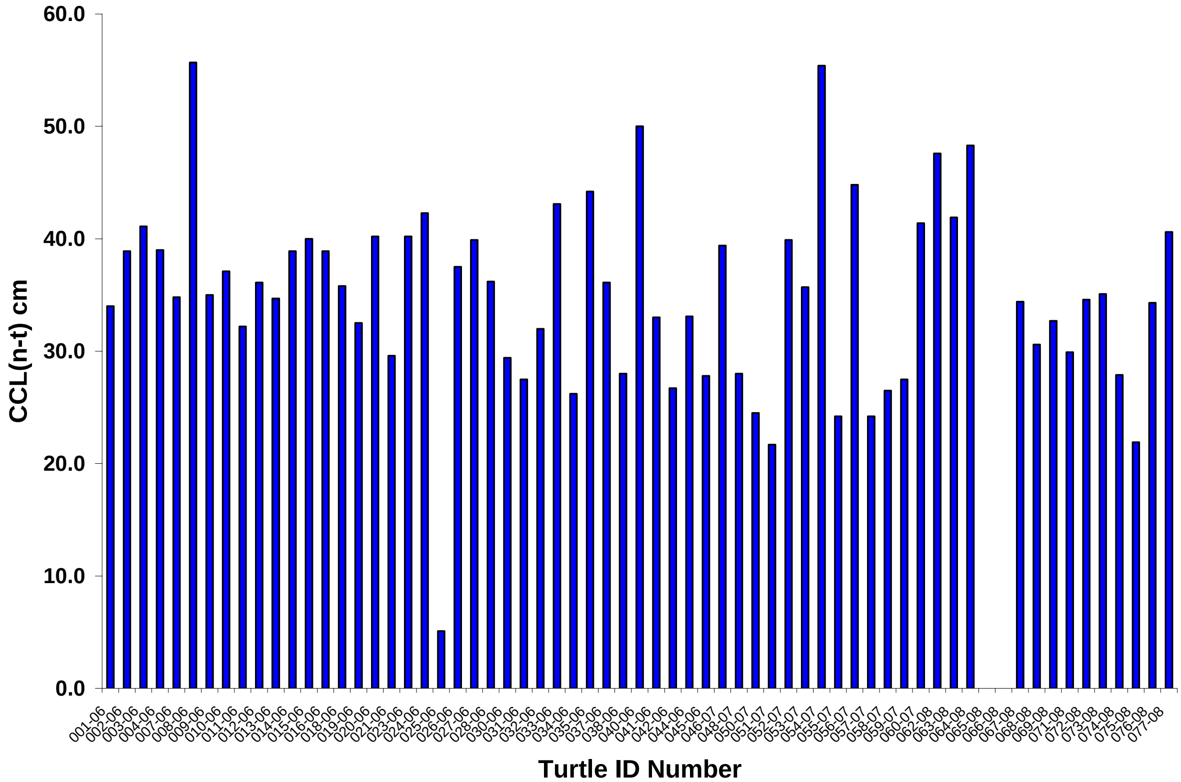


Figure 15. Maximum curved carapace lengths of all *E. imbricata* measured from March, 2007 – December, 2008.

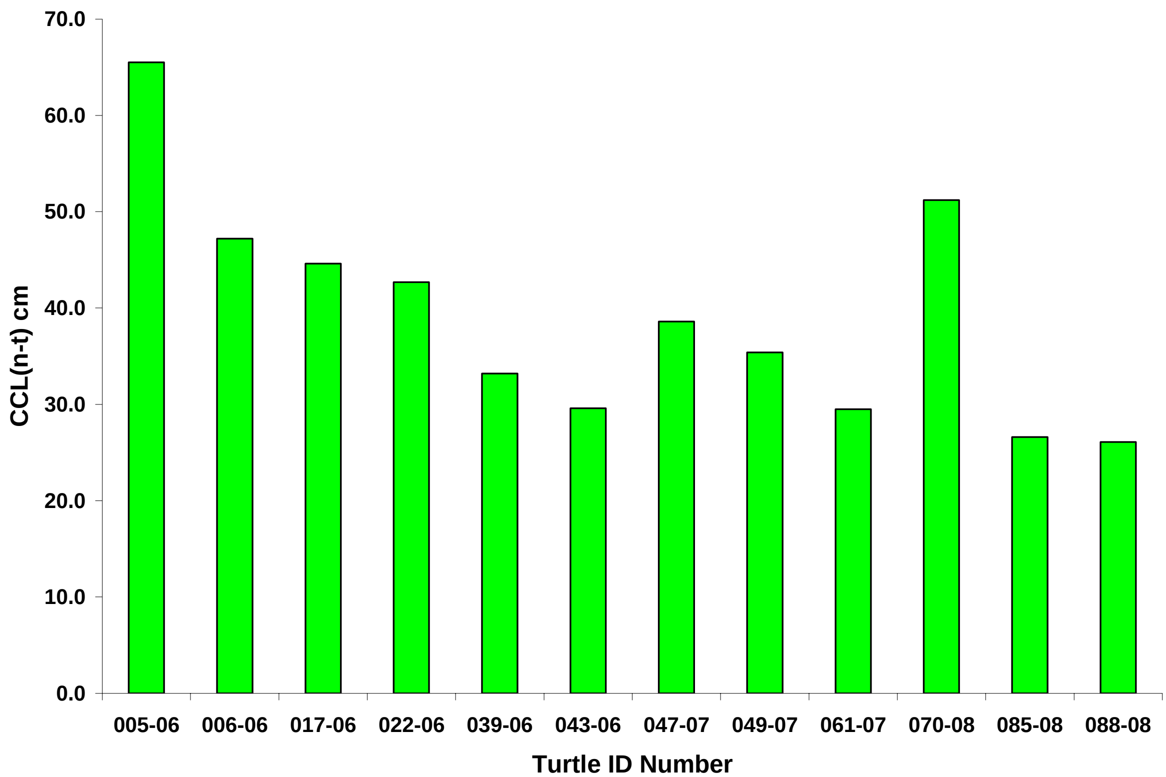


Figure 16. Maximum curved carapace lengths of all *C. mydas* measured from March, 2007 – December, 2008. Four individuals were not measured with SCL.

Table 3. Measurements of hawksbill (*E. imbricata*) and green (*C. mydas*) sea turtles at Oak Ridge, Roatán during T1 (February – March, 2006), T2 (June – July, 2006), T3 (September, 2006 – September, 2008), and T4 (March, 2007). CCL = curved carapace length. H = hawksbills; G = greens.

Time	Species (N)	Weight (kg) Range	CCL_{Max} Range	Mean Weight (kg)	Mean Length (cm)
T1	H (64)	0.8 – 16.9	21.7 – 55.7	4.52 ± 0.42	35.5 ± 0.95
T1	G (12)	1.7 – 22.6	26.1 – 65.5	7.03 ± 1.85	39.2 ± 3.38
T2	H (22)	1.8 – 17.4	28.8 – 57.4	5.2 ± 0.75	36.86 ± 1.43
T2	G (3)	7.3 - 23	44.6 – 65.7	13.6 ± 4.79	52.63 ± 6.59
T3	H (14)	2.8 – 19.2	31.2 – 58.5	7.26 ± 1.09	40.54 ± 1.79
T3	G (3)	7.7 – 21.2	44.7 - 65	13.2 ± 4.09	52.6 ± 6.28
T4	H (4)	4.1 – 8.7	36 – 43.9	6.9 ± 1.00	40.9 ± 1.71
T4	G (2)	7.7 – 11.7	44.5 - 49	9.7 ± 2.00	46.8 ± 2.25

Growth Rates

In Table 4 it can be seen that turtles both gained and lost weight. Between all measurement times *E. imbricata* increased in weight, while *C. mydas* had increases in both the first and last measurement times, but had a mean decrease between T2 and T3.

Table 4. Weight differences (kg) of turtles weighed during T1 to T4. H = hawksbills; G = greens.

Species	Weight (kg) T1 – T2 (N)	Weight (kg) T2 - T3 (N)	Weight (kg) T3 – T4 (N)
H	0.23 ± 0.12 (22)	0.68 ± 0.16 (14)	0.63 ± 0.31 (4)
G	0.46 ± 0.12 (3)	-0.40 ± 0.70 (3)	0.5 ± 0.5 (2)

Radio Tracking and Home Range Analyses of Hawksbills

The home range analysis is ongoing and results are preliminary, but it appears that home ranges are small. Five of the six turtles remained close to their release sites (Figures 17-21), moving only short distances to surrounding shallow patch reefs. On the other hand one turtle moved approximately 2.5 km away from its release sight, but eventually situated itself on a shallow patch reef (Figure 22).

Figure 17. The movements of turtle 037-06 "Freddie" during the summer of 2007. ☆ represents the release sight, while ○ represents sightings.

Figure 18. The movements of turtle 044-06 "Rollie-Pollie-Yollie" during the summer of 2007. ☆ represents the release sight, while ○ represents sightings.

Figure 19. The movements of turtle 046-07 "Awesome" during the summer of 2007. ☆ represents the release sight, while ○ represents sightings.

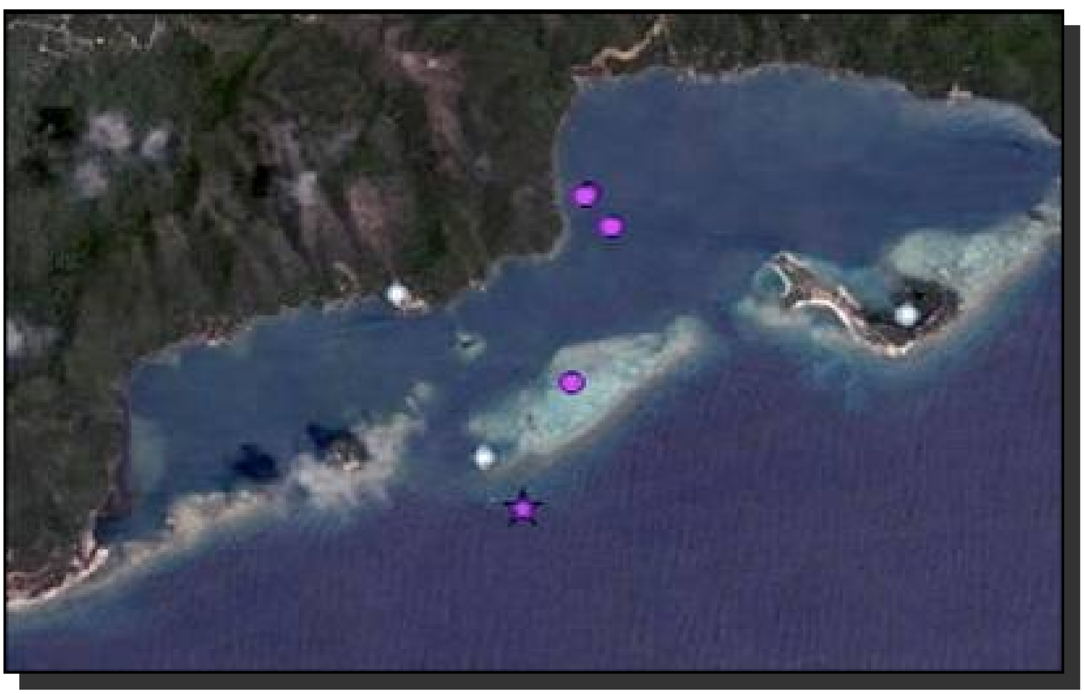


Figure 20. The movements of turtle 052-07 "Little Gem" during the summer of 2007. ☆ represents the release sight, while ○ represents sightings.

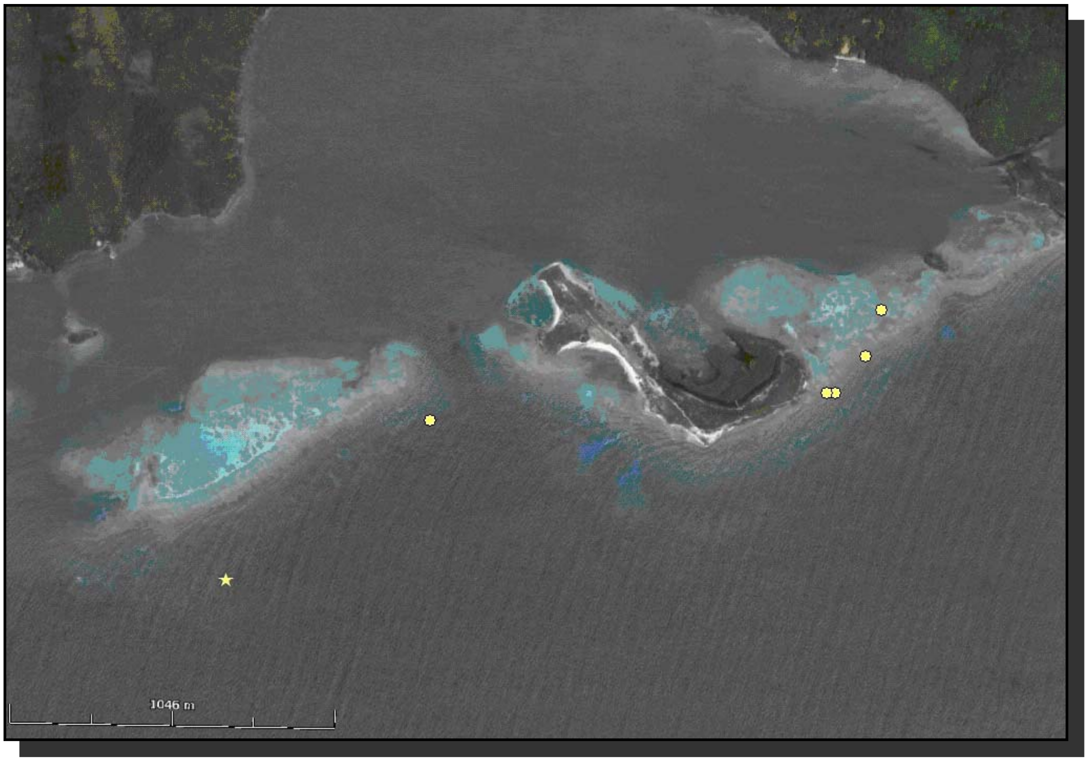


Figure 21. The movements of turtle 073-08 “Rico” during the summer of 2008. ☆ represents the release sight, while ○ represents sightings.

Figure 22. The movements of turtle 053-07 “Pooko” during the summer of 2007. ☆ represents the release sight, while ○ represents sightings.

Minimum convex polygon calculations do convey a small home range for all six turtles (Table 5). While the fixed kernel density calculations have yet to be completed, by looking at preliminary figures it can be observed that these turtles are clustering around certain areas (Figure 23)

Table 5. The home range areas calculated for the six juvenile hawksbills over the summers of 2007 and 2008.

Turtle ID	**Area (m^2)**
037-06	168684.2689
044-06	547473.6639
046-07	458972.2840
052-07	154043.4391
053-07	509692.5897
073-08	563249.6651

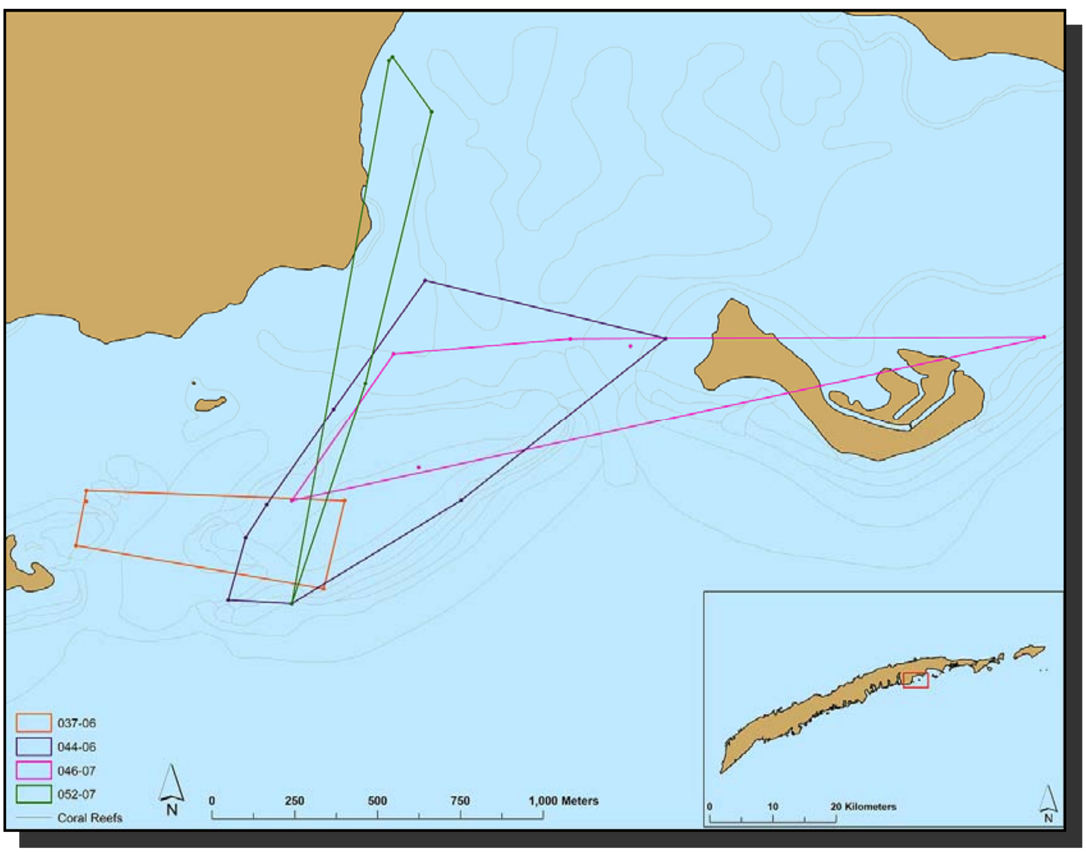


Figure 23. Home range polygons for 4 juvenile hawksbill sea turtles tagged with radio transmitters between July, 2007 and March, 2008.

Hawksbill Prey Species Analyses

The mean abundance was higher for six of the 12 species surveyed when comparing the turtle versus non-turtle sites. The means of these six species in the turtle sites increased by a minimum of 10.3 % in *Chondrilla nucula* and a maximum of 1695.0% in *Spirastrella coccinea* (Table 6).

The species with the lowest means in the non-turtle sites were *Chondrosia reniformis* at Calvin's Crack with a mean of 0.25, and *Geodia neptuni* at Dos Hermanas with a mean of 0.25 (Table 7). The species with the highest means in the non-turtle sites were *Pseudoptergorgia sp*. at Tortuga Wall with a mean of 96.00 and *Geodia gibberosa* at Church Wall with a mean of 107.30 (Table 7).

Table 6. The means for each species in both non-turtle and turtle sites, and the percentage increase in species with a higher mean in turtle sites. * represents species that had a higher mean in turtle sites.

Species	Mean for species in non-turtle site	Mean for species in turtle site	Percentage increase in mean
Acorina sp.	0.58	0.47	
Chondrilla nucula	27.18	29.97*	10.30%
Chondrosia reniformis	0.43	0.74*	71.70%
Geodia gibberosa	29.74	65.08*	118.80%
Geodia neptuni	1.47	0.86	
Pseudoptergorgia elisabethi	12.00	37.47*	212.20%
Pseudoptergorgia sp.	40.22	14.57	
Spirastrella coccinea	0.17	2.99*	1695.00%
Suberites ficus	0.08	0.03	
Suberites domuncula	9.00	1.77	
Anemonia sulcata	0.00	0.41*	
Palythoa caribaeorum	6.58	3.02	

The species with the lowest means in the turtle sites were *Suberites ficus* at Lime Cay with a mean of 0.20, *Anemonia sulcata* at Diamond Wall, and *Chondrosia reniformis* at Paradise Wall both with a mean of 0.25 (Table 8). The species with the highest means in the turtle sites were *Pseudoptergorgia elisabethi* at Diamond Wall with a mean of 131.00, and *Geodia gibberosa* at The Lodge with a mean of 135.50 (Table 8).

Table 7. The means for each species in non-turtle sites, arranged by survey site.

Species	Caribe Point	Calvin's Crack	Church Wall	Alcoholic Dog	Tortuga Wall	Dos Hermanas
Acorina sp.	1.25	2.25	0.00	0.00	0.00	0.00
Chondrilla nucula	0.40	16.25	29.33	22.67	18.67	75.75
Chondrosia reniformis	0.00	0.25	2.33	0.00	0.00	0.00
Geodia gibberosa	7.75	8.00	107.33	11.33	6.00	38.00
Geodia neptuni	2.5	2.75	0.00	3.33	0.00	0.25
Pseudoptergorgia elisabethi	2.75	5.50	2.00	14.00	8.00	39.75
Pseudoptergorgia sp.	25.00	39.25	33.00	24.33	96.00	23.75
Spirastrella coccinea	0.00	0.00	0.00	0.00	0.00	1.00
Suberites ficus	0.50	0.00	0.00	0.00	0.00	0.00
Suberites domuncula	2.00	0.75	1.67	2.67	0.67	1.25
Anemonia sulcata	0.00	0.00	0.00	0.00	0.00	0.00
Palythoa caribaeorum	3.25	9.50	8.33	0.33	9.33	8.75

Table 8. The means for each species in turtle sites, arranged by survey site.

Species	Paradise Wall	Port Royal Gorge	Port Morgan	The Lodge	The Reef	Lime Cay	Calabash Bight	Diamond Wall
Acorina sp.	1.00	2.00	0.00	0.00	0.00	0.00	0.00	0.75
Chondrilla nucula	9.00	13.67	67.00	1.00	56.67	27.40	24.00	41.00
Chondrosia reniformis	0.25	0.00	0.00	0.00	0.00	0.00	5.67	0.00
Geodia gibberosa	43.00	19.67	101.67	135.50	46.67	27.60	80.00	66.50
Geodia neptuni	1.25	5.67	0.00	0.00	0.00	0.00	0.00	0.00
Pseudoptergorgia elisabethi	85.00	70.33	0.00	0.00	0.00	13.40	0.00	131.00
Pseudoptergorgia sp.	14.50	9.67	0.00	0.00	0.00	9.00	11.60	71.75
Spirastrella coccinea	0.00	0.00	0.33	19.50	0.00	2.60	0.00	1.50
Suberites ficus	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
Suberites domuncula	1.00	1.00	0.33	10.00	0.00	0.80	0.00	1.00
Anemonia sulcata	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.25
Palythoa caribaeorum	6.75	4.67	2.33	2.00	0.33	0.40	2.67	5.00

When comparing the mean abundance and mean density for non-turtle and turtle sites an independent t-test showed a significant difference for two species, *Pseudoptergoria elisabethi* and *Palythoa caribaeorum*. *Pseudoptergoria elisabethi* is more abundant in turtle sites (Figure 24), while *Palythoa caribaeorum* is marginally more abundant in non-turtle sites (Figure 25).

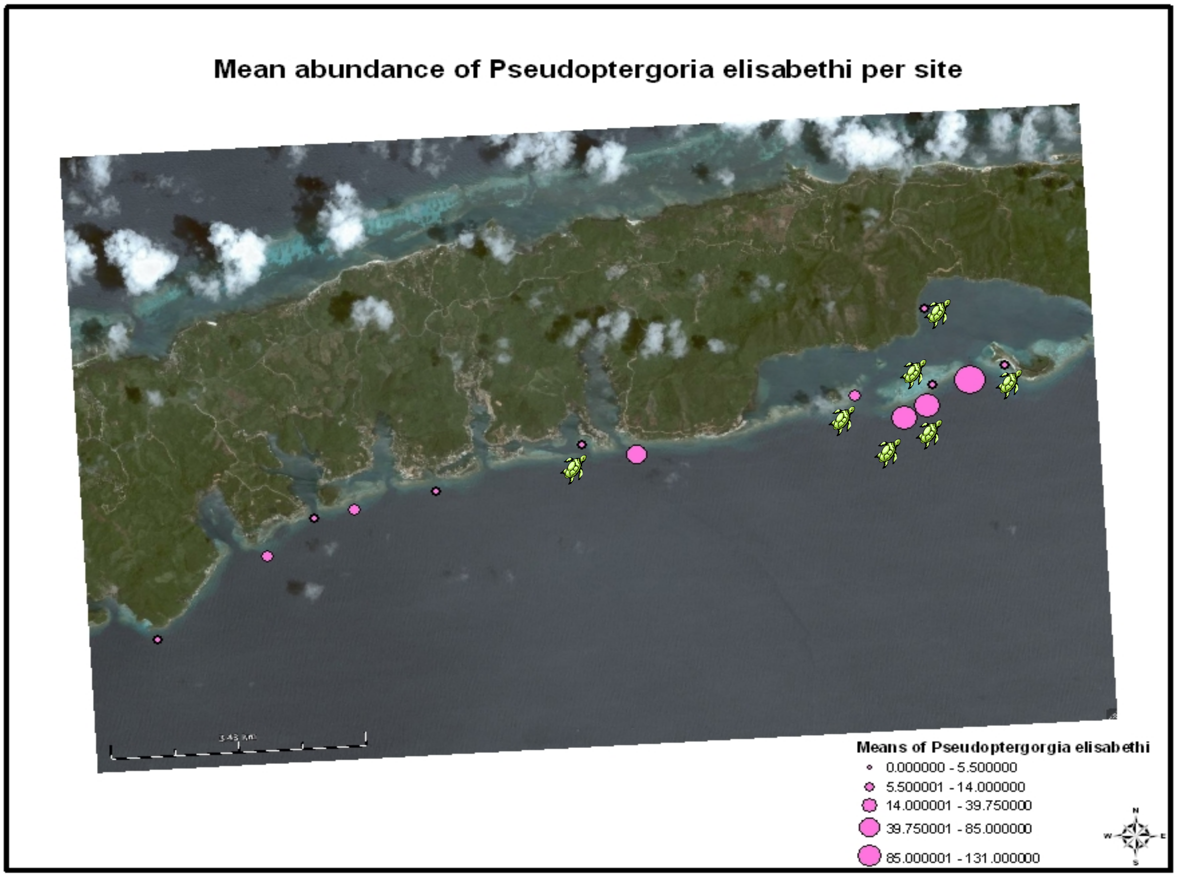


Figure 24. Distribution of *Pseudoptergorgia elisabethi* among the turtle and non-turtle sites.  denotes a turtle site.

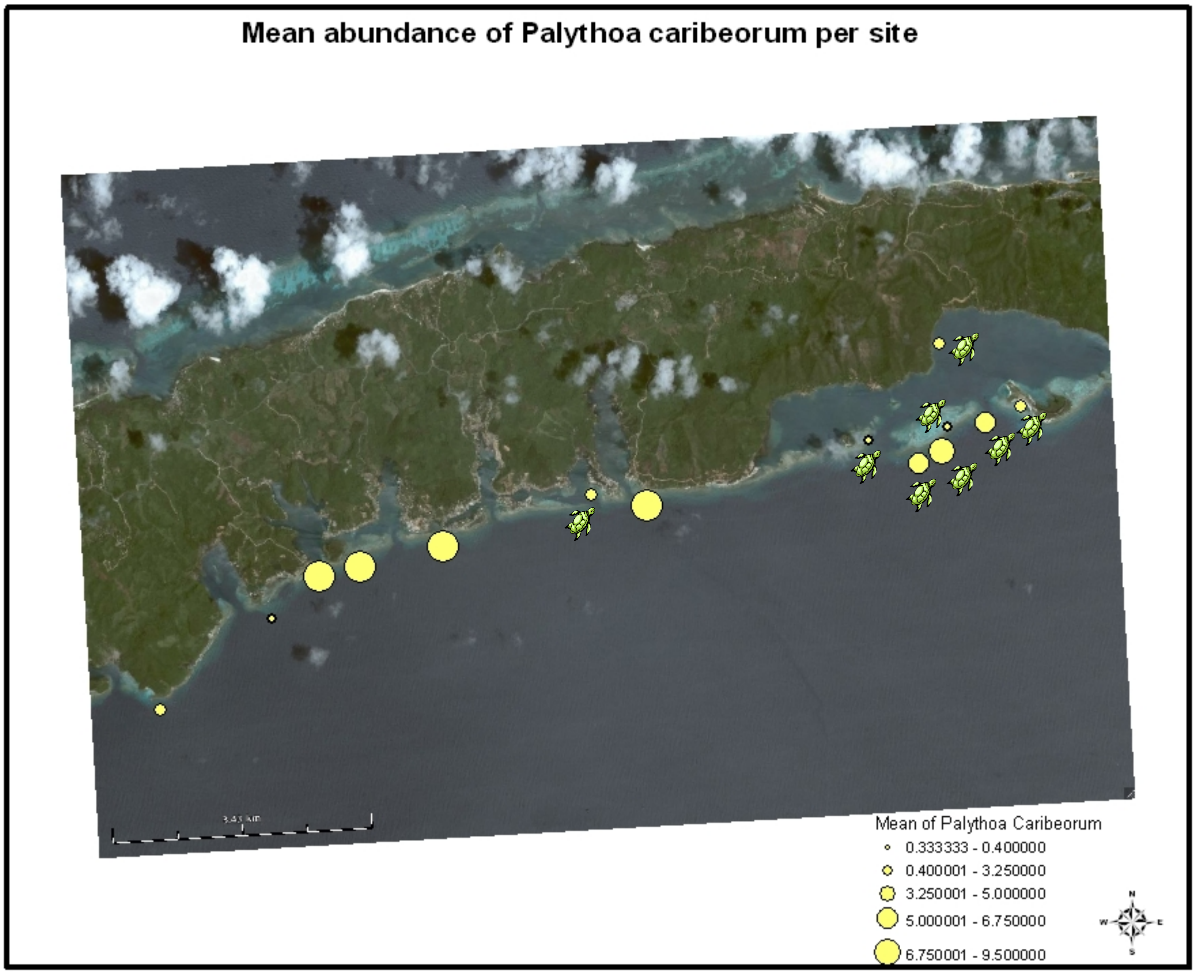


Figure 25. Distribution of *Palythoa caribaeorum* among the turtle and non-turtle sites.  denotes a turtle site.

Hawksbill Nesting Beach Reconnaissence

During the pre-project activity period of 2006, we visited and monitored (for a portion of the nesting season) 11 beaches. We received anecdotal evidence of turtle nesting on all of the beaches we visited (Figure 26), and collected information on each beach (Table 9). Unfortunately, many of the people we interviewed were unable to provide definitive evidence of species-level identification for nesting turtles. Some reports provided by interviewees suggested that nesting had taken place on a few beaches as recently as the year before (i.e. 2005), but most beaches had not been visited by turtles in the last three to five years (according to residents). Furthermore, during the 2006 investigation period, we were unable to find any confirmed evidence of hawksbill nesting on any of the beaches we investigated.

The nesting season was reported by local community members to be between the months of June and November. These anecdotal estimates coincided well with the hawksbill nesting season for nearby Cayos Cohinos as reported by Hasbún (2002).

Figure 26. Map of potential nesting beach locations around Roatan, Honduras.

Table 9. Data recorded for each beach surveyed and monitored for the period March, 2006 – September, 2008. Monitoring group codes: SGD = Stephen G Dunbar; JB = Joe Breman; IB = Irma Brady; MB = Melissa Berube; OE = Outlook Expeditions; CD = Clay Donnelly; O = Osman Paz; DK = David Kirkwood.

Date	Beach Name	Lat/Long	Beach Area (m^2)	Monitoring Time	Monitoring Group
3/2/2006	Punta Gorda Beach	N16°24’40.1” W086°22’29.1”	43,267	9:30am – 12:10pm	SGD
3/7/2006	Flower’s Bay Beach	N16°17’24.6” W086°34’23.5”	44,273	2:00pm – 4:40pm	SGD,JB,IB
6/19/2006	Punta Pimienta Beach	N16°21’55.6” W086°29’45.5”	16,632	10:50am – 12:45pm	SGD,JB,IB
6/20/2006	West Bay Beach	N16°17'19.8" W086°35'46.0"	11,546	11:30am – 2:25pm	SGD,JB,IB
6/27/2006	Pandy Beach	N16°25'50.9" W086°16'42.3"	30,749	1:30pm – 2:45pm	SGD
6/27/2006	Camp Bay Beach	N16°25'44.7" W086°17'26.8"	18,909	10:35am – 1:20pm	SGD,IB
6/27/2006	Paya Bay Beach E	N16°25'38.0", W086°18'39.4"	21,586	1:20pm – 2:20pm	SGD
6/27/2006	Paya Bay Beach W	N16°25'43.55",W086°18'51.38"	3,529	11:25am – 1:10pm	SGD
6/27/2006	Franklin’s Beach	N16°23'39.5", W086°24'57.1"	31,999	9:30am – 11:00am	SGD
6/30/2006	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		12:30am – 5:00am	SGD,MB
7/7/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		12:15am – 4:15am	SGD,MB
7/14/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		12:25am – 3:45am	SGD,MB
7/17/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		8:15pm – 4:30am	OE
7/18/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		8:15pm – 4:30am	OE
7/18/2007	Paya Bay Beach E	N16°25'38.0", W086°18'39.4"		8:15pm – 4:30am	OE
7/19/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		8:15pm – 4:30am	OE
7/19/2007	Franklin’s Beach	N16°23'39.5", W086°24'57.1"		3:30pm – 5:20pm	SGD
7/19/2007	Pigeon Cayes Beach	N16°24'44.4", W086° 7'12.2"	37,841	2:30pm – 4:00pm	SGD,CD
7/20/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.78"		8:15pm – 4:30am	OE
7/20/2007	Paya Bay Beach E	N16°25'38.0", W086°18'39.4"		8:15pm – 4:30am	OE
8/11/2007	Lizzette’s Beach	N16°21'35.2", W086°25'27.9"	11,799	4:00pm – 9:00pm	O
8/14/2007	Camp Bay	N16°25'44.7", W086°17'26.8"		8:15pm –	OE

	Beach			4:30am	
8/15/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		8:15pm – 4:30am	OE
8/15/2007	Paya Bay Beach E	N16°25'38.0", W086°18'39.4"		8:15pm – 4:30am	OE
8/16/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		8:15pm – 4:30am	OE
8/17/2007	Camp Bay Beach	N16°25'44.7", W086°17'26.8"		8:15pm – 4:30am	OE
9/4/2007	Lizzette's Beach	N16°21'35.2", W086°25'27.9"		4:00pm – 9:00pm	O
9/9/2007	Lizzette's Beach	N16°21'35.2", W086°25'27.9"		5:15pm – 10:20pm	O
9/14/2007	Lizzette's Beach	N16°21'35.2", W086°25'27.9"		5:15pm – 10:20pm	O
9/21/2008	Morat Beach S	N16°25'39.7", W086°11'24.8"	18,909	11:30am – 1:00pm	SGD,DK
9/21/2008	Morat Beach N	N16°25'42.5",W086°11'29.3"		1:00pm – 3:00pm	SGD,DK

During the nesting season in 2008, we received anecdotal reports of hawksbills nesting on Morat Beach (N16°25'42.5", W086°11'29.3") from community members at the fishing village of St. Helena (N16°25'7.3", W086°12'31.4"). When we investigated the beaches on Morat on September 21, we were unable to verify the presence of crawls, nests, hatchling remains, or egg shells. We were later told by a fisherman from St. Helena that he expected turtles to begin nesting there at the beginning to middle of October. To date, we have received no confirmation of nesting activity there, although we have not been able to return to the island since the initial visit in September.

Hawksbill Aerial and Dive Monitoring

We made four flights over Roatán between July 16, 2007 and August 22, 2008 (Figure 14). Total flight time was 328 minutes. On all occasions we had two observers. We calculated the man-hours involved in the aerial surveys at 10.9 h, to date.

Locations of turtles sighted during aerial surveys are provided in Table 10. During the 328 minutes of survey time, we spotted 22 turtles, of which 22.7 % (5 individuals) were *E. imbricata*. Other species observed were greens (*Chelonia mydas*) and loggerheads (*Caretta caretta*) (Figure 27).

Table 10. Sightings and locations of turtles spotted during aerial surveys between July 16, 2007 and August 22, 2008.

Date	Latitude and Longitude	Species Spotted
July 16, 2007	N16°24'26.5",W086°25'45.2"	*C. mydas*
July 16, 2007	N16°25'33.4",W086°21'49.3"	*C. mydas* or *C. caretta*
July 16, 2007	N16°24'50.8",W086°15'6.5"	*C. mydas* ?
July 19, 2007	N16°25'21.0",W086°12'7.6"	*C. mydas*
July 19, 2007	N16°24'49.7",W086°23'11.7"	*C. mydas* or *C. caretta*
August 19, 2008	N16°26'15.7",W086°17'58.8"	*E. imbricata*
August 19, 2008	N16°24'54.7",W086°14'18.3"	*E. imbricata*
August 22, 2008	N16°16'10.9",W086°36'20.6"	*C. mydas* or *C. caretta*
August 22, 2008	N16°19'38.0",W086°34'53.4"	*C. mydas* or *C. caretta*
August 22, 2008	N16°22'3.1",W086°30'47.6"	*C. mydas*
August 22, 2008	N16°22'3.1",W086°30'47.6"	*C. mydas*
August 22, 2008	N16°22'3.1",W086°30'47.6"	*C. mydas*
August 22, 2008	N16°23'49.8",W086°27'1.6"	*C. mydas* or *C. caretta*
August 22, 2008	N16°24'22.8",W086°25'17.0"	*C. mydas* or *C. caretta*
August 22, 2008	N16°24'59.6",W086°23'32.0"	*C. mydas*
August 22, 2008	N16°26'5.8",W086°20'33.2"	*C. mydas*
August 22, 2008	N16°26'4.6",W086°20'13.5"	*C. mydas*
August 22, 2008	N16°26'15.1",W086°18'27.5"	*C. mydas* or *C. caretta*
August 22, 2008	N16°26'27.2",W086°15'37.7"	*E. imbricata*
August 22, 2008	N16°26'3.8",W086°12'4.4"	*E. imbricata*
August 22, 2008	N16°24'36.0",W086°15'25.0"	*E. imbricata*
August 22, 2008	N16°21'32.1",W086°24'38.2"	*C. mydas* or *C. caretta*

We also collected reports by dive operators on turtles sighted during dives by tourists through the activities of three dive resorts on the southeast end of Roatán. These dive operators were the Reef House Resort, CoCo View Dive Resort and Fantasy Island Dive Resort. Results for dive sightings of adult and juvenile hawksbills are shown in Figures 28 and 29, respecively. Most dive sightings of adult hawksbills (85.8 %) occurred on the SE and SW sides of Roatán (42.9 % each), while the remaining 14.3 % of sightings were on the NW side of the island (Figure 28). In addition, a single adult male has been seen repeatedly at Pirates Point, along the SE coast during the 2008 mating season (as recently as November 23). Juvenile hawksbills were sighted by divers most often (89.5 %) along the SE coast of the island, while 3.9 % were seen off both the SW and W shores, respectively. Of the juveniles sighted, 2.6 % were seen along the NW shores of the island (Figure 29).

In total thus far, 5 adult males, 1 adult female, 8 unsexed adults, and 76 juveniles have been seen by divers or local fishermen while free diving (Figure 30).

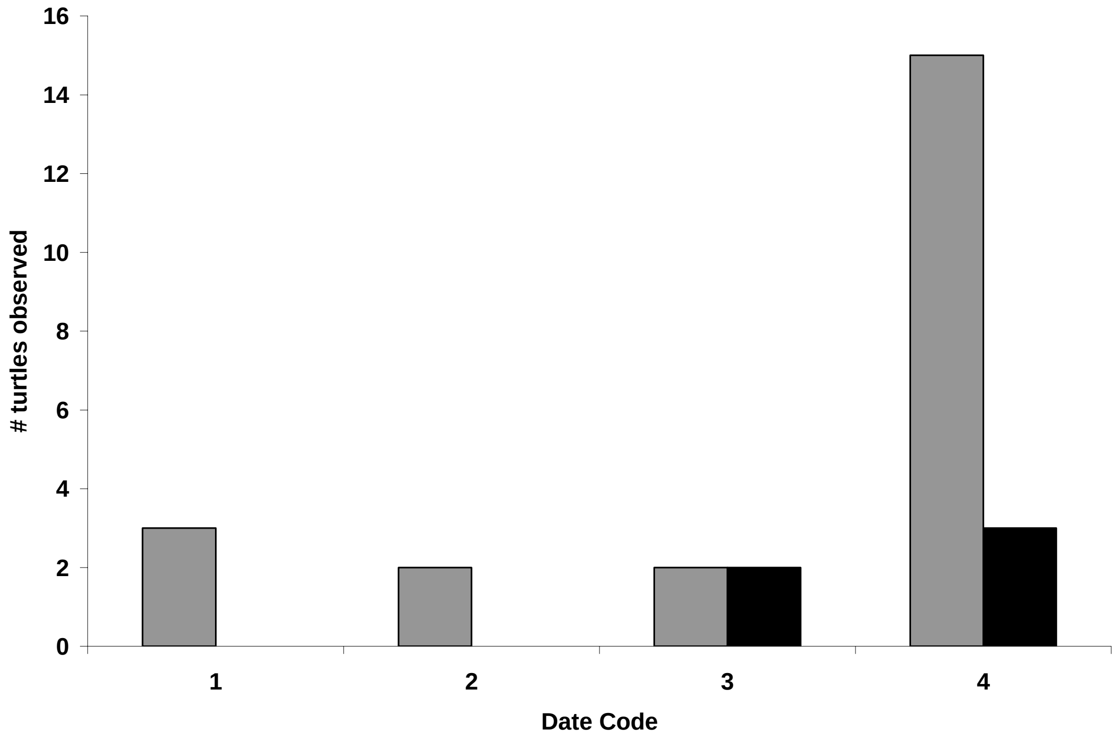


Figure 27. Number of turtles spotted during 338 minutes of aerial surveys with two observers. Grey bars represent all turtles spotted independent of species. Black bars are the number of hawksbill turtles spotted. Date codes: 1 = July 16, 2007; 2 = July 19, 2007; 3 = August 19, 2008; 4 = August 22, 2008.

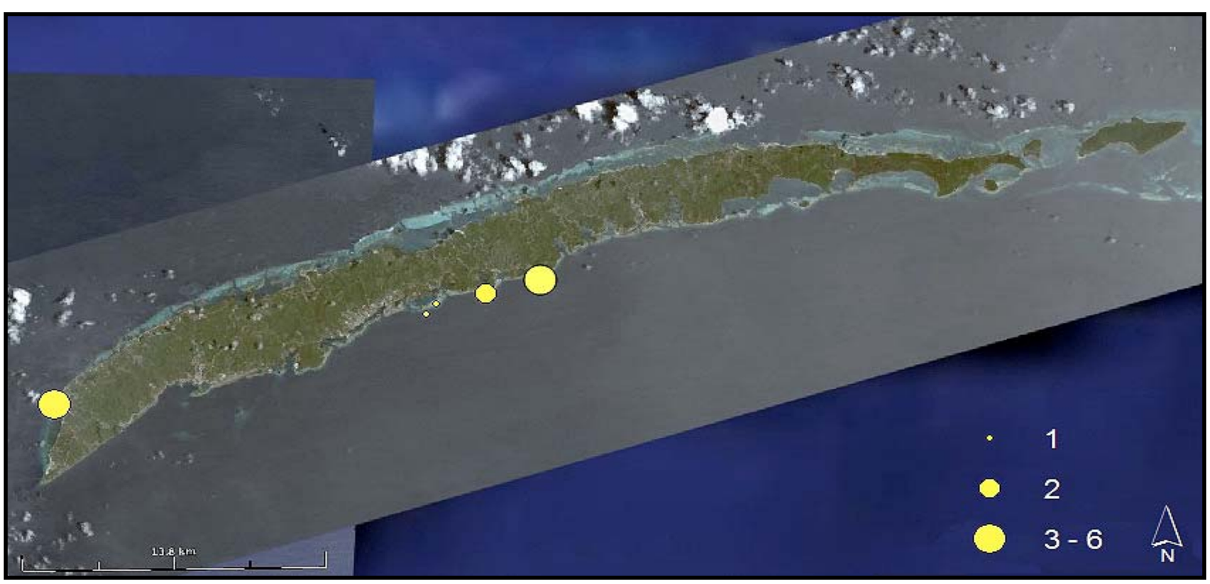


Figure 28. Map of Roatan showing predominant dive locations where adult *E. imbricata* were sighted between 2007 and 2008.

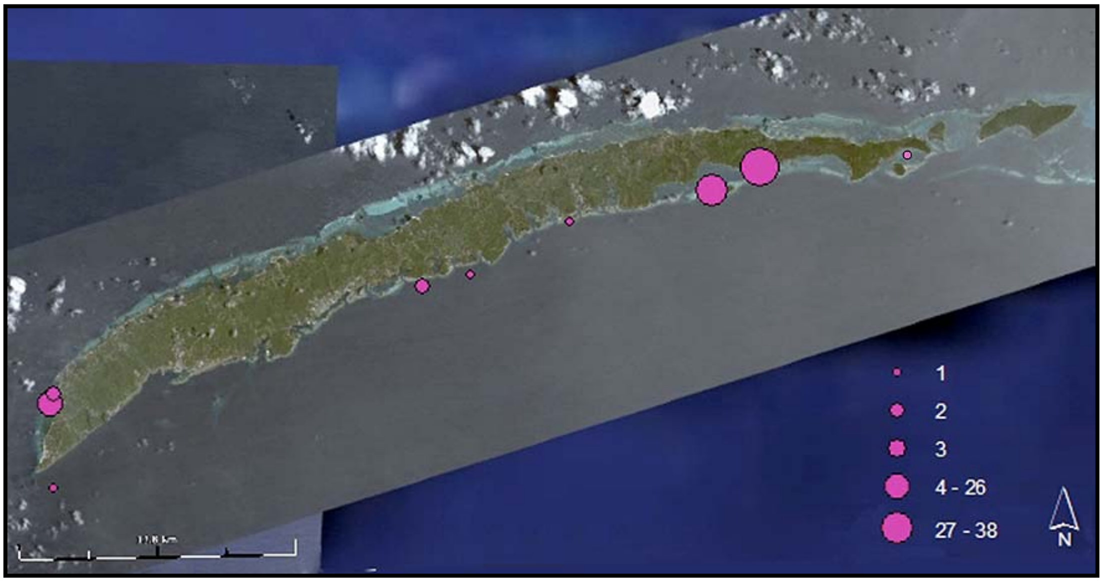


Figure 29. Map of Roatan showing the predominant dive locations where juvenile *E. imbricata* turtles were sighted between 2007 and 2008.

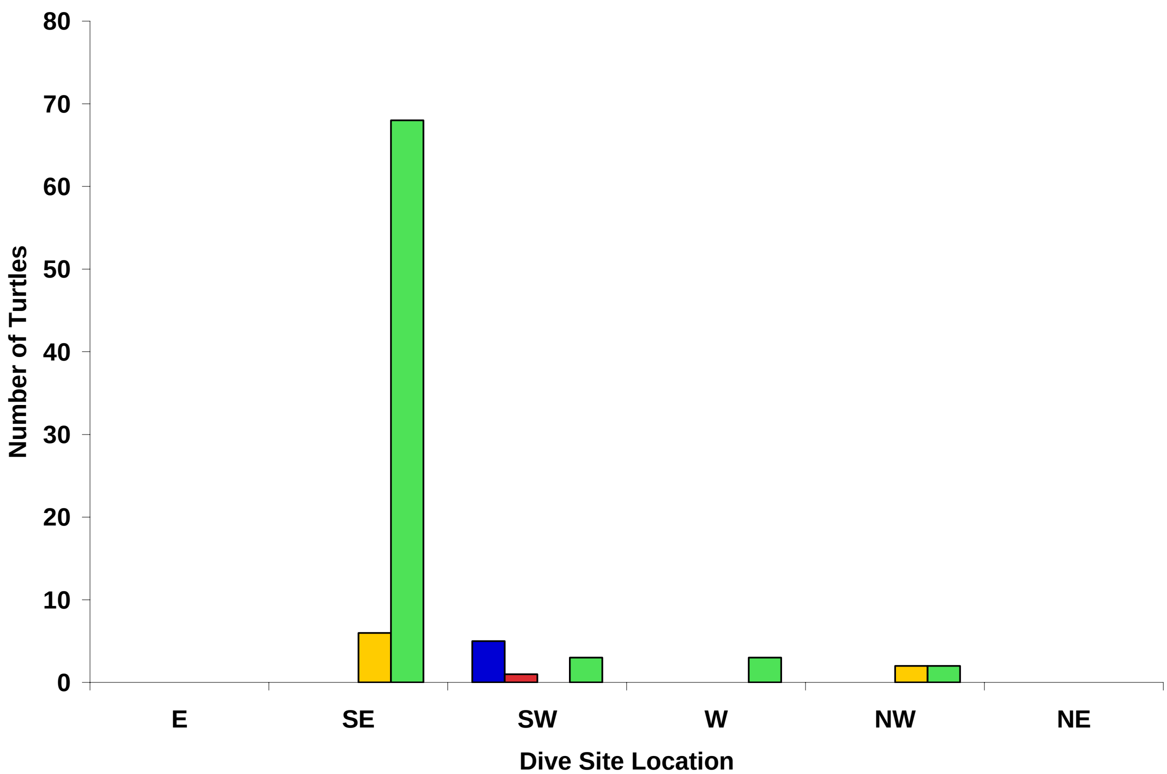


Figure 30. Number of *E. imbricata* sighted during dives between 2007 and 2008, where ☐ = juveniles; ☐ = adult males; ☐ = adult females; ☐ = unsexed adults.

Turtle Nesting Hotline Art and Jingle Challenge

To date, we have been able to attend 12 schools throughout Roatán (Table 2), and have addresses approximately 1086 students around the island. Although Grades 4 – 12 have been the target audiences for the presentations and "Challenge", student audiences have ranged from Kindergarten to Grade 12. Student groups receiving the presentation and "Challenge" ranged from one-room school groups of 6 – 8 students, to school campuses with over 400 students.

From the entries received, a small panel selected four pieces of art which will be printed as posters with the Hotline numbers. These posters will then be placed throughout Roatán to publicize the numbers to call when a turtle is sighted at any beach on the island. From the jingle entries received, a jury will select one jingle which will be recorded in a studio in Spanish and English to be played on public radio stations throughout Honduras as a public service announcement. Each competition winner will receive public recognition of his/her artwork and/or jingle each time it is displayed, or announced. Each art competition winner will also received US$40, while the jingle competition winner will receive US$50.00

DISCUSSION

Measuring, Weighing, Tagging and Tissue Sampling

All tagged turtles to date have been juveniles, as evidenced by carapace lengths less than 69.7 cm (Boulon, 1994; Dunbar et al., 2008; León and Diez, 1999; van Dam and Diez, 1996; van Dam and Diez, 1997). It is possible that the area in which the majority of the incidental captures by local fishermen occurs, is an area of juvenile recruitment, as suggested by Dunbar et al (2008). In most other areas along the south coast of Roatán, there are few reports of juvenile *E. imbricata* and more reports of adults of this species, both to the east and west of Port Royal.

Weights of juvenile sea turtles have been correlated with carapace length in previous studies (Dunbar et al., 2008; Georges and Fossette, 2006). The measurement of both length and weight allow the estimation of growth rates. Understanding growth rates is critical to sound managemnet of sea turtles because the steady increase in growth rates have implications for the possibility of rapid growth in the wild (Frazer, 1982). Because food may be a growth limiting factor, reduced growth rates may cause juvenile turtles to be susceptible to longer periods of potential predation (Balazs, 1982a). Although the capture of juvenile turtles in the wild is difficult, and studies concerning captive turtles may have little relevance to determine growth rates of wild turtles, Frazer (1982) suggests that both types of studies should allow us to estimate growth curves for juvenile turtles in the wild, and will help us make better estimates of mean age at maturity using the current data.

Radio Tracking and Home Range Analyses of Hawksbills

While we have few data to date, there is evidence to suggest a separation of habitat. Juvenile *E. imbricata* have been reported on other occassions to establish and maintain small home ranges. According to our preliminary results, home ranges are small. Studies indicate that juvenile sea turtles maintain a small home range (Horrocks et al. 2001; Seminoff et al. 2002; Avens et al. 2003), and the results of the current study likewise suggest these juvenile *Eretmochelys imbricata* maintain small home ranges. All six turtles maintained home ranges near shallow reefs once released. The findings of this study are also similar to that of work on juvenile greens (Avens et al., 2003), who also established home ranges close to their release site.

The fact that each of these turtles has maintained a range, and their locations appear clustered around shallow reef may indicate that home ranges may be related to food availability. Since hawksbills feed on a variety of reef species, such as sponge and soft coral (Bruenderman and Terwilliger 1994; Horrocks 1992), and the turtles in this study are distributed around reef areas, this suggests that food availability may play a role in where home ranges are established. This was also found by van Dam and Diez (1997), who concluded that the home ranges of juvenile hawksbills in Puerto Rico were influenced by food availability.

Hawksbill Prey Species Analyses

When comparing overall abundance of total prey species in both the turtle and non-turtle sites, *Geodia gibberosa, Chondrilla nucula,* and *Pseudoptergorgia elisabethi* had the highest abundances. In the non-turtle sites, the species with the highest means and densities were *Pseudoptergorgia sp.* and *Geodia gibberosa*, and in the turtle sites the species with the highest means and densities were *Pseudoptergorgia elisabethi* and *Geodia gibberosa*. This correlates with the results from literature that show hawksbills prefer *Geodia sp., Chondrilla sp.*, and *Pseudoptergorgia sp.* (Leon and Diez, 1999; Leon and Bjorndal, 2002; Diez et al. 2003; Cuevas et al. 2007). The high abundance of *Geodia gibberosa, Chondrilla nucula*, and *Pseudoptergorgia elisabethi* in the non-turtle sites may be due to a number of reasons. It is possible that these species are some of the most abundant sponge and soft coral species located within the reefs around Roatán, so hawksbills may be establishing their habitat based on selectivity for other species. Perhaps the sites that are considered non-turtle were not always that way, it is possible that in the past juveniles were located in these sites or that they are present now, and have not been sighted.

The significant difference in abundance and density between non-turtle and turtle sites for *Pseudoptergoria elisabethi* and *Palythoa caribaeorum* was somewhat unexpected. The distribution of *Pseudoptergoria elisabethi* demonstrates this species is more abundant in turtle than non-turtle sites, however, this species was also abundant in non-turtle sites. The higher abundance of *Pseudoptergorgia elisabethi* in turtle sites than non-turtle sites correlates with results from the literature which show that hawksbills have a high preference for this food species, and tend to distribute themselves in areas where it is highly abundant (Leon and Diez, 1999; Leon and Bjorndal, 2002; Diez et al. 2003; Cuevas et al. 2007). The high abundance of this species in non-turtle sites could be the result of it being a common reef species. The distribution of *Palythoa cariabeorum* shows a higher abundance in non-turtle than turtle sites, but the abundance between non-turtle and turtle sites does not vary drastically. It has been demonstrated that hawksbills around Roatán do feed on *Palythoa caribaeorum* (Dunbar et al., 2008), so the fact that this species is more abundant in non-turtle sites may have little to do with the distribution of hawksbills in the area.

The results of this study are preliminary. The purpose was to examine the sponge, soft coral, zoanthid, and anemone composition at sites where juvenile hawksbills are known to currently reside and compare the relataive abundance of these species to sites where juvenile hawksbills are not known to currently reside.

Hawksbill Nesting Beach Reconnaissence

We were unable to meet three objectives originally proposed in the project supported by the USFWS-MTCF grant for the project. The tagging of nesters and assessment of hatching success was not undertaken because, aside from the single hawksbill nesting at Lizzette's Beach, we were unable to locate any nesting turtles during monitoring events. This impacted project results by not allowing us evaluate numbers of nesting attempts, successful nestings, or hatching success on any measurable scale. With additional intensive monitoring, as well as the Turtle Nesting Hotline, we are hopeful that we will see more results in the 2009 season.

One aspect of beach reconnaissance that did not meet our objectives was the number of beaches we were able to monitor. Although the objective of the project was a preliminary reconnaissance, being able to monitor more beaches more closely may have provided substantially more information. We plan to develop an intensive, season-long monitoring system for the coming seasons.

The proposed training aspect of the project was also not fully realized. Although we had planned to train several local community members, we found resistance by local people to receive training if it did not include some form of compensation. This may have impacted the amount of information that was reported to us because potential local participants did not have a vested interest in reporting sightings without any form of reward or remuneration.

Hawksbill Aerial and Dive Monitoring

The data resulting from dive sightings are likely to be highly influenced by the concentration of research on juvenile *E. imbricata* carried on in the SE vicinity of the island by the TAPS project. The remaining dive sightings result from the three dive operators on the SE and SW of the island (Reef House Resort, Coco View Resort, and Fantasy Island Resort) that have been trained and (more or less) consistently collect sightings data. Both Coco View and Fantasy Island Resorts regularly visit dive sites along the SW and W of the island. With the addition of Barefoot Cay (part of the Roatán Marine Park) and dive operators on the north and northeast coasts of the island over the 2009 season, we expect to see an increase in the number of sightings of *E. imbricata*, as well as *C. caretta*, and *C. mydas*.

Turtle Nesting Hotline Art and Jingle Challenge

The "Turtle Nesting Hotline's Turtle Art and Jingle Challenge" has generated significant interest in sea turtle conservation among schools and school children on the island of Roatán. The majority of students to whom the program was presented expressed both curiosity and concern about the species and status of sea turtles in the waters around Roatán. Through informal question and answer sessions during and after the presentations, the low level of awareness regarding sea turtle conservation, threats to survival, biology and ecology were repeatedly confirmed. However, by the completion of each presentation, students and teachers were more enthusiastic and willing to become involved in some type of conservation effort than prior to the presentations. We were very pleased with the support and enthusiasm of school teachers and administrators who were eager for their students to both hear about sea turtle conservation, as well as become involved with conservation efforts on the island. Under the direction of Ms. Carolyn Veith, the Biology class from the Children's Palace School organized a visit to the Reef House Resort to see the TAPS program. This enthusiastic group comprised 15 students, three adults and one child. After the TAPS visit, Ms. Veith requested to become a TAPS Partner and volunteered her Biology class to become involved in quarterly beach clean-ups on Roatán. We're excited to know that ProTECTOR has inspired this school to become actively involved in seat turtle conservation with us.

Another very positive result of the project was the establishment of a ProTECTOR – Roatán Marine Park (RMP) partnership. This resulted from an invitation by ProTECTOR to the RMP to take part in presenting the "Challenge" to schools Dunbar was unable to attend. On reviewing the presentation and recognizing that it was compatible with RMP goals, personnel at the RMP translated the presentation into Spanish and began making presentations to schools throughout the island. As a result, the RMP is also interested in becoming a TAPS partner.

One drawback of the project was the limited time in which to publicize the "Challenge" over only one summer. However, we are contemplating modifying and continuing the presentation in the schools we were unable to invite into the "Challenge" in order to continue the awareness campaign of ProTECTOR and the "Turtle Nesting Hotline" around the island.

These data further underscore the need for a concerted, national program of turtle research to be launched into all aspects of sea turtle ecology, biology, life-history, physiology, conservation and management in Honduras.

RECOMMENDATIONS

The previously described studies represent significant advancement in our knowledge of the activities and distributions of sea turtles around the Bay Islands of Honduras to date. While these studies have been successful, they are limited in both temporal and spatial scales. For these reasons we provide the following brief recommendations to SAG: SERNA, DiBio, and DIGEPESCA:

1. Whereas each of the reported activities has been limited in data collection and in application of the data to the populations of sea turtles at large around the Bay Islands, **we recommend** that these studies be continued on an ongoing basis to collect further data on the status of hawksbill, green, and loggerhead sea turtles around the island of Roatán.
2. Whereas the reported studies were conducted only in a limited area of Roatán, **we recommend** that the study be expanded to include the other Bay Islands, such as Utila, Guanaja, Morat, Barbarat, and Cayos Conhinos, providing a standard methodology for data collection, and estimation of current population numbers of sea turtle species found in the Caribbean waters of Honduras.
3. Whereas the projects were limited by funding support from the central government of Honduras, **we recommend** that funds be earmarked for the continuance and expansion of these studies, and furthermore, that the government agencies involved in the conservation and protection of endangered sea turtles in the waters of Honduras, provide both actual funding support, as well as in-kind support to the projects.
4. Whereas there is no current vehicle to facilitate the sharing of data and information regarding the sea turtles of the Bay Islands, **we recommend** that an annual meeting be scheduled for the Bay Islands in which all agencies and individuals interested in the conservation and protection of marine turtles may have the opportunity to present

updated data, and discuss the direction of sea turtle research and conservation in the Bay Islands area.

5. Whereas the permitting for these studies has expired (June, 2009), **we recommend** that by actions of SAG, SERNA, DiBio, and DIGEPESCA, the renewal of a substantially longer-term permit be granted, and that the permit provide for the expansion of these studies to all Bay Islands.

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APPENDIX IA

Nesting Beach Data Collection Sheet (Nesting Female Data)

Date ________________ **Time of Laying** ______________________________

Beach Name ____________________ **Lat/Long (GPS)** _________________________

Turtle ID # N __________ - 07 ______ **Turtle Species** ____________________

Front Left Tag Number ______________ **Rear Left Tag #** ________________

Names of Data Recorder and Partner ____

Nest Tag # and Color	
Nest Depth (cm) - Bottom	
Nest Distance from Water (meters)	
Nest Location Habitat (bare sand, grass, in/under vegetation)	
Egg Count (# laid)	
Eggs Damaged (# broken during laying)	
Egg Diameter (cm) (10 normal eggs)	
Egg Weights (g) (same 10 eggs as measured above)	
CCL n-n[1] (cm)	
CCL n-t[2] (cm)	
CCW[3] (cm)	
SCL n-n (cm)[4]	
SCL n-t (cm)	
SCW (cm)	
Additional Comments, Markings, Health, etc.	

[1] Curved Carapace Length, notch to notch
[2] Notch to tip
[3] Curved Carapace Width. Measure all animals at the widest position.
[4] Straight Carapace Length, notch to notch.

APPENDIX IB

Nesting Beach Data Collection Sheet (Hatching Data)

Date ________________ **Time of First Emergence** ______________________

Beach Name ____________________ **Lat/Long (GPS)** _________________________

Nest Tag # and Color[1] ___________________ **Turtle Species** ____________________

Nesting Female Turtle ID # **N________- 07**

Nesting Female Front Left Tag Number ___________ **Rear Left Tag #** ______________

Names of Data Recorder and Partner ____

Date Nest Laid	
Incubation Length	
# Emerged	
# Broken Shells in Nest	
# Live in Nest	
# Dead in Nest	
# Unhatched Eggs	
Additional Comments	

[1] From Nesting Female Data Sheet. These numbers should be the same.

APPENDIX IIA

REGIONAL SEA TURTLE ACTION PLAN FOR THE MESOAMERICAN REEF

Field Data Collection Form
Roatan, Bay Islands, Honduras

Tortugas Marinas

Key:
AD – ADULT TURTLE
JV – JUVENILE TURTLE

DATE	DIVE SITE	DEPTH OF SIGHTING	DIVER LOGGING	HAWKSBILLS		GREENS		LEATHERBACKS		LOGGERHEADS		OTHER/ NOT IDENTIFIED	

Notes:
Record all zeros (0)
Fill in all cells
If uncertain about species use "Other/not identified"
Fill in for next 10 consecutive dives/snorkels
Note all turtles seen off boat as well (before/after dives)
Observations:

Please record data and return data sheets electronically at the **end of each month** to the e-mail listed above for Dr. Stephen Dunbar
Thank you for your participation!

APPENDIX IIIA (English)

Hawksbill (*Eretmochelys imbricata*)

- Overlapping plates on the shell.
- Four scales on the sides of the shells.
- Saw-toothed shell plate edges.
- Four scales in front of the central head scale.
- Sharp, down-turned "beak."
- Moderately sized as adults.

Loggerhead (*Caretta Caretta*)

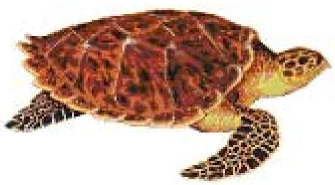
- Sutured plates on the shell.
- Five scales along the sides of the shells.
- Smooth shell plate edges.
- More than two scales in front of the central head scale.
- Large head and neck.
- Large size as adults.

Green (*Chelonia mydas*)

- Sutured plates on the shell.
- Four scales along the sides of the shells.
- Smooth shell plate edges.
- Two scales in front of the central head scale.
- Very large size as adults.

TAPS SERNA PROTECTOR DiBio

APPENDIX IIIB (Español)



Hawksbill (*Eretmochelys imbricata*)

- Platos emplalmados en la concha
- Cuatro escamas en los lados de la concha.
- Forma de diente de serrucho por los lados de la concha.
- Cuatro escamas delante de la escama principal central.
- "Pico" agudo
- Moderado en el tamaño.

Loggerhead (*Caretta Caretta*)

- Platos juntos en la concha
- Cinco escamas a lo largo de los lados de la concha.
- Bordes lisos de la concha
- Más de dos escamas delante de la escama principal central.
- Cabeza y cuello grande.
- Grande en el tamaño.

Green (*Chelonia mydas*)

- Platos juntos en la concha.
- Cuatro escamas a lo largo de los lados de la concha.
- Bordes lisos de la concha.
- Dos escamas delante de la escama principal central.
- Muy grande en el tamaño.

TAPS SERNA PROTECTOR DIBio