Final Report

The PROTECTIVE TURTLE ECOLOGY CENTER FOR TRAINING, OUTREACH, AND RESEARCH, Inc. (ProTECTOR)

Loma Linda University

With

Fundación Cuero y Salado (FUCSA) and

Bay Islands Conservation Association (BICA Utila)

Community-Directed Capacity Building for Hawksbill Conservation and Population Recovery in Caribbean Honduras

For

The Unites States Fish and Wildlife Services (USFWS) - Marine Turtle Conservation Fund (MTCF)

Stephen G. Dunbar, Angela Randazzo, Lidia Salinas, and Jenny Luque

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FINAL REPORT OF THE COMMUNITY-DIRECTED CAPACITY BUILDING FOR HAWKSBILL CONSERVATION AND POPULATION RECOVERY IN CARIBBEAN HONDURAS

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We're grateful to the communities of Salado Bar, Orotina, La Rosita, Boca Cerrada, Utila, and Los Cayitos and the many individuals from these communities that took part in the interview process and provided invaluable information regarding turtle sightings on beaches of their communities and at sea. Some of these participants also assisted with direct data collection, including Chepe, Chepe, and Nando. We are especially grateful to Rigo, Omar, and Mato Chebo who collected in-water sightings data, and to the young boys and girls, Edwin, Jose Armando, Chepin, Cristian, July, Dunia, and Sara who assisted with night and day monitoring at Salado Bar Beach. In addition, we are grateful to the CSWR guards, and military guards, who provided assistance on nightly monitoring patrols. We gratefully acknowledge Department of Fisheries (DIGEPESCA), and the Secretary for Agriculture and Ranching (SAG) for providing research permits to ProTECTOR and continuing to support the work of sea turtle research and conservation throughout the coastal regions of Honduras. Permits for research were granted by the DIGEPESCA, under SAG. We are especially thankful to the Director of DIGEPESCA Abg. Rene Elizabeth Gutierres and to Abg. Gabriela Pineda, for their continued support and encouragement, and for their assistance with renewing our research permits.

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These studies were conducted under approval from the Loma Linda University Institutional Animal Care and Use Committee (IACUC) (Protocol # 89029), and the Loma Linda University Institutional Review Board (IRB) (Protocol # 5120308 and # 5120097), and in compliance with United States and Honduran law.

EXECUTIVE SUMMARY

The following constitutes the final report of the activities carried out by Loma Linda University and the Protective Turtle Ecology Center for Training, Outreach, and Research, Inc. (ProTECTOR) supported by a grant from the United States Fish and Wildlife Service – Marine Turtle Conservation Fund (USFWS-MTCF). We undertook the current study to assess the potential and actual nesting of Hawksbill (*Eretmochelys imbricata*) turtles in the coastal zone of Cuero y Salado Wildlife Refuge along the north coast of the mainland of Honduras, and the marine protected coastal zones of Utila in the Bay Islands of Honduras. The study took place concurrently at both sites from July, 2011 until the end of September, 2012 and involved conducting personal interviews among local community members in the communities of Salado Bar, Boca Cerrada, La Rosita, Orotina, Utila, and Las Cayitos. The majority of interview respondents were fishers, who have fishing experience ranging from less than 10 years up to more than 60 years, and thus, provided a wide range of respondents who have differing experiences in sighting turtles at sea, as well as on the beaches of their respective communities.

We analyzed the data gathered from interviews and used the resulting information, along with input from community members, to guide the research phases of the study. These included undertaking in-water monitoring, beach monitoring for Hawksbill nesting, monitoring for tracks of adults and hatchlings, beach profiling, and beach vegetation characterization. In addition, specific studies were undertaken that incorporated flipper tagging, satellite tracking, nest temperature monitoring, hatchling blood sampling, and hatchling sex determination.

We used this study as an opportunity to seek direction from community members and local NGO's, as well as to launch a wide variety of educational outreach efforts and public awareness campaigns in collaboration with partner organizations. Through valuable partnerships, we increased local awareness of sea turtle ecology, research, threats, and status among all age groups and education levels, as well as among local governments and private industry.

There is need to continue to undertake further community-based conservation efforts. However, these must be undertaken within the context of further assessment, research, monitoring, and educational outreach. Additionally, there is need to further build capacity among local community members and NGO's for decision-making and sea turtle management. At the conclusion of the findings presented in this report, we provide 5 recommendations based on this study and the need for additional similar and more intensive studies, with the belief that Hawksbill conservation and population recovery are goals that are attainable in Caribbean Honduras.

Table of Contents

CODES and ACRONYMS

BICA – Bay Islands Conservation Association
CREDIA – El Centro Regional de Documentación e Interpretación Ambiental
CSWR – Cuero y Salado Wildlife Refuge
CURLA - El Centro Universitario Regional del Litoral Atlántico
DiBio - Dirección de Biodiversidad
DIGEPESCA - Dirección General de Pesca y Acuicultura
FUCSA – Fundación Cuero y Saldo
LLU – Loma Linda University
PROCORREDOR - Proyecto de Gestión Sostenible de Recursos Naturales y Cuencas del Corredor Biológico Mesoamericano en el Atlántico Hondureño
ProTECTOR – Protective Turtle Ecology Center for Training, Outreach, and Research, Inc.
SERNA – Secretaría de Recursos Naturales y Ambiente
USFWS – United States Fish and Wildlife Service

I. INTRODUCTION

Hawksbills have historically been plentiful throughout the Caribbean coast of Honduras (de Rochefort 1666; Long 1774; Dampier 1968), with this coastal region listed as one of seven major historic nesting areas for this species (McClenachan et al. 2006). More recently, numbers of Hawksbills have been reported to be severely reduced, with few sightings being reported over the last two decades (Carr et al. 1982; Cruz and Espinal 1987; Meylan 1999). However, there is ample evidence that insufficient conservation efforts have been undertaken along the Caribbean coast of Honduras, and there is a paucity of information on all species of turtles in Honduran waters (Carr et al. 1982; Meylan 1999; Bräutigam and Eckert 2006). Furthermore, Brautigam and Eckert (2006) testify to the lack of planning for sea turtle management, with no national or sub-national management strategy or plan. One reason for this is that the country of Honduras has very little financial and scientific infrastructure to address endangered species conservation. However, local communities have cultural and anecdotal historical knowledge of populations over time. Surprisingly, no international scientists have filled gaps in our knowledge of turtles in Honduran waters, prior to the work of the Protective Turtle Ecology Center for Training, Outreach, and Research (ProTECTOR) throughout Honduras, (Dunbar 2007,2008; Dunbar and Berube 2008; Dunbar and Salinas 2008; Dunbar et al. 2008a; Dunbar et al. 2008b; Dunbar et al. 2009). Humans are severely impacting the properties and profiles of beaches which have, for generations, hosted nesting female turtles. Beach erosion due to coastal development, the addition of lighted facilities and increased pollution are all affecting the ability of females to come ashore during nesting seasons. In turn, changes in beach conditions will likely have a long-lasting influence on turtle populations well into the future. In Honduras, these changes are further complicated by the direct effect of local community members taking both nesting females and entire clutches of eggs as non-essential food sources, despite their recognition of declining Hawksbill numbers. Additionally, laying females and eggs can fall prey to domestic dogs, feral cats and pigs (Maturbongs 1999).

Aside from vey recent land and aerial survey maps for nesting Hawksbills on Roatán (Dunbar and Berube 2008), there are currently no maps of known nesting beaches, no estimates of populations based on nesting females, no investigations into hatching success, and no conservation programs encompassing nesting beaches in the Bay Islands, or along the majority of the Caribbean coast of Honduras, although recent studies have been undertaken on juvenile Hawksbills in Roatán (Berube et al., 2012). Consequently, there are no local or national databases for marine turtles throughout the country, and no information on current status and trends that may assist in recovery of the species toward historical numbers in this area of the Hawksbill's range. Without such basic information, few effective efforts can be made by managers to protect nesting beaches, foraging habitats, or turtle populations.

Because consistent monitoring has never taken place in Utila, no consistent nesting information exists. Recently (July and August, 2010 and 2011), Ortega and Dunbar confirmed more than eight nests on a single two-acre, privately-owned cay, as well as at least eight Hawksbill nests (photographic confirmation) on Pumpkin Hill beach on Utila. The remainder of Utila and several other cays with potential for hosting Hawksbills have not been surveyed due to logistics and lack of funds. In addition, Hawksbills are regularly reported by dive operators among the reefs of Utila, although no monitoring or recording of sightings has taken place. In the Cuero y Salado wildlife refuge, we planned to assist the communities living within the refuge in establishing a

Hawksbill conservation program along some 24 km of beach. In the refuge, as elsewhere along the Caribbean coast of Honduras, no conservation programs for Hawksbill nesting, foraging, or migratory habitats have previously been undertaken.

Honduras does not currently have a national strategy for the conservation of sea turtles. To develop a strategic plan is one of the main objectives of ProTECTOR, fostering the establishment of a national research program and protection of marine turtles that are present on the beaches or in marine areas of the country. This can be done by increasing research, education, community participation, and institutional coordination in key areas to maintain populations of sea turtles at nesting sites and in foraging grounds.

McClenachen, et al. (2006) suggest the concentration of conservation on a few, large, modern nesting sites is faulty, and that conservation efforts should also include small nesting populations throughout the Caribbean.

The main aims of this project were to address the need for local communities to be assisted by partners that could provide technical assistance and capacity-building in the development of conservation measures that protect and promote nesting beaches, foraging areas, migration routes, and populations of nesting Hawksbills in the Caribbean. The focus sites of the project were two major protected areas in the Caribbean region of Honduras, consisting of the marine protected area of the island of Utila (Bay Islands), and within the wildlife refuge at Cuero Y Salado on the north coast of Honduras.

The overall goals for the project were:

Goal 1. To increase local community capacity for conservation of nesting beaches, foraging habitats, migration routes, and Hawksbill population recovery.

Goal 2. To engage local communities that rely on consumption of sea turtles, in educational outreach and awareness.

Goal 3. To provide a framework on which to build a long-term national nesting beach conservation program.

Goal 4. To establish a long-term index site for population monitoring for nesting Hawksbills in Caribbean Honduras as part of the Caribbean Region Wide population monitoring program.

Goal 5. To facilitate Hawksbill population recovery in the Caribbean Honduras.

I.I Study Areas

Four of the six species of marine turtles present in the Caribbean are found in Caribbean Honduras: the Leatherback turtle (*Dermochelys coriacea*), for which sites have been reported nesting on the north and Moskitia coasts; the Green turtle (*Chelonia mydas*), for which only nesting beaches have been reported in the area of Columbus; the Loggerhead (*Caretta caretta*), for which nesting sites have been reported along the north coast, in the Bay Islands and Cayos Cochinos; and the Hawksbill (*Eretmochelys imbricata*), for which nesting sites have been

reported along the north coast, the Bay Islands and Cayos Cochinos, and more recently in the Golf of Fonseca (Dunbar et al. 2012)

Cuero y Salado Wildlife Refuge

The Cuero y Salado Wildlife Refuge (CSWR) is located between 15°50'00" and 15°20'00" North latitude, and 86°45'00" and 87°30'00" West longitude (not including the recent extension of the marine segment of the reserve), and lies approximately 30 km west of the city of La Ceiba, along the north coast of the mainland of Honduras. The zone was declared a protected area through the Legislative Directive 99-87 on the 29th of July, 1987, followed two years later by the creation of the Foundation Cuero y Salado (FUCSA) which now administers the refuge (Martinez 2011).

In CSWR there is a great diversity of ecosystems, including fluvial, terrestrial, and marine, as well as the two communities of Boca Cerrada and Salado Barra (Fig. 1). The refuge currently has a total area of 37,067.81 hectares, of which 7989.53 hectares comprise terrestrial and freshwater habitats, and 29,078.28 hectares which are comprised of marine area[1].

Among the most important ecosystems are rivers and canals, the tropical forest, mangrove forest, beaches, coral reefs and agricultural systems (see Appendix I). The land and water part of the refuge is home to a great diversity of species (see Appendix I), in which many species of plants, birds, mammals, amphibians, and reptiles, as well as 53 families of insects (Martinez 2011), and 60 species of fishes in the rivers (Carrasco 2010) have been reported.

[1] Recently, an extension of the maritime area has been put in place, increasing the marine protected area of the refuge six-fold. Pers. comm., Anna Paz.

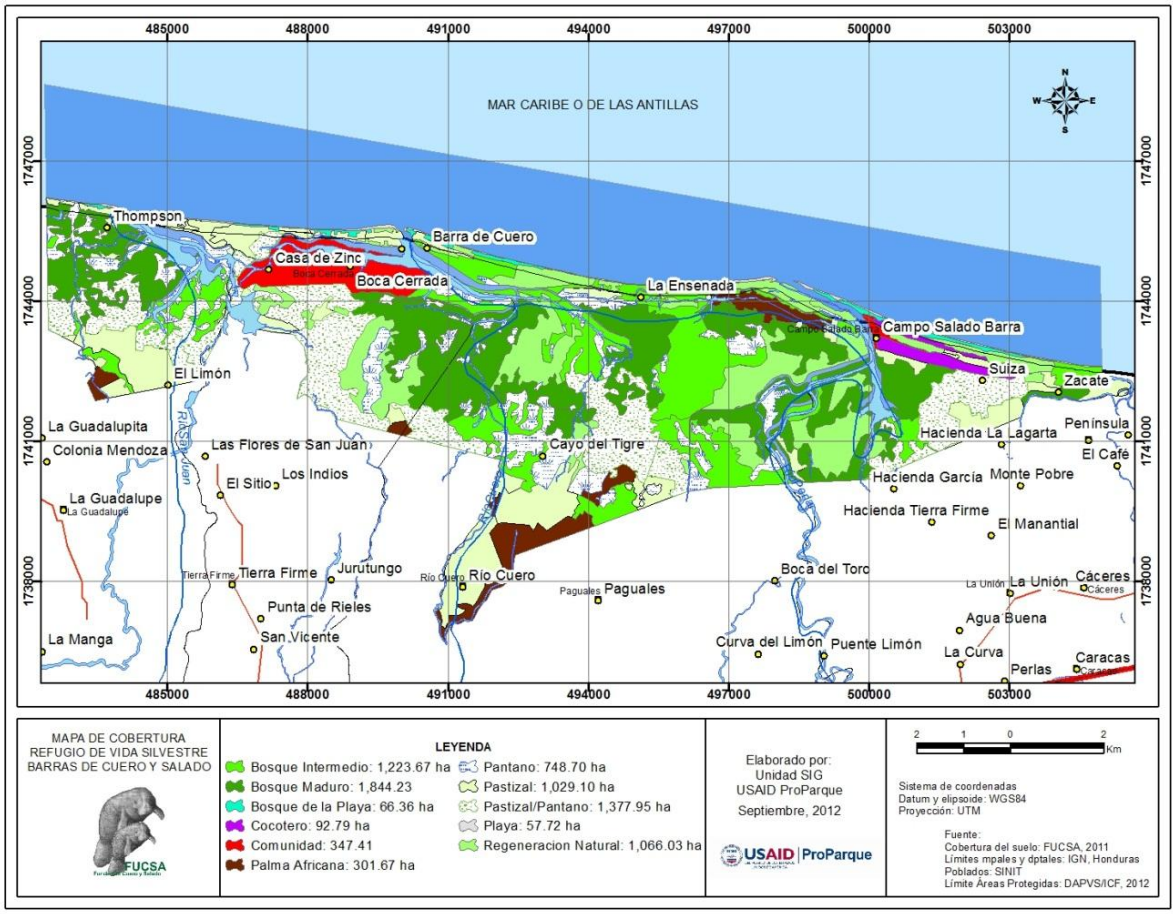

Figure 1. Map of the terrestrial use of CSWR, as well as the location of its river system and its position with respect to different communities in the department of Atlantida and the Caribbean Sea. Map source: USAID, ProParque, and FUCSA (2012).

The CSWR is well known for the presence of turtles in its waters and on its beaches, yet there have been no studies on any species of marine turtles in the zone, and the current population status is undetermined for the area.

Utila and Los Cayitos

The island of Utila lies approximately 36.8 km northwest of La Ceiba off the north coast of the mainland of Honduras in the Caribbean ocean. The island is one of three main Bay Islands, and is highly built-up with tourism infrastructure and coastal development. The island measures 12.3 km long by 4.5 km wide. To the southwest of the island, there are a number of small cays, some of which are uninhabited, comprising the area known as Los Cayitos (Fig. 2).

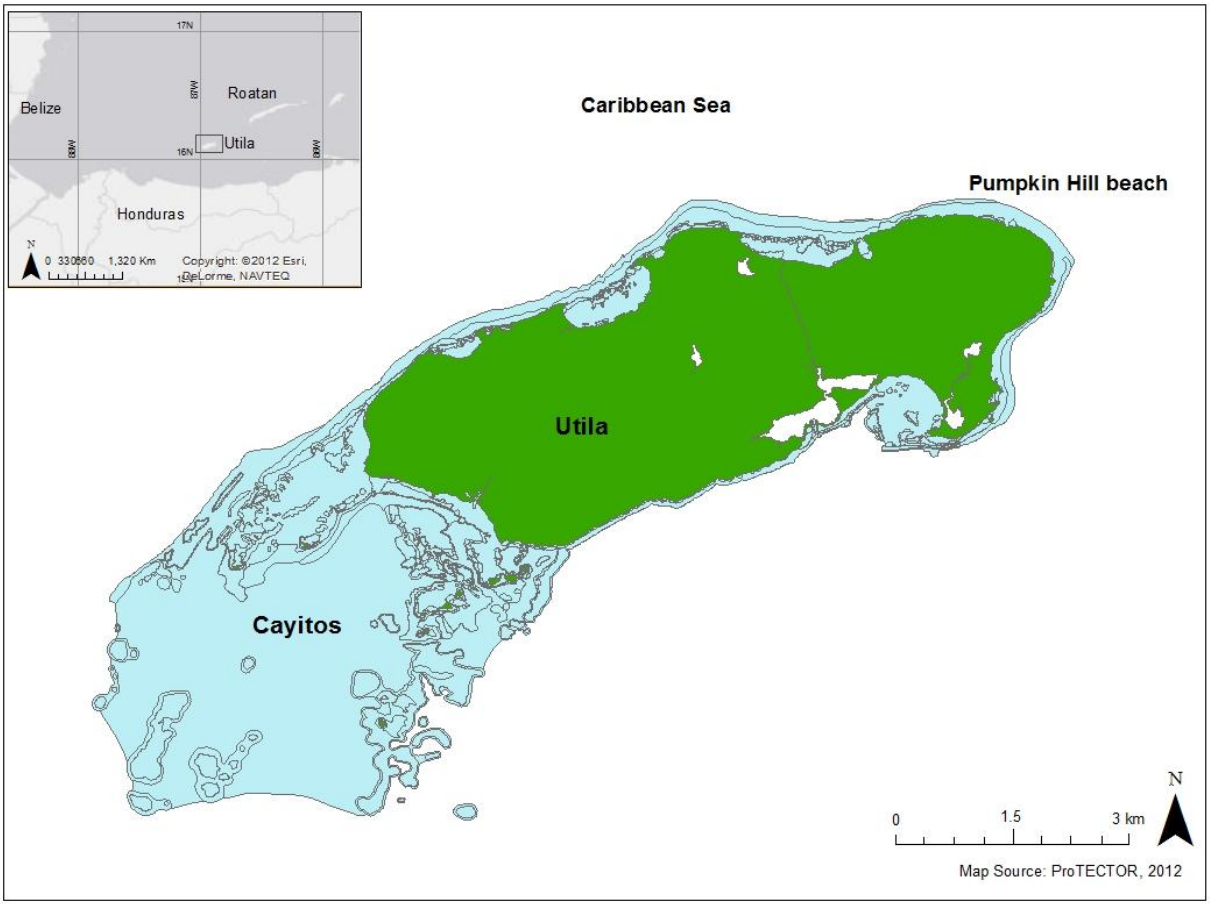

Figure 2. Map of Utila and Los Cayitos. Inset map showing the north coast of Honduras and the region of the Bay Islands.

II. PROJECT OVERVIEWS

Cuero y Salado Wildlife Refuge

This study was divided into two stages with the first from February to April, 2012, and the second from late June to the end of August, 2012. The first period allowed a preliminary study in which we collected information on the presence of sea turtles in CSWR and key data on diversity, distribution, seasonality, abundance, and threats through surveys in different communities (February to March). This information was confirmed by timely monitoring both in the marine area and along the beaches within the Refuge during March and April, 2012. From this information, protocols were developed in April, 2012 for both in-water and beach monitoring adapted to the Refuge following the standard protocols used by ProTECTOR in other areas of the country (Punta Raton and El Venado in the Gulf of Fonseca; Utila and Roatán in the Bay Islands). In a second term, we returned to the Refuge to coordinate monitoring of nesting females at night, diurnal monitoring for tracks and neonates, and occasional in-water monitoring. In addition, descriptive analyses were undertaken on vegetation, slope, and pollution data collected from the beaches where day and night monitoring was conducted.

Meanwhile, a series of presentations provided environmental education in the communities during February, March, and April, for both children and adults. These sessions enabled open

discussions on the biology, ecology, and threats of sea turtles and addressed issues of natural resources protection in a comprehensive manner. These approaches created interest in the subject of sea turtles and built confidence between communities and ProTECTOR early on in the process of the project.

In addition, the study has facilitated opportunities to work with various institutions, such as CURLA, CREDIA, and the Falls Brook Center to promote the objectives of ProTECTOR, increasing the visibility of both the project and the organization in Honduras (see Fig. 3). Collaborations with these organizations in promoting the Refuge provided occasions for environmental celebrations, environmental concerts, story contests, environmental documentaries, a community first aid course, and meetings to address specific issues, such as Refuge regulations. These kinds of collaborations were of great value in promoting ProTECTOR in the work of developing comprehensive awareness of sea turtle issues in the area, as well as promoting the welfare of people who directly depend on these resources.

Figure 3. Stephen G. Dunbar (President, ProTECTOR) and Angela Randazzo (Project Field Assistant) present the work of ProTECTOR in Honduras over the past six years on March 22, 2012 at the CREDIA Environmental Conference.

Utila and Cayitos

The study on Utila was divided into two stages, as in CSWR, with the first stage from July, 2011 to May, 2012, and the second from late June to the end of September, 2012. The first stage was a preliminary study in which we collected information from local community members in Utila and from the small cays around Utila (Los Cayitos) on the presence of sea turtles around the island and cays, including data on turtle species diversity, abundance, locations of in-water sightings and nesting beaches, and threats to sea turtles at sea and on the beaches.

In the case of Utila, we were unable to confirm interview responses through in-water monitoring during March to May, 2012. During the second phase of the project we concentrated our beach monitoring on one confirmed nesting beach from late June to the end of September, 2012. Methods were adapted from standard protocols used by ProTECTOR at CSWR. We also satellite tagged nesting females and undertook analyses of Hawksbill nests and hatchlings. In addition, descriptive analyses of beach slope and vegetation characteristics were done for the single beach at which nesting and hatchling monitoring took place.

During this phase of the project a number of education outreach activities took place. A training session (Fig. 4) provided volunteers and local non-governmental organization (NGO) personnel with opportunities to openly discuss aspects of sea turtle biology, ecology, conservation and

threats to turtles in the area of Utila. Opportunities to educate local community children and adults, as well as international volunteers provided ways for ProTECTOR and BICA to engage interested participants and community members at all age and education levels in decision-making and planning for sea turtle conservation in Utila and throughout the Bay Islands of Honduras.

Figure 4. Loma Linda University and ProTECTOR graduate student, Lindsey Damazo, facilitates a workshop and discussion on sea turtle biology, and her research work with nesting *E. imbricata* and hatchlings with international volunteers at the office of BICA Utila in July, 2012.

The study has also facilitated work with other institutions aside from our local partner, the Bay Islands Conservation Association (BICA). These included several elementary and high schools, as well as dive shops and other NGOs, such as the Utila Whale Shark Research Project, and the Utila Iguana Research Station, all of whom have been interested in continuing collaborative efforts on subsequent projects with ProTECTOR.

III. STUDY METHODS

III.I Preliminary Study

III.I.I Community Questionnaires

Cuero y Salado Wildlife Refuge

The surveys used in the preliminary study were developed based on surveys conducted in communities in southern Honduras, adapting and improving them for the communities at CSWR (see Appendix II). Target interviewees were fishermen operating within the fishing area of the Refuge, who know the area well and were able to provide spatial and temporal information with regards to turtle sightings in-water and on Refuge beaches. We sought to obtain a representative sample of the target group. Thus, we worked in the four communities that have the greatest influence on the fishing banks of CSWR. From east to west these are: Orotina (OR), Salado Bar (SB), Boca Cerrada (BC) and La Rosita (RO) (see Appendix III A).

According to a census conducted in the communities of CSWR in 2010 (Sánchez 2010), there were 16 fishers in SB, 8 in OR and 8 in BC. Through personal communications with the Presidents of the different fisher groups in each community, we were able to make contact with 24 individuals in SB, 8 in OR, 10 in BC, and 9 in RO, for a total of 51 interviewees. Of these, 92 % (47/51) were fishers and 4 were non-fishers.

The fishermen interviewed were mainly those who were organized by a group of fishers and/or tourism committee. Thus, we were unable to interview some fishermen who did not belong to any of these groups, as well as four fishers in La Rosita, and three in Orotina, due to difficulty accessing these communities without timely and appropriate transportation during this study period. There was also a fisherman in BC that did not respond to the survey. In any case, for the purposes of this preliminary study we have interviewed an estimated 84% of all fishermen in the area.

Each of these communities generally used fishing banks off the bar nearest the river outfall. Thus, our coverage of fishermen in these four communities is likely to be an adequate representation covering the entire marine area of the refuge. Most marine fishing is done within 9 km from the coastline, on elevated coral reef areas (Rico and Medina 2010). There are large coral reefs parallel to, and 3 - 9 km out from the coastline. However it is estimated that these reefs have been heavily impacted by inappropriate use of fishing gear and habitat degradation (Rico and Medina 2010).

III.I.II Questionnaire Data Analyses

To process and analyze data resulting from the questionnaires, we used Sphinx plus (Sphinx Développement, Chavanod, France, supplier), which is able to process and analyze survey data, handling both qualitative and quantitative data for frequency tables and charts. For the preliminary study, we present the data for each question in the survey through charts and percentages. Histograms are used to present results for which answers are ordinal, either chronologically or quantitatively. We also investigated if there were correlations between sociological and biological variables to try to identify trends among responses and sociological characteristics of respondents.

Utila and Cayitos

We used surveys in the preliminary study in Utila that were developed based on the surveys used at CSWR, with slight modifications appropriate to the situational differences between Utila and the Refuge. We targeted fishers and boat captains, some who also worked in the sports diving industry, as respondents for the interviews. However, we also were able to collect responses from people of other professions on the islands, including a police officer, a builder, and the Mayor. The majority of respondents provided information regarding where they have seen turtles at sea or on nearby beaches of either the main island of Utila, or the small cays surrounding Utila, collectively known as "Los Cayitos." Unlike the interview situation at CSWR, respondents from the islands of Utila are not considered different communities for the purposes of this study. Instead, although respondents did live in different communities of Utila, we pooled all respondents from the main islands and considered these respondents as "Utila", while those that live on the outlying cays we pooled together and considered them as from Los Cayitos (see Appendix III B).

Through the work of BICA personnel and assistants, we were able to contact a total of 20 respondents, of whom 12 were fishers. We spoke with 6 respondents from Cayitos, 50 % of whom were fishers. In Utila, we interviewed 14 individuals of whom 64 % were fishers and 36 % were sport dive boat captains. There were likely many other fishers throughout the island that may have been interviewed, however, transportation around the island is made difficult by the lack of roads to the more remote parts of the main islands, and the difficulty and expense of transportation to the outer cays. While the sample size of fishermen is small (n = 12), survey responses from fishers indicted that these fishers covered the main fishing areas generally accessed by fishers in the area, including the passage between the mainland of Honduras (the north coast) and Utila, a distance of approximately 36 km. Still, most localized, artisanal fishing activity is done within 3 – 10 km of the coastal zone of Utila or the outlying cays.

III.I.III Questionnaire Data Analyses

We used Excel to process and analyze the resultant data from questionnaires, and produced frequency tables and charts. For the preliminary study, as with results from CSWR, we again present data for each survey question mainly as histograms and proportional charts.

III.II Preliminary Point Monitoring

Cuero y Salado Wildlife Refuge

The analysis of data from surveys with residents of the CSWR area engaged in open ocean fishing, allowed us to obtain general information on temporal and spatial use of area habitats by sea turtles. Based on this information, we initiated point monitoring of the CSWR marine area and beaches. We conducted point monitoring in the marine zone (NE Fishing Bank of Boca Cerrada) April 16, 2012, and night monitoring in six different sectors of CSWR beaches on March 20, 27, and 30, 2012, and April 7, 9, and 17, 2012.

The information obtained through interviews and point monitoring were then validated and clarified through concentrated monitoring during the second period of the study in the CSWR from June to late August, 2012. To perform this monitoring, we used monitoring protocols adapted for CSWR, each of which is further explained in Appendix IV.

Utila and Cayitos

Data collected from respondents through interviews with fishers from Utila and Cayitos allowed us to gain general insights on the temporal and spatial use of coastal areas around Utila by different species of sea turtles. Unlike at CSWR, we were unable to coordinate with artisanal fishers to undertake any point monitoring at sea. However, based on responses from the surveys and on data collected at nesting beaches in 2011 (Dunbar and Ortega, unpublished data), some preliminary point monitoring was established from June to August, 2011 at Pumpkin Hill Beach.

IV RESEARCH STUDY

Cuero y Salado Wildlife Refuge

According to the spatio-temporal characteristics of the area revealed in the analyzed results of the surveys conducted in the four communities of the CSWR, we proposed four monitoring protocols, 2 for in-water and 2 for the beaches, to use depending on the availability of resources and the time of year. The details of each protocol (materials, budget items, recommendations and monitoring sheets) are provided in Appendix IV.

Utila and Cayitos

As a result of information gathered from the interviews, and from prior knowledge of nesting activities on Utila, we proposed 2 monitoring protocols for the beach at Pumpkin Hill. These protocols were modified from protocols used at CSWR and from standard ProTECTOR procedures used with hatchlings on the south coast of Honduras. The details of these two monitoring protocols are further provided in Appendix IV.

IV.I In-Water Monitoring

Cuero y Salado Wildlife Refuge

According to data collected during the first period of the study, the frequency of turtle sightings on beaches is much lower than sightings at sea (locations of sighting are generally between 3 and 9 km from the coast). Due to the considerable cost of conducting in-water monitoring in the CSWR, it was not possible to perform regular monitoring at sea. However, we were able to train and build capacity for fishers who could utilize their regular fishing trips to provide data on turtle species sighted, locations, time of sightings, turtle behavior, and estimated size of sighted individuals. It should, however, be noted that the outputs of the fisherman were dependent on sea conditions, and the carrying out of other employment opportunities, such as crab fishing in August, or tree planting in a concurrent project to restore mangrove forests.

Participating fishers were provided training on identification of marine turtle species and on how to collect data at sea. The materials for this monitoring, entitled M2, are found in Appendix IV.

IV.II Beach Monitoring

Cuero y Salado Wildlife Refuge

We undertook nightly beach monitoring from June 27 to August 25, 2012 because these months were identified by respondents during the first phase of this study as the peak months of sea turtle sightings. Monitoring itineraries varied by night, and were influenced by factors such as

beach safety (drug trafficking occurs in the area), and recurrent lightning storms in close proximity to the beach during the nesting season.

For beach monitoring, we enlisted the assistance of CSWR guard personnel, community youth, and a number of Honduran Naval Forces personnel (for security), all of whom were trained in marine turtle monitoring and data collection through this project. Monitoring was conducted quietly and in the dark, with lighting only when a turtle track was suspected to have been found.

Each night, monitoring began at 6:00pm and took place on either the East (East Beach) or West (West Beach) of the main entrance onto the beach. Each beach was further divided into two sectors, with one group of monitors covering one of the sectors, allowing coverage of greatest possible walking distance of the beach. The two groups were in communication via radios and cell phones. Each of these groups was composed of protective personnel and youth from the community. At times, Honduran Naval personnel and volunteers were also involved with nightly patrols.

All volunteers who participated were trained on basic beach monitoring techniques, data collection, flipper tagging and measuring, as well as appropriate monitoring behavior. In addition to monitoring, community youth who participated had several training sessions on basic sea turtle biology, night monitoring, threats, and conservation. Each signed a “Contract of Trust” with a CSWR guard, in which he or she undertook to ensure the protection of sea turtles and maintain a policy of discretion regarding nest locations and beach sightings information within the community (if nest locations are known, community members will harvest the eggs for personal consumption).

Equipment needed for beach monitoring included GPS (Garmin eTrex Venture HC), 60m flexible wind-up tape measure, data sheets, flipper tag applicator, Inconel 680 flipper tags (Archie Carr Center for Sea Turtle Research, University of Florida, supplier), Polysporin, Betadine, 1 m soft measuring tape, rubber gloves, needle and syringe, cell lysis buffer-filled blood collection vial, and digital camera. For a complete list of materials, see Appendix IV, monitoring type M3.

A standard beach monitoring data collection protocol was followed, as outlined in Dunbar et al (2011).
Briefly, these include:

1. Encounter of female emerging or at nest.
2. Allow turtle to dig nest and begin deposition of eggs.
3. During deposition, CCLmin, CCLmax, and CCW (Fig. 5) can be measured, GPS position, and distance of nest to water are recorded. Data sheet photographed.
4. Once deposition is complete and nest covered, turtle is restrained and flipper tag is applied to front right flipper on proximal scale of trailing edge of the flipper. Betadine and polysporin are applied to the flipper and tag, respectively, prior to tag application.
5. Once tagging is completed, photographs are taken of the flipper tag, the dorsal surface of the head and the lateral views of the face for photographic identification.
6. Turtle is released and allowed to return to the water.
7. Erase tracks to prevent the poaching of the nest.

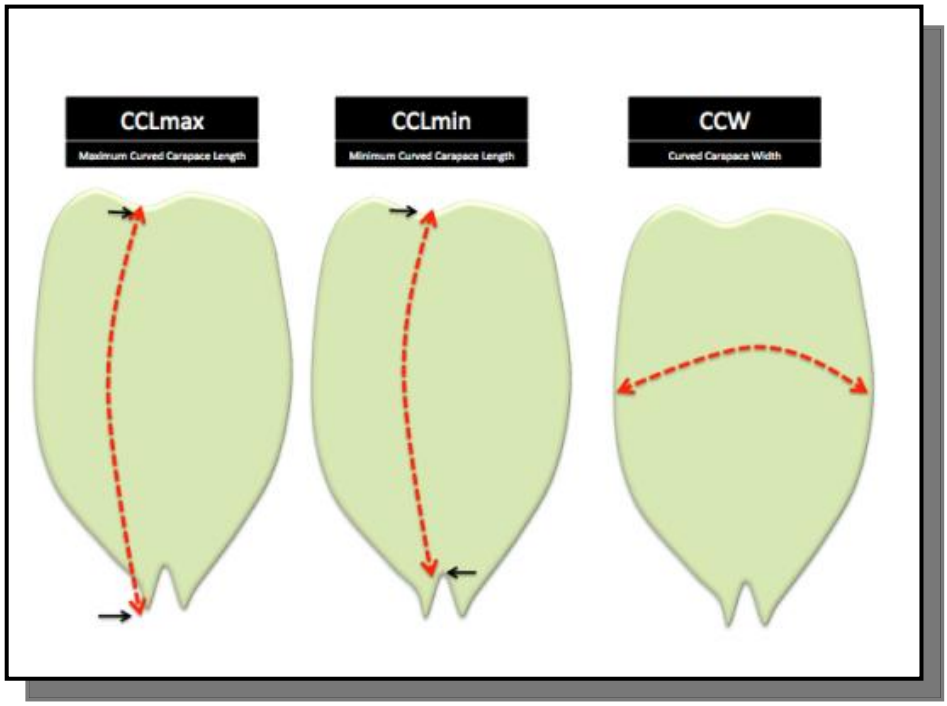

Figure 5. Illustration of the main morphometric measurements recorded from turtles encountered on the beach.

Utila and Cayitos

Data collected during the first phase of the study on Utila suggested that while some turtles were encountered on the beaches around Utila, all respondents reported seeing turtles at sea, despite the fact that not all respondents were fishers or were spending time regularly at sea. We were able to collect data on the sizes respondents believed turtles encountered at sea were, and locations of main fishing areas where respondents reported sighting turtles at sea. Fishers in Utila appeared to be less interested in receiving training for collecting data on sighted turtles at sea while fishing than were fishers in CSWR. This may presumably be because fishers in the coral reef areas surrounding Utila and the Cays are likely to generate a higher income with the sale of fish to restaurants and hotels in Utila than are fishers in CSWR who are mainly selling to fellow community members.

During the second phase of the project, we enlisted the assistance of several BICA volunteers, as well as ProTECTOR Interns who worked alongside LLU/ProTECTOR graduate student, Lindsey Damazo in beach monitoring and profiling, measuring, flipper tagging, and satellite tagging adult turtles, as well as data collection from nests and blood sample collections from hatchlings.

Detailed procedures for measuring and flipper tagging can be found in previous ProTECTOR reports (Dunbar et al. 2008b; Dunbar et al. 2009; Berube et al. 2012). In short, when adult turtles were located, CCLmin, CCLmax, and CCW were measured with a soft tape measure (see Fig. 5) during the egg-laying phase (but after the nest had been dug). On completion of egg-laying and the initiation of nest burial, turtles were restrained by hand, and the first scute proximal to the body, on the trailing edge of front and rear right flippers were cleaned with

Iodine (if available). The piercing tooth of the flipper tag (Inconel 681 style) was coated with Polysporin prior to application to reduce potential for infection of the turtle. Latex gloves were worn by investigators to reduce potential zoonotic infection. The flipper tag was applied with a standard tag applicator.

In the cases where satellite tags (Wildlife Computer Spot5) were attached, we first cleaned the crown of the carapace with freshwater, then alcohol, then dried with a soft, clean towel. Once dry, the scutes on which the satellite tag was to be affixed were scraped with sand paper to roughen the area. A small amount of low heat, Anchorfix 2 two-part epoxy was applied to the base of the satellite tag then pressed in place on the crown of the carapace. This assembly was left to dry for 10 – 15 minutes. Once dry, successive layers of epoxy were applied to the sides of the tag and smoothed outward on the carapace to produce as streamline a profile as possible. Once completely dry, the turtle was observed for an additional five minutes to ensure no injury to the turtle had occurred, then released to crawl down the beach and out to sea.

To collect hatchling blood samples, nests were left unmarked and *in situ*, but their locations were recorded by triangulation and with GPS. At the end of the calculated incubation period, a wire net was erected around each nest, and participants guarded the nest 24 hrs/day. When eggs hatched and surfaced, all hatchlings were collected from the nest enclosure and placed in a cooler box with sand substrate lining the bottom. Hatchlings were then transported back to the laboratory and kept cool and dark to reduce activity. Once at the lab, 0.1 ml blood samples were collected from each individual by veinipuncture of the dorsal surface of the cervical sinus with 25 gauge needles attached to 1 ml syringes. Prior to sampling, we aspirated trisodium citrate into the needle to inhibit blood coagulation of the samples. Samples were then expelled into a 1.5 ml microcentrifuge tube and centrifuged for 10 minutes at 5,000 rpm. The supernatant (the plasma portion of the sample) was decanted off and collected into another 1.5 ml microcentrifuge tube lined with trisodium citrate. Both samples were then placed on ice until stored in a freezer at -20 °C.

IV.III Beach Profiling

IV.III.I Rapid Beach Profiling

Cuero y Salado Wildlife Refuge

We undertook two types of beach assessments: a rapid overview assessment, and a detailed descriptive assessment. The rapid overview consisted of walking 8 km of beaches taking GPS points to characterize spatial heterogeneity, taking into account the characteristics of the slope (angle, distance from the high tide, beach width) and the distribution of vegetation (see Fig. 6). The equipment needed for this study is specified in Appendix IV.

The person responsible for selecting points describing the heterogeneity of the beach was familiar with the beach. At each point, GPS information was recorded, along with several measures to characterize existing features at that point, and the description of the vertical distribution of sand and vegetation.

Figure 6. View of the beach from the west during the rapid overview assessment.

Utila and Cayitos

A rapid beach survey was undertaken by first walking the entire length of potential nesting area at Pumpkin Hill Beach (1 km) (Fig. 7), and determining what areas of the beach were potentially accessible to nesting turtles from the water. After determining inaccessible areas of the beach, these were then excluded from the detailed beach profiling and vegetation analyses.

Figure 7. The length of beach on which a rapid survey was done to inform the detailed beach profiling and vegetation analysis.

IV.III.II Detailed Beach Profiling

Cuero y Salado Wildlife Refuge

Detailed beach profiling was conducted by using the polar line level method (Mossa 1998) making vertical transect measurements of the beach every 5 m, conducting associated vegetation transects and assessing points of contamination. Beach profiles were developed by measuring a reference height at a 0-point located at the high tide mark for each transect, as shown in Fig. 8. Figure 9 shows a cartoon representation of the orientations (X, Y, and Z) of transects along a stretch of beach.

Figure 8. ProTECTOR Volunteers and Project Site Coordinator, Angela Randazzo (R), undertaking a perpendicular transect of the beach profiling study from the high tide mark to 15 m up on the beach.

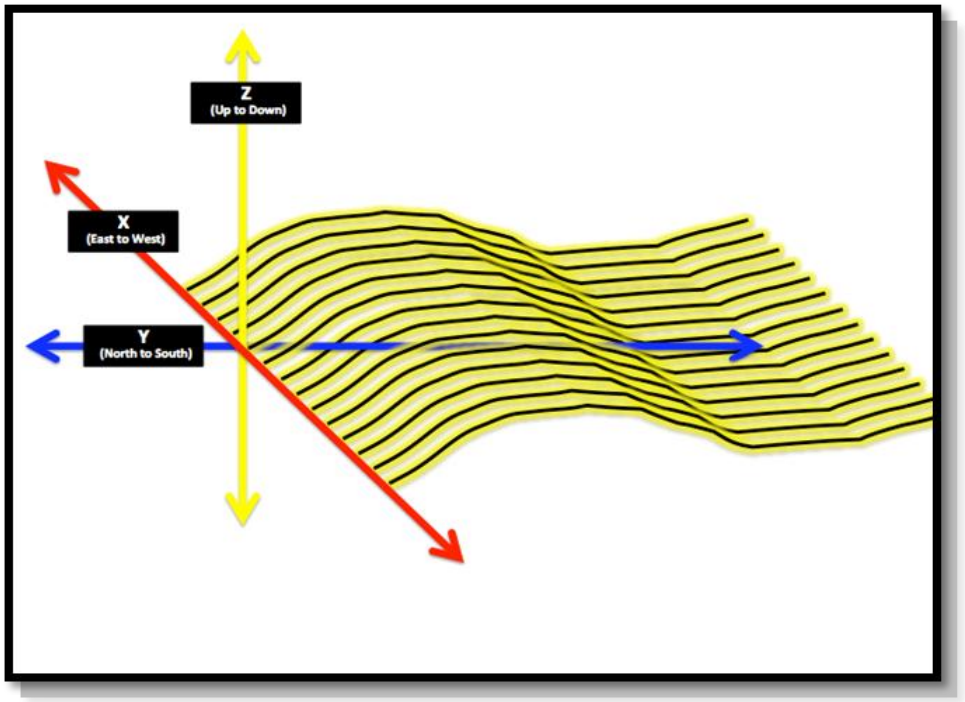

Figure 9. Cartoon displaying the X (East to West and parallel to the high tide water line), Y (North to South and perpendicular to the high tide water line), and Z (altitudinal changes) orientations of transect lines along a stretch of beach used in the beach profiling study.

From this initial measurement, we then measured the height of the beach relative to the previous point at 5, 10, and 15 m from the starting point (see Fig. 10).

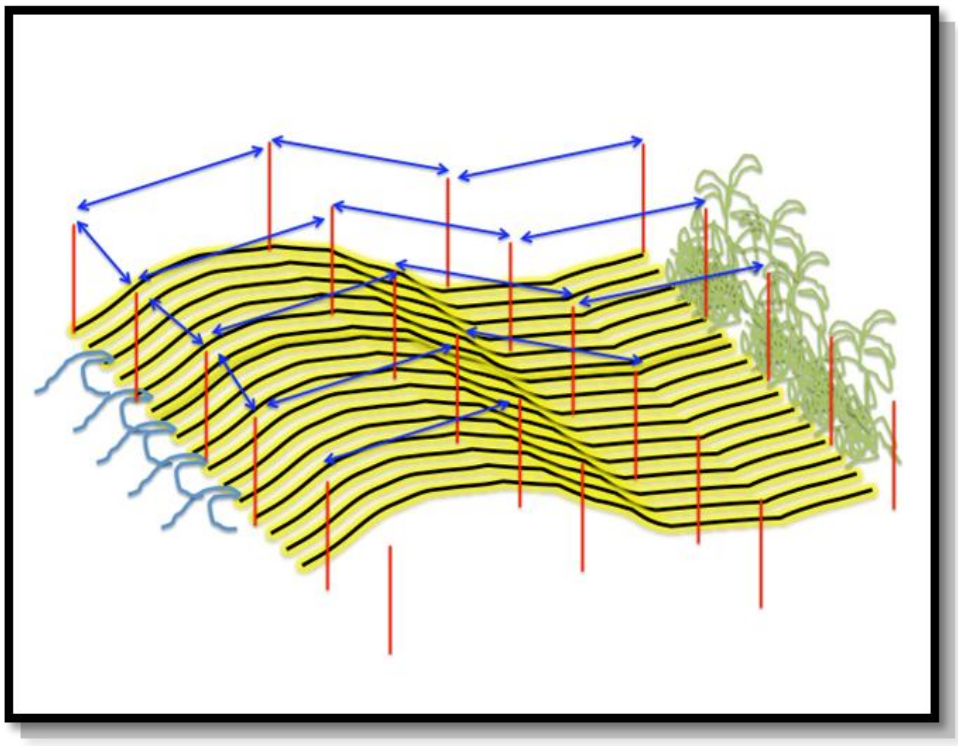

Figure 10. Illustration of the maintenance of parallel transects (black and yellow lines) perpendicular to the high tide line. Also shown are the 5 m intervals (red vertical lines) between parallel transect lines, and between measurement points moving landward on each transect.

Poles were kept level with respect to the beach and the line between the tubes by the use of circular levels, while the line between the poles was kept level with a line level. The orientation of each transect was kept constant by using the same compass bearing for each transect (Figs. 11 and 12).

Figure 11. Orienting the transect perpendicular to the high tide line and parallel to the previous transect using a handheld Global Positioning System (GPS) unit.

Figure 12. Ariana Cunningham (L), Edwin Martinez (C), and Angela Randazzo (R), level the vertical profile of the Western sector of Salado Bar Beach.

The equipment needed for this type of study is listed in Appendix IV.

Where beach vegetation permitted, we measured 15 and 20 m above each transect starting point at the low tide line. At the 15 or 20 m height on the beach, we ran contiguous 20 m transects parallel to the beach. Once the transect was established one member of the team walked the 20 m length of the parallel transect identifying the vegetation types found along the length of the tape measure while the other team member recorded the data. Vegetation transects (parallel to the length of the beach) were prepared once the profile transects (perpendicular to the length of the beach) for a section of the beach were completed, at which point the 15 m height of the beach was marked with wooden stakes (see Figs. 13 and 14). When a plant was not identifiable, we took photos and a small sample of the plant to provide to a botanist. Appendix V shows the various plants found during this study.

Figure 13. Panoramic view of different types of substrate on the beach and different layers of vegetation in the eastern sector of Salado Bar Beach.

Figure 14. View of the plant species diversity on the eastern sector of Salado Bar Beach.

We also incorporated an evaluation of plastic pollution by weight and type every 60 m along the length of the beach in both the East and West sectors of Salado Bar beach. Samples were collected at the high tide mark and sorted and weighed by type of plastic material or other pollution material (Fig. 15).

Figure 15. Example of accumulated pollution along the high tide line in the West zone of Salado Bar Beach.

Utila and Cayitos

In Utila, detailed beach profiling was undertaken using a David White Meridian L6-20 Level, consisting of a tripod with a scope on a leveling platform. A 2 m long measuring pole was constructed out of PVC pipe with a bullet level attached to the side and a measuring tape affixed along the length of the pole. An initial "zero" spot was chosen where the transit level was set up and leveled. The height of the transit level scope was measured with the 2-m pole and recorded. The elevation of the beach was then taken by reading the measurement on the pole through the transit level scope (Fig. 16). Points on the beach were measured in a grid that went in 5 m increments in the X direction for the entire length of the beach, and 2 m increments in the Y direction for a distance of approximately 20 m perpendicular to the water. When the visual limits of the transit level scope were reached, the transit level was moved to the position of a previously measured point, the scope was leveled, and the height of the scope measured. In this way the difference in height for each point could be traced back to the initial zero point. At each measured point the substrate type was also recorded. When the substrate was vegetation (Figs. 17 and 18), detailed photographs were taken of each new plant species for the purpose of identification (Figs. 19 and 20).

Figure 16. Lindsey Damazo undertaking beach profiling on Utila at Pumpkin Hill. She used a surveyor's scope level and vertical line pole for measuring changes in elevation.

Figure 17. In addition to beach slope, beach vegetation was surveyed and characterized along this stretch of nesting beach at Pumpkin Hill.

Figure 18. Vegetation measurements were undertaken by transects running perpendicular to the high tide water line, as far as 20 m up into the high vegetation.

Figure 19. Photograph of beach vegetation biodiversity. Each plant species was then photographed individually in detail for identification.

Figure 20. Example of the detailed photograph of beach vegetation used for vegetation identification. This photograph shows the common Beach Morning Glory, *Ipomoea pes-caprae*.

To determine beach vegetation characteristics, we placed a soft 60 m tape measure along the seaward edge of the vegetation, then took consecutive photographs of the vegetation from approximately 4 m seaward of the exposed beach (in the water) along the entire length of the beach (Fig. 21). Beach vegetation was identified from photographs to Genus or species level (when possible). The point measurements and substrate locations will be entered into ArcGIS to create a 3D profile of the beach depicting elevation changes and vegetation coverage.

Figure 21. One of a series of landward photographs from approximately 5 m into the water, showing vegetation gradients along the beach at Pumpkin Hill.

To assess pollution levels on the beach (Fig. 22), we chose two 25 m sectors along the length of the beach, then selected sites within each sector and rated them as having either high (> 75 % pollution cover), medium (approximately 50 % pollution cover), or low (< 25 % pollution cover) levels of pollution. Within each 25 m sector of beach, a 1 meter square quadrate was randomly tossed onto the wrack line (Fig. 23) of each of the designated pollution sites so that one sample was collected from each of low, medium, and high levels of pollution within the sector. All pollution material resting on the surface of the sand that was at least 50 % within the quadrate was collected by hand, using latex gloves for protection. Collected materials were then separated by hand into categories based on litter type, and each type category was quantified by weight and recorded as a percentage of the total pollution material collected for each quadrate sample.

Figure 22. A “high” pollution section of Pumpkin Hill Beach in which many types of plastic materials collect together to produce a potentially hazardous area of nesting beach for both adults and hatchlings.

Figure 23. A random quadrate thrown onto the “wrackline” of seaweed and plastic pollution to estimate the types and relative abundances of plastics on the beach at Pumpkin Hill, Utila.

IV.IV Links and Education Outreach

Cuero y Salado Wildlife Refuge

During the two phases of the study, we enlisted significant community input and participation. In the preliminary phase, data collected was heavily dependent on the willingness of community residents to work on the project. Before engaging in the interviews, we gave a brief explanation of the objectives, methods, and importance of the findings of the study to all participants in the area. Thus, to gain participants' trust, the importance of this study was related to the interviewees in a manner that potential participants could understand and relate to. We then asked potential participants for their collaboration in providing information that would facilitate the study process.

In addition, we held several talks in the communities in which we worked that covered aspects of sea turtle biology and ecology, and provided updates of the results of the study for the area as data were analyzed. These meetings revealed the interest of the community and specific people to implement the next stage of this study at CSWR. It was important for us to carry out this kind of exchange, allowing community members to engage in the collection of data, the visualization of the results, and discussions of prospects for future conservation.

During the second period of the present study, we directly involved members of the community of Salado Bar, especially young people, in nighttime monitoring and data collection on the beach, as well as in-water monitoring. This was done primarily in order to show people in the community that they could take advantage of the resource of live turtles (non-consumptive use), rather than consuming the turtles once and for all (consumptive use). These young people contributed their efforts either in the evening during monitoring data collection on the beaches, or worked in collecting data on turtle sightings at sea. Each of these participants was provided specific training and each received a small payment in compensation for their efforts.

Throughout the project period, we built capacity among both national and international volunteers who sought to learn about sea turtles and their related habitats, in addition to experiencing the CSWR. They assisted with data collection, environmental outreach activities, and community education. This also facilitated important cultural exchanges, in which the communities gained valuable experiences in learning how to further develop scientific tourism within the Refuge.

Similarly, in order to establish trust between the communities and ProTECTOR, we developed outreach activities to create synergies, define alternatives to the consumptive use and exploitation of natural resources, and worked to improve the living conditions of the inhabitants of CSWR during the entire period of the project (see Fig. 24).

Figure 24. Activities linking with the children of Salado Bar. All these children participated in a short story competition regarding the Honduran Caribbean Biological Corridor and won t-shirts with examples of species in the area, book bags, and identification cards of area birds.

Utila and Cayitos

During both phases of the study, we solicited assistance and direction from community members, fishers, and other conservation NGO's in the area of Utila. Data collection was, as in CSWR, heavily dependent on the willing participation of individuals in the surrounding communities. Before enlisting participants in the interview process, we provided them with information regarding the study, the interview process, how the data would be utilized, and offered them the opportunity to take part. They were also free to elect not to participate in the interviews.

To gain participant trust, and to also engage children and young people in the process of environmental care and conservation, we undertook several forms of environmental education outreach, with special emphasis on coastal and marine environments and turtle biology and ecology. The majority of education outreach was organized by personnel of our partner organization, BICA, who regularly carry out environmental education throughout the island of Utila and the outlying cays. Several of these educational initiatives were funded, or supported by additional BICA partners. However, we used each opportunity to facilitate learning about marine ecosystems and the importance of sea turtles to the health of ocean and beach habitats.

V. RESULTS FROM CUERO Y SALADO WILDLIFE REFUGE

V.I Preliminary Study

Characteristics of interview participants

Given that the key informants for the beginning of the study were defined as marine fishermen, it is not surprising that the final group of interview respondents is essentially homogeneous in terms of profession. Of the 54 people interviewed, 94% were marine fishermen, and 98% of respondents were male. However, five respondents were excluded because they were under the required age limit. Thus, there were a total of 49 respondents (see Table 1).

We also interviewed key informants which could provide information in regards to sea turtle nesting activities, as fishermen were unable to provide detailed information on this aspect of marine turtle sightings. These key informants were mainly comprised of ethnic Garifunas living within the CSWR, and who traditionally consume turtles and their products. In addition to these, we also interviewed individuals who live near to the beach.

Table 1. Professions, numbers and frequencies of interview respondents from the preliminary study in CSWR.

Profession	No. Interviewed	Frequency (%)
Marine Fisher	45	92.0
Refuge Guard	1	2.0
Housewife	1	2.0
Fish Merchant	1	2.0
Retired Fisher	1	2.0
TOTAL OBS.	**49**	**100%**

We found that 74.5% of fisher respondents (35/47) were older than 28 years (see Fig. 25), and that 66.0% of fishers (31/47) had 10 or more years of marine fishing experience (see Fig. 26). Of the fishers we interviewed, 46.8% (22/47) spend more than 260 days of the year at sea (see Fig. 27). It follows that the sea fishermen we interviewed are experienced, know local marine resources, and their responses are thus of importance for understanding sea turtle sightings in the area.

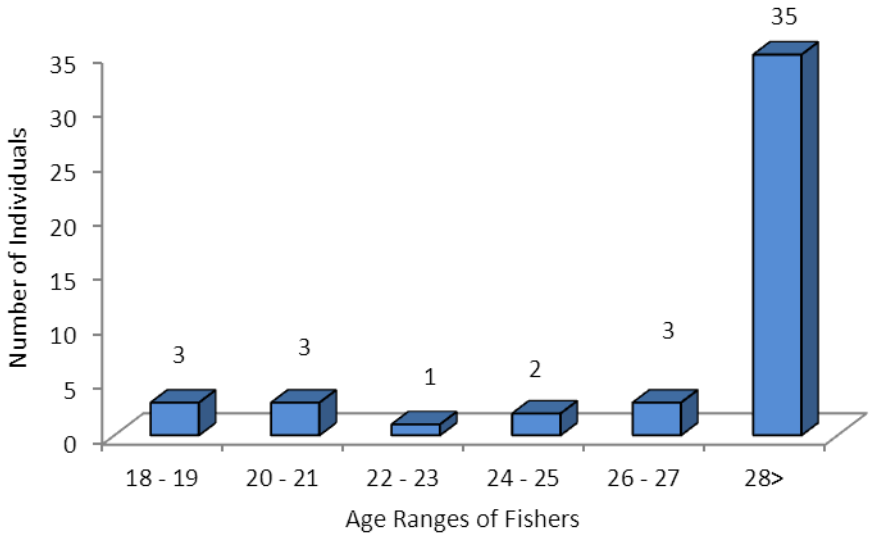

Figure 25. Number of fishermen in each age category who participated in interviews.

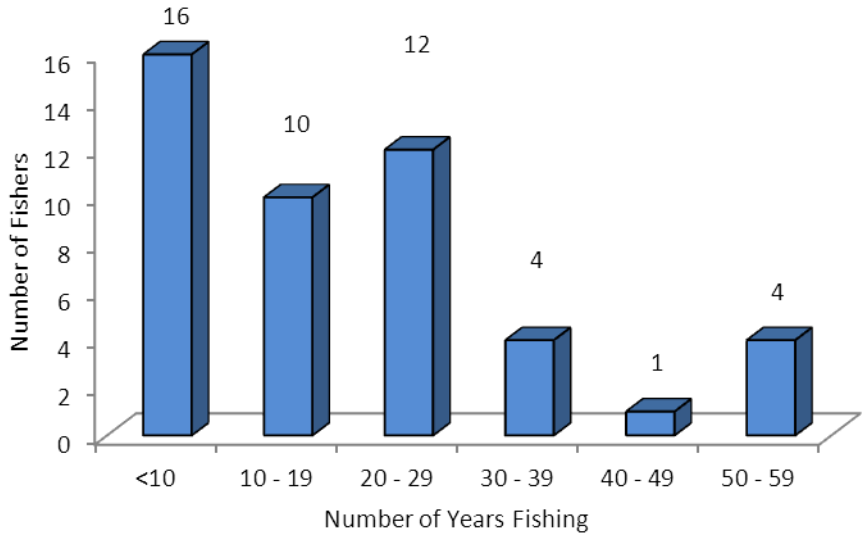

Figure 26. The number of fisher respondents with years of fishing experience.

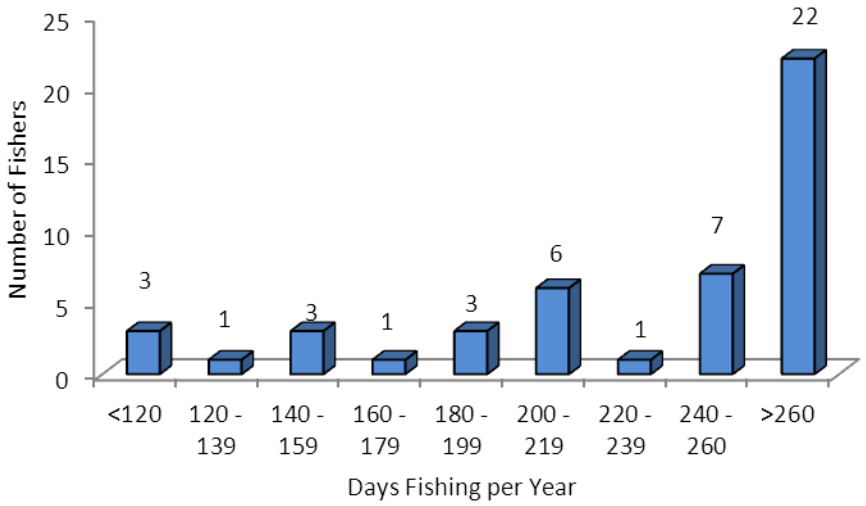

Figure 27. The number of days spent fishing per year by interview participants who are fishers.

The types of fishing gear used by artisanal fishers and others interviewed are mainly based on traditional hook and line, although a small number use gill nets, and one respondent stated he used a long line net. The main means of transportation to and from the fishing grounds is by canoe. The importance of fishing in these communities is also reflected in previous studies on fishing practices conducted in the area in 2007. Some fishermen interviewed have their own

motor boats and collaboratively fish with other fishers, while most use small canoes, or "cayocos."

V.II Turtle Sightings at Sea

The vast majority of respondents confirmed the presence of sea turtles within the marine portion of the CSWR boundary, with 98.0% of all respondents stating that they had seen turtles at sea in the past (Fig. 28). The three respondents who had never seen a turtle at sea included a housewife, a 21 year old fisher with 2 years' experience, and a 24 year old fisher with 5 years' experience. In each of the four communities, fishers were engaged in artisanal fishing in the coastal area of the Refuge nearest to their respective communities. It was in these fishing grounds that respondents reported sighting turtles.

Species diversity in the CSWR (see Fig. 29) appears to harbor the same species diversity as the remainder of Caribbean Honduras, with 45 % of responses stating that they have sighted *E. imbricata* in the Refuge, while 40 % stated they have seen *C. caretta*. More rare are those who have recognized Green sea turtle (Chelonia mydas, Cm), 14 % of respondents, and 9 % have recognized a Leatherback turtle (Dermochelys coriacea, Dm).

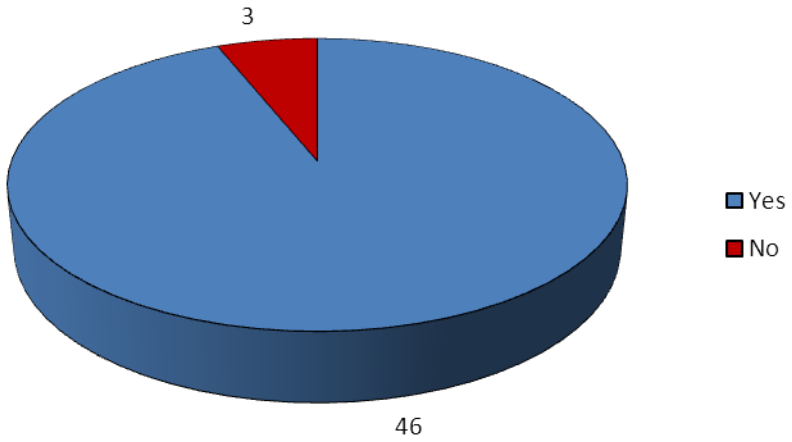

Figure 28. Diagram of responses from 49 participants noting if they have seen turtles at sea.

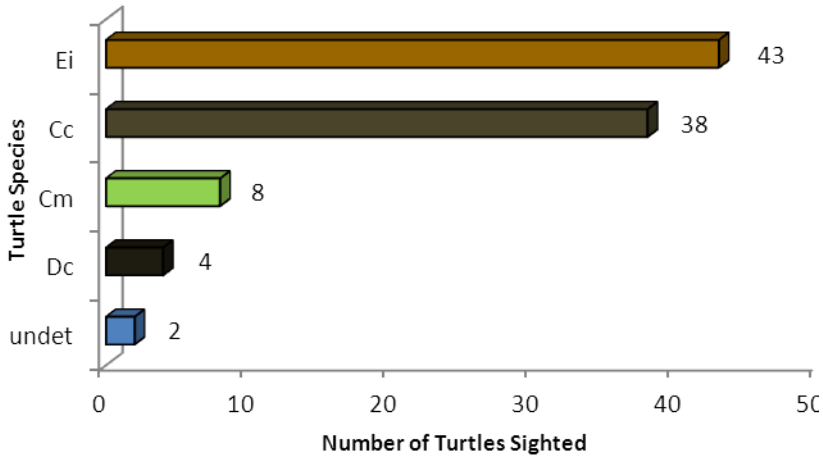

Figure 29. The number of each turtle species sighted by fishermen at sea. Species codes are: Ei (*Eretmochelys imbricata*); Cc (*Caretta caretta*); Cm (*Chelonia mydas*); Dc (*Dermochelys coracea*); undet (undetermined).

In the case of the community of Orotina, all respondents agreed that there are turtles off the Zacate bar. Yet, responses varied in the extent of turtle distribution, either to the Salado bar or up to Boca Cerrada (Fig. 30).

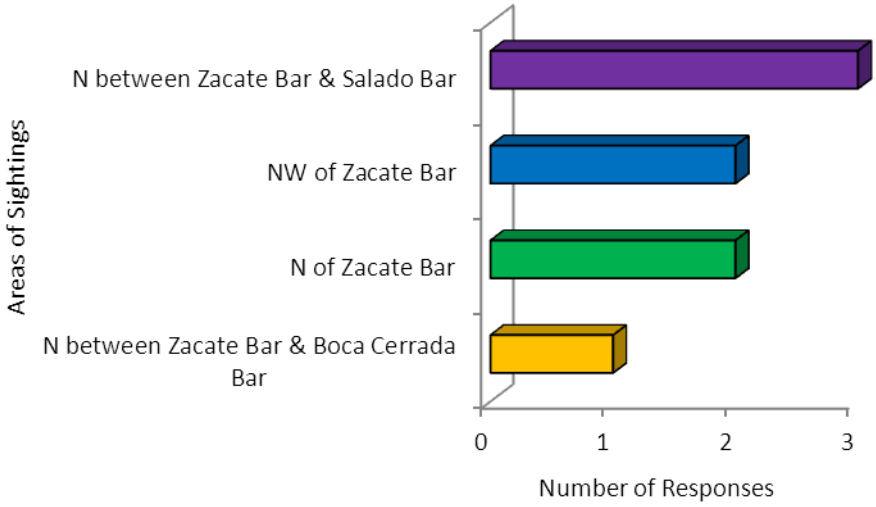

Figure 30. The number of responses from the community of Orotina that emphasized specific fishing areas important for sighting turtles. N = north.

As many as 41.7% of respondents (10/24) from the community of Salado Bar, stated that the fishing area off Salado Bar was an important area for seeing turtles (see Fig. 31). It is also interesting to note that 25% (6/24) of respondents reported the region between Salado Bar and Boca Cerrada Bar as an important sighting area. Other interviewees spoke of large areas (between Zacate and Thompson, for example) or different segments of Salado Bar or Boca Cerrada Bar as important for turtle sightings.

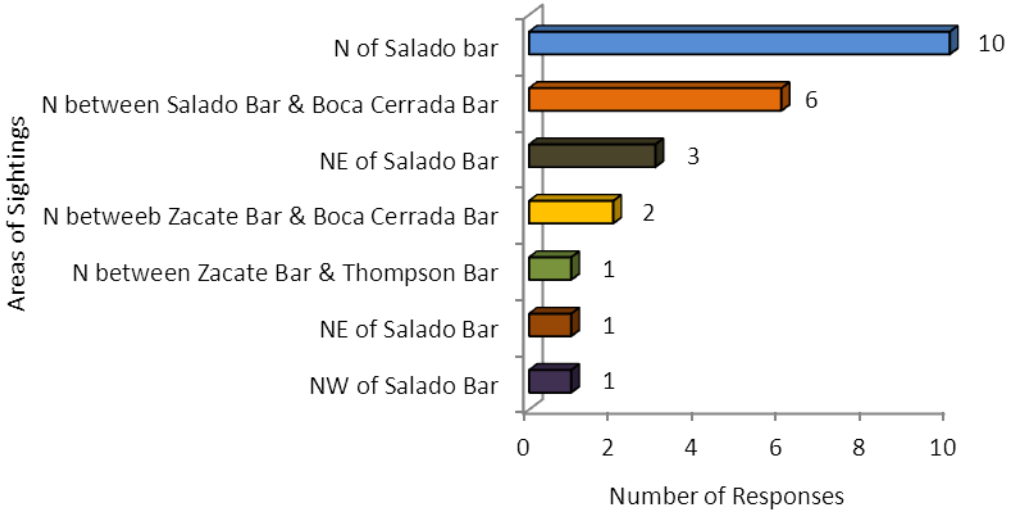

Figure 31. The number of responses from the community of Salado Bar that emphasized specific fishing areas important for sighting turtles. N = north; NE = northeast; NW = northwest

In the case of Boca Cerrada community, 80% of respondents agreed that they sight turtles to the north of Boca Cerrada Bar (Fig. 32), while one respondent expressed the importance of the area between Salado Bar and Boca Cerrada Bar. A single respondent did not know where there were good turtle sighting areas.

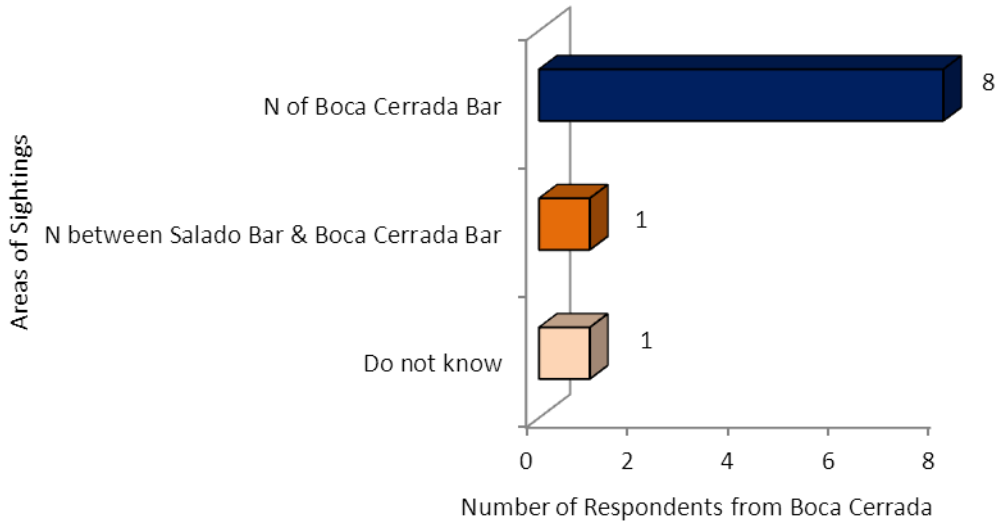

Figure 32. The number of responses from the community of Boca Cerrada that emphasized specific fishing areas important for sighting turtles. N = north

In the community of La Rosita, half of the respondents agree that there are turtles north of Thompson (Fig. 33). Responses differed among interviewees as to the extent of this zone in which turtles could be sighted at sea.

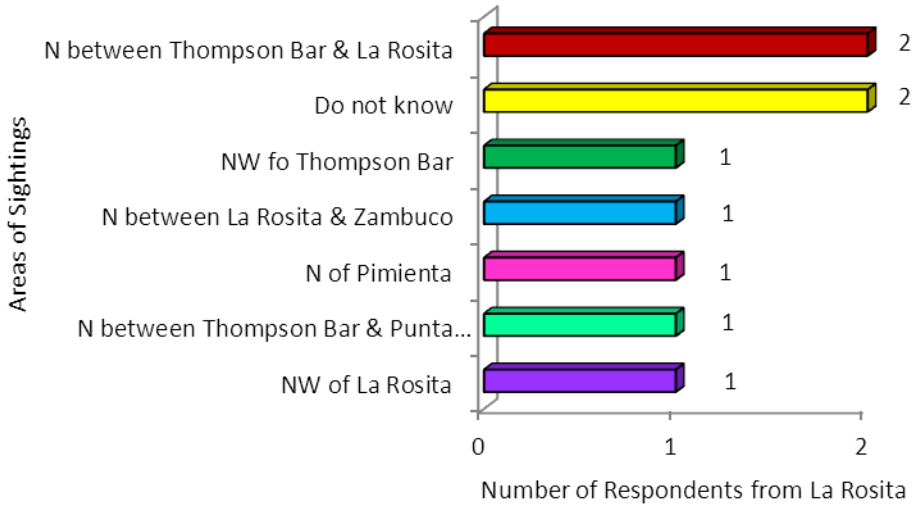

Figure 33. The number of responses from the community of La Rosita that emphasized specific fishing areas important for sighting turtles. N = north; NE = northeast; NW = northwest

The areas in which turtles are sighted coincide with the fishing zones of the four communities, and are called the fishing banks (Fig. 34). These fishing banks are also areas of unsurveyed coral reefs, which the fishers call "stone." Of all respondents who have seen sea turtles at sea, 78% of responses (46/59) stated they had observed turtles in association with reef habitat (Fig. 35). Some fishers we interviewed considered turtles to be guides, indicating to fishers on the open water where reef areas are, and thus, potential fishing zones.

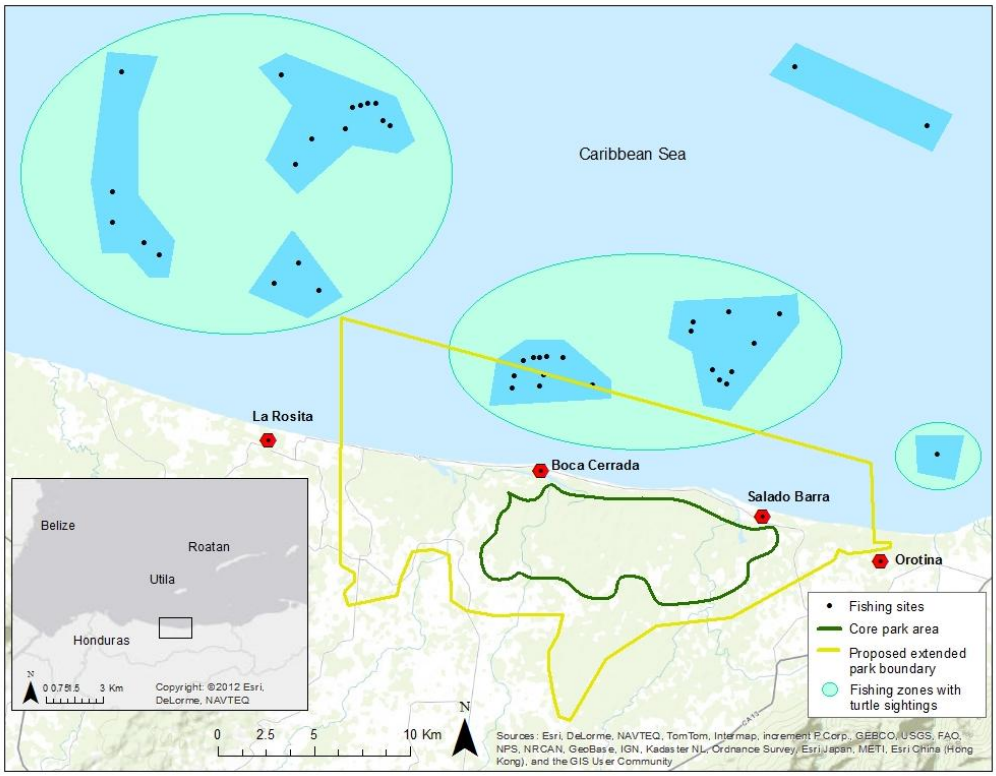

Figure 34. Map of sea turtle sightings coinciding with important fishing areas respective to each community in the region of CSWR. See map key for definitions.

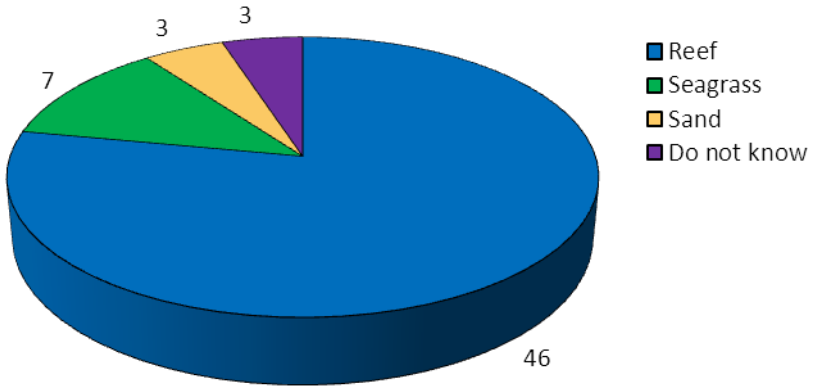

Figure 35. Pie chart showing the number of respondents that specified types of habitat in which turtles are observed at sea.

According to 85.2% (46/54) of responses, when turtles are directly observed, they are usually foraging rather than mating (Fig. 36), in the areas just off shore of the CSWR. Only 7.4% (4/54) of responses stated they had ever observed turtles mating.

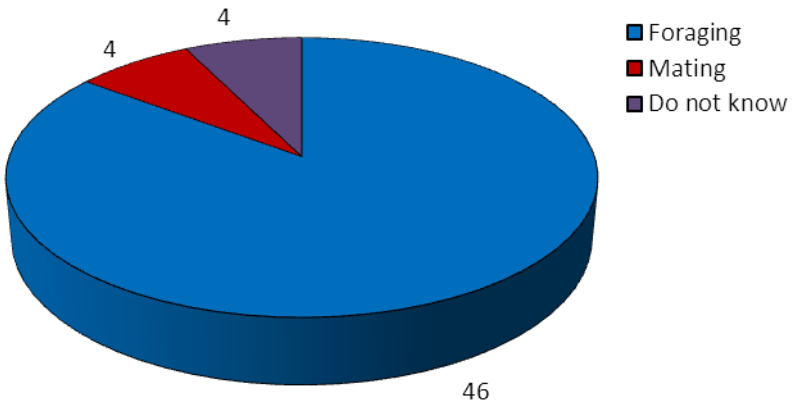

Figure 36. The number of respondents reporting foraging or mating activities of turtles when observed at sea.

Initially, we asked interviewees to state the approximate size and species of turtles they observed at sea. However, it quickly became apparent that the respondents were unable to confirm either the species or the size, since they usually only briefly observe the turtles, and in most cases do so only as a brief distraction from their fishing activities. Still, anecdotal reports suggest that fishers observe both juvenile and adult turtles at sea. From approximate hand measurements given by respondents, it appears that juvenile turtles seen at sea may be between approximately 22 – 32 cm in carapace length, while large turtles may be between 80 and 130 cm in carapace length.

We found that the perception of season in which turtles are observed at sea differed among communities. In the community of Salado Bar, it is widely perceived that turtle sightings occur throughout the fishing year, exclusive of storm intervals (Fig. 37). These storm intervals are obviously variable depending on the year.

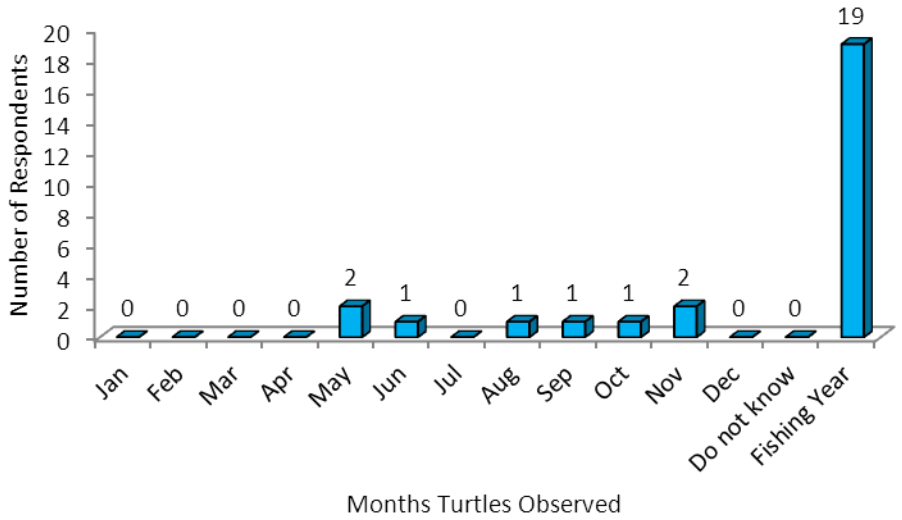

Figure 37. Seasonality of observations of turtles at sea as related by respondents from Salado Bar.

In the other communities, respondents suggested that sea turtle sightings at sea take place mainly over the “summer” months (i.e. from April to September) (Figs. 38, 39 and 40). When responses from all communities were combined, the majority of respondents suggested that turtles were observed all year in the waters off the Refuge (Fig. 41). However, there was a clear unimodal trend of observations occurring in the months from April to August with the peak in May and June (Fig. 41). Some people within these communities also mentioned seeing females "cerquita" to the shore during the summer months.

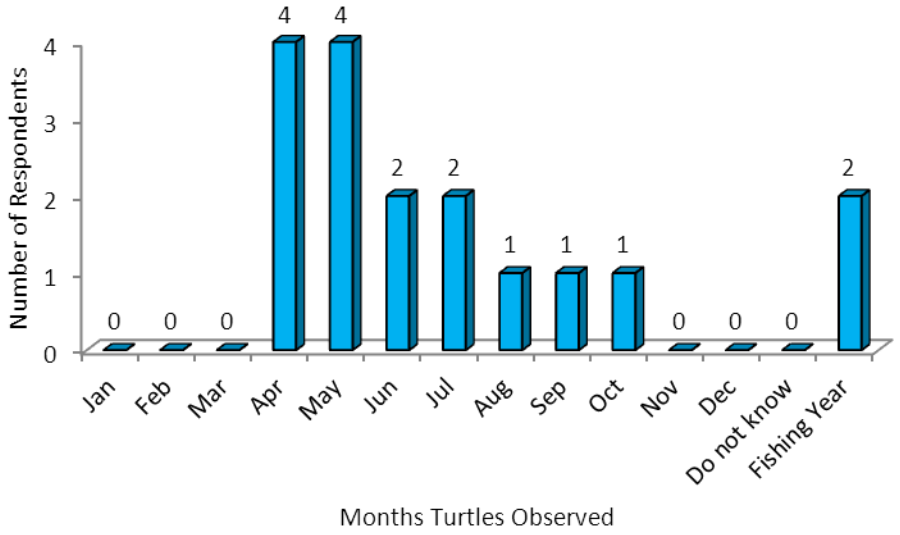

Figure 38. Seasonality of turtle sightings at sea as related by respondents from Orotina.

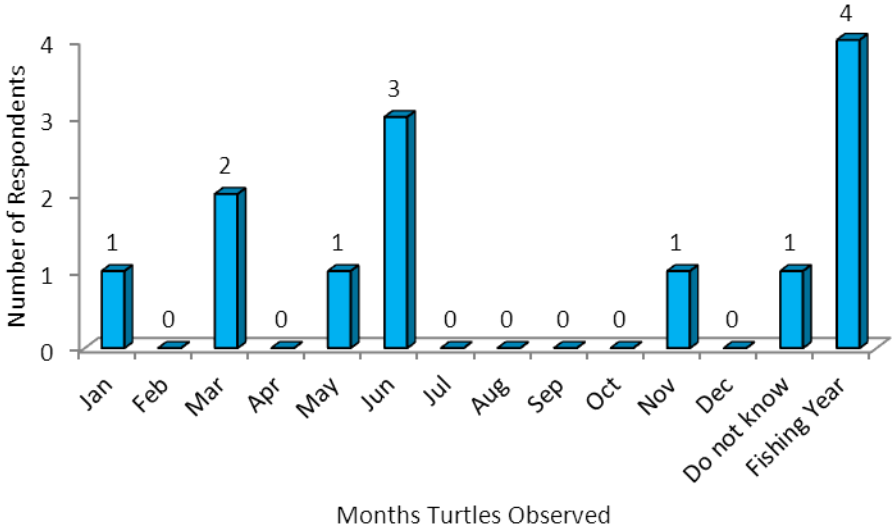

Figure 39. Seasonality of turtle sightings at seas as related by respondents from Boca Cerrada.

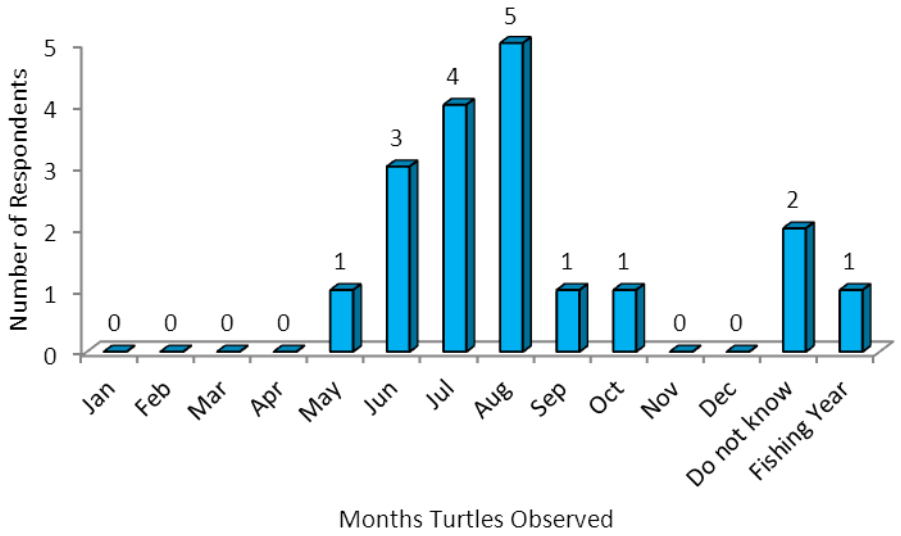

Figure 40. Seasonality of turtle sightings at sea as related by respondents from La Rosita.

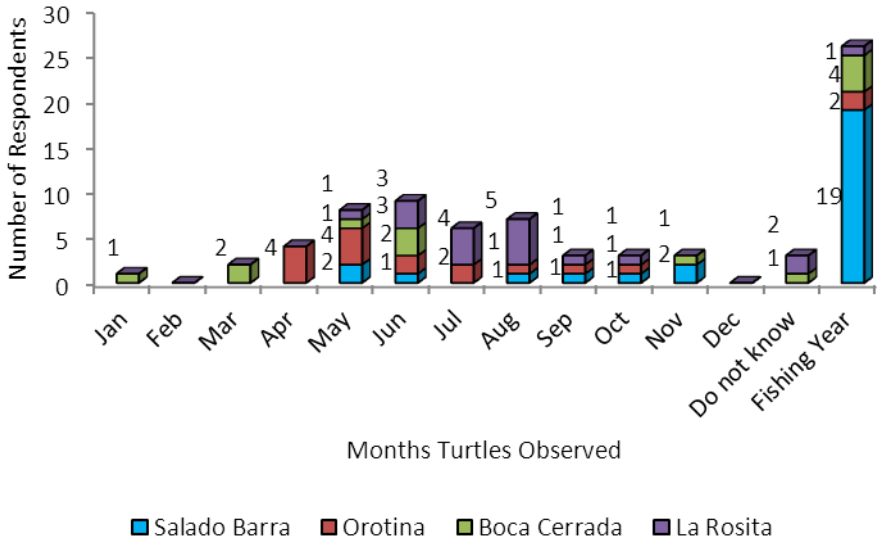

Figure 41. Seasonality of sightings of turtles at sea as related by all respondents from the four communities.

Of the 98% (48/49) of respondents who have been at sea, 57% (28/49) stated they had observed turtles in the water 50% or more of the times they engage in fishing activities (Fig. 42).

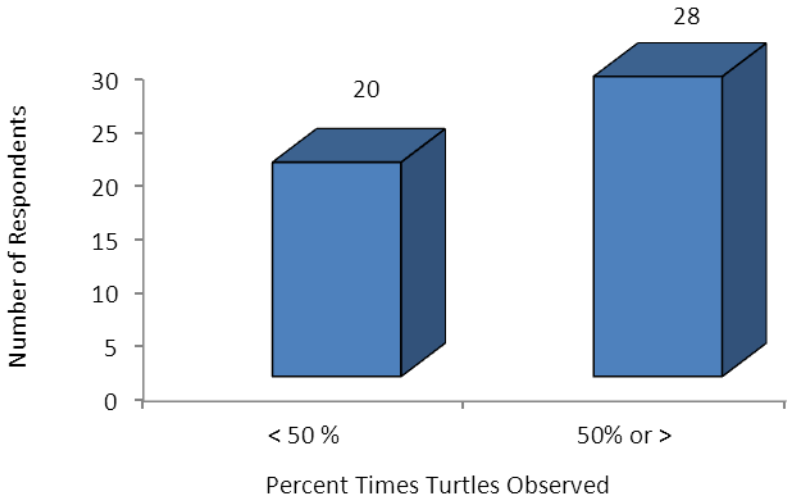

Figure 42. The number of respondents who observe turtles at sea less than 50% or more than 50% of the times they undertake fishing trips.

V.III Turtle Sightings on the Beaches

The presence of sea turtles on the beaches of CSWR was confirmed by 89.8% of respondents (Fig. 43). Responses to questions of species diversity of turtles on the beaches of CSWR reflected the same pattern of abundance as responses for diversity of turtle species observed at sea, with dominance of Hawksbills, followed by Loggerheads, Greens, and Leatherbacks (Fig. 44). Respondents could not confirm the species identification of turtles observed on the beaches of CSWR in only 5.8% of responses.

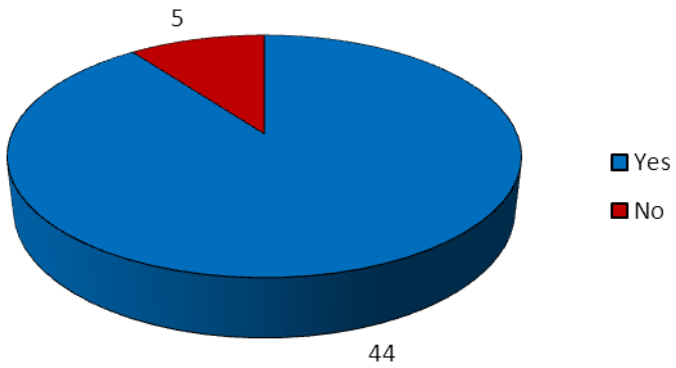

Figure 43. Pie chart representing the number of respondents who confirmed or denied the presence of turtles on the beaches of the CSWR.

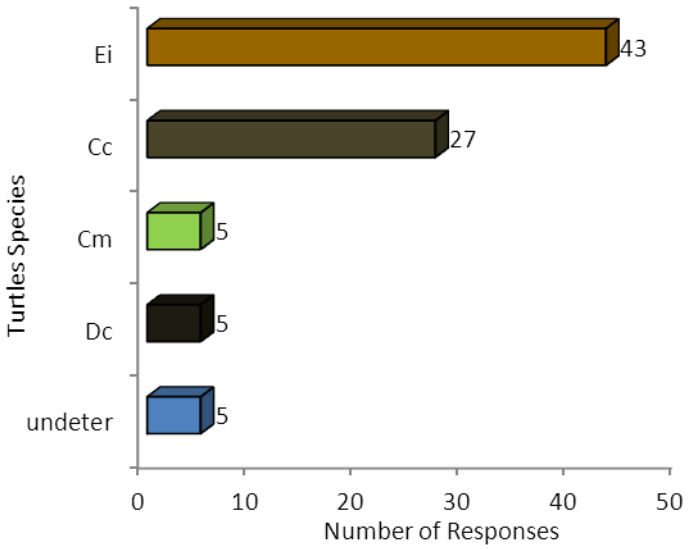

Figure 44. The number of responses that identified turtle species from observations of turtles on the beaches at CSWR.

Approximately 50 % (43/85) of responses suggested that the Hawksbill (*Eretmochelys imbricata*) is sighted nesting on the beaches (Fig. 44). Some 31.8 % of responses stated that the Loggerhead turtle (*Caretta caretta*) is also seen nesting in the area. A small percentage (5.9 %) indicated the presence of the Green turtle (*Chelonia mydas*) and Leatherback (*Dermochelys coriacea*). The proportion of responses suggesting that Green and Leatherback turtles nest in the area of CSWR is similar to the proportion of those turtles reported at sea.

Importantly, respondents were generally unable to identify from photographs or illustrations, the species that come to nest at CSWR, and, in most cases, have not actually observed turtles nesting in the Refuge. Their knowledge of the different species nesting at the Refuge is generally based on finding different types of tracks and eggs when encountered on the beaches. This may be one of the reasons that the pattern of species diversity on the beaches is very similar to the pattern of species diversity reported at sea.

With respect to nesting areas, respondents in each community indicated the closest beaches to their respective communities. Thus, important beach area referred to by respondents changed according to the respondent within the same community.

Of the respondents from Salado Bar 60.9 % (14/23) concluded that there are turtles nesting on the beaches between Zacate Bar and Boca Sarrada Bar (Fig. 45), representing approximately 16 km of beach.

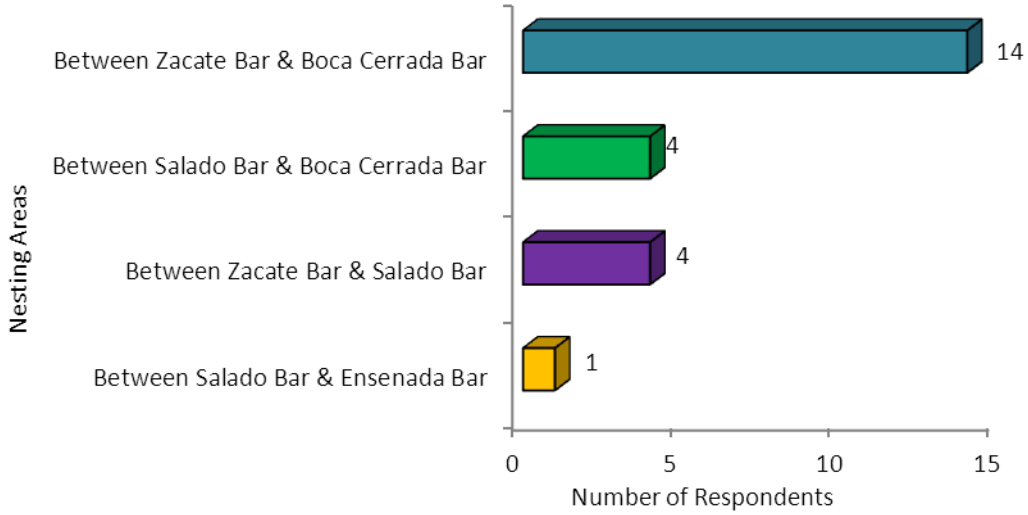

Figure 45. Nesting areas according to respondents from Salado Bar.

In Orotina, the responses were quite variable, with little convergence regarding the extent of the nesting area and the reference beaches (Fig. 46). There was some consistency, however, in that at least 71.4 % (5/7) of the respondents included the beach at the entrance to Zacate Bar.

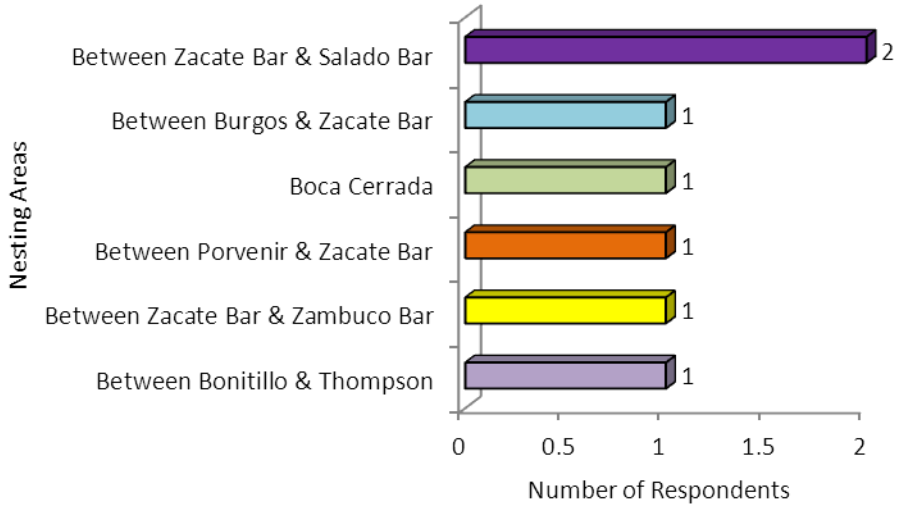

Figure 46. Nesting areas according to respondents from Orotina.

In the community of Boca Cerrada (Fig. 47), approximately one third of respondents indicated the bar area of Salado to Thompson (17 km of beach) was where turtle nesting took place. Almost one third of respondents stated nesting took place to the east of the community between Salado Bar and Boca Cerrada Bar (11 km of beach), while more than one third of respondents defined the area to the west between Boca Cerrada Bar and either Thompson Bar (6 km of beach) or to La Rosita-Pimienta (7 km more) as nesting beach.

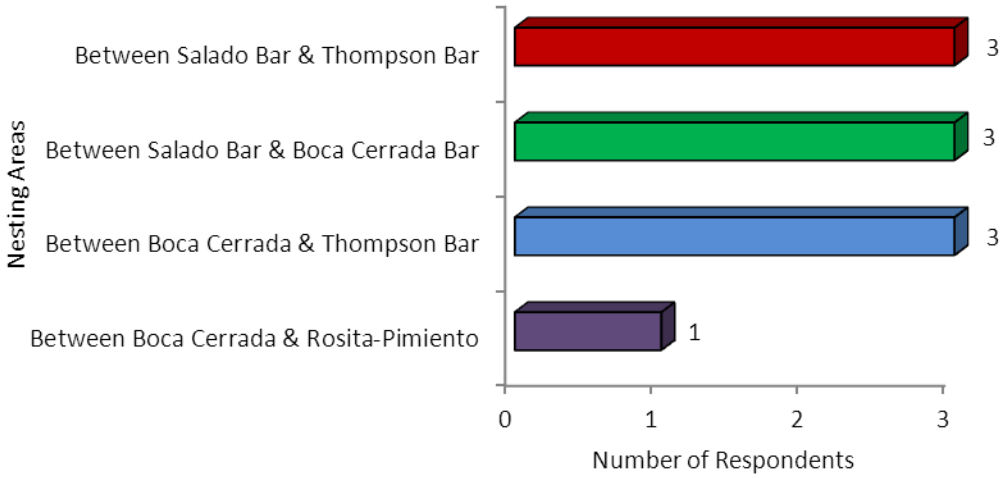

Figure 47. Nesting areas according to respondents from Boca Cerrada.

In the community of La Rosita, responses were also quite variable in terms of the extent of beach area that is used for nesting and reference locations (Fig. 48). If anything, respondents consistently selected areas that lie between Thompson Bar and Zambuco (approximately 10 km of beach), as areas where they perceived nesting to be taking place.

According to respondents from all four communities combined, and when all turtle species diversity in the area are integrated, the nesting season appears to be concentrated from April to September, with peak nesting occurring in August (Fig. 49). When respondents who did not know when turtles nested were factored out, 43.3 % (29/67) of responses stated that turtles were nesting in the months of July and August, while 65.7 % (44/67) stated that turtles were nesting over the months from June to September.

In terms of nesting season, it is worth noting that 24.5 %, (12/49) of respondents from different communities did not know what months constituted nesting season for sea turtles in the area (Fig. 49).

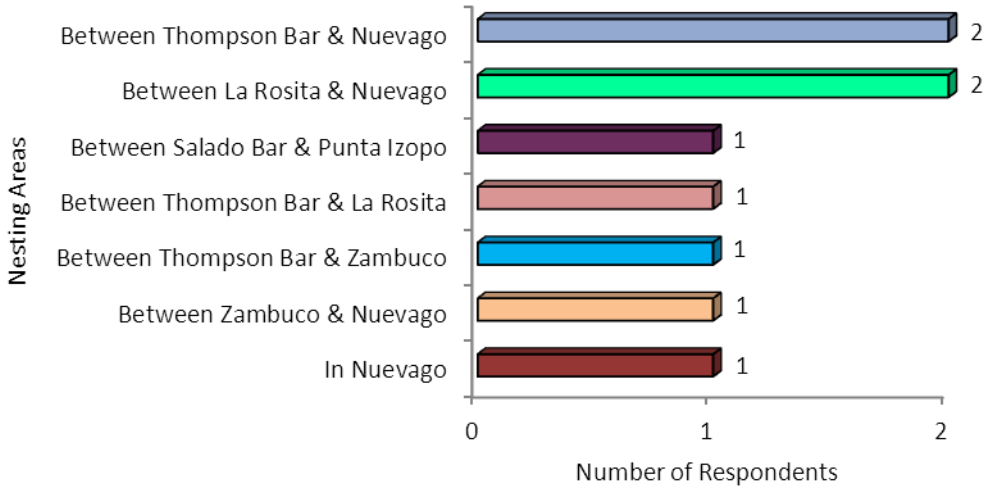

Figure 48. Nesting areas according to respondents from La Rosita.

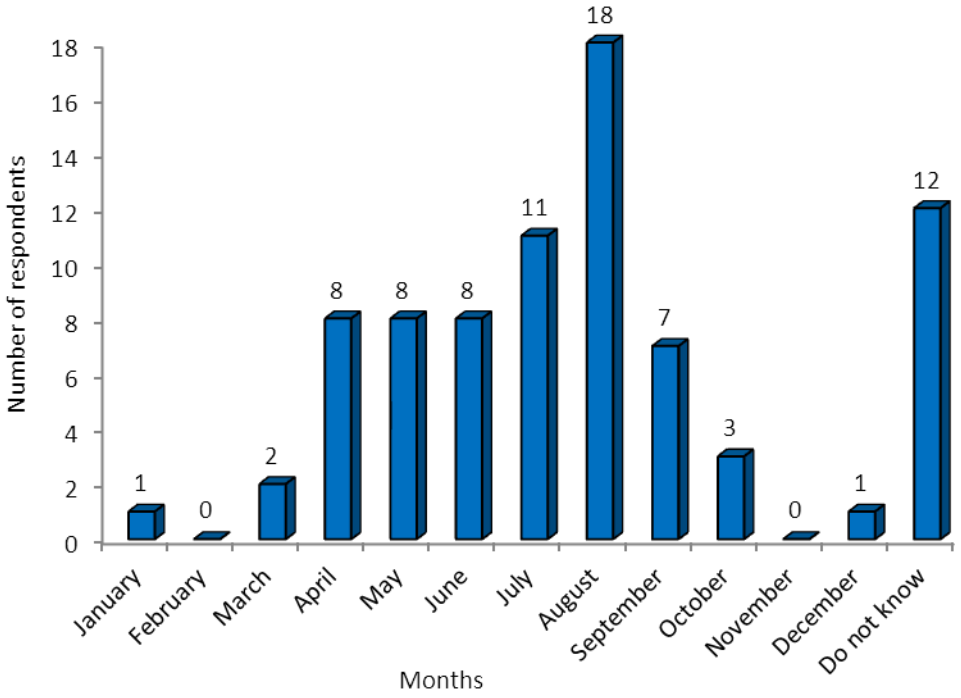

Figure 49. Nesting season for sea turtles on the beaches of CSWR, as suggested by respondents from all four communities combined.

When asked how many turtles they see nesting in areas designated as nesting beaches, 49 % (24/49) of respondents estimated that fewer than 10 turtles per year nest in these areas (Fig. 50).

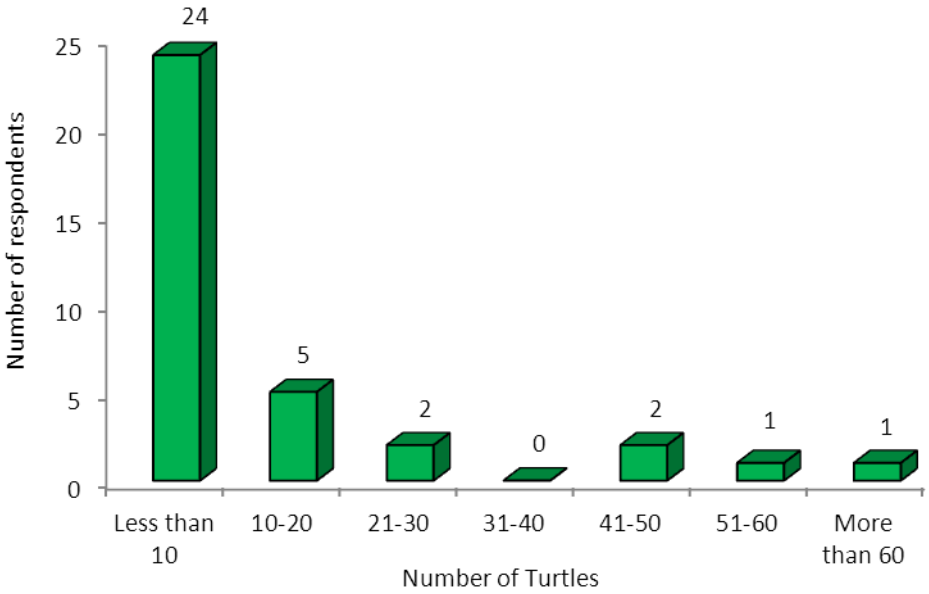

Figure 50. The number of turtles nesting in areas designated as nesting beaches throughout the CSWR, according to respondents from all communities in the CSWR combined.

V.IV Threats

V.IV.I At Sea

Cuero y Salado Wildlife Refuge

Of respondents from all communities combined, 87.8 % (43/49) stated that they respected sea turtles when they saw them at sea (Fig. 51). We found that 6.1 % of respondents suggested that they would like to eat turtles when trapped in their nets or found at sea, yet recognized that capturing and eating turtles is illegal. They also noted that with the fishing gear they use (line, hook, and small canoe) they find it very difficult to capture turtles at sea while fishing alone.

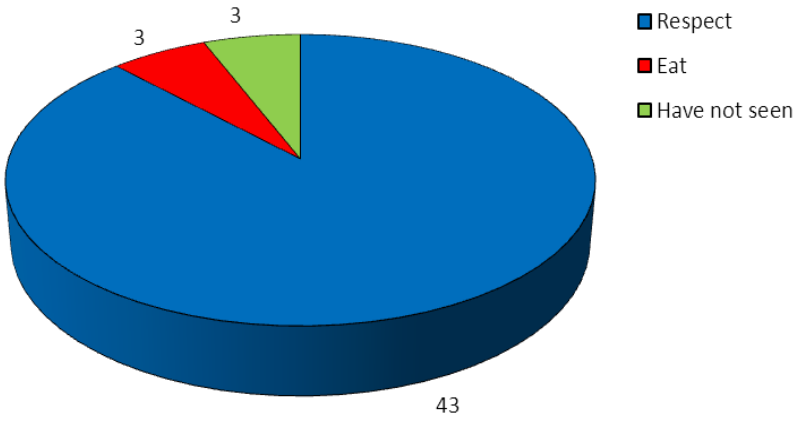

Figure 51. Pie chart representing the attitudes of respondents toward turtles when turtles are observed at sea.

When community members were asked their opinion on whether any aspects of current fishing practices were a threat to sea turtles at sea, 51 % of respondents affirmed that there is a threat, while 47 % did not believe that current fishing practices in the CSWR marine area was a threat to turtle survival (Fig. 52).

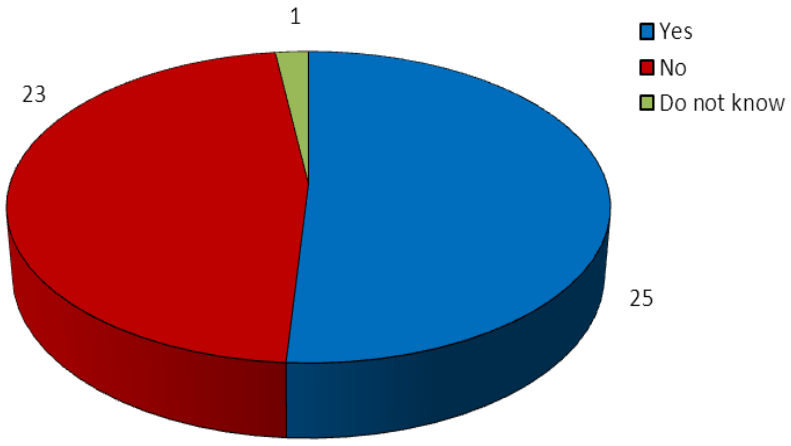

Figure 52. The number of respondents from all communities in the CSWR combined regarding current fishing practices in the zone as possible threats to turtle survival at sea.

The division of responses is different when analyzed according to each of the communities surveyed. For example, in Salado Barra the trend is clear that most of the respondents 65.2 % (15/23) believed that there were threats to turtle survival in the water (Fig. 53) from both nets and spear fishing divers. However in Orotina, opinions on whether or not there are threats were almost equally divided between the affirmative (57 %) and the negative (43 %) (Fig. 54). In the community of Boca Cerrada, 60 % of respondents stated that there is no threat to turtles at sea from current fishing practices (Fig. 55), and 67 % of respondents at La Rosita agreed that no threat to turtles exists (Fig. 56).

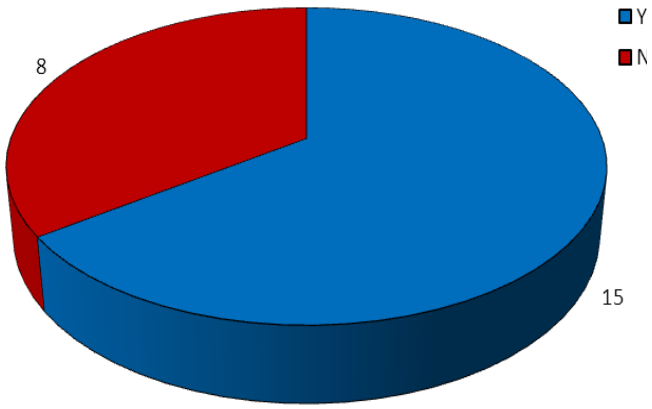

Figure 53. Opinions of respondents from the community of Salado Bar to the question of whether current fishing practices in CSWR are a threat to turtle survival at sea. Yes (Y); No (N).

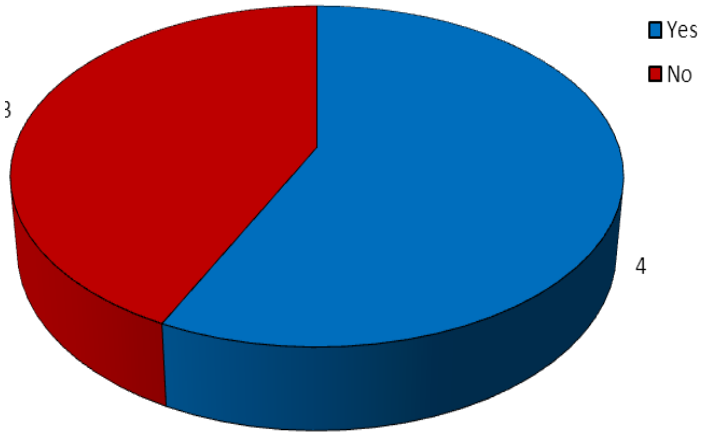

Figure 54. Opinions of respondents from the community of Orotina to the question of whether current fishing practices in CSWR are a threat to turtle survival at sea.

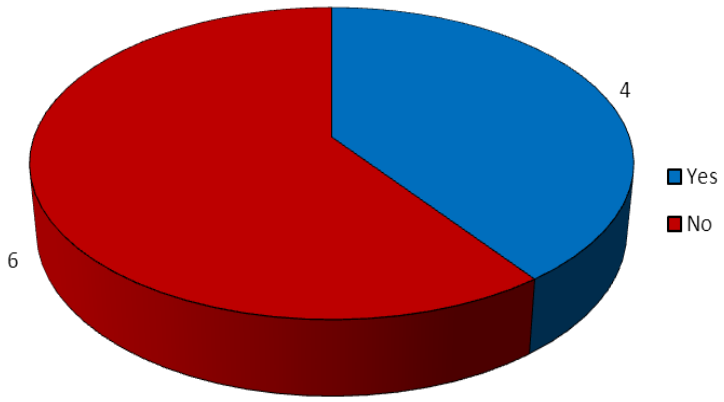

Figure 55. Opinions of respondents from the community of Boca Cerrada to the question of whether current fishing practices in CSWR are a threat to turtle survival at sea.

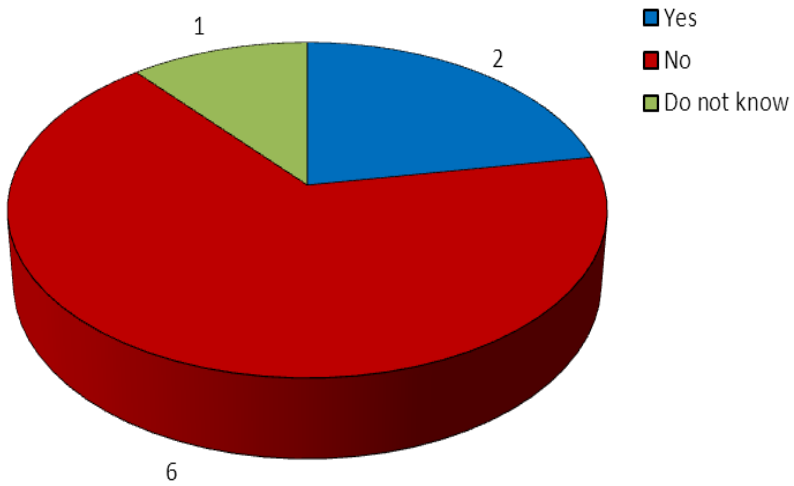

Figure 56. Opinions of respondents from the community of La Rosita to the question of whether current fishing practices in CSWR are a threat to turtle survival at sea.

Among all communities combined, when asked what types of fishing gear threatened turtle survival at sea, 45.8 % (27/59) of responses indicated that some type of net (trammel nets, shrimp nets, and seine nets) constituted the main threats from fishing gear (Fig. 57). However, a full 42.4 % (25/59) of responses suggested that there were no threats to turtles from any form of fishing gear used in the CSWR.

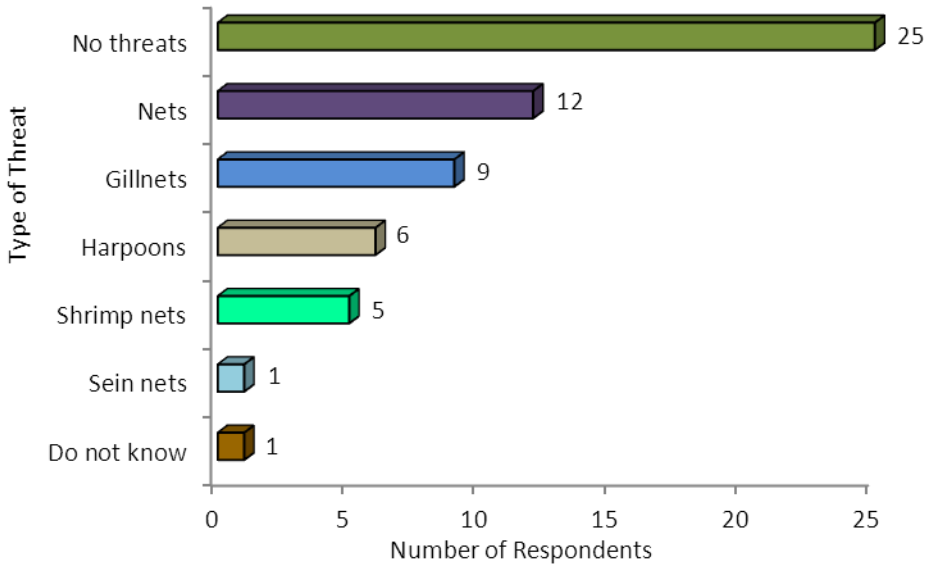

Figure 57. Types of threats to turtles at sea from fishing gear types, as suggested by respondents from all communities combined.

Still, most respondents 94 % declared that they had never found a turtle in a fishing net, with only 3 respondents stating they had found turtles caught in fishing gear; 1 individual twice and 2 individuals once (Fig. 58).

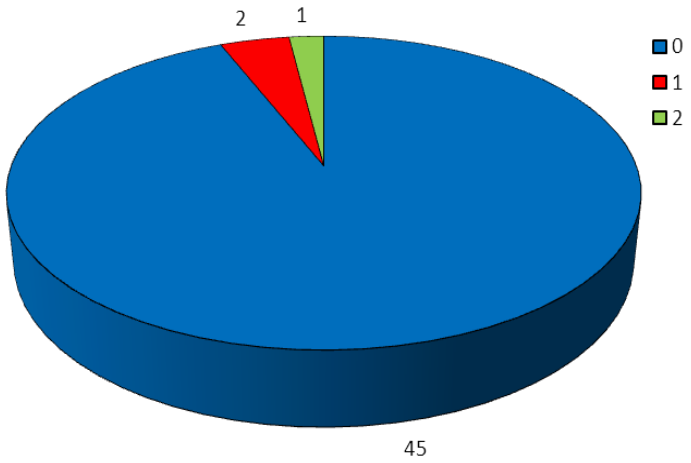

Figure 58. The numbers of respondents who have not seen a turtle caught in a net at sea, have seen a single caught at sea, or who have seen 2 turtles caught in nets at sea.

V.IV.II On the Beaches

On the beaches, attitudes are more differentiated (Fig. 59), dominated by 49 % (24/49) of respondents who have not actually seen turtles on the beaches, but relate having seen turtle tracks, or have heard anecdotes in the community that turtles have nested in the area. Some 26% (15/57) of respondents openly admitted to having collected eggs from the beaches. One Garifuna respondent stated that if he found a turtle on the beach he would kill it for consumption.

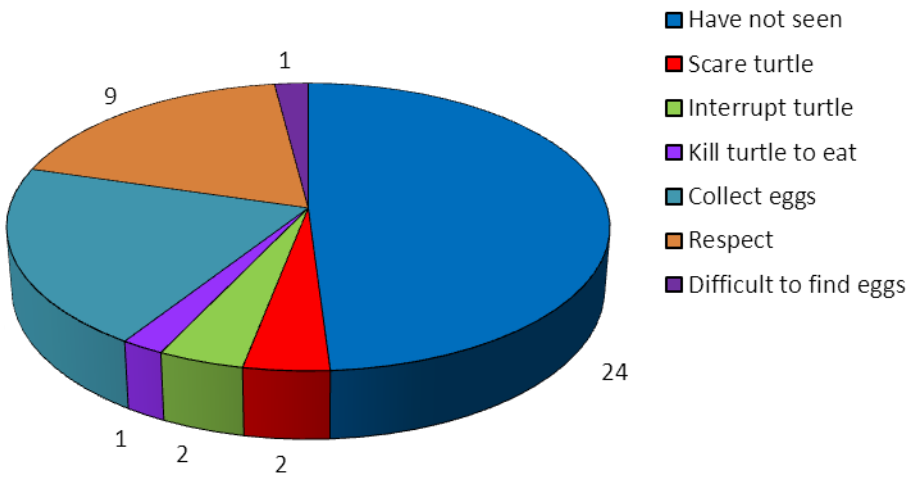

Figure 59. The numbers of respondents who report attitudes toward turtles found nesting on the beaches at CSWR.

Figure 60 shows the opinion of respondents in relation to the percentage of turtle eggs harvested from beaches of the Refuge. We found that 40.8 % (20/49) suggested that a low percentage of nests (from 0 – 24 %) are harvested for consumption. However, this information is likely subject to bias in the responses provided, since it is clear that respondents know that using this resource is prohibited. What appears to be reality is that, despite the number of tracks seen on the beaches by community members, there are few sea turtles attempting to nest in this area, and fewer are subsequently given the chance to complete nesting.

In any case, eggs that are harvested appear to be more for personal consumption between family and community members, than sold through a commercial system, such as a food market or egg vendor. From all responses combined, 78.3 % (47/60) stated the eggs are eaten (Fig. 61), and only 18 % of responses suggested that eggs are sold in some sort of commercial system. Thus, it appears that there is little commercial business activity linked with egg harvesting, as reflected in responses from these communities. However, eggs that are sold are sold in markets within close proximity to the communities. In the case of Salado Bar, eggs are sold in the town of La Union. From Boca Cerrada, eggs are sold in the town of La Masica. Eggs harvested in La Rosita are typically sold in Sparta, while it appears that there is not much marketing of harvested eggs in the community of Orotina, perhaps because this community is farthest from the beach.

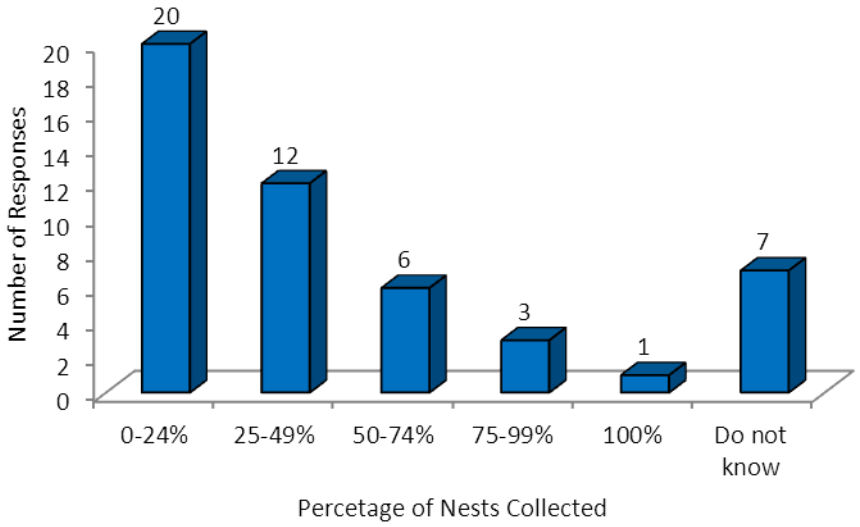

Figure 60. The number of responses regarding the percentage range of eggs harvested from beaches of the CSWR.

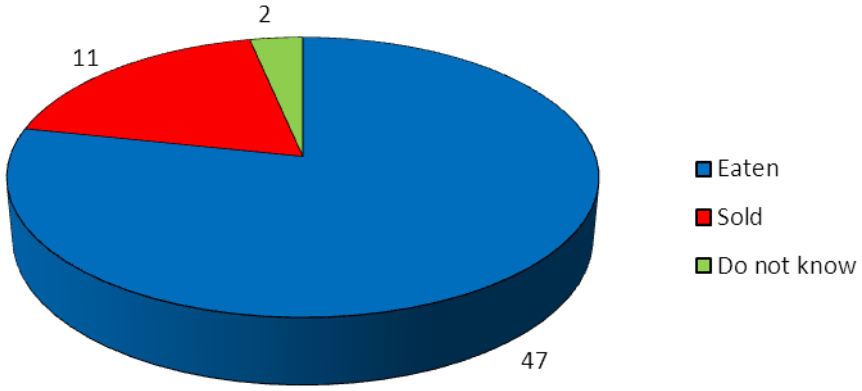

Figure 61. The combined number of responses to the question of how eggs harvested from the beaches at CSWR are used.

Respondents suggested that threats to turtles in the area of CSWR, including both the marine and beach habitats, ranged from fishing nets to disturbing turtles on the beaches. The most prominent threat, according to respondents from all communities combined, appeared to be fishing nets of all kinds. Some 39 % of respondents stated that nets, in general, are a problem for turtles. When the response of “nets” was combined with specific types of nets, a total of 51 % of respondents stated that general or specific net types are a threat to turtles in this area (Fig. 62). Some 13.6 % of responses indicated that harpooning from conch and lobster divers is a threat, and 11.9 % indicated that egg harvesting at the beach threatens turtles in the CSWR (Fig. 62). Only 3.4 % of responses suggested there was no threat to turtles in this area.

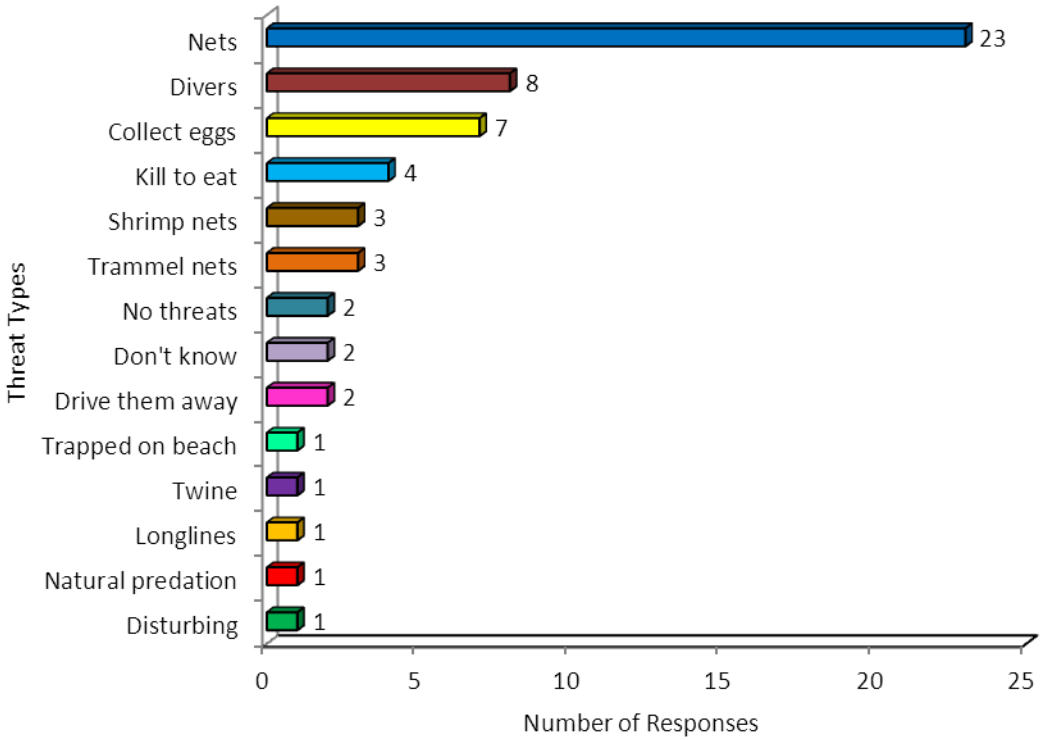

Figure 62. The principal threats to turtles at sea and on the beaches in the area of the CSWR, according to responses from members in all communities combined.

V.V Trends at Sea

We asked respondents their opinion on the trend of turtle population dynamics at sea. The trend is that most of the respondents believe that turtle sightings at sea were more numerous 5, 10, and 20 years ago than they are at present (Figs. 63 A, B, C), potentially representing a strong decline in turtle numbers over the past 20 years. It should be noted that a large percentage (53%), responded that they did not know the trend over the past 20 years, and that they were too young to remember, or had not been fishing long enough to have seen a trend from that far back in time. There is a general positive correlation of those who did not know what the trends were with increasing historical time.

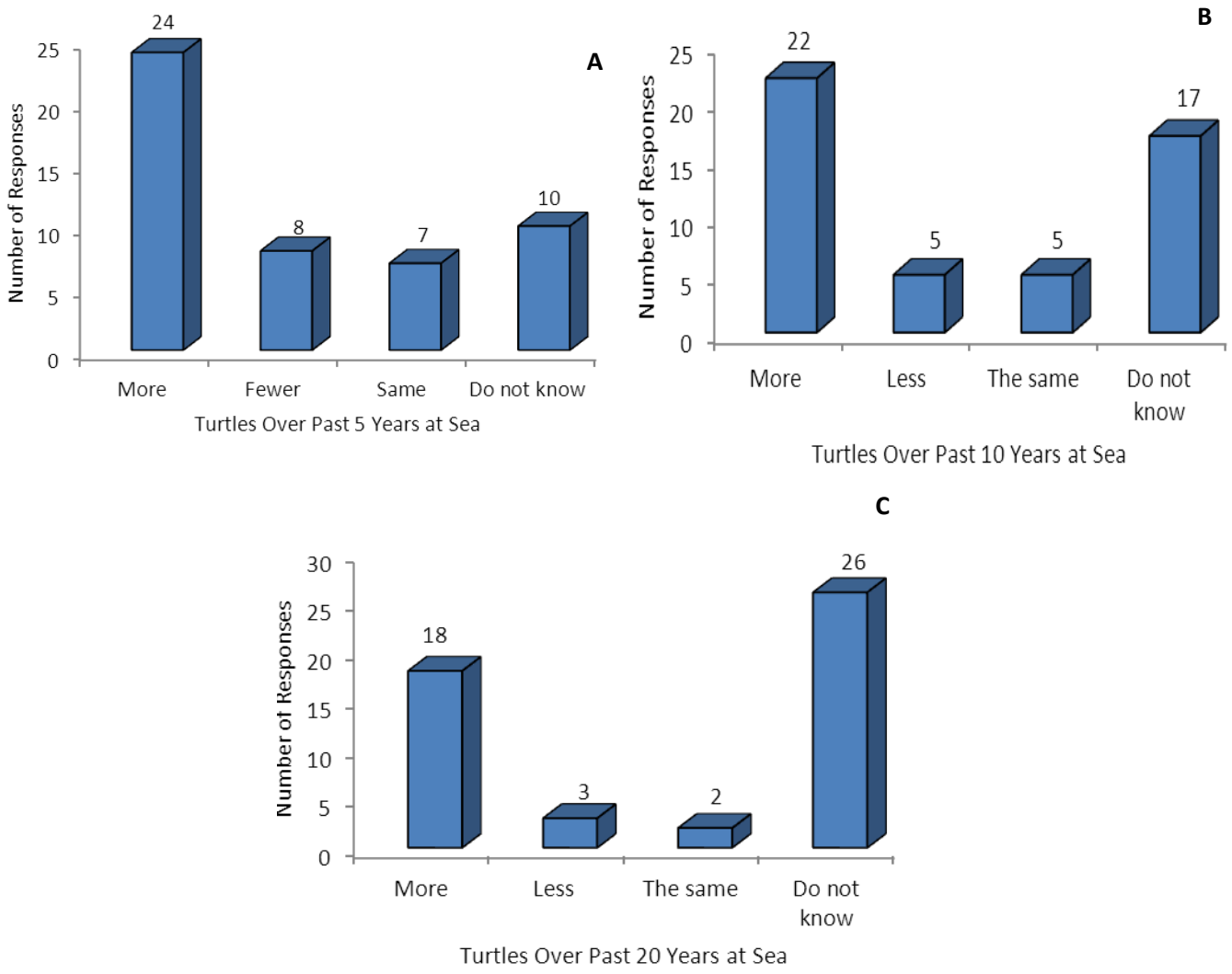

Figure 63. The number of respondents from CSWR who believe they saw more, fewer, or the same number of turtles at sea 5 years ago (A), 10 years ago (B), and 20 years ago (C), than they see now.

V.VI Trends on the Beaches

The same question was asked of anecdotal respondents, whose answers converge even more heavily and more homogeneously on the decline of turtle populations visiting the beaches of the refuge (see Fig. 64). When asked if more or fewer turtles were sighted 5 years ago than at present, the great majority of respondents (65 %) stated that there were more 5 years ago (Fig. 64 A), while only 12 % suggested there were fewer sightings of nesting turtles 5 years ago. When asked to compare sightings 10 years ago to today, again the majority (61 %) stated there were more 10 years ago (Fig. 64 B). Again, the majority of respondents (61 %) suggested that there were more sightings of turtles on the beaches 20 years ago than at present, while only 6 % suggested there were fewer then than now (Fig. 64 C). It should be noted that the number of respondents who stated that they "do not know" was positively correlated with increasing historical time.

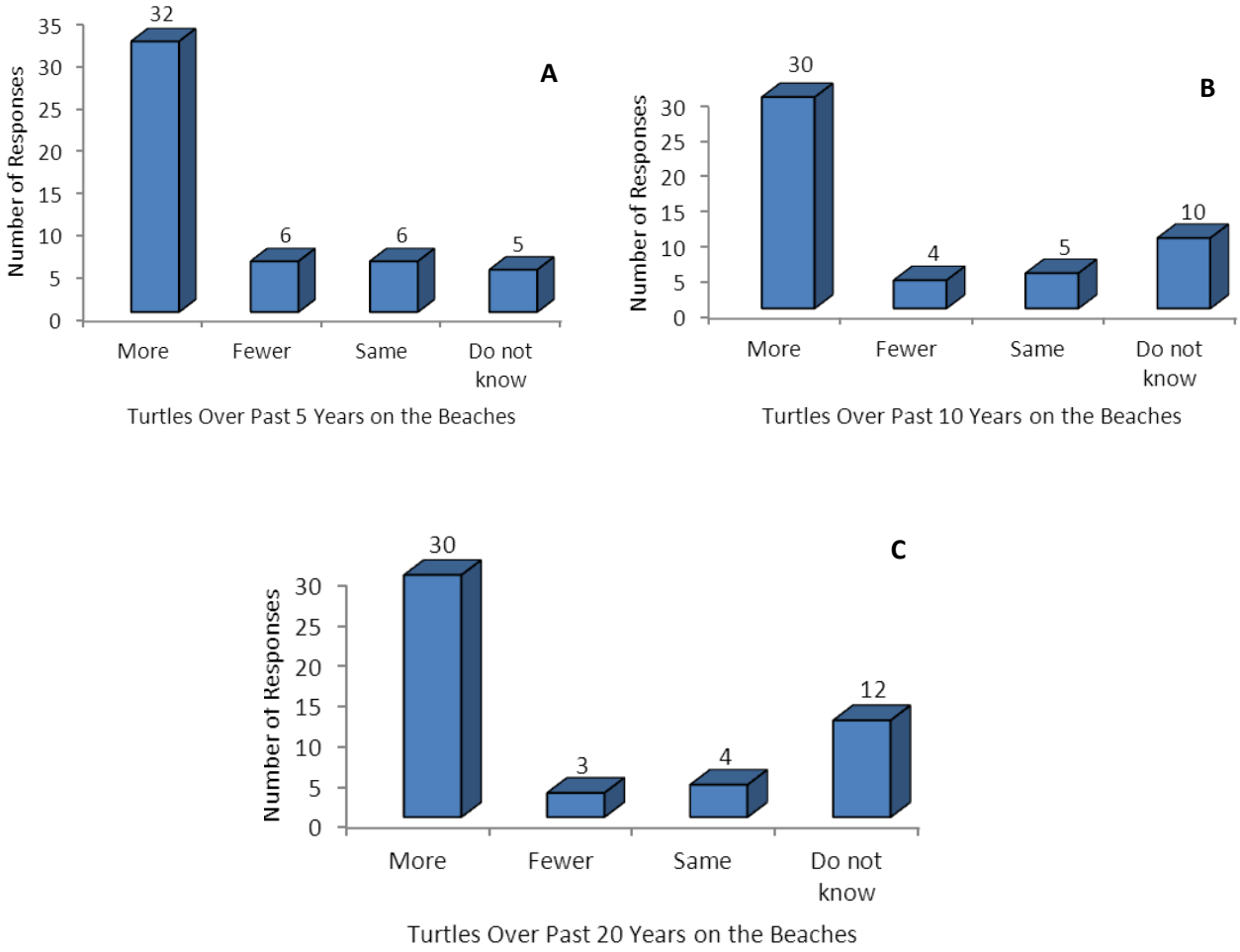

Figure 64. The number of respondents who believe they saw more, fewer, or the same number of turtles on the beaches 5 years ago (A), 10 years ago (B), or 20 years ago (C) than they see now.

V.VII Monitoring

Cuero y Salado Wildlife Refuge

According to the spatio-temporal characteristics of the area revealed from results of the surveys conducted in the four communities of CSWR, we proposed four monitoring protocols; 2 for the sea and 2 for the beaches. These can be used depending on the availability of resources and the time of year. The details of each protocol (materials, budget items, recommendations and monitoring sheets) are provided in Appendix IV.

For the CSWR maritime area, two types of monitoring are possible. A cost-efficient monitoring process, and therefore one that can possibly be used in a timely manner is in-water monitoring, which a trained and responsible fisher can undertake. We trained a fisher for this study who regularly moves to and from the fishing banks off the bars of the rivers that flow out of the CSWR. In this study we used monitoring type 1 (or M1). This type of monitoring can collect the

date, time and GPS point of sighted turtles, and other information (turtle species, estimated size, behavior) and can also collect data on habitat (type and description).

For the second type of monitoring at sea (M2) trained fishermen from the communities can collect data on sea turtles at sea (date, time, description and site name, species of turtle, estimated carapace size, weather conditions, comments) in exchange for some form of symbolic compensation.

On the beaches, two types of monitoring are recommended for the area. The first type (M3), is dedicated to finding emerging females or tracks leading to the nest. Upon finding a nest, data is collected on the date, time, and place of the discovery of the nest, and if it is a true or false nest. If the females are sighted, the species can be identified by counting lateral carapace and prefrontal scutes, and data is then collected over time for population dynamics (presence and identification number of flipper tags), genetic analysis, and morphometric measures. All turtles are photographed for continuing identification, and data would be collected on environmental variables, such as beach vegetation, distance to high tide, moon phase, wind, and rain events. Such monitoring should be done at night, when the majority of females come ashore to nest. The last type of monitoring (M4) is dedicated to monitoring for hatchlings and is performed at sunrise or sunset. When a hatching event is observed, the data collector would count the number of hatchlings that are live, those remaining in the nest alive and dead, and the number of eggs that did not hatch. Two to five days later the monitor should return to count the number of shells remaining to record the number of hatchlings and also investigate the number of infertile eggs and those in which developing embryos did not emerge. In this way one can estimate the hatching success of each nest encountered, if allowed to remain *in situ*.

This monitoring is proposed in order to obtain data which allow scientists to estimate how different sea turtle species utilize the marine and beach areas of CSWR. These protocols may also be modified and can be applied over time. Table 2 sets out a prospective timeline that could be used for each of these monitoring types within the area of CSWR.

Table 2. Recommended monitoring time periods resulting from responses from all community members interviewed in the four communities of the CSWR.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M1												
M2												
M3												
M4												

During 2012, ProTECTOR performed 4 types of monitoring within the CSWR. Table 3 summarizes the seasons in which we conducted the respective types of monitoring.

Table 3. Monitoring activities undertaken by ProTECTOR in the CSWR during the 2012 season.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M1												
M2												
M3												
M4												

V.VIII RESULTS OF RESEARCH STUDY

V.VIII.I Monitoring Effort

Cuero y Salado Wildlife Refuge

ProTECTOR personnel returned to the CSWR in late June, 2012 and remained there until the end of August to coordinate M2, M3 and M4 type patrols, and to undertake a description of the beaches identified as suitable for Hawksbill nesting.

A total of 44 hours of in-water monitoring (type M2) was completed. In addition, 117 hours of night patrols (type M3) totaling 245.5 km of beach, and 17.5 hours of daytime patrols (M4 type) totaling 42 km of beach, were also undertaken.

Figure 65 shows the numbers of hours per week in which turtles were monitored at sea during the season from June 27 to August 26. The amount of time engaged in this activity was determined by the output frequency of the fishers who collected these data, which was influenced by sea state, as well as other daily activities in which these fishers were engaged.

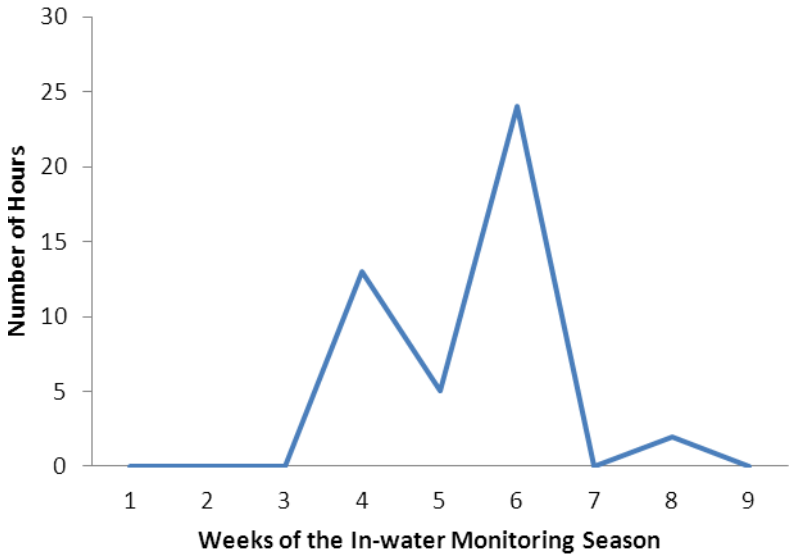

Figure 65. Total numbers of hours per week collaborating fishers were engaged in in-water monitoring for Hawksbills at sea.

Figure 66 represents nightly monitoring hours per week depending on season, while Fig. 67 shows the distance traveled during beach monitoring per week during the monitoring period. These two figures are clearly correlated. Factors such as lightning storms and general safety (especially during the harvesting season for the blue crab, *Callinectes sapidus*) were important considerations during weeks 5 and 7, so that during these weeks little patrolling was accomplished. During the remaining weeks of the study, the monitoring effort in terms of hours and distance remained consistent. On average, we patrolled during the night and early morning hours, monitoring approximately 13 hrs and covering approximately 27 km per week during the season (June 27 to August 26).

Similarly, Figs. 68 and 69 represent the numbers of hours per week undertaking daytime monitoring. Daytime monitoring was dedicated to finding hatchling tracks or tracks of females that had not been detected during night patrols. Thus, we performed and average of 2 hrs per day during each week of monitoring, covering approximately 5 km per week, during the beach monitoring study.

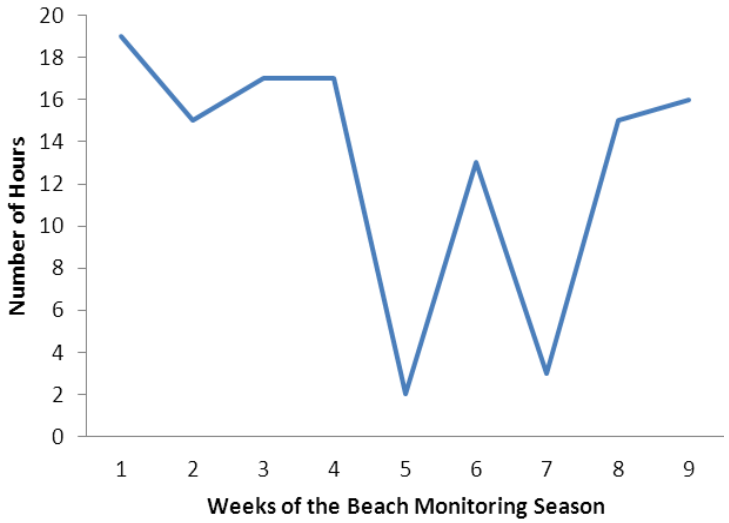

Figure 66. Number of hours per week spent monitoring the beaches of CSWR for the presence of turtles.

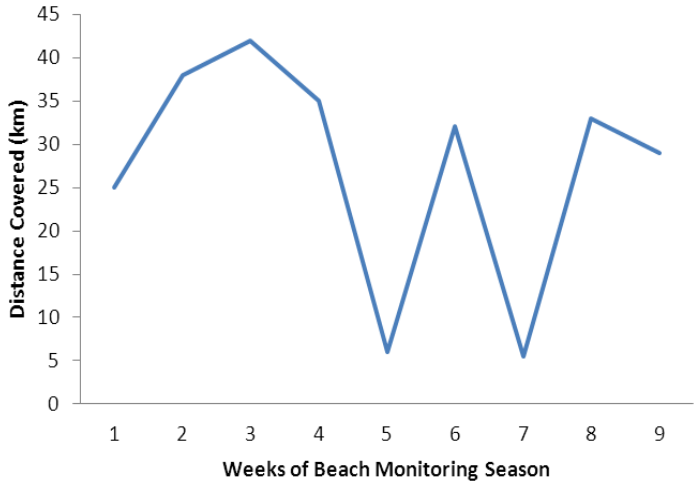

Figure 67. Total kilometers walked per week during nightly beach monitoring over the beach monitoring season from June 27 to August 26, 2012.

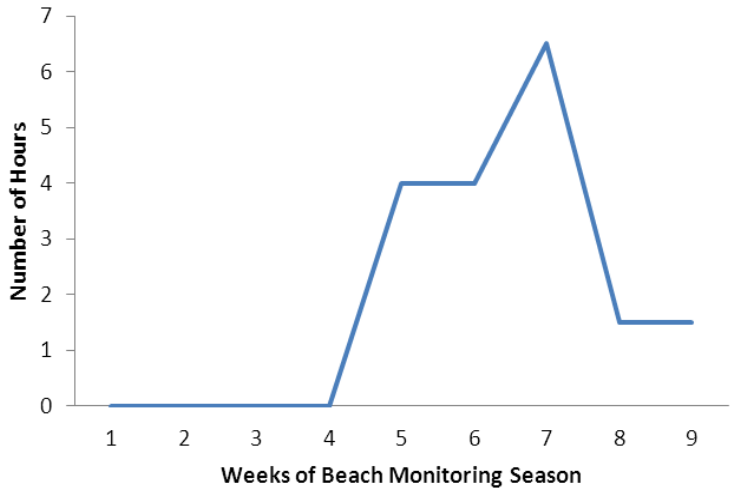

Figure 68. Number of hours per week spent in daytime monitoring during the beach monitoring season.

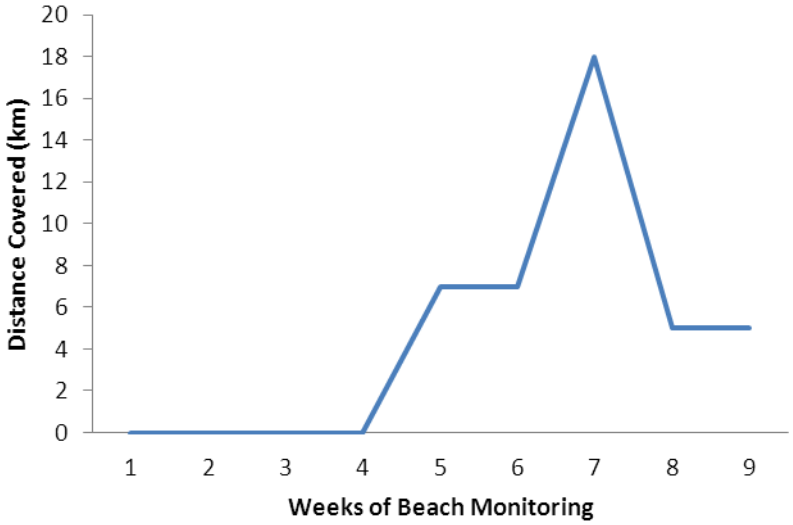

Figure 69. Total kilometers walked per week during daytime monitoring throughout the beach monitoring season.

During the monitoring season, several members of the community participated in data collection and nightly monitoring. We had a total of 5 young people from the community of Salado Bar, 5 young Naval personnel, 9 young volunteers made up of 6 foreign participants and

3 Honduran participants, and 2 members of the ProTECTOR staff. In all, we had 21 people participating in the monitoring activities during the season. On average, we had 5 people involved in monitoring, especially at night. This allowed us to form two groups and facilitated covering more distance during monitoring.

V.VIII.I.I Results of In-Water Monitoring

During the 44 hours of monitoring at sea, the fisher who was trained to collect data observed a total of 10 sea turtles (Fig. 70), giving a frequency of 0.23 turtles per hour or an average of 1 turtle spotted in the sea during every 5 hours of fishing. According to the fisher, he sighted 8 Green turtles (*C. mydas*) and 2 Hawksbills (*E. imbricata*) (Figs 71 and 62, respectively). However, data specifying turtle species must be taken cautiously because even if the fisherman was trained to recognize different species of turtles present, it is difficult to identify a turtle to species level from the surface of the water, especially distinguishing Hawksbills from Greens.

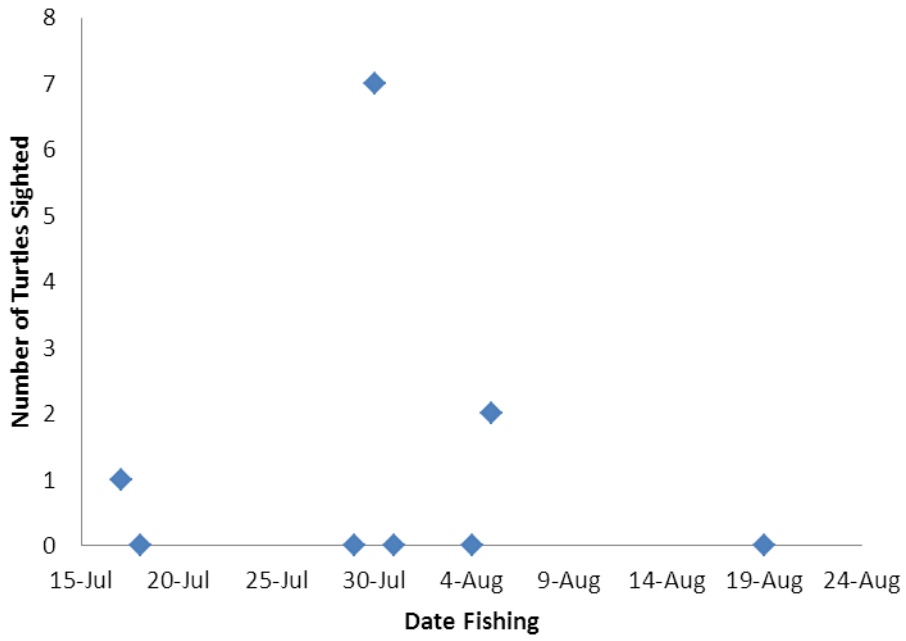

Figure 70. Sightings of turtles at sea by a collaborating fisher who was trained to record turtle sightings data while fishing. Each point corresponds to a date on which the fisher went out to sea.

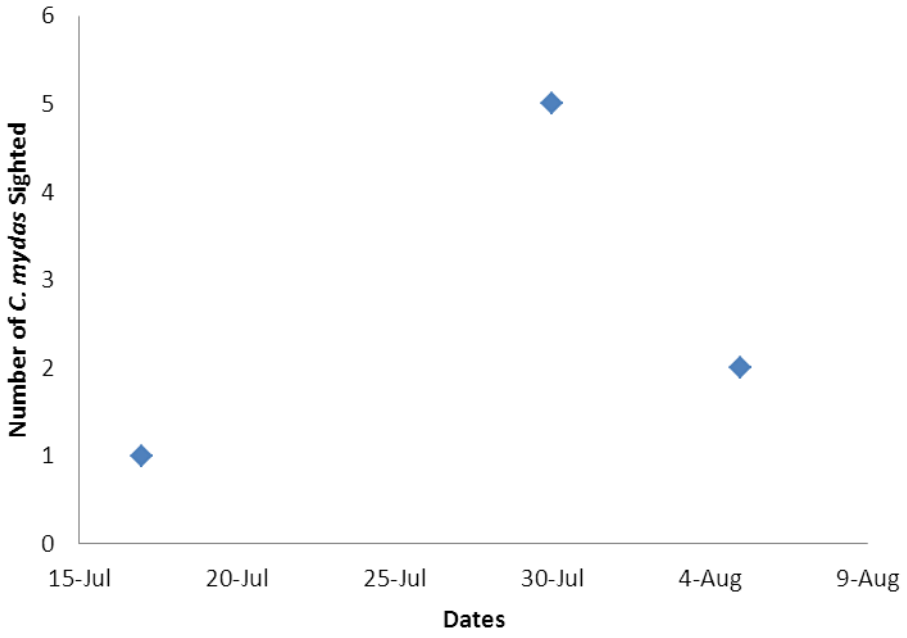

Figure 71. Sightings of *C. mydas* at sea by a collaborating fisher who was trained to record turtle sightings data while fishing. Each point corresponds to a date on which the fisher went out to sea.

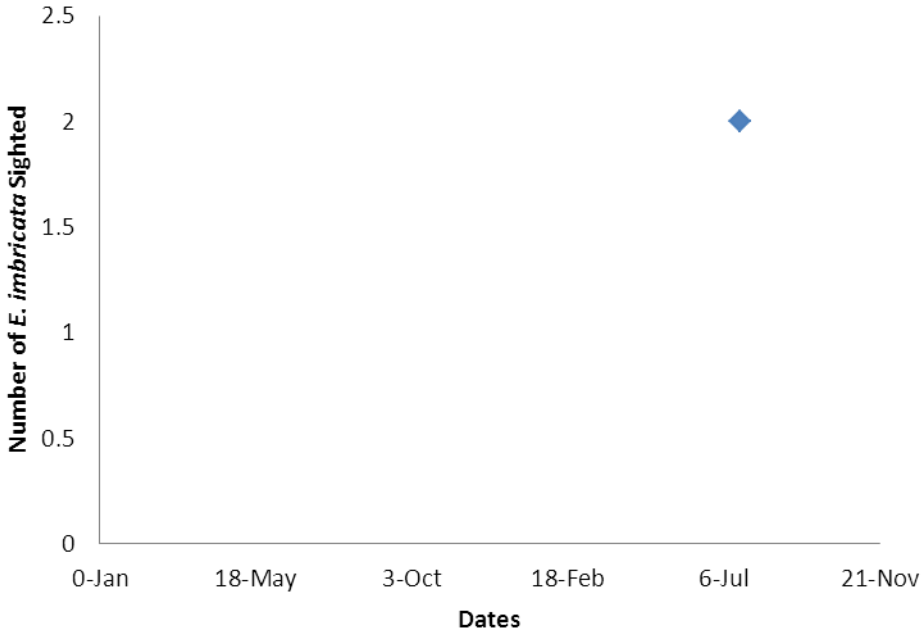

Figure 72. Sighting of *E. imbricata* at sea by a collaborating fisher who was trained to record turtle sightings data while fishing. Each point corresponds to a date on which the fisher went out to sea.

The estimated size of Green turtles sighted averaged 58 ± 18 cm. For Hawksbill turtles, the average size was estimated at 150 cm. Despite having a small sample of turtles sighted at sea, these data suggest that of those turtles that were observed, Green turtles are smaller than Hawksbills. These data were also consistent with those from interview responses.

V.VIII.I.II Results of Beach Monitoring

During the preliminary study from February to April, 2012, we conducted 6 night patrols over a total of 14.5 hours and 29 km of beach. On March 27, 2012, on the beach between the community and Salado Bar (western sector), we observed the successful nesting of a single Leatherback (*Dermochelys coriacea*) (Fig. 73).

Figure 73. The lone *D. coriacea* that nested on the western sector of the beach between the community and Salado Bar on the night of March 27, 2012

Upon completing the nesting process and the turtle returning to sea, we erased the turtle tracks and kept this information in confidence in the community for fear that this nest would be poached. Although fishermen from other communities had mentioned the presence of Leatherback turtles on the beaches of their communities (La Rosita and Boca Cerrada), this species has not previously been reported on the beaches of Salado Bar. Hatchlings were scheduled to erupt from the nest around May 27, 2012. However, during this time, ProTECTOR personnel were unable to be on site, and no Refuge guards were on staff. No information is available concerning the fate of the nest.

During the second period of study at the CSWR (June 27 to August 26), we performed a total of 117 hours of monitoring and covered 245.5 km of beach without encountering any nesting females, hatchlings, or turtle tracks. This, despite having been consistent throughout these

months and having varied our nightly monitoring schedules to cover various times of the night.

V.VIV Results of Rapid Beach Profiles

In parallel with the sea turtle monitoring (at sea or on beaches), we conducted a beach profiling study describing the characteristics of beaches where both day and night monitoring was performed. A total of 51.5 hours of work was carried out for beach profiling, averaging 6 hrs per week.

Figure 74 shows the changes in value, in degrees, of the slope angle closest to the high tide mark on the western sector along the length of Salado Bar Beach. This length was from the bar at the Salado River up to the bar at Ordiñón. The distance between the community beach at Salado Bar (P0W) and the bar at Ordiñón (P23W) was 3.5 km, with an average distance between transects of 150 m. It can be seen from this figure that slope angles are very high (almost 90°) in some areas and very low (essentially 0°) in others (i.e. between P19W and P23W).

Figure 75 shows the changes in value, in degrees, of the slope angle closest to the high tide mark on the eastern sector along the length of Salado Bar Beach. This length was from the bar at the Salado River up to the bar at Zacate. The distance between the community beach at Salado Bar (P0E) and the bar at Zacate (P27E) was 4.5 km, with average distance between transects of 165 m. As on the sector to the west, some slopes are very high (almost 90°) in some areas and very low (almost 0°) in others (i.e. from P20E to Zacate Bar).

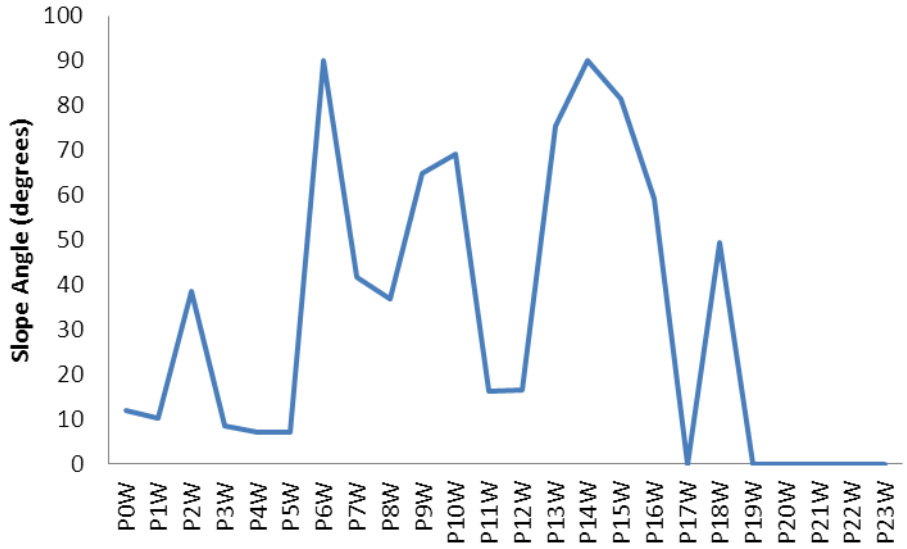

Figure 74. Angle in degrees of slope closest to the high tide mark in the 3.5 km of beach from the West (W) for each transect (P). Each point is spaced an average of 150 m apart parallel to the water line.

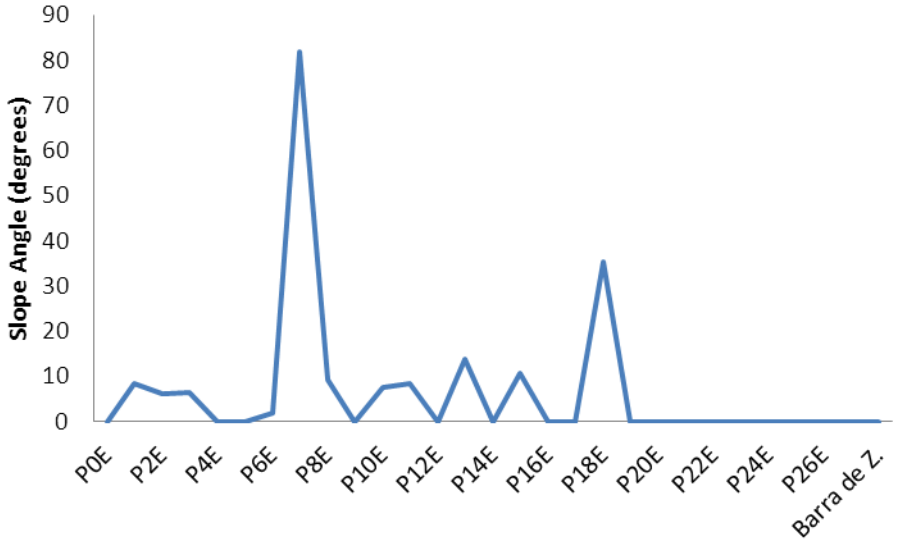

Figure 75. Angle in degrees of slope closest to the high tide mark in the 3.5 km of beach from the East (E) for each transect (P). Each point is spaced an average of 150 m apart parallel to the water line.

In addition to observations taken from these data, it appears that the length of beach at the high tide mark is both more steep and rugged along the western sector than along the eastern sector.

V.X Results of Detailed Beach Profiling

In summary, for the beach monitoring study, we conducted the following data collections:
- 1,000 m of beach in which we described the profile of the, with 500 m of the western sector and 500 m of the eastern sector.
- Over the same 1,000 m (500 m to the West and 500 m to the East, corresponding to 50 transects of 20 m each), we surveyed vertical transects (perpendicular to the water line) to describe beach vegetation located up to 20 m from high tide.
- In this same area, we measured plastic pollution every 60 m and weighed different types of plastic materials (in grams), gathering a total of 16 point sites, with 8 in the Western sector and 8 in the Eastern sector.

Figures 76 and 77 present the amount of coverage of each type of substrate encountered in the beach vegetation study along a line parallel to the coastline with each transect having a constant length of 15 m running perpendicular from the high tide mark. Details of these substrates are found in Appendix VI. These figures show that in the 500 m in the eastern sector there is more diversity of substrates than in the 500 m of the western sector.

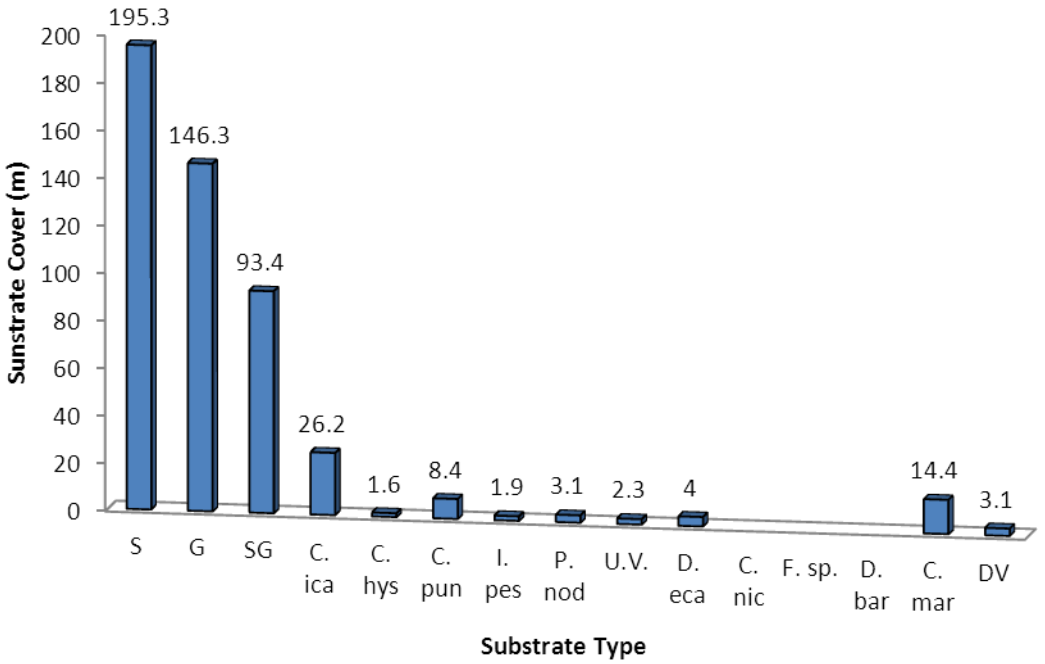

Figure 76. Area cover in meters of substrates encountered along 500 m of the western sector of Salado Bar Beach. Transects ran vertically (perpendicular to the high tide line) up the beach 15 m from the high tide line.

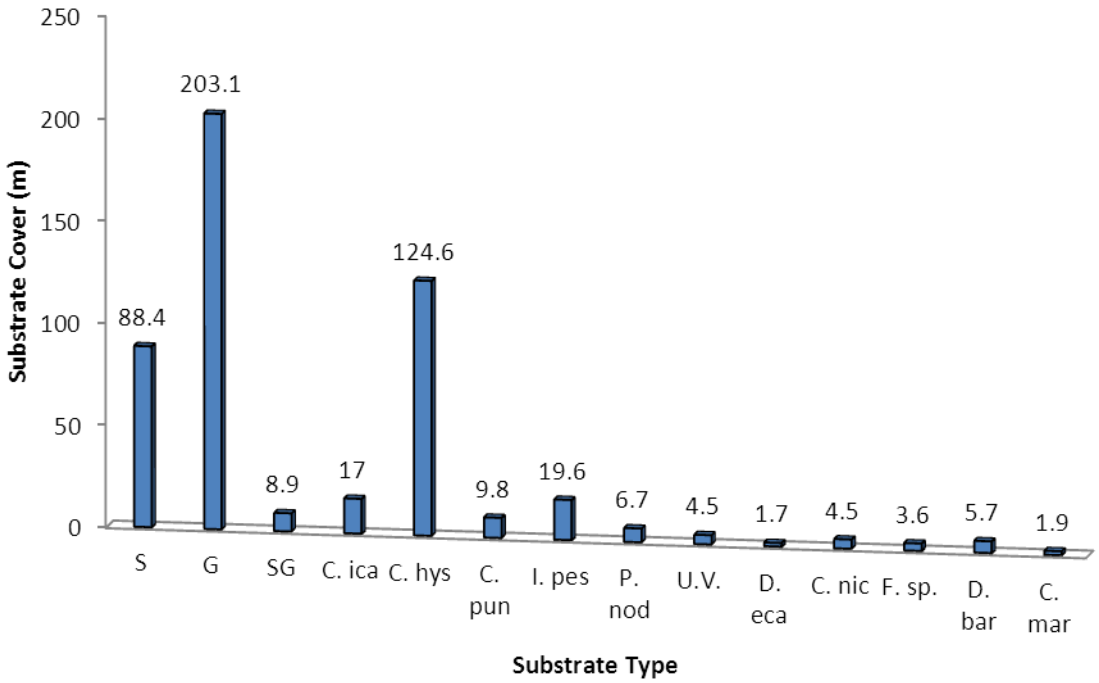

Figure 77. Area cover in meters of substrates encountered along 500 m of the eastern sector of Salado Bar Beach. Transects ran vertically (perpendicular to the high tide line) up the beach 15 m from the high tide line.

In Figs. 78 and 79 we present the percentage of coverage in the 500 m of each of the sectors, West and East, respectively. The three dominant substrates in the case of the western sector were: sand, grass (unidentified sp) and sea grapes (*Coccoloba uvifera*), amounting to 87% coverage, while in the eastern sector they were: grass, hyssopleaf sandmat (*Euphorbia hyssopifolia*) and sand, totaling 83 % (see Tables 4 and 5 for details of coverage).

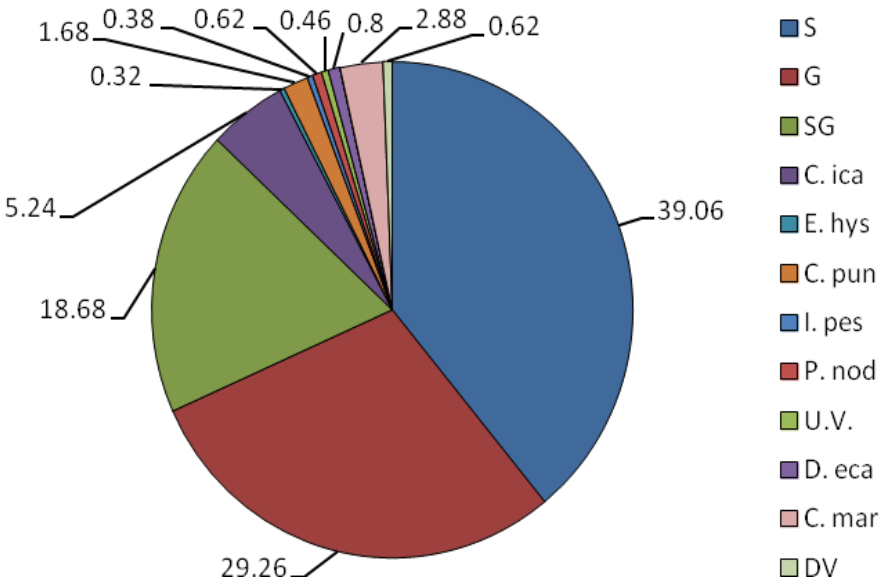

Figure 78. Percent coverage of substrate types over a 500 m stretch on the western sector of Salado Bar Beach. See Appendix VIII for definitions of substrate types listed in the figure legend.

Table 4.

S	G	SG	*C. ica*	*E. hys*	*C. pun*	*I. pes*	*P. nod*	U.V.	*D. eca*	*C. nic*	*F.* sp.	*D. bar*	*C. mar*	DV	TOTAL
195.3	146.3	93.4	26.2	1.6	8.4	1.9	3.1	2.3	4	0	0	0	14.4	3.1	500 m
39.06	29.26	18.68	5.24	0.32	1.68	0.38	0.62	0.46	0.8	0	0	0	2.88	0.62	100%

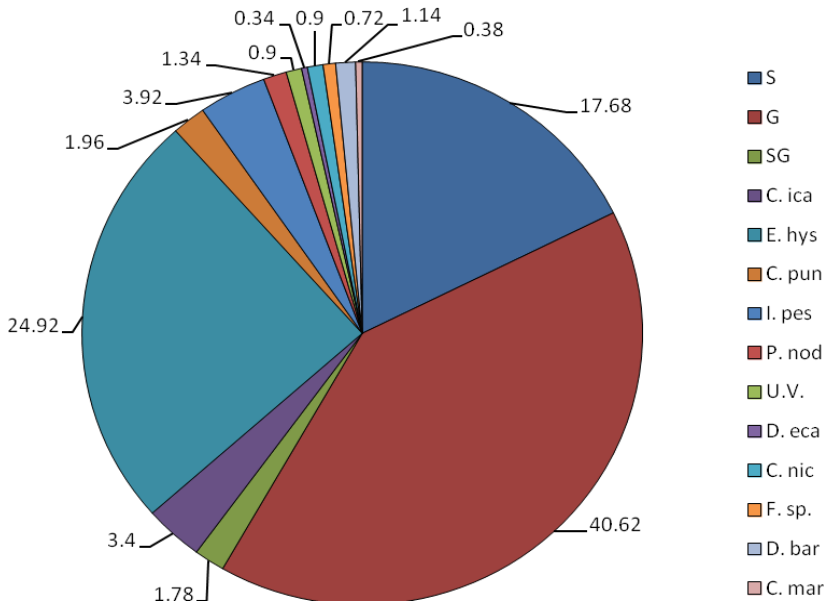

Figure 79. Percent coverage of substrate types over a 500 m stretch on the eastern sector of Salado Bar Beach. See appendix VII for definitions of substrate types listed in the figure legend.

Table 5.

S	G	SG	*C. ica*	*E. hys*	*C. pun*	*I. pes*	*P. nod*	U.V.	*D. eca*	*C. nic*	*F. sp.*	*D. bar*	*C. mar*	TOTAL
88.4	203.1	8.9	17	124.6	9.8	19.6	6.7	4.5	1.7	4.5	3.6	5.7	1.9	500 m
17.68	40.62	1.78	3.4	24.92	1.96	3.92	1.34	0.9	0.34	0.9	0.72	1.14	0.38	100%

V.XI Results of Pollution Study

The beaches we surveyed within the CSWR were relatively clean. However, in some areas, especially after large storms or high winds, the retreat of high tide left large amounts of waste accumulation behind (see Fig. 15).

Figures 80 and 81 show the amount of plastic found at the high tide mark along both the western and eastern sectors, respectively. Although this study was only undertaken at one point in time, we observed more plastic in the eastern sector.

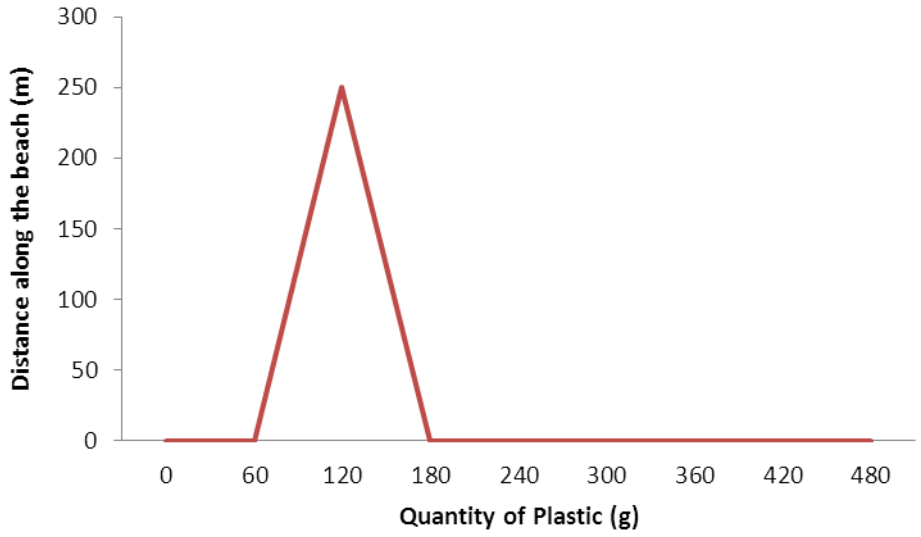

Figure 80. Quantity of plastic (g) encountered along the high tide mark of the western sector of the Salado Bar Beach.

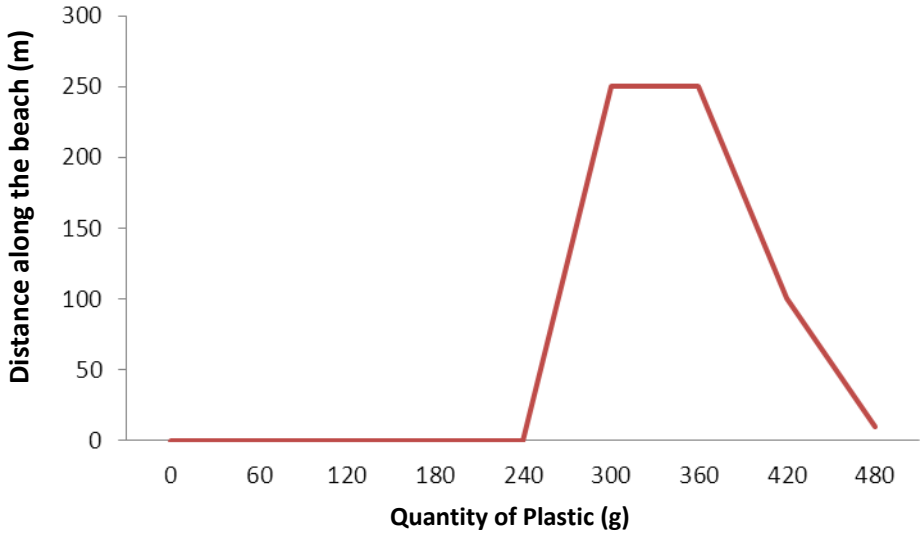

Figure 81. Quantity of plastic (g) encountered along the high tide mark of the eastern sector of the Salado Bar Beach.

V.XII Results of Educational Outreach

Cuero y Salado Wildlife Refuge

With the initiation of the project at the CSWR, several misconceptions of marine turtles in the community were dispelled through interactive educational programs for children and adults in the communities in which we carried out the study. In early February, 2012 when we began working among the different communities, it became evident that most community members did not know the difference between freshwater and marine turtles. Through a variety of

workshops and information sessions, especially with young fishers in the Salado Bar community, most of the people in the communities are now able to distinguish the different species of sea turtles found along the Caribbean coast of Honduras.

This was mainly achieved through education and awareness of sea turtle ecology. Indeed, several training sessions were conducted in different communities regarding various aspects of sea turtles (see Fig. 82), as well as school and community presentations to communicate preliminary results from the work done in the first phase (interview surveys) of this study (Fig. 83). We also participated in celebrations, such as the Environment and Wetlands Day, organizing fun activities to teach the participants about sea turtles (Fig. 84). Also, from June to August, we arranged training sessions on the themes of night monitoring, tracking, and behavioral data collection in the community of Salado Bar. During this season we worked together with several members of this community, especially young boys and girls, in day and night monitoring and data collection for beach profiles.

Figure 82. Environmental education regarding marine turtles for students in the community school at Boca Cerrada. Note the military guard at the window.

Figure 83. Communication of results of the interviews undertaken in Orotina, to a group of fishers and other members of the tourism committee for this community.

Figure 84. Children's activity about the life cycle of sea turtles presented during the Wetlands Day.

The fact that we secured a presence in the area for 5 months enabled ProTECTOR staff to be key players in the development of various outreach activities in order to instill the value of collaborating with different organizations and institutions within the community. We participated in educational activities, such as organizing a first aid training event for young people and children in Salado Bar through the Central Regional University of the Atlantic Coast (CURLA) (see Fig. 85). We also worked with the Regional Center for Environmental Documentation and Interpretation (CREDIA), the Foundation for Cuero y Salado (FUCSA), and the Project of Sustainable Management of the Natural Resources and Basins of the Mesoamerican Biological Corridor in Atlantic Honduras (PROCORREDOR) to coordinate the visit of children from the community of Salado Bar to the CREDIA facilities in La Ceiba, during the launch of the education campaign on North Coast protected areas, which opened with a presentation from the CSWR (Fig. 86).

Figure 85. First Aid course for young people and children in the community of Salado Bar.

Figure 86. Children from the community of Salado Bar visit the CREDIA facilities in La Ceiba during an educational campaign of the Biological Corridor of Caribbean Honduras.

In July we also began a weekly English class every Monday for youth and children (Fig. 87). The class was initiated by a Loma Linda University Summer Undergraduate Research Program student working with ProTECTOR, and provided opportunities to teach about the environment, and the importance of protecting endangered species. The aim was to create a positive learning environment for children and youth in the community. The initiative is now run by other volunteers who have recently come to the area.

ProTECTOR was also involved with a series of artistic workshops which were conducted with various youth and children, particularly on the issue of solid waste recycling. This is an important topic within the CSWR and is especially central in the current context of local pollution issues in the Refuge. We were also involved in organizing a concert by the environmental song writer, Guillermo Anderson, who came to Salado Bar to dedicate a concert to the children of the community (see Fig. 88).

Figure 87. Angela Randazzo assists young people and children at the English class held each Monday of July and August, 2012 at the Visitor's Center in the community of Salado Bar.

Figure 88. Environmental Song writer, Guillermo Anderson, providing a special concert to the children of Salado Bar community, as part of the environmental outreach organized by staff of ProTECTOR.

Finally, during the last two months of the study, 9 volunteers (6 foreign and 3 nationals), took part in the ProTECTOR research project within the Refuge. These volunteers further developed the concept of research tourism within the community. Indeed, the arrival of these volunteers

provided dynamic exchange with community members, and facilitated innovative educational and artistic activities, such as the first-ever electric cello concert in the Refuge. The concert was given by ProTECTOR Intern, Ms. Robyn Reeve, and it was the first time for many of the community members to have heard or seen this instrument (see Fig. 89). The accommodation of these volunteers also facilitated employment of community members in specific jobs, such as janitorial services, laundering, cooking, and local tour guiding.

Figure 89. ProTECTOR Intern, Ms. Robyn Reeve, provides children from the community their first contact with an electric cello after giving a free concert .

VI. RESULTS FROM UTILA AND LOS CAYITOS

VI.I Preliminary Study

In Utila, interview respondents were from both Utila proper, and the several small cays that collectively make up the area known as “Los Cayitos” (Fig. 90). The island is surrounded by fringing coral reef that extends to the southwest of the main island and out into the cays. There are relatively substantial areas around the island and the cays that are potentially appropriate

for Hawksbill nesting, and many areas of the reef associated with both Utila and the cays that are appropriate Hawksbill foraging habitat.

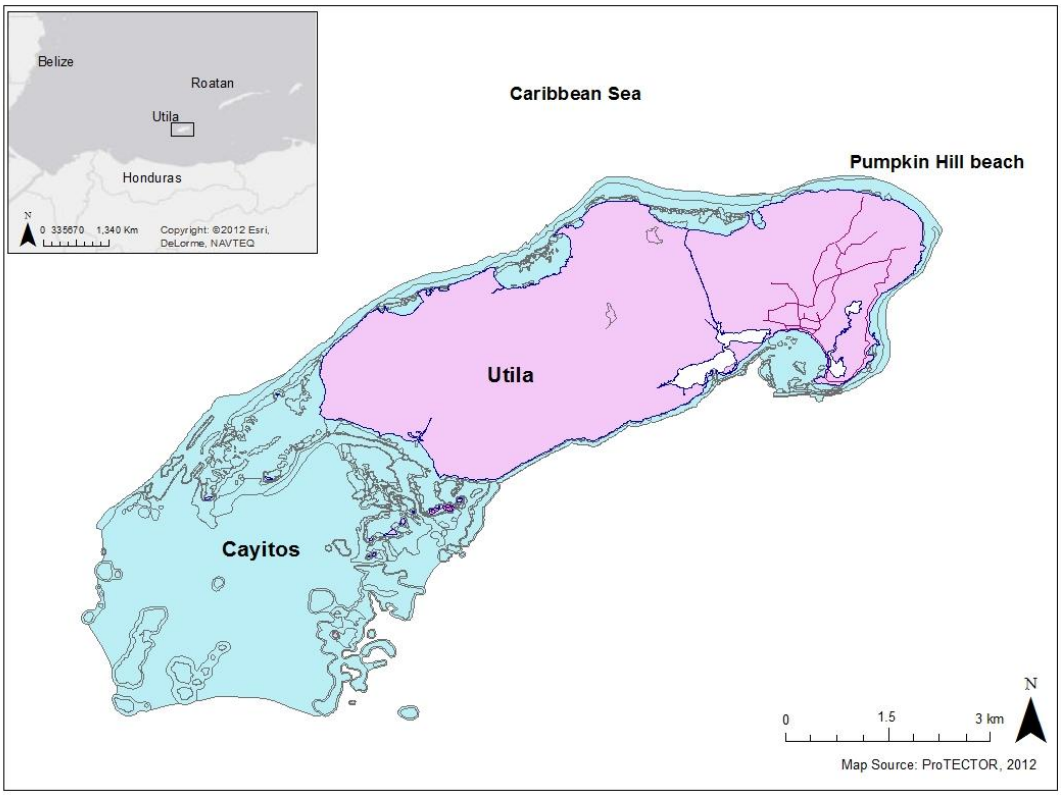

Figure 90. Map of the area of Utila, including Utila proper, and Los Cayitos. A regional map is provided in the inset.

We interviewed a total of 20 respondents and collected information on their professions (see Table 6). Interviews resulted in the declaration of 21 professions (one respondent listed two professions) of whom 57 % of responses involved fishing as a profession, while 23 % were involved with the sport diving industry as captains of dive boats (Table 6). The remaining respondents were involved with public duties and private industry.

Table 6. Professions, number and frequencies of interview respondents from the preliminary study in Utila.

Profession	No. Interviewed	Frequency (%)
Marine Fisher	12	57
Fish Merchant	1	5
Police	1	5
Builder	1	5
Dive Boat Captain	5	23
Mayor	1	5
TOTAL OBS.	**21**	**100%**

In this area, we found that 95 % of all respondents were over the age of 28, with as many as 55 % being 50 years old or more (Fig. 91). However, when non-fishers were factored out, we found that 100 % of respondents involved with fishing were over the age of 28, with 58 % of these respondents over the age of 60 (Fig. 92).

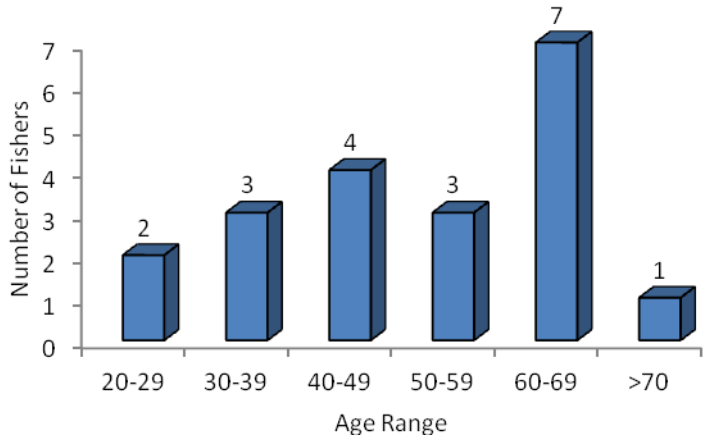

Figure 91. The number of interview respondents in each age category from Utila and the surrounding cays, Los Cayitos.

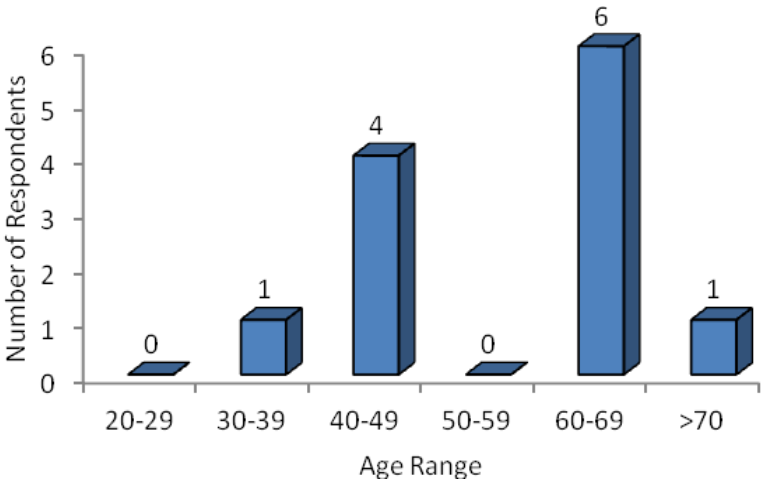

Figure 92. The age ranges for those interview respondents who are fishers.

A full 50 % (6/12) of fisher respondents had from 50 – 59 years of fishing experience (Fig. 93). The data suggest that fishers in this area may begin fishing at approximately 10 years of age and continue fishing on a regular basis into their late 60's or early 70's.

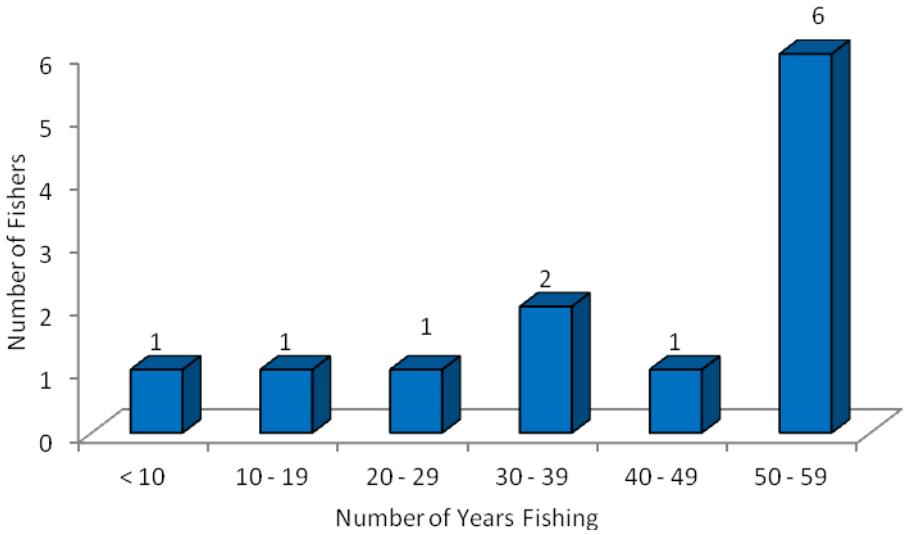

Figure 93. The number of years fishing experience for respondents who are fishers.

When we divided respondents into the two main locations of the survey (Utila and Los Cayitos), we found that the majority (64 %) of respondents we interviewed from Utila were fishers (although one person stated they were both a fisherman and the local Mayor, thus giving 15 responses from 14 respondents), while 36 % were involved with the sports diving industry as boat captains (Fig. 94). Meanwhile, in Los Cayitos, 50 % of respondents stated they were fishers, while the remaining respondents were involved in public service or private industry (Fig. 95).

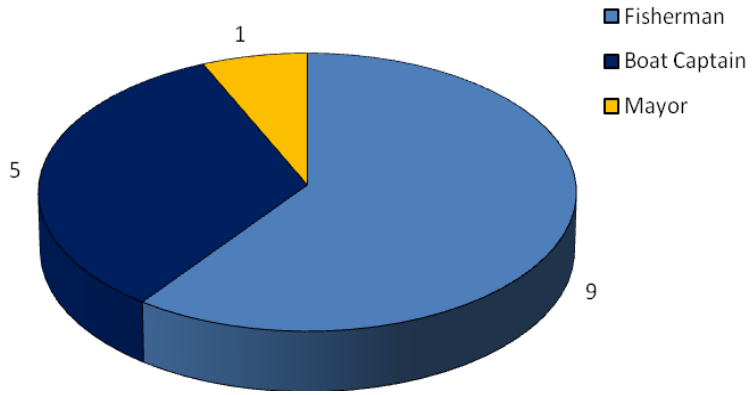

Figure 94. The range of professions of respondents from Utila.

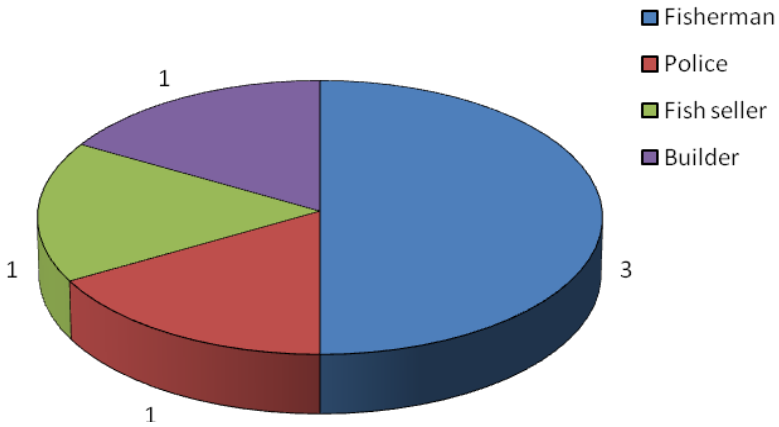

Figure 95. The range of professions of respondents from Los Cayitos.

VI.II Turtle Sightings at Sea

Of the people interviewed, 100 % (20/20) responded that they had seen sea turtles at sea. Of the 12 fishers interviewed, 11 responded to the number of times they go to sea to fish. Of these, 55 % (6/11) stated they go out fishing every week, 27 % (3/11) stated that they go fishing all through the year, 9 % (1/11) suggested that they go out about 300 days of the year, and 1 individual (9 %) stated he goes out about half the year (~ 160 - 170 days) (Fig. 96).

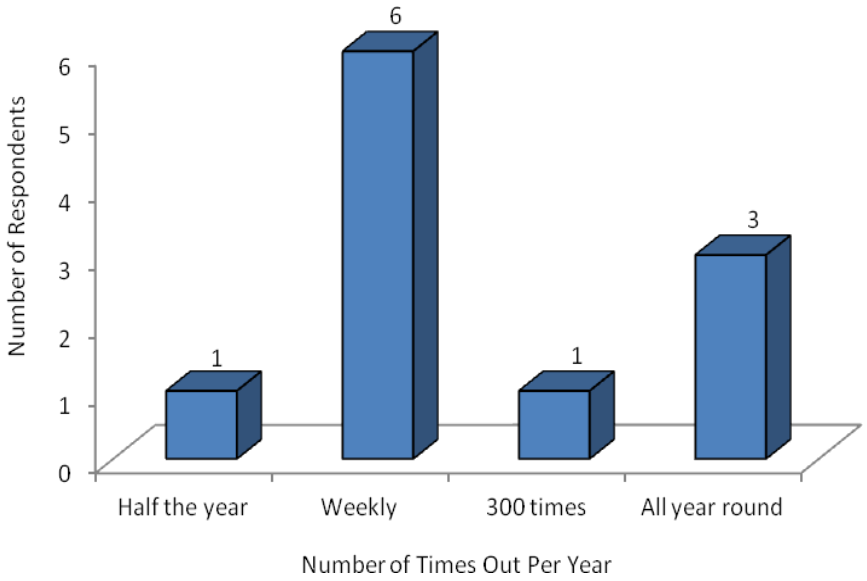

Figure 96. The number of fishers and frequency of times out fishing per year.

Figure 97 illustrates that 70 % of respondents who were dedicated fishers reported seeing turtles more than half of the times they go out to fish at sea, while 30 % of respondents reported seeing turtles less than half the times they are out at sea to fish.

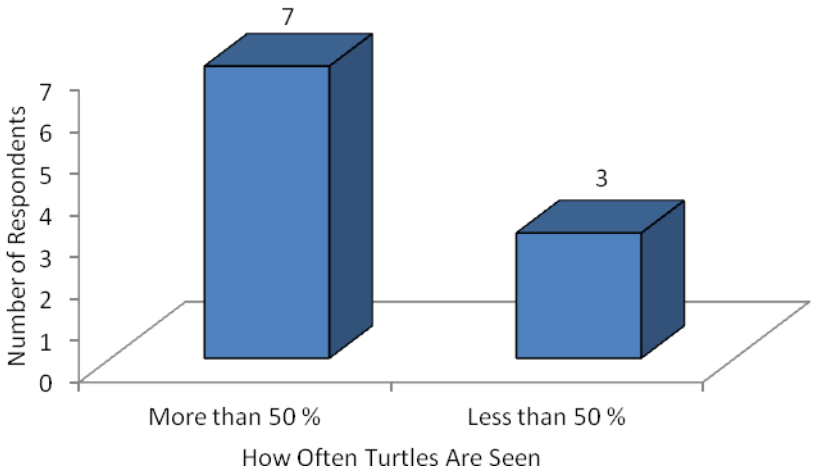

Figure 97. The number of fishermen that report seeing turtles at sea either less than 50% of the time they go out to sea, or more than 50% of the time they go out to sea.

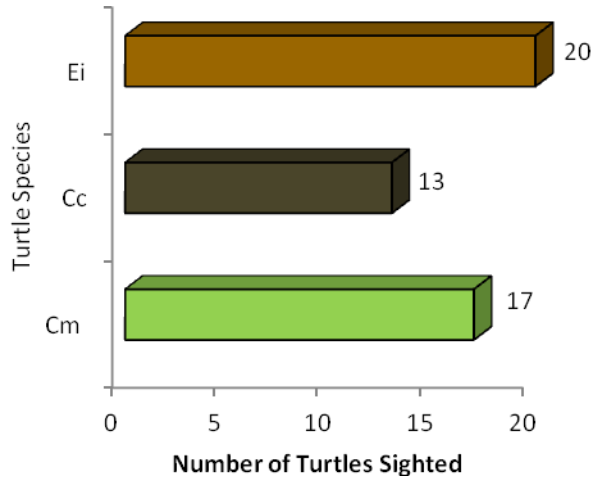

Figure 98. Bar diagram illustrating the diversity of turtle species seen at sea.

Of the 20 people interviewed from both Utila and Los Cayitos, Fig. 98 shows that all 20 reported sighting *E. imbricata* turtles at sea, 17 (85 %) reported sighting *C. mydas* at sea, and 65 % reported sighting *C. caretta* at sea. When asked where they sighted Hawksbills (*E. imbricata*) at sea, the majority of responses (52 %) suggested that Hawksbills could be sighted all around Utila and Los Cayitos, whereas 20 % of respondents stated they mainly see them on the North side of Utila (Fig. 99). Only 3 (12 %) responses were given suggesting that they had sighted Hawksbills in the Cays, and 4 responses specified sighting Hawksbills on the south side of Utila, including the waters between Utila and La Ceiba.

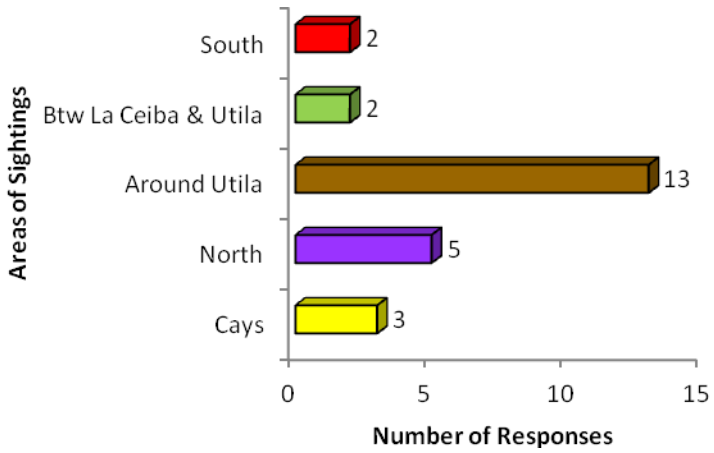

Figure 99. Areas where respondents reported sighting *E. imbricata* at sea.

When asked about sightings of Loggerhead (*C. caretta*) and Green (*C. mydas*) turtles at sea, most responses given suggested that these species are sighted all around the island (Figs. 100

and 101, respectively). However, some respondents indicated that they sighted these species at approximately the same respective frequencies, specifically on the north and south sides of the island and in the Cays.

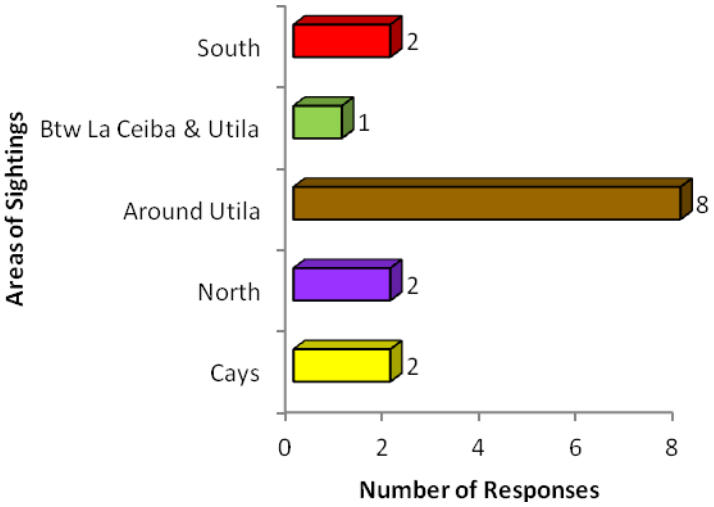

Figure 100. Areas where respondents reported sighting *C. carretta* at sea.

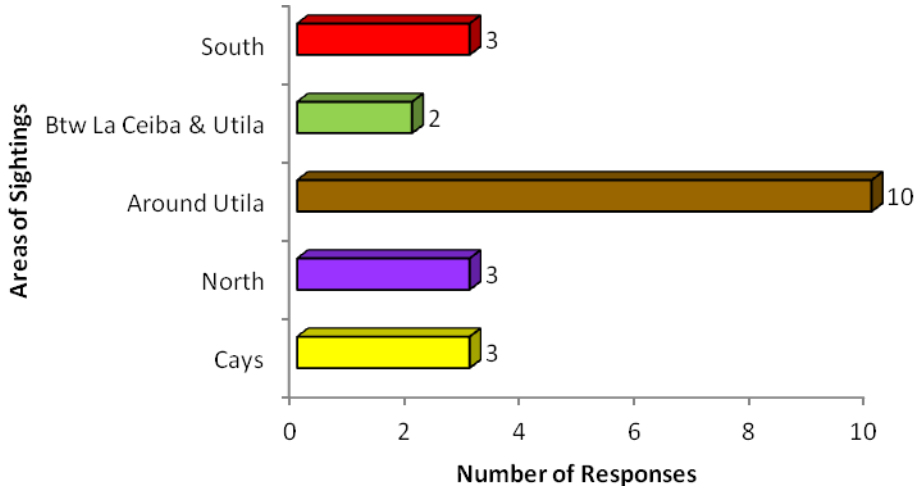

Figure 101. Areas where respondents reported sighting *C. mydas* at sea.

Taken together for sighting any species of turtles, the majority of respondents (60 %) from Utila proper, indicated they had sighted turtles at sea all around the island (Fig. 102), while 13 % of respondents specified that they sight turtles on the north side of the island and on the south side (Fig. 102).

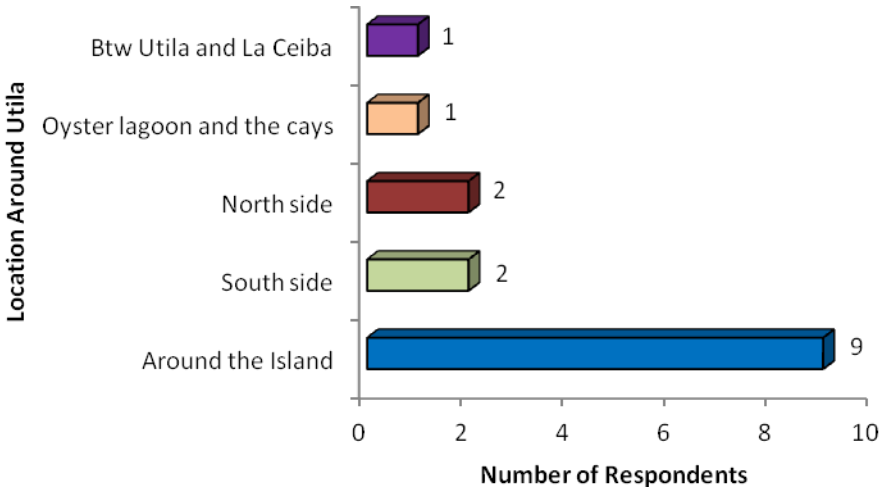

Figure 102. Important areas for sighting turtles at sea according to respondents from Utila.

The six respondents from Los Cayitos provided eight responses to where they sight turtles, irrespective of species, at sea. Fifty percent of responses stated that turtles were sighted all around the island (including Los Cayitos). The specific locations of South West Cay, Turtle Harbor, Rock Harbor, and between Utila and La Ceiba were all identified as sighting areas, but with much less frequency than all around the island (Fig. 103). A map of the locations of specific fishing sites where turtles are sighted at sea as reported by all respondents, is provided in Fig. 104.

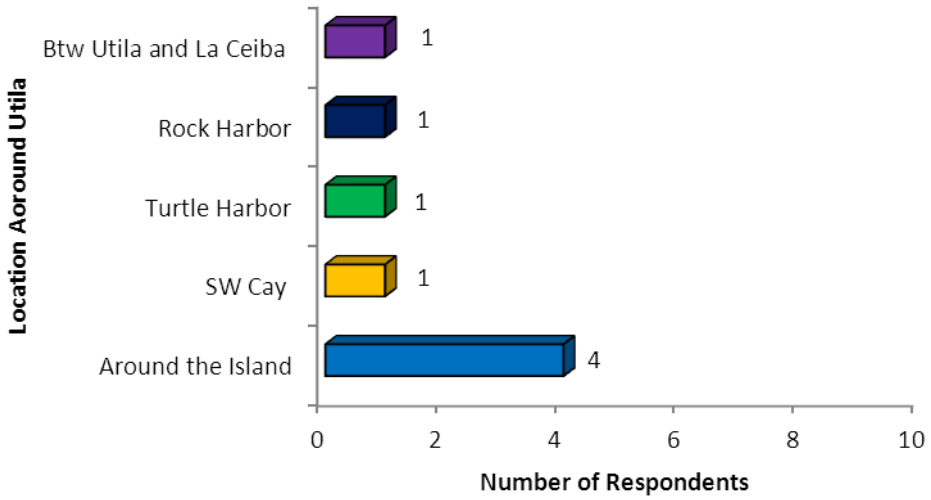

Figure 103. Important areas for sighting turtles at sea according to respondents from Los Cayitos.

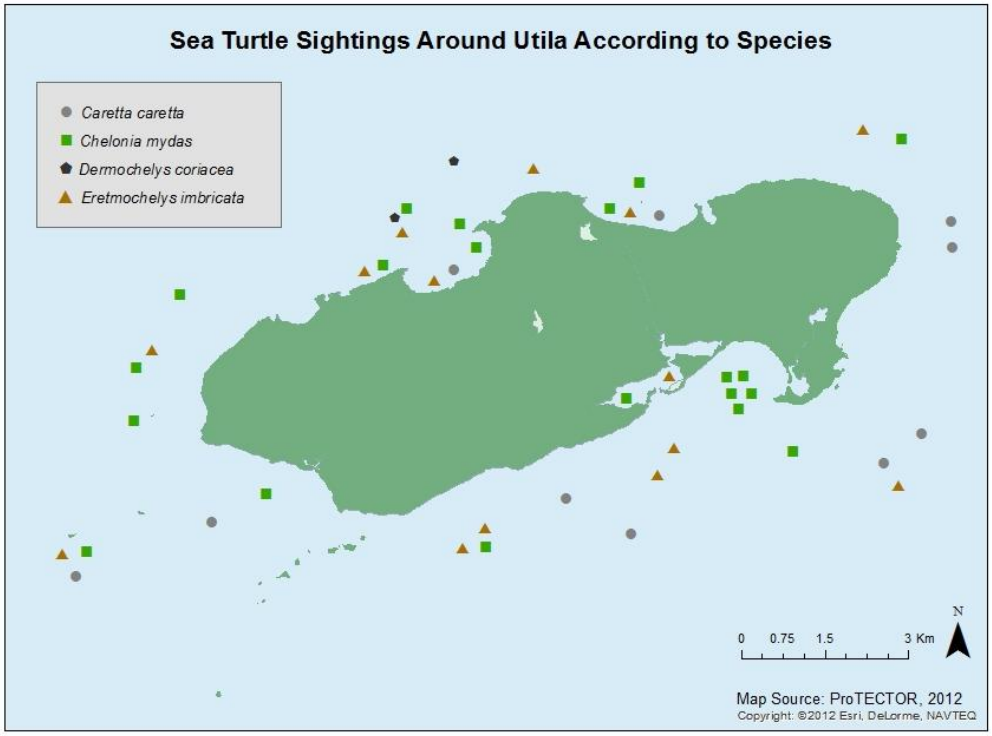

Figure 104. Map of the island of Utila and the outlying cays (Los Cayitos), showing the areas respondents suggested were important fishing areas, as well as areas where turtles are sighted.

We gathered information on the activities of each species when sighted by respondents, including activities at sea and on the beach. Some respondents admitted that they did not know what the turtles were doing when observed, while other specified various activities that are commonly reported by observers of turtle behavior in other locations. These included feeding, breathing at the surface, swimming at sea, and nesting when sighted on the beaches (Fig. 105).

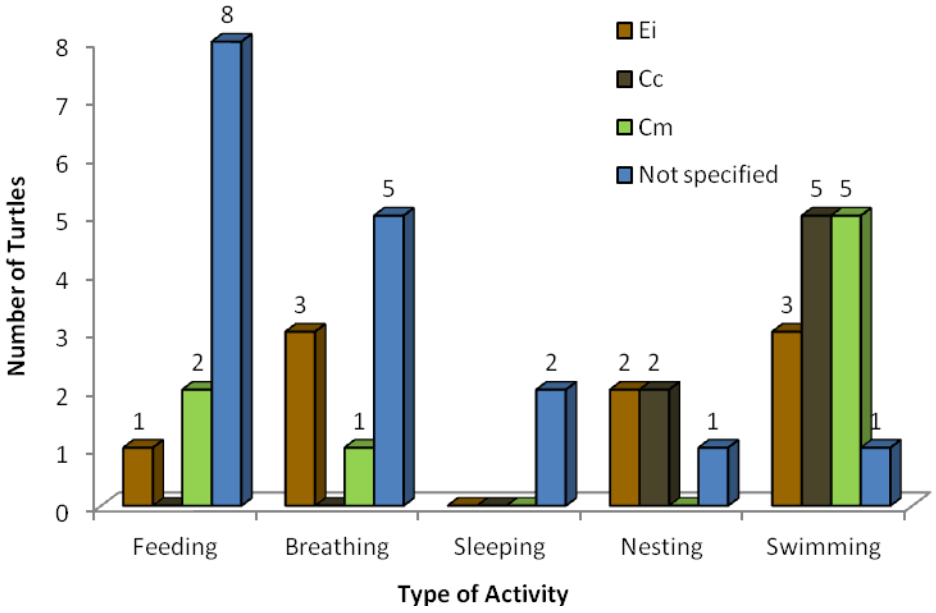

Figure 105. Activities of different species of turtles when cited according to combined responses from both Utila and Los Cayitos.

Although there is likely to be a wide range of error in size estimates by casual observers, we nevertheless asked respondents who were fishers to estimate the sizes of different turtle species they had sighted. While some respondents did not provide specific size numbers, several did provide very specific sizes which ranged from 3 cm to 1 m (Fig. 106). It appears that both *C. mydas* and *C. caretta* are sighted during hatchling and adult stages. No respondents reported sighting either of these species during juvenile stages (according to sizes reported). In contrast, *E. imbricata* appears to be sighted at all life stages in the waters around Utila (Fig. 106). However, some turtles were reported in the juvenile life stage size range (30 – 60 cm), but were unspecified with respect to species.

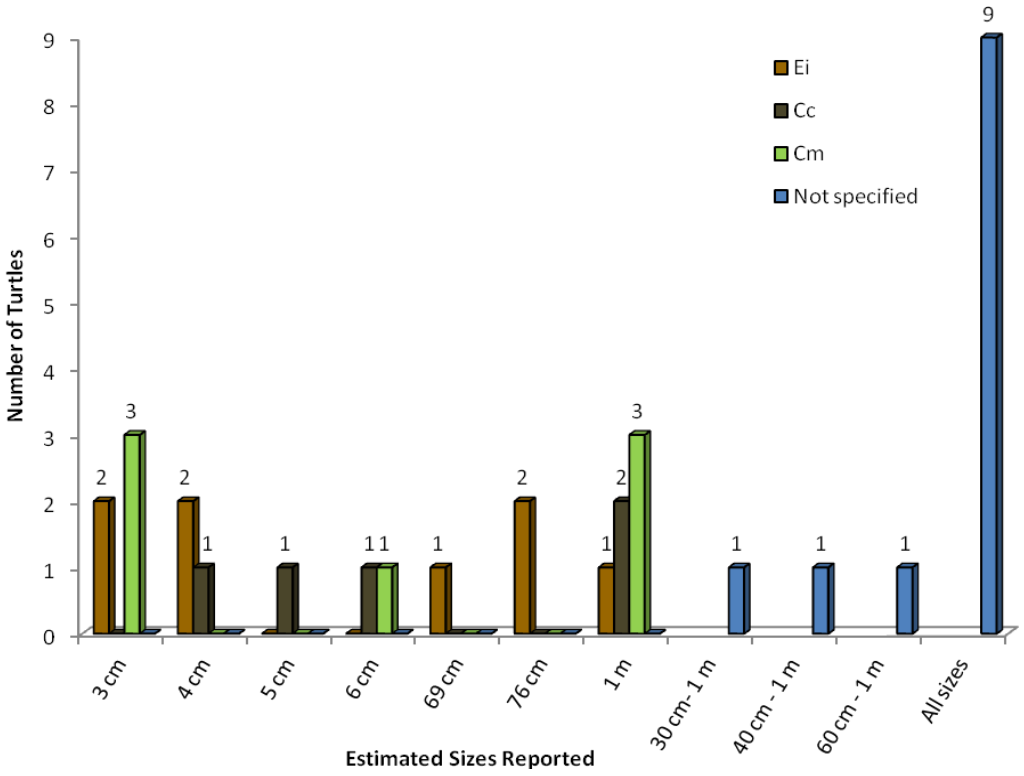

Figure 106. Estimated sizes of turtles sighted, as reported by respondents from Utila and Los Cayitos. Ei = *Eretmochelys imbricata*; Cc = *Caretta caretta*; Cm = *Chelonia mydas*.

To determine when turtles were being sighted throughout the year, we pooled responses from all fisher respondents and plotted them for each species. For all three species, we found that times reported for sightings were unimodal, but peek sighting times were different among species. In the case of *E. imbricata*, turtles were sighted throughout the year, but peek sightings reported were from April to September (Fig. 107)

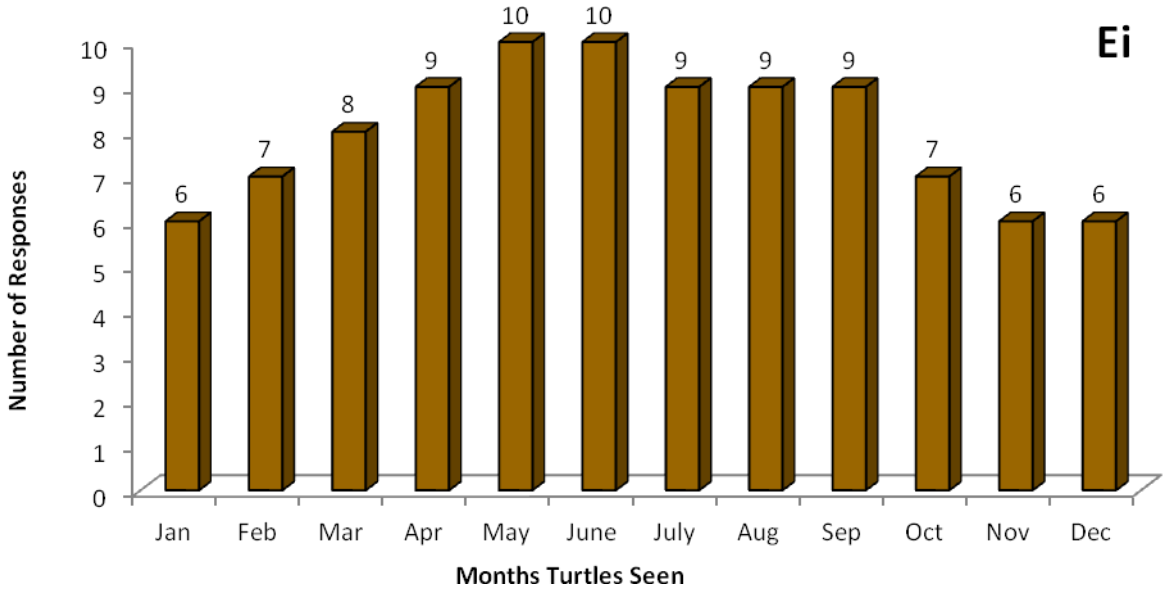

Figure 107. Months in which respondents from both Utila and Los Cayitos reported sighting *E. imbricata* turtles at sea.

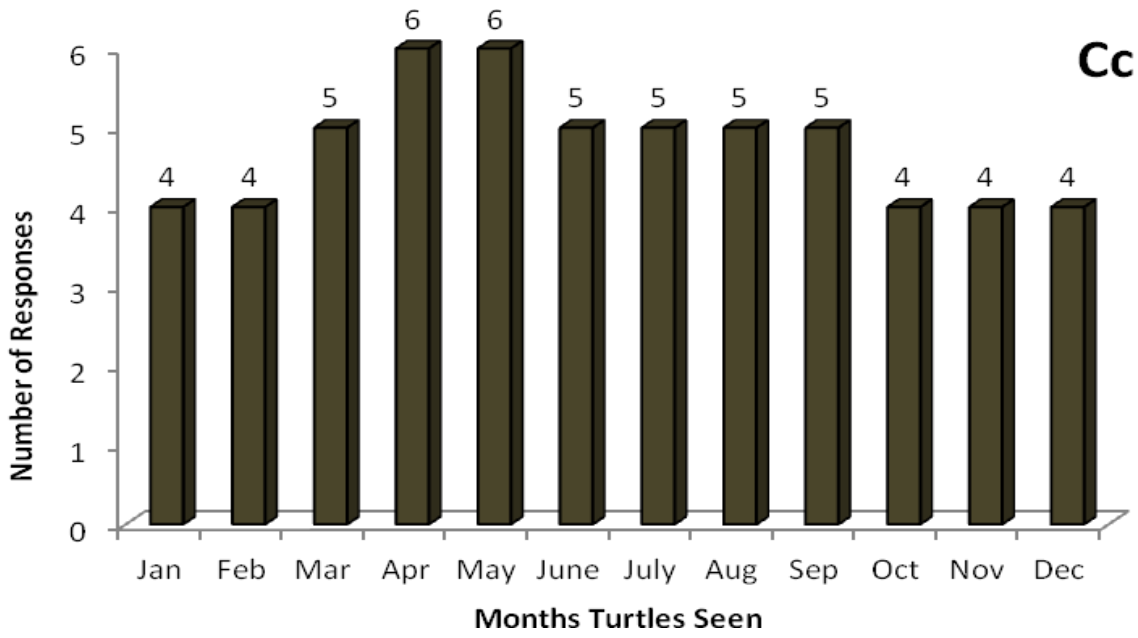

Figure 108. Months in which respondents from both Utila and Los Cayitos reported sighting *C. caretta* turtles at sea.

The peak season for sighting *C. caretta*, according to respondents, was from March to September, although this species can also been seen throughout the year (Fig. 108). Figure 109 shows the peak sighting times for *C. mydas* are from March to August. Once again, all

respondents stated they are able to observe this species throughout the year in the waters around the island. When all species were taken together, peak times for sighting turtles were from June to August (Fig. 110).

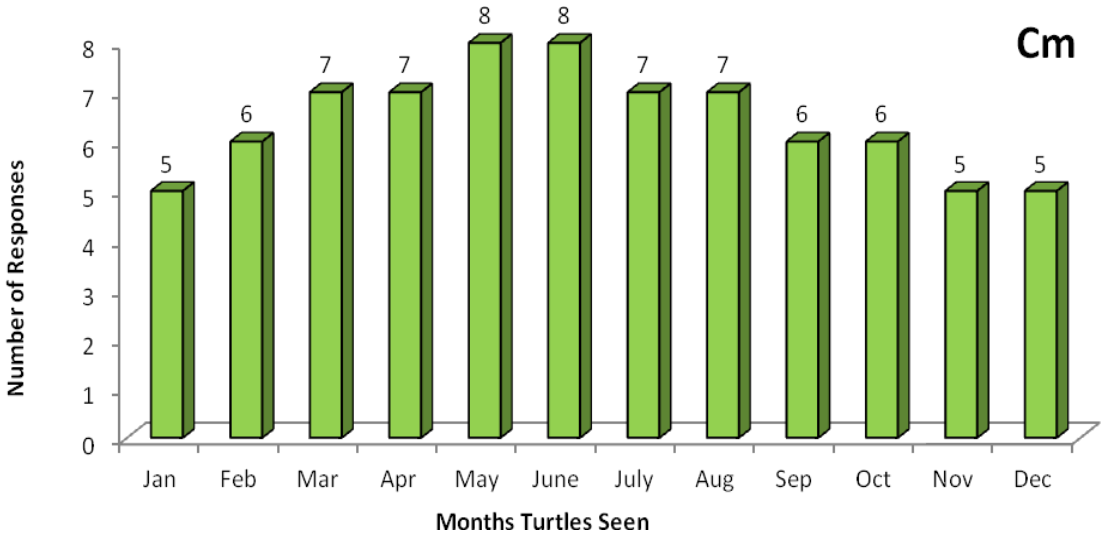

Figure 109. Months in which respondents from both Utila and Los Cayitos reported sighting *C. mydas* turtles at sea.

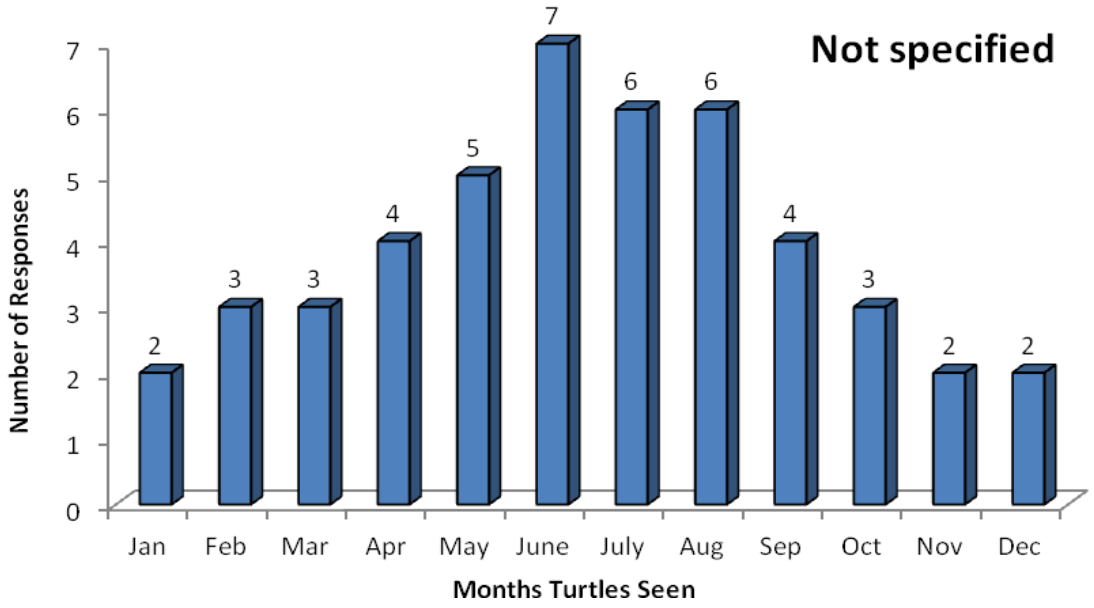

Figure 110. Months in which respondents from both Utila and Los Cayitos reported sighting unspecified turtle species at sea.

VI.III Turtles Sightings on the Beaches

The presence of sea turtles on the beaches of Utila and Los Cayitos was confirmed by 100 % of respondents. We found that 50 % of respondents suggested that there were more than one species nesting on the beaches of Utila and Los Cayitos, while 85 % of respondents recognized there were species differences of turtles that nested in the area. Only 15 % of respondents could not distinguish differences among species, and therefore did not know how many species nested on beaches in the area (Fig. 111). The species diversity of nesting turtles corresponds directly with the diversity of turtles sighted at sea, according to respondents (Fig. 112), with more than 51 % of respondents stating that they knew Hawksbills nested on the island.

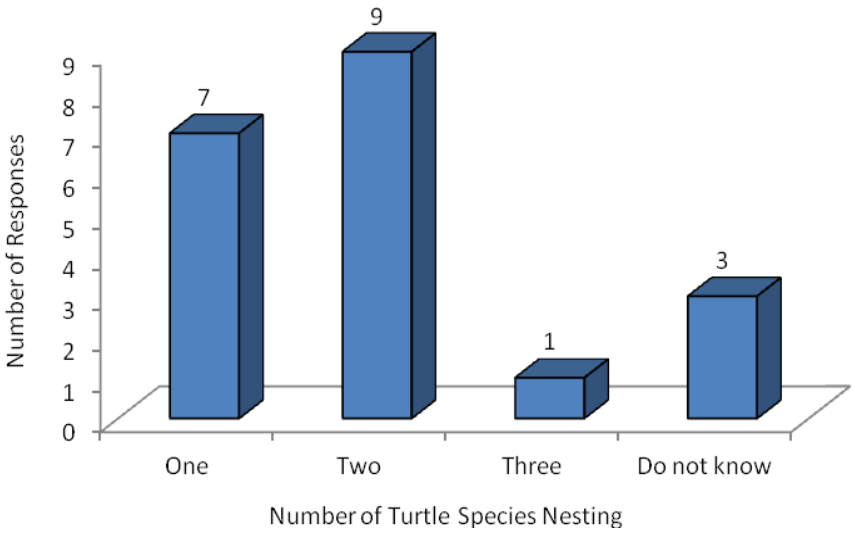

Figure 111. The number of turtle species reported to nest on Utila and Los Cayitos.

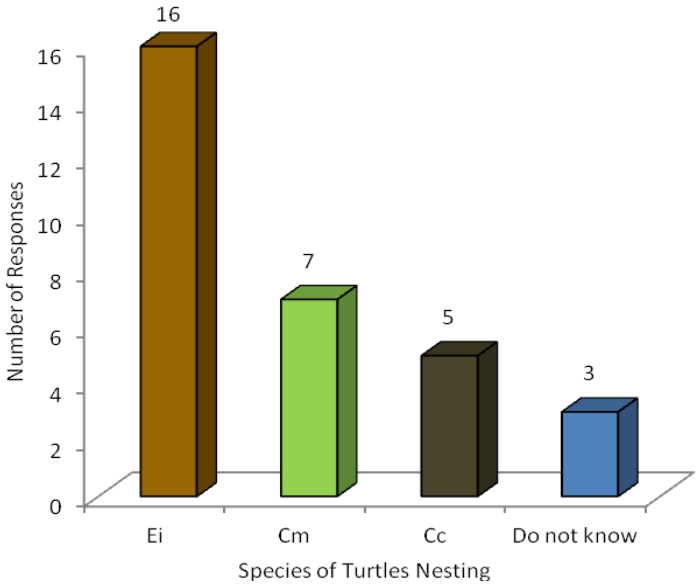

Figure 112. An histogram illustrating the diversity of sea turtle species seen nesting on the beaches of Utila and Los Cayitos. Ei = *E. imbricata*; Cm = *C. mydas*; Cc = *C. caretta*.

Figure 113 illustrates nesting sites around Utila where respondents stated they had sighted turtles of different species. The majority of respondents stated they had seen *E. imbricata*, *C. mydas*, and *C. caretta* on the north side of the island. Pumpkin Hill Beach also appears to be an area where respondents stated they had seen *E. imbricata* and *C. mydas*. Respondents reported seeing *E. imbricata* at all sights specified. It is interesting that while respondents reported that *C.* caretta had been sighted nesting in all other beach areas, there were no reports of this species nesting at Pumpkin Hill (Fig. 113). There were also no reports of *C. mydas* in the areas of Los Cayitos.

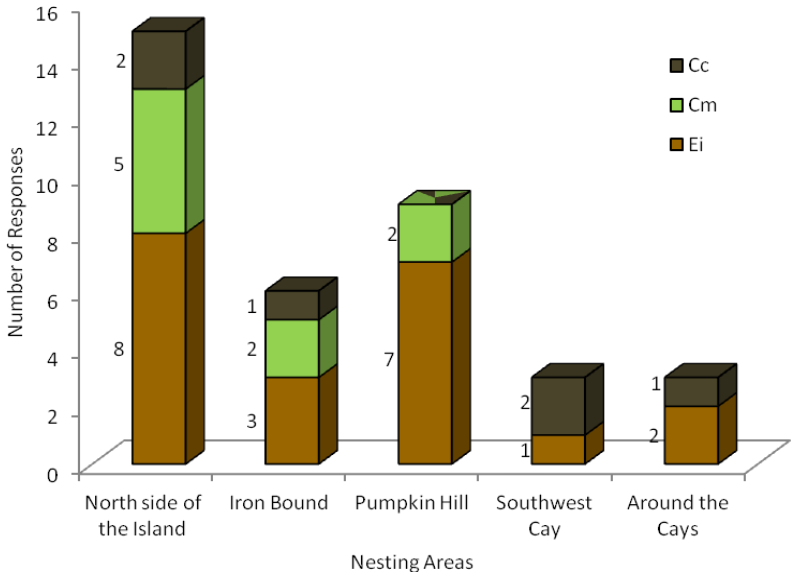

Figure 113. Important areas for nesting turtles of different species, according to respondents from both Utila and Los Cayitos.

While there are several beaches around Utila and Los Cayitos that appear to have conditions favorable to turtle nesting, only a few sights, such as Airport Beach, Southwest Cay, and Jack Neil Beach have had recent anecdotal reports of nesting. We were unable to confirm these anecdotes during the current study. Only Sandy Cay and Pumpkin Hill beaches (Fig. 114) have had previously confirmed nestings of *E. imbricata*, and these were again confirmed during the 2012 nesting season (Fig. 115).

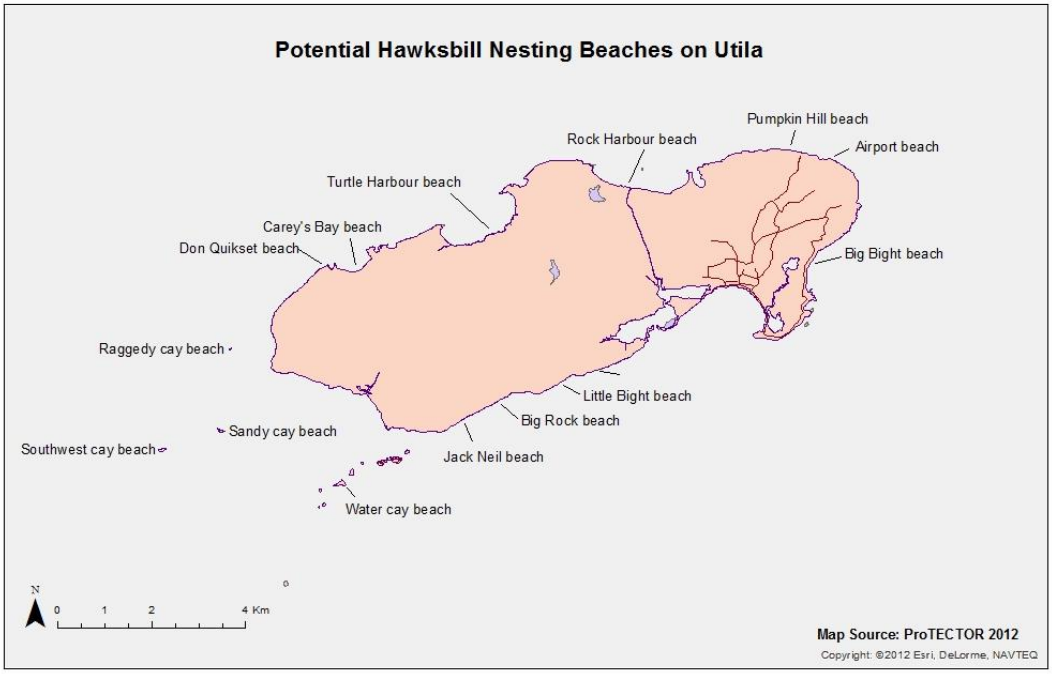

Figure 114. Map of Utila and Los Cayitos where turtles have been reported to nest. Some sites have had confirmed *E. imbricata* nesting, while the majority of potential sites have not been confirmed.

Figure 115. One of the *E. imbricata* turtles that nested during the 2012 nesting season at Pumpkin Hill Beach.

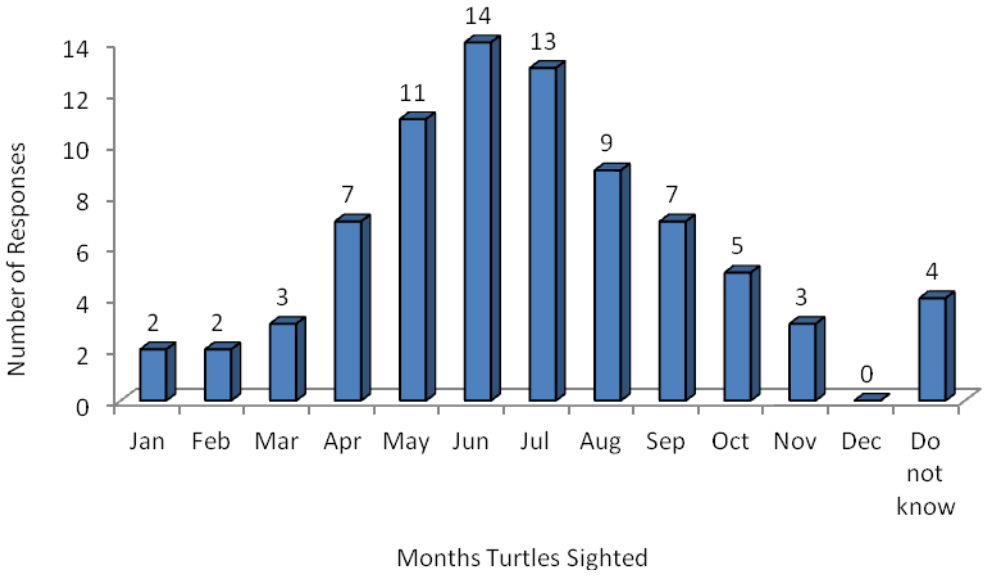

Figure 116. Seasonality of sightings of turtles on beaches on Utila and Los Cayitos, according to respondents.

Figure 116 shows the seasonality of nesting turtles on beaches, according to respondents from both Utila and Loa Cayitos. We found that the peak nesting season, according to interview responses, was between May and August, with the highest months for sighting nesting turtles in June and July. Data gathered on the numbers of turtles nesting throughout Utila and Los Cayitos suggests that 45 % of respondents did not know how many turtles might be nesting on the island, while 30 % stated that there were likely less than 5 per season. As many as 36 – 50 turtles nesting per season were reported by 10 % of respondents (Fig. 117).

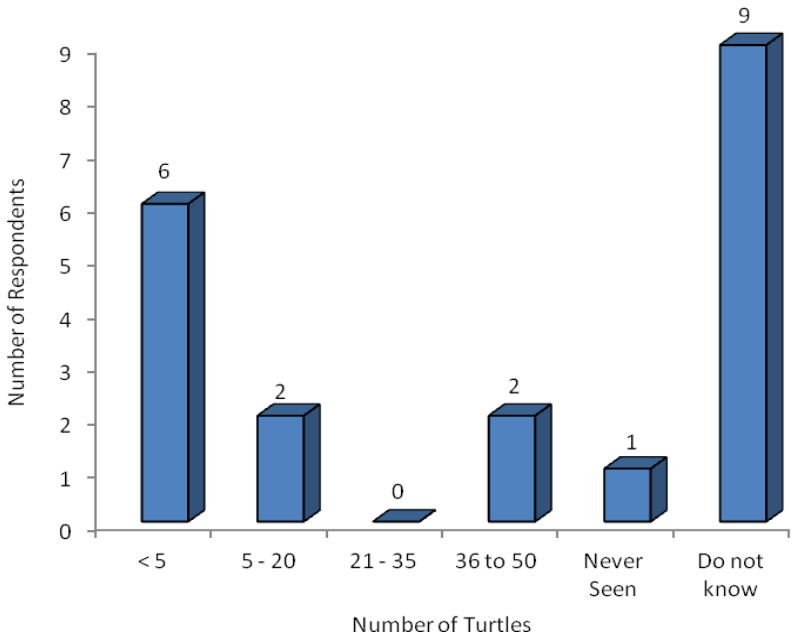

Figure 117. Numbers of turtles reported nesting on beaches of Utila and Los Cayitos, as reported by interview respondents.

VI.IV Threats

VI.IV.I At Sea

When we asked respondents about their attitude towards sea turtles when turtles are sighted at sea (Fig. 118), 70 % of respondents said they respected the turtles, while 25 % (5/20) stated they had not considered their own attitudes, and did not know what they felt when they sighted a turtle at sea. Only one respondent stated that he would be excited and approach to see the turtle closer.

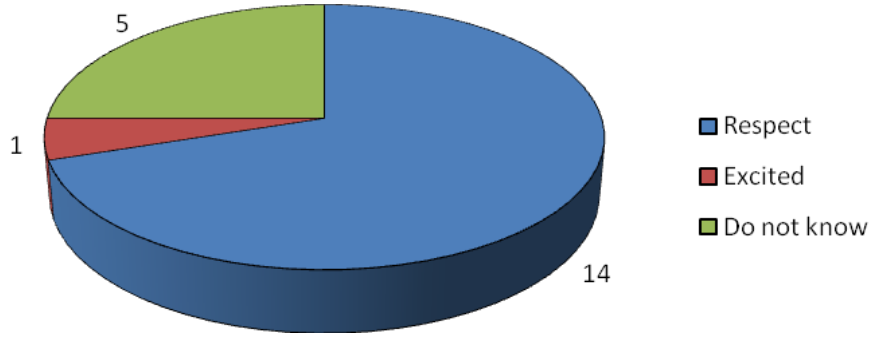

Figure 118. Attitudes of respondents towards turtles when sighted at sea.

The majority of respondents (75 %) stated that they did not believe that turtles were being caught in nets at sea around Utila, while only 10 % stated that they were being caught in nets (Fig. 119). Some respondents stated clearly that they did not know if turtles were being caught at sea in fishing or turtle nets.

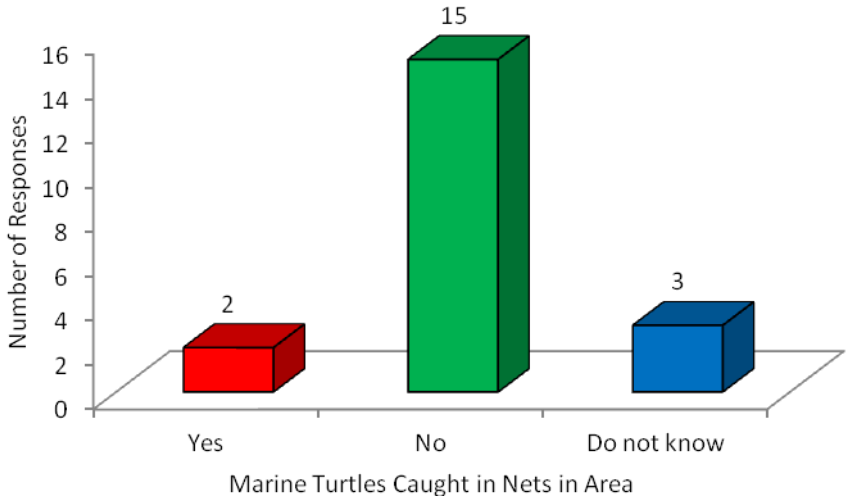

Figure 119. Responses to the question of whether sea turtles were entangled by fishing nets at sea.

While respondents generally suggested that turtles were not being caught at sea in nets (Fig. 119), responses (by fishers) to the question of how many time fishers encountered turtles caught in nets at sea were contradictory, with 42 % of respondents suggesting that they encountered turtles caught in nets approximately 25 % of the times they went out to sea to fish. At least 2/12 (17 %) of fisher respondents stated that they saw turtles caught up in nets every time they went out to sea to fish (Fig. 120). In all, 75 % of fisher respondents said they saw turtles caught in nets at sea 25 % or more of the times they went out fishing, while the remaining 25 % of respondents suggested that they never saw turtles entangled in nets when they went out fishing (Fig. 120). Furthermore, 50 % of fishers stated they released turtles when they encountered them entangled in nets (Fig. 121). Unfortunately, 42 % of fishers stated they would likely capture an entangled turtle to kill and eat it (Fig. 121), despite knowing that such actions are illegal.

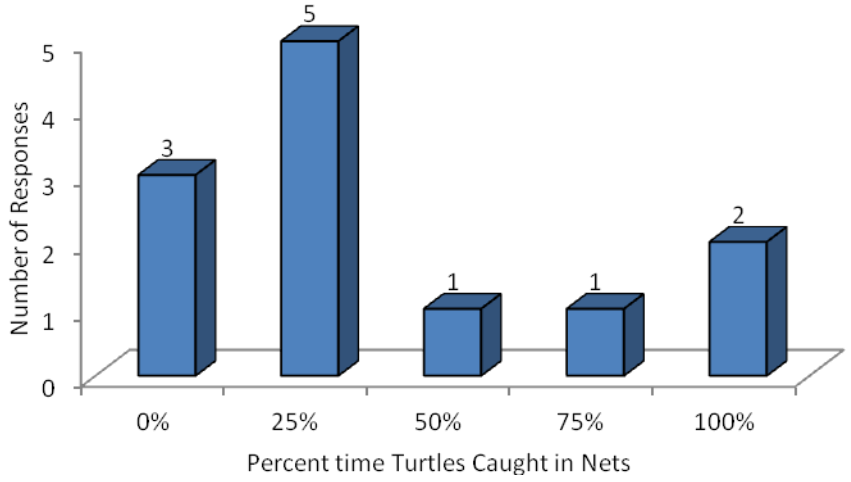

Figure 120. The percentage of times fishers encounter turtles entangled in fishing nets at sea.

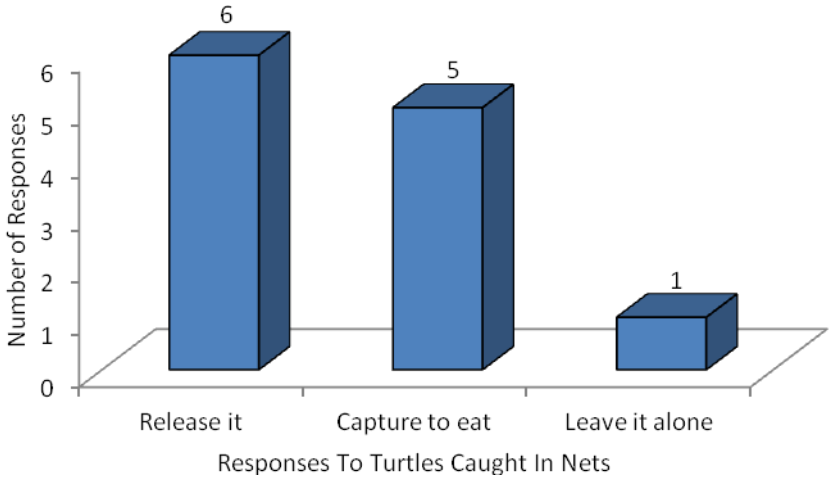

Figure 121. Attitudes of respondents toward sea turtles when fishers encounter turtles at sea.

VI.IV.II On the Beaches

With reference to attitudes of respondents to sighting sea turtles on the beaches around Utila and Los Cayitos, Fig. 122 shows that 70 % of respondents stated that when they saw a turtle nesting, they respected it and left it alone to nest and return to the water, while 25 % did not know what their attitudes were toward sighting a nesting turtle, and a single respondent (5 %) said they were excited to have the experience of seeing nesting turtles.

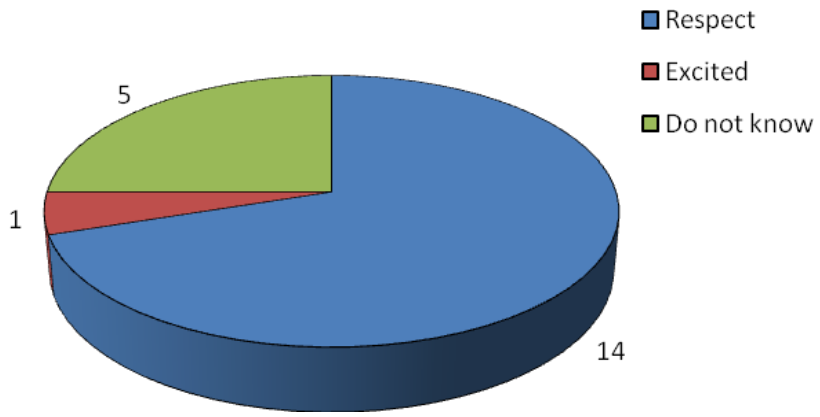

Figure 122. Attitudes of respondents toward sea turtles when encountered on the beaches around Utila and Los Cayitos.

In contrast to stated personal attitudes toward nesting turtles on the beach, responses varied with respect to what happens with turtle eggs. A full 40 % of respondents suggested that eggs were not poached from nests laid on Utila and Los Cayitos (Fig. 123). However, 40 % of respondents stated that anywhere from 25 – 75 % of eggs were poached from nests laid on beaches around the island. As many as 20 % of respondents did not appear to know if eggs were or were not poached from nests around the island (Fig. 123).

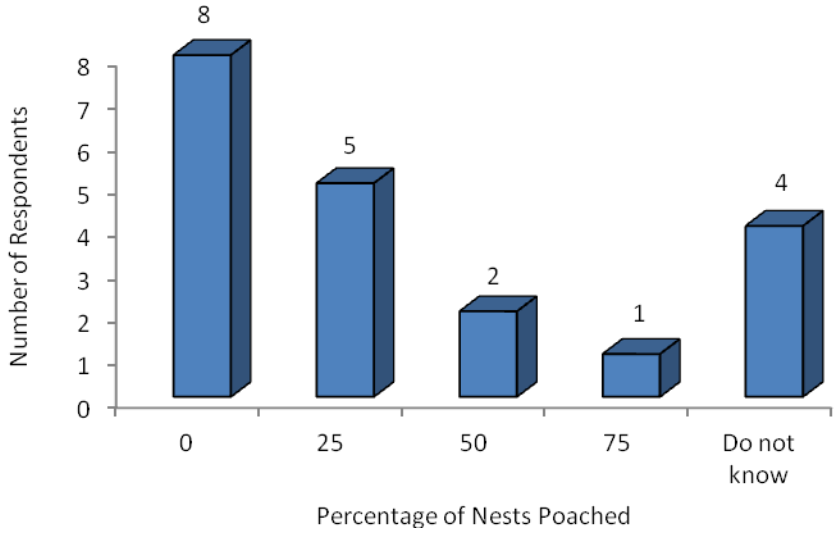

Figure 123. The percentage of eggs poached from beaches around Utila and Los Cayitos according to respondents from both areas.

When asked to suggest the fate of eggs harvested from local beaches, most respondents (60 %) suggested that harvested eggs were usually eaten domestically (usually within a family or shared with neighbors), while 15 % of respondents suggested that eggs were sold either privately or through a local market (Fig. 124). Some respondents did not have an opinion on what was done with harvested eggs.

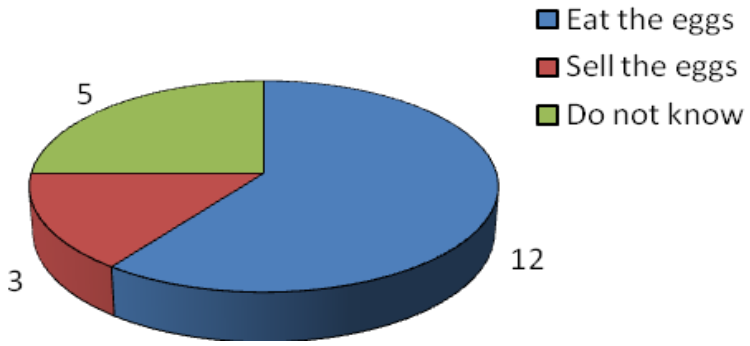

Figure 124. The fate of eggs poached from beaches around Utila, according to respondents from both interview communities.

Overall, when respondents were asked what they perceived as the greatest threats to sea turtles both in the water and on the beaches, we found the greatest number of responses (44 %) suggested that turtle capture was the main threat to turtles in both Utila proper and in Los Cayitos combined, while 36 % stated that egg collection (or harvesting), was the next greatest threat (Fig. 125). It is interesting to note that only 16 % of respondents suggested that fishing nets were a threat to turtle survival, and only 1 respondent stated that divers were a threat.

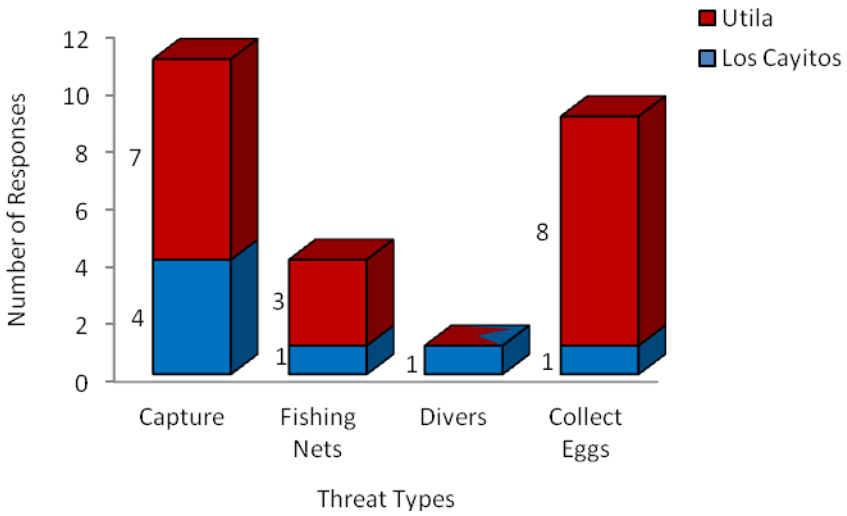

Figure 125. The main threats to turtles at sea and on the beaches of the area of Utila, as suggested by interview respondents from both Utila and Los Cayitos.

VI.V Trends at Sea

We assessed information from respondents regarding trends of turtle sightings at sea 5, 10, and 20 years ago in comparison to current sightings. In Fig. 126 A, it can be seen that the majority (50 %) of respondents stated that they believed that they sighted fewer turtles 5 years ago than they do now, while 45 % believed they sighted more turtles 5 years ago than they do now. There was consensus among respondents that the number of turtles sighted now was not the same as it was 5 years prior. Fig. 126 B shows 65 % of respondents believed that they sighted more turtles at sea 10 years ago than they do now, while only 25 % believed they sighted fewer turtles 10 years ago than they do currently. Again, none of the respondents believe the numbers sighted have remained the same. In Fig. 126 C, we again see that the majority of respondents (65 %) believe they sighted more turtles at sea 20 years ago than they do at present. Two respondents reported that they believe they used to see many more turtles 20 years ago than they do now. None of the respondents believed they saw fewer turtles 20 years ago than now, and again, none reported that the numbers sighted at sea were the same as 20 years prior (Fig. 126 C).

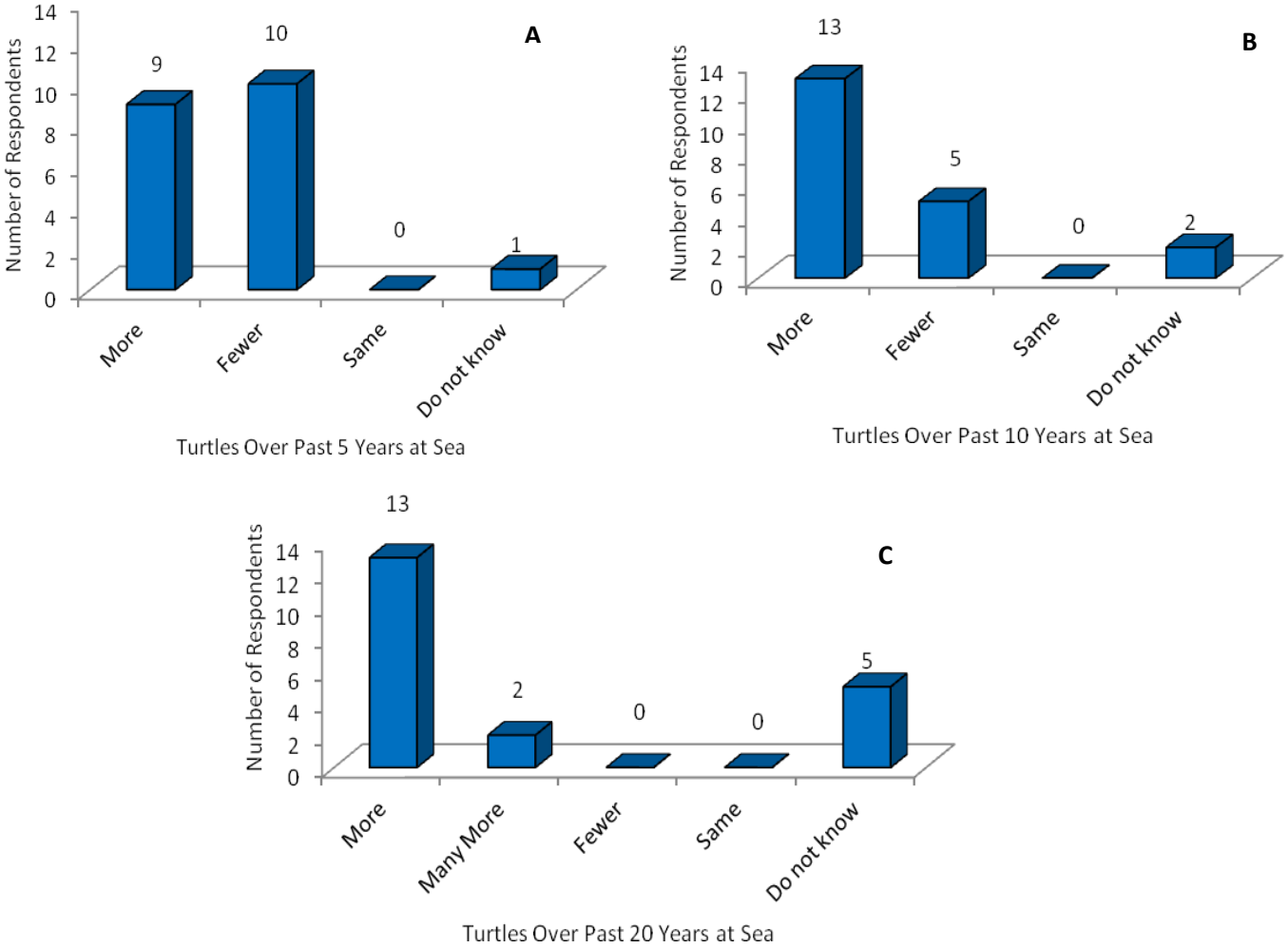

Figure 126. The number of respondents who believe they saw more, many more, fewer, or the same number of turtles at sea 5 years ago (A), 10 years ago (B), or 20 years ago (C) when compared with the present.

VI.VII Trends on the Beaches

When asked about trends of turtle sightings on the beaches of Utila and Los Cayitos, 65 % of respondents believed that they sighted more turtles 5 years ago when compared with now. Only one respondent believed turtle sightings on beaches were fewer 5 years ago than are currently encountered (Fig. 127 A). When asked to compare current sightings of turtles on beaches to those 10 years ago, 65 % of respondents believed there were more sightings 10 years ago than now, while none of the respondents believed there were fewer or that there were the same number (Fig. 127 B). In comparison to sightings of nesting turtles 20 years ago (Fig. 127 C), 30 % of respondents believed there were more turtles sighted 20 years ago, while the majority (70 %) admitted they did not know if there were more or fewer turtles sighted nesting 20 years ago compared with the present. Still, none of the respondents believed that there were fewer or the same number of sightings on the beaches 20 years ago when compared with the current situation (Fig. 127 C).

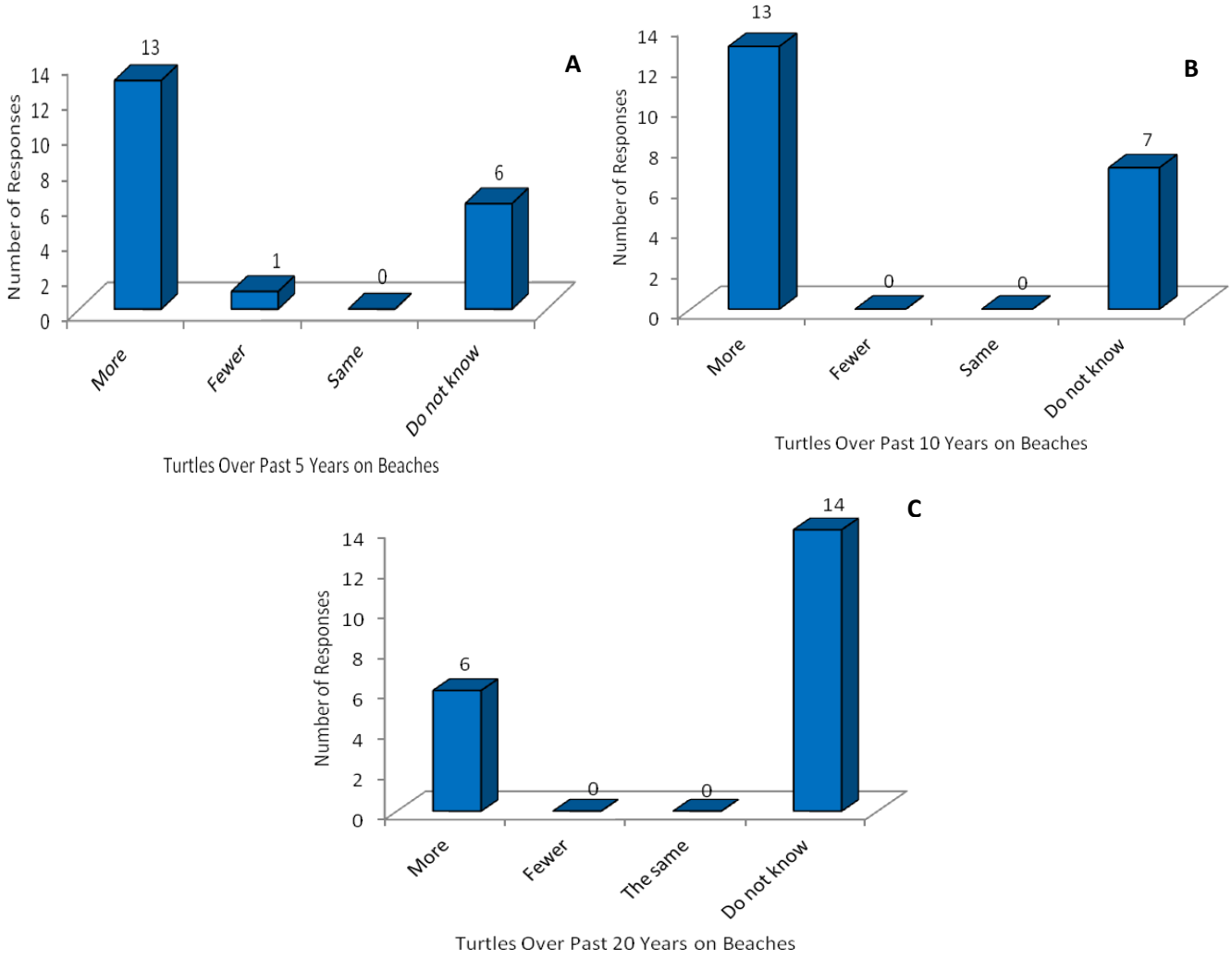

Figure 127. The number of respondents who believe they saw more, fewer, or the same number of turtles on the beaches 5 years ago (A); 10 years ago (B); or 20 years ago (C) when compared with the present.

VI.VIII Monitoring

Utila and Los Cayitos

BICA personnel began occasional monitoring of Pumpkin Hill Beach in June, 2012. However, efforts increased to nightly monitoring starting June 25 and continued until August 13. From August 13 until October 15, we carried out irregular monitoring because nesting attempts had dropped off substantially. Monitoring entailed walking the beach each evening from 5:00PM until 5:00AM. We set up a small camp each day and used this shelter for resting and in case of storms.

We recorded 12 nesting attempts by Hawksbill, not all of which were successful. On the first turtle recorded, we were unable to apply flipper tags due to some misunderstandings in methodology among BICA personnel. However, once these were corrected, flipper tagging and satellite tagging progressed smoothly. We flipper tagged (Fig. 128) a total of 5 Hawksbill turtles with Inconel (681 style) flipper tags (Archie Carr Center for Sea Turtle Research, University of Florida, Supplier) on the right front and right rear flippers, as is the standard protocol for ProTECTOR's Turtle Awareness and Protection Studies (TAPS) program throughout the Bay Islands. These tags have allowed us to continue to identify returning turtles and to begin to estimate nesting population numbers at specific beach sites.

Figure 128. Lindsey Damazo applies an Inconel flipper tag to the front right flipper of one of the nesting Hawksbills named "Chel."

We were able to fix satellite transmitters (Wildlife Computers, Spot 5) to two nesting Hawksbills. The first was placed on “Chel” on July 11, 2012 (Fig. 129). Shortly after being fitted with the transmitter, this turtle began to move northwest, away from Utila and toward the coast of Belize. The turtle stayed east of the coast of Belize until coming to the area of Corazal, where she then hugged the coastline making her way further north along the coastal zone of Quintana Roo. Chel eventually stopped at Cayo Culebra in the Sian-Ka’an Biosphere Reserve, just south of Cozumel (see Fig. 131). The transmitter signal was eventually lost after 90 days on October 9, 2012.

Figure 129. “Chel” fitted with a satellite tag for tracking migratory movements away from Pumpkin Hill Beach on Utila.

A second satellite tag was launched on August 12 on “Ginger” (Fig. 130). This turtle left the Bay Islands on August 13 and moved directly toward the coast of Belize, skirting south of Glover Reef, and moving northwest toward Dangriga. She continued a northern trek along the coast until stopping near Water Cay at the southernmost end of the Drowned Cays (see Fig. 131).

Ginger appears to have settled near Water Cay, possibly representing the end of her post-nesting migration to her regular foraging ground. The transmission from Ginger stopped on October 3, 2012, just 20 days after launch.

Figure 130. "Ginger" outfitted with a satellite tag and receiving the second flipper tag on the right rear flipper.

We recorded 9 successful nests. A nest temperature study was also undertaken with nests at Pumpkin Hill Beach. Nest temperatures were monitored with TidBit temperature data loggers placed at two depths within the nests (Fig. 132). We were able to monitor 4 nests and 4 control (false) nests. Nests were then monitored until hatching. All live hatchlings from monitored nests were then collected and a small blood sample of 0.1 ml was collected from each. We collected 222 blood samples from hatchlings.

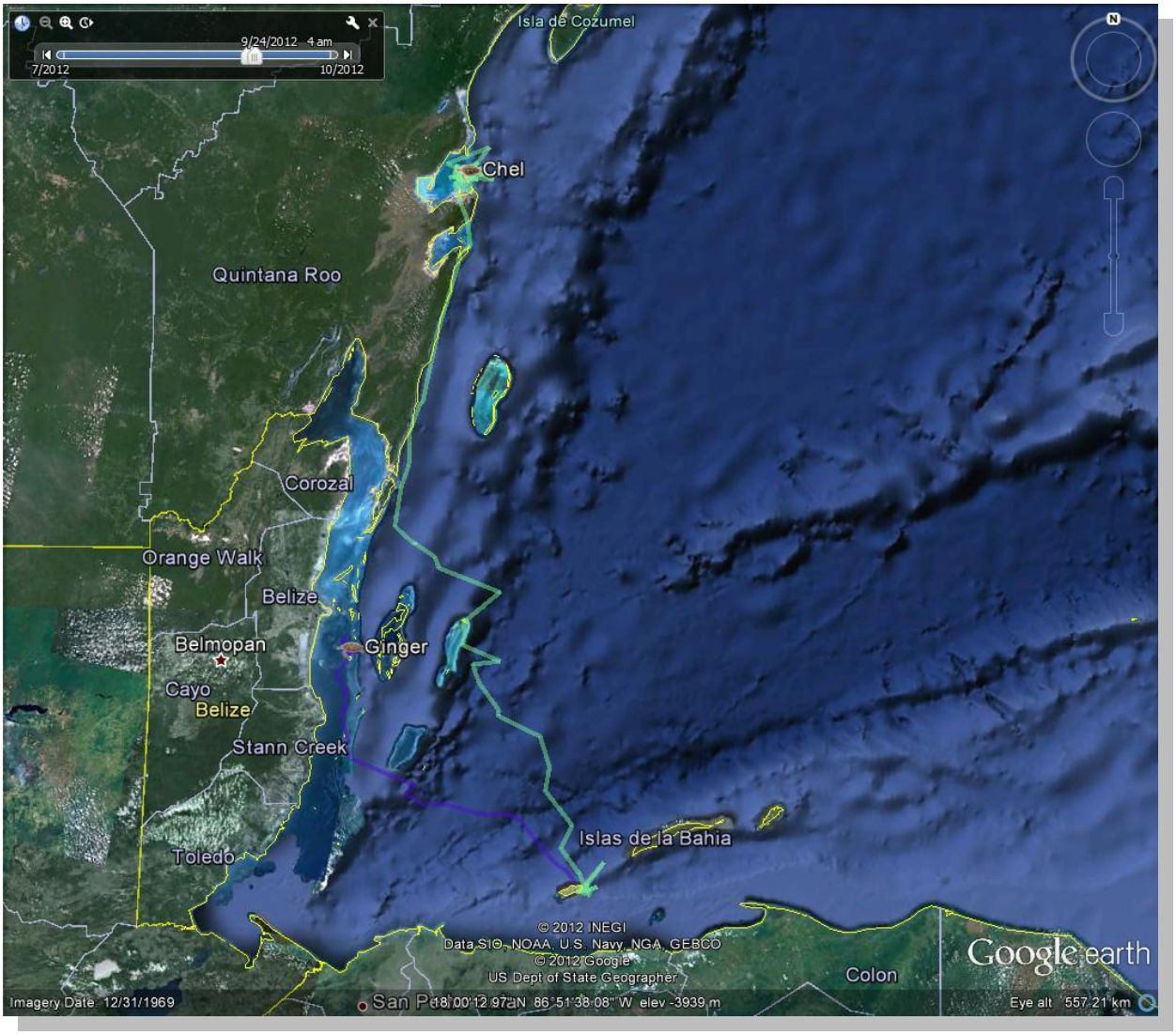

Figure 131. A Google Earth map showing the unfiltered migration paths of “Chel” and “Ginger” after nesting on Utila.

Figure 132. Giselle (“Chel”) Morales helps to count and re-bury Hawksbill eggs from a recently-laid nest.

VI.IV Results from Beach Pollution Study

Data gathered through the pollution study at Pumpkin Hill Beach, is currently being analyzed.

VI.V Results of Educational Outreach

Utila and Los Cayitos

In all, six community activities and three training sessions were carried out during the project period. Some of these were supported by funds from USFWS, ProTECTOR, and BICA through the current study, while others were supported by other BICA partnerships. These included beach clean-ups (Fig. 133) prior to and after the nesting season, environmental camps for high school students (Fig. 134), awareness campaigns with elementary school children (Fig. 135), business owners, and real estate developers, and training and awareness sessions with volunteers and other NGO's (Figs. 136 and 137).

Fig. 133. A group from Utila organized by project partner, BICA, for a beach clean-up along the north beaches, including Pumpkin Hill Beach.

One beach clean-up specifically targeting Pumpkin Hill Beach gathered 356 large garbage bags of plastic pollution materials, while four sports dive centers undertook underwater clean-ups in different locations around Utila.

Many of the reported activities, such as those at elementary and high schools, are re-occurring and ongoing. In addition, beach clean-ups continue on a semi-annual, or as-needed basis, supported by BICA and BICA volunteers and supporters.

Figure 134. A group of young students from a Utila High School prepare to depart on an environmental camp day with organizers from BICA.

Figure 135. At a Utila Elementary School, children interact with the puppet story to learn about sea turtle life cycles and what they can do to protect sea turtles at sea and on the beaches of Utila.

In July, 2011, Stephen Dunbar put on a workshop for BICA staff and volunteers, as well as volunteers and representatives from other local conservation NGO's on the island. During this two-day workshop, more than 14 people attended, providing a platform for discussions on conservation and local activities with regard to turtle conservation in that area. In late June, 2012, we held another small research and conservation workshop open to volunteers at BICA and other local NGO's around the island (Fig. 136). We had a total of nine individuals attend this workshop who became involved with the project. In addition, graduate student, Lindsey Damazo, provided an information session for attendees regarding her research work on

Hawksbill nesting and hatchling ecology (Fig. 137). Some of the volunteers then assisted in beach profiling and monitoring at Pumpkin Hill Beach.

Figure 136. Project PI, Stephen G. Dunbar, facilitates a small workshop for volunteers from BICA and other local NGO's at the BICA facility.

Figure 137. Loma Linda University and ProTECTOR graduate student, Lindsey Damazo, explains her research work to volunteers who will assist with some aspects of the project at the turtle research and conservation workshop at BICA headquarters on Utila.

VII DISCUSSION

VII.I Interviews

VII.I.I Turtles at Sea

Cuero y Salado Wildlife Refuge

Results from interviews with fishers and community members in four communities in the area of CSWR provided a wealth of information that has previously been unavailable with regards to sea turtle sightings and nesting. We interviewed a wide age-range of participants, providing a large range of experiences and observations from those involved. Obviously, older fishers had more years of fishing experience along with more potential insights to changes in both threats to turtles and turtle sightings over time. The proportion of time spent fishing per year also varied widely among individual respondents. Depending on the type of question, respondents could provide single (as in the case of how often they sight turtles at sea) or multiple responses (as in the case of all the places where they sight turtles while at sea).

Many of the respondents provided information that suggests that Hawksbill turtles in both juvenile and adult stages are commonly sighted off the coast of the refuge, both within and beyond the refuge marine boundaries. Fisher responses provided key information on areas in which turtles are sighted at sea. It is clear from their responses that turtles are seen in reef areas utilized as fishing grounds, and that fishing grounds are more or less specific to the individual communities in which we interviewed study participants. The specificity of fishing grounds in relation to their communities could potentially bias respondents to speak more favorably of their fishing grounds than of those associated with other communities. We have yet to fully evaluate this potential issue.

It also became clear that, although fishers are observing turtles at sea, there is some ambiguity as to what species are being sighted. Several respondents were unable to definitively identify different species when shown illustrations or photographs. Additionally, respondents admitted that they do not often observe turtles for more than a few seconds at a time, and that viewing turtles from the low angle of incidence afforded by their small skiffs and “pangas” does not often allow them clear sight of the turtles in order to distinguish species. However, most respondents appear to be aware that four species (*E. imbricata*, *C. mydas*, *C. caretta*, *D. coriacea*) are present in the waters off the coast of CSWR, and characteristics provided by respondents correlate well with characteristics of species that have been confirmed to inhabit these areas.

The proportion of turtles sighted in relation to species was *D. coriacea* < *C. mydas* < *C. caretta* < *E. imbricata*. This appears to essentially follow the proportions of turtles by species reported in other areas, such as in Roatán and in Utila. The proportion of turtles sighted in each species category may also be influenced by fishing area locations. It appears that most artisanal fishing takes place in areas proximal to coastal coral reefs, although some fishing is practiced in areas where extensive sea grass beds occur.

When asked to distinguish activities of turtles sighted at sea between mating and foraging, the overwhelming majority of respondents stated that turtles they sighted were usually foraging, with only a few respondents suggesting that mating activity was observed. While we were unable to tease these data into species-specific proportions, these results may suggest that the

area along the coast of the refuge is a potentially important foraging area for both juvenile and adult turtles of all four species reported. However more specific in-water assessments are needed to confirm this.

Responses to the question of seasonality of turtle sightings at sea varied with community. However, when all responses were pooled and provided without respect to species, responses resulted in a unimodal graph with peak sighting season between April and August. However, the majority of responses stated that turtles are sighted at sea all through the year. These estimates of seasons and peak seasons of sightings provided by participants coincide well with peak seasons of these species reported in other areas of the region, and suggest that while turtles may be aggregating to the area for mating from April to August, there may also be populations of different turtle species that utilize these local reefs and sea grass beds as primary foraging grounds.

Utila and Los Cayitos

We gathered data from local fishers and community members in the area of Utila and Los Cayitos through a series of interviews. We had a total of 20 respondents, with 14 from Utila proper, and 6 from Los Cayitos. Depending on the type of question, respondents could provide single (as in the case of how often they sight turtles at sea) or multiple responses (as in the case of all the places where they sight turtles while at sea).

Results provided much information on sea turtle sightings at sea and on the beaches of Utila, perceived threats to turtles at sea and on beaches, as well as attitudes of respondents towards sea turtles at sea and on beaches. Although a preliminary interview process, this information has not be previously available, and no general information on sighting of turtles, aside from unrecorded anecdotal reports, has previously been provided in a published format.

Respondents provided information that suggests Hawksbills, as well as other species of turtles (*C. mydas*, *C. caretta*, and *D. coriacea*) are sighted both at sea and on beaches of Utila and Los Cayitos. While responses from interviews may contain some degree of bias, these reports nevertheless do provide data that appear to correspond well with anecdotes and confirmed sightings of Hawksbills and other species in the area of the Bay Islands. It is clear that not all interview respondents are able to distinguish the four species of turtles usually sighted in the region, and that some of the respondents do not concern themselves with either understanding the ecology of sea turtles or the fate of turtles in relation to the conservation of these species.

It was also apparent that the fate of turtles at sea and on the beaches is not clearly understood by respondents, some of who stated both that nets were a major threat to sea turtles, and also that they had never seen a turtle entangled in netting at sea. Additionally, while some respondents stated they knew the fate of eggs harvested from nesting beaches and the species of turtles nesting on beaches of Utila, most respondents themselves, had never sighted a turtle on the beach. This could be, as is the case in CSWR, because these respondents were comprised of fishers and people of other professions, and were not involved with turtles for any commercial purposes. Thus, they are unlikely to be aware of the details of turtle ecology and seasonality. As well, because there is no organized and commercial system for the harvesting of eggs in this region, people who work all day as fishers (and are likely to be more lucrative at that

activity than in illegally harvesting and marketing turtle eggs), are unlikely to spend their nights walking the beaches in the search of nesting turtles. As such, they take relatively little notice of when turtles are nesting or are returning to local waters during the mating season.

Nevertheless, responses to the seasonality of sightings of turtles both at sea and on the beaches did appear to correlate with confirmed sightings and nesting both at CSWR and in the other Bay Islands. From responses we gathered, it appears that an increase in sightings by fishers at sea occurs in March and a drop off occurs in October. The peak sighting season for Hawksbills is reported to be in May and June. These seasonal delineations do appear to fit the nesting season for Hawksbills that we have confirmed both here on Utila and also in Roatán, and thus provide reference points from which more specific research work can be carried out in this location.

VII.I.II Turtles on the Beaches

Cuero y Salado Wildlife Refuge

The great majority of interview participants stated that they had sighted turtles on the beaches of the CSWR. It is interesting to note that the proportions of the species sighted on the beaches of the refuge are somewhat similar to the proportions of species sighted at sea. This may lend further validity to the notion that during the peak season months described by respondents, turtles of all three species may be nesting at the refuge. Actual beaches reported as nesting sites varied among and within communities, with the beaches most frequently referred to being between Zacate Bar and Boca Cerrada Bar.

When asked which months turtles were seen on the beaches of CSWR, respondents stated they saw turtles most between April and September with a unimodal peak in July and August. These data appear to coincide well with data for sightings at sea for potential nesting events. However, the majority of respondents stated that they believed they saw fewer than 10 turtles nesting on beaches of the Refuge per year. Surprisingly, some respondents suggested that as many as 40 or more turtles may be nesting on these beaches. However, responses did not distinguish species and thus, it is, as yet, unclear how many Hawksbills may be nesting in the area.

Indeed, much of the 59 km of beaches within the CSWR boundary (taking into account the beach extensions resulting from sand build-ups) are potentially viable nesting beaches for different types of sea turtles, with the exception of those parts of these beaches where there is extensive erosion, and where nesting turtles may not encounter sufficient substrate cover to lay eggs.

Utila and Los Cayitos

From Fig. 114 it can be seen that respondents stated turtles were nesting on a large number of beaches on Utila and Los Cayitos. While many of these beaches have not yet been confirmed as nesting beaches for Hawksbills, we have confirmed active and continuing nesting at Pumpkin Hill Beach and at Sandy Cay, and continue to carry out monitoring activities on both of these beaches. Further monitoring efforts are necessary to confirm Hawksbill nesting on Airport Beach, Southwest Cay and Jack Neil Beach, from which anecdotal reports have been gathered, but which have not yet been confirmed.

Other beaches around Utila and the Cays have appropriate conditions for Hawksbill nesting. However, these beaches have not yet been confirmed to have Hawksbill nesting activity. Many of the beaches labeled in Fig. 114 are difficult to access by foot or by boat. Thus, monitoring of these beaches to determine if, indeed, they are utilized for nesting, will take further funding and specific long-term planning.

VII.II.I Threats to Turtles at Sea

Cuero y Salado Wildlife Refuge

The majority of respondents, when asked what their attitude toward turtles sighted at sea was, stated that they respected turtles, while a few stated they would capture and eat the turtle. There may be some bias in the response given by the majority of people, since it is well understood among community members, that the capture and killing of turtles is illegal. We noted that when respondents were asked if current fishing practices in the zone were a threat to turtles at sea, more than half stated that they were. However, when responses were divided by community, the majority of respondents in the two communities of Boca Cerrada and La Rosita did not believe that current fishing practices were a threat to turtles at sea. These responses may result, on the one hand, from the fact that current fishing practices in these two communities is, indeed, of little threat to turtle survival. On the other hand, they may stem from a desire to protect current, but harmful or illegal fishing practices carried out by fishers from these communities. There is some anecdotal evidence that illegal fishing nets were continuing to be used by fishers from some communities in the CSWR zone. However, we did not pursue further clarification on which communities were using illegal nets in the marine protected area of the refuge. Further data collection will need to be undertaken to ascertain specific details regarding these practices.

Overall, interview participants listed the main threats to turtles at sea as nets (gill nets, sein nets, shrimp nets) and harpoons (presumably referring to spearfishing). Nets comprised the greatest perceived threats to turtles at sea. However, almost half of all respondents stated that they believed there were no threats to turtles at sea as a result of fishing gear. These data appear to agree with the number of fishers who stated they had not seen turtles caught in fishing gear.

Utila and Los Cayitos

According to respondents, fishing nets around Utila did not constitute a major threat to sea turtles at sea. However, 75 % of fishers did state that they estimated that approximately 25 % of the times they went out to sea they would sight turtles caught in nets. Additionally, the majority of fishers reported that if they saw turtles caught in nets at sea, they would release them. Still, some 42 % of respondents reported that if they saw a turtle caught in a net, they would kill and eat it.

Reports from fishers stating that they would release caught turtles may contain some bias, providing the answer they felt most appropriate to provide, since it is commonly understood that capturing and killing turtles is punishable by law. It appears that in the Bay Islands, with on sight organizations, such as BICA, there is greater awareness of the potential consequences of breaking national conservation laws, as some people have been prosecuted, to some extent, for

poaching turtle eggs or killing turtles caught at sea or on nesting beaches. It therefore, appears to be necessary to strengthen enforcement of national conservation laws, and increase awareness of consequences. Providing part-time or full-time opportunities for employment in conservation activities may encourage increased involvement in conservation efforts.

VII.II.II Threats to Turtles on the Beaches

Cuero y Salado Wildlife Refuge

Participants who reported seeing turtles on the beaches, also reported their attitudes toward turtles found on the beaches of the Refuge. The majority of respondents stated they had not actually seen a turtle nesting on the beaches. We found that because the majority of respondents were fishers and because there is no legal egg harvest, as there is in the north coast of Honduras, fishers had little incentive to keep track of nesting times and seasons, and details of nesting species. These respondents appeared to have limited knowledge regarding turtle nesting in the area. Still, 26 % of respondents openly admitted that they would harvest eggs from nesting turtles in the Refuge, and one individual stated that he would kill and eat the turtle if he sighted one on the beach.

Because egg harvesting has not been legalized in this region of the country, as has been done by the Ministry of Environment (SERNA) in the south coast with *Lepidochelys olivacea*, there is little incentive for community members to spend the time monitoring beaches for nesting turtles. Most working adult males in these communities earn the greatest proportion of their annual income through fishing during the day. They thus have little incentive to continue to work through the night to harvest relatively few nests for which there is a small market. The majority of responses (65 %) stated that less than 50 % of eggs laid were harvested in this area. Only one response suggested that 100 % of eggs laid on the beaches of CSWR are harvested. However, it is unlikely that all eggs are harvested from the region. During monitoring of Salado Bar Beach during July and August (the suggested peak nesting season), we noted that there were essentially no community members on the east or west sectors of the beach throughout the night or in the early morning. We also did not receive any reports of egg harvesting from anyone in the communities in which we conducted the study during the monitoring phase of the study. Nevertheless, 78 % of respondents from all communities combined stated that eggs that were harvested are eaten locally within families or shared among neighbors, while only 18 % of respondents suggested that eggs were sold through a commercial mechanism. While only a few respondents openly admitted to harvesting Hawksbill eggs from the beaches of the CSWR, there are likely many others who have, but refrained from providing that information knowing that that the consumption and sale of turtle eggs is prohibited by law. This lends further support to the idea that commercial egg harvesting is minimal in CSWR, but that incidental harvesting may be depleting eggs from the potentially small number of nesting turtles that utilize the beaches of the refuge. It appears that while community members are not organized for an egg harvesting season (nor do they have interests in doing so), that incidental harvesting and private egg consumption does take place and likely accounts for the majority of eggs removed from nests on the beach. At present we have not been able to quantitatively confirm the numbers of eggs harvested or eggs lain per season. This will require further detailed assessment in the area of the Refuge.

Trends of reduced turtle sightings on the beaches at CSWR may reflect the activity of egg harvesting, which, although not an organized or commercial endeavor, is nevertheless something that has been practiced in the past and that may be one of the threats that weigh on current estimations of low numbers of sea turtles in the area. Another threat that may negatively impact the presence of females currently nesting on the beaches is the pressure of commercial shrimp fishing in the area of the Refuge in the past (approximately from 2000 to 2007), and the current presence of large trammel nets within the Refuge boundaries, mentioned by respondents.

With respect to overall threats to turtles at sea and on the beaches of CSWR, respondents stated that nets of various kinds were potentially the greatest threats to sea turtle survival in the area. Divers (shrimp and lobster divers), egg collecting (or harvesting), and killing turtles for consumption appear to follow in rank order as additional major threats. Although low ranking, respondents were at least aware of other factors, such as entrapment on the beaches due to pollution, natural predation, and disturbance during nesting, as potential threats to turtles at sea or on the beaches.

Utila and Los Cayitos

Respondents who reported sighting turtles on the beaches around Utila, also reported their attitudes toward turtles when they were sighted. The great majority of respondents stated they would respect turtles they sighted on the beaches, while 25 % of respondents did not know how they would respond to turtles they sighted. Again, these responses may contain socially acceptable bias, since respondents may provide answers they know would be socially acceptable.

From information collected, it appears that some 25 – 75 % of eggs laid are harvested (poached), according to interview responses. Eggs that are poached from beaches on Utila and Los Cayitos appear to mainly be personally consumed among family members and neighbors. Only a few respondents suggested that harvested eggs were sold. This appears to be a result of the lack of both an organized egg harvesting program, as along the south coast of Honduras, and the lack of a commercial market for the sale of eggs in the Bay Island. Despite the lack of commercial pathways for the sale of turtle eggs, some sales to local hotel and restaurants does take place. However, these are small scale sales and are incidental in nature only.

VII.III.I Trends at Sea

Cuero y Salado Wildlife Refuge

We investigated the perceived trends of sea turtle sightings at sea among fishers from the four communities at CSWR by asking respondents to compare the number of current turtle sightings to the number of sightings they recall 5, 10, and 20 years ago.

The majority of respondents believed they were sighting more turtles at sea 5 or 10 years ago than currently. It appears from these responses that the majority of respondents were in agreement that sightings of turtles at sea have declined over the last 20 years. It should be noted, however, that when asked to recall sightings from 20 years ago, the majority of

respondents did not know if there were more, fewer, or the same numbers sighted when compared with current sightings. Information we collected on the number of years fishing experience (Fig. 26) showed the majority of fishers from these communities had less than 30 years fishing experience, with 26/47 fishers having less than 20 years of experience at sea. Thus, many of the fishers we interviewed would have limited knowledge of turtle sightings from 20 years prior. Still, when "Do not know" answers were factored out, the majority (78 %) of the remaining 23 responses stated they sighted more turtles 20 years ago than they do at the present time.

The questions regarding historical comparisons posed to respondents have the inherent weakness of requiring fishers (whose primary purpose is fishing and *not* turtle sightings) to recall and compare information from years past. This may introduce response bias, including both acquiescence bias and social desirability bias (Paulus 1991). Still, the reported trend would correspond well to other reports for both the region and for the coastal areas of Caribbean Honduras.

Utila and Los Cayitos

Data we collected showed perceived trends of current turtle sightings at sea around Utila versus sightings from 5, 10, and 20 years ago. Of those interviewed, the majority (50 %) stated that there were fewer turtles sighted at sea 5 years ago when compared with the present. However, 45 % of respondents stated that there were more sightings 5 years ago than there are now. When compared with 10 years ago, 65 % said there were more sightings at sea around Utila at that time then there are now, while 25 % stated there were fewer sightings 10 years ago than now. None believed that the number of turtles sighted now was the same as 10 years ago. When asked to compare sightings at sea from 20 years ago with sightings now, 65 % of respondents stated there were more 20 years ago than there are now, while only 10 % stated there were fewer sightings at that time then currently. Some 25 % stated they did not know if numbers were higher or lower now, but once again, no respondents stated the numbers were the same, and none stated the numbers 20 years ago were fewer than now.

These responses may, as in the case of CSWR, reflect response biases and therefore may lack strong validity. Nevertheless, these responses do provide a starting point on which further discussions can be developed with community members and decision-makers with respect to how best to proceed with the development of community-led sea turtle conservation strategies in this area. Once again, the trends reported here by respondents do correspond well with trends reported for many areas of the wider Caribbean where no strong conservation measures are in place.

VII.III.II Trends on the Beaches

Cuero y Salado Wildlife Refuge

When asked about historical trends of sighting turtles on the beaches now when compared with 5, 10, and 20 years ago, the majority of respondents in each case (65 %, 61 %, and 61 %, respectively) believed that they were sighting more turtles 5, 10 and 20 years ago than they are now. The percentages of respondents who believed there were either fewer or the same

number of turtles sighted on the beaches in the prior year categories as there are now, were small and essentially equal.

These reported trends are somewhat surprising, considering that only 51 % (25/49) of respondents reported ever seeing turtles on the beaches. Again, there may be some bias in answers provided by respondents in favor of negative outcomes from the communities in the Refuge. However, reporting that there are fewer turtles sighted today on the beaches of the Refuge when compared with 5, 10, and 20 years ago, may not be seen as favorable on the Refuge or the community. That trends for turtle sightings are negative may stem from anecdotes and awareness of conservation education, and the general perception that biodiversity in the region may be declining over recent times.

Utila and Los Cayitos

It appears from data we collected from survey participants, that there is a strongly held belief that the number of sightings of nesting turtles on the beaches of Utila and Los Cayitos is currently lower than it was 5, 10 and 20 years ago, although when asked to compare sightings on beaches 20 years ago with the present, the majority of respondents did not know if numbers were more or fewer 20 years ago. However, none of the respondents stated that there were fewer or the same number of sightings 20 years ago. Still, 30 % of respondents believe that they sighted more turtles nesting 20 years ago than they do now.

Once again, these data may reflect certain response biases, and may thus be difficult to correctly interpret. Still, these responses show correspondence with responses from community members interviewed at CSWR, as well as information gathered from Roatán in previous studies (Dunbar and Berube, 2008). These data can provide a backdrop for further discussions in developing conservation programs that take local beliefs and attitudes into consideration while developing strategies for strong conservation programs that aim to increase the numbers of turtles nesting in this area.

VII.IV Research Study

VII.IV.I In-Water Monitoring

Cuero y Salado Wildlife Refuge

We enlisted the help of fishers to undertake in-water monitoring data collection in late June, 2012. A total of 44 hours of in-water monitoring was logged. This activity built capacity with fishers, giving participants opportunities to diversify their source of income and develop new mechanisms for utilizing sea turtles as a live-value resource. In addition, at the end of the second period of study, fisherman mentioned that collecting in-water data on sea turtles made regular fishing activities more interesting. However, we were unable to engage fishers for in-water monitoring over the long-term, as the funds we were able to offer as supplementary income were not equivalent to their regular income from fishing. In addition, they were also engaged in other employment activities offered by other NGO's at the Refuge. The timing for these activities conflicted with daily in-water monitoring. Thus, we were only able to employ one fisher during limited and irregular times over 5 weeks. Nevertheless, the fisher we trained was able to sight 10 turtles during the monitoring period, resulting in a frequency of 0.23 turtles per hour effort.

According to the single fisher that worked with us on in-water monitoring, he sighted 8 Greens and 2 Hawksbills. Still, species specific data from fishers must be considered cautiously, since the fishers themselves admit that species confirmations at sea and during brief encounters with turtles at sea, are difficult and tenuous. Sightings of the 8 Greens reported were during mid-July, the last day of July and early August, whereas sighting of the 2 Hawksbills reported were both in early July. No sizes or sexes of sighted turtles were reported, so it is unclear if these turtles were adults or juveniles, or males or females, and therefore no conclusions can be drawn regarding whether these may have been resident or transient individuals.

One important consideration here is that according to interviewees, approximately five years ago there was considerable illegal fishing by shrimp fishers. Respondents stated that at that time, they recalled that several turtles had been captured in large shrimp trawl nets, along with many more species of marine life. Several studies (Dayton et al. 1995; Agardy 2000; Crowder et al. 2008) indicate that industrial shrimp fisheries may be highly destructive for marine resources and ecosystems. In addition, respondents mentioned that for five years it seems that this illegal activity has been controlled by the synergistic work of FUCSA, DIGEPESCA and the Honduras Navy. However, respondents continue to insist that there is the ongoing problem of large trammel and gillnets used in the area, causing major losses of marine resources.

Utila and Cayitos

We were unable to carry out in-water monitoring around Utila due to the expense of fuel, boat and captain hire, and other logistics. In-water monitoring could be undertaken by sport dive operators. However, this needs to be coordinated by someone who oversees the project throughout an entire year.

In the case of in-water sightings of turtles, while not all respondents were fishers, those that are involved with other professions also spend time on the sea during transportation to and from Los Cayitos and to other areas of Utila. It is therefore reasonable to assume that during transportation events, respondents have seen turtles at sea.

VII.IV.II Beach Monitoring

Cuero y Salado Wildlife Refuge

Preliminary beach monitoring from February to April over 29 km of beach and over 14.5 hours of activity did not result in any observations of nesting Hawksbills on the beaches of CSWR. However, on the evening of March 27, we encountered a female Leatherback (*D. coriacea*) completing nesting activities on the western sector of Salado Bar Beach between the community and Salado Bar. Once nesting had terminated, the turtle returned to the sea. The tracks were erased and the nest position was recorded (no GPS). The Refuge guards that accompanied us were asked to keep the location of the nest confidential for fear that the nest would be poached by local residents. Unfortunately, none of the project personnel were on site when the calculated hatching time occurred, thus, we have no confirmation that the eggs remained *in situ*, or that there was a successful hatching event. Upon return to the Refuge, the nest could no longer be located, and no excavation was undertaken.

Although interview respondents suggested that Leatherbacks nested on the beaches at CSWR, this is the first reported confirmation that *D. coriacea* do, in fact, nest along the beaches at the Refuge.

In terms of the nesting season, it is worth noting the relatively high percentage of responses (15 %; 12/79) in different communities who did not know what months comprised this season (see Fig. 49). This may be because these communities do not have commercial (financial) interests linked to egg harvesting. It appears that if nests are harvested, it is because community members happen upon the tracks left by nesting females and incidentally collect the eggs for non-commercial consumption. Our study suggests this is unusual because nesting turtles do not appear to be highly abundant in CSWR. This conclusion appears to be consistent with responses to questions of nesting turtle abundance in which 69 % (24/39) of respondents estimate that fewer than 10 turtles per year nest on the beaches identified as nesting areas (see Fig. 50). This mostly reflects the scarcity of turtles that come to nest, and the fact that people in these communities appear to be mostly unaware of the months in which turtles are reported to nest. This is perhaps because many of the respondents do not live next to the beach and are mainly involved with fishing activities. It is likely that reports of the presence of turtles on the beaches are anecdotal and subjective.

During the second phase of the project, ProTECTOR personnel monitored the East and West sectors of Salado Bar Beach over a total of 117 hours covering 245.5 km of beach from June 27 until August 26. However, during that time, we did not encounter a single nesting turtle (of any species), nor did we encounter adult or hatchling tracks either at night or during daytime beach profiling work.

Utila and Los Cayitos

We focused our beach monitoring efforts on Pumpkin Hill Beach, on which Dunbar and Ortega had previously confirmed nesting Hawksbills (unpublished data). Monitoring of this Beach began in early June, but was intensified at the start of July to maximize the potential of encountering nesting Hawksbills at the site. Graduate student, Lindsey Damazo was trained to apply Inconel (681 style) flipper tags following the Turtle Awareness and Protection Studies (TAPS) protocols for flipper tagging Hawksbills in the Bay Islands (Dunbar, et al., 2009), as well as how to affix satellite transmitters (Wildlife Computers Spot5) to turtles for satellite tracking. In all, five Hawksbill turtles were flipper tagged and two turtles were satellite tagged.

Flipper tagging efforts have already allowed us to identify multiple intra-nesting events of specific turtles at Pumpkin Hill, while satellite tracking has revealed, for the first time in the history of Honduras, where Hawksbill turtles nesting in the Bay Islands migrate after nesting. These data have opened up potential new areas of research, linking our turtles in Honduras to both Belize and Mexico. Further investigations will include population and genetic stock analyses of Honduran Hawksbills.

Our results from satellite tracking represent the first efforts to track the post-nesting migrations of any turtles in Caribbean Honduras. Although not fully analyzed, as yet, these results provide us with important data regarding migratory pathways of turtles from Honduras.

VII.V Beach Profiles

Cuero y Salado Wildlife Refuge

We collected data on beach slope angles from the high tide mark up to 20 m up on the beach with transects perpendicular to the tide line. We covered a distance of 3.5 km to the West (from Salado Bar to Ordiñon), and 4.5 km to the East (from Salado Bar to Zacate Bar). We found that in many locations, the slope angles of the beach are very high, whereas at other areas the slopes are essentially 0°. Thus, there is much variability in profile along the 8 km of beach in front of Salado Bar.

Utila and Los Cayitos

We surveyed the beach at Pumpkin Hill in detail for both beach profile and for characterization of beach vegetation. The beach profile data has yet to be analyzed and summarized. This will be done as part of the post-project analyses of the large data set of information gathered from this study. Beach vegetation data from Pumpkin Hill is also yet to be analyzed. We have dozens of digital photographs of the beach vegetation along the entirety of this beach and will be mapping the plant diversity and distribution on the beach in a GIS as part of the work undertaken by graduate student, Lindsey Damazo.

VII.VI Plastic Pollution

Cuero y Salado Wildlife Refuge

Although this study was only undertaken at one point in time, we observed more plastic in the eastern sector that is more influenced by the prevailing currents in the area than in the western sector. Currently, there are no regular programs that promote community beach clean-ups, and such programs may not be seen as necessary by community members, since there is relatively little plastic pollution on the large open coastal zone that comprises the CSWR, and because there are few turtles that utilize the area for nesting. However, interview respondents did recognize the threat of discarded nets, twine, and other waste materials to turtle survival, and so should be encouraged to develop a program of beach pollution collection.

A related issue is what to do with the collected material. In most cases, the plastic waste is simply burned in open fires around the community and near private homes (which are usually open to the resulting toxic chemical smoke). The problem of collected waste removal is of concerned, since there is no organized system of removal or recycling. This is a common problem in all coastal areas of the country. At this time, there is no solution to this enormous problem.

Utila and Los Cayitos

Beach pollution was partially analyzed by separating samples collected at Pumpkin Hill Beach into their constituent plastic types. We then weighed each type of plastic to find the proportion of the total sample that was made up of each plastic material type. These data are being further analyzed and future studies are being developed to investigate the influence of plastic pollution on nesting turtles and hatchlings.

The beach at Pumpkin Hill undergoes at least one annual beach clean-up by community members and school groups under the direction of BICA. A major beach clean-up is undertaken

immediately prior to the Hawksbill nesting season. Despite these efforts, the beach remained polluted with a wide variety of plastic litter, which is continually deposited on the beach due to high tides and storm surges. At present, we consider this to be an ongoing and growing problem in Utila, as well as the other coastal zones of Honduras.

VII.VII Education Outreach

Cuero y Salado Wildlife Refuge

We were able to carry out most of the educational outreach efforts that we proposed in CSWR. Initial meetings with community members allowed us to select interview respondents who provided a wealth of information regarding many aspects of turtle awareness and ecology. These respondents also allowed us to assess the attitudes of fishers and community members towards turtles at sea and on the beaches, at times revealing activities that are prohibited.

Outreach to school-aged children comprised several meetings that involved games and environmental education. Some of these events were organized in partnership with other organizations, yet facilitated opportunities to discuss aspects of sea turtle biology and ecology, and the importance of community-directed conservation efforts. As an additional step, we enlisted the assistance of young people to help with nightly beach monitoring and daily beach profiling activities (with full prior consent of the children's parents). These activities provided young people with opportunities to move beyond a theoretical knowledge of sea turtles to the realistic experiences of being involved with sea turtle conservation work. It is our belief that these experiences will stimulate young people to further engage in additional efforts to develop turtle conservation programs in the area of the Refuge.

Utila and Los Cayitos

Education outreach on Utila and Los Cayitos was mainly carried out through the project period by on-sight project partner, BICA. BICA has linked with other local NGO's on the island to undertake long-term environmental education at all levels of school education, as well as with private businesses on the island. These activities included beach clean-ups, talks and environmental camps for high school and elementary school-aged children, and workshops for community members and businesses.

Three workshops directly related to the study were conducted throughout the project period with two of these directed by project PI, Dunbar, and another facilitated by LLU/ProTECTOR graduate student, Lindsey Damazo. These workshops resulted in exposing volunteers to the ecology of sea turtles, as well as increasing awareness of the immediate threats to turtles at sea and on the nesting beaches. Specific activities were coordinated for BICA volunteers, as well as ProTECTOR Interns, to be directly involved with collecting field data on nesting Hawksbills, as well as on the nesting habitat at Pumpkin Hill Beach.

Continued education outreach includes public media outreach through television, radio, and newspaper. Although we gave interviews to the press during the presentations at CREDIA in March, 2012, none of the provided press releases were published. We are currently seeking

outlets that will publish continuing efforts by ProTECTOR and our partners for the conservation of sea turtles throughout the country.

VIII FINAL RECOMMENDATIONS

The completion of this study represents the first effort to formally collect and analyze data on sea turtles from both Cuero y Salado Wildlife Refuge and Utila Island. These areas are well recognized as protected areas managed by foundations and NGO's that are tasked with ensuring that some level of environmental protection takes place within these sites. However, in both cases, no prior work has been undertaken to evaluate local knowledge of sea turtle habits and threats, and no concerted and focused efforts toward the investigation and conservation of sea turtles has taken place. Thus, these study results provide important data that can be used to stimulate further research and conservation efforts in the Caribbean region of Honduras, and are hereby provided with the following recommendations:

1. Further international funding be secured to facilitate a national assessment for sea turtles along the Caribbean coast of Honduras. This is a primary and necessary step in determining areas of Caribbean Honduras in which to focus further conservation and research efforts. Although some assessment has previously been conducted by ProTECTOR (including the current study), these have been done on an *ad hoc* basis, rather than a systematic coverage of the region. The lack of systematic coverage has mainly been due to lack of sufficient funding and trained personnel. Therefore, we recommend a surge of international funding to support a national assessment for sea turtles in this region.

2. The Honduras government, through the Ministry of Environment (SERNA) and the Department of Biodiversity (DiBio), establish a realistic and viable commitment to the conservation of sea turtles in the country, by establishing policy measures that will ensure the protection of sea turtles throughout the country. At present, while there are many token gestures toward sea turtle conservation, the Central and regional governments have yet to adequately fund conservation efforts in the country, or provide assistance to organizations endeavoring to undertake research and develop conservation strategies in the region. This commitment should also take the form of assisting community organizations that are interested in sea turtle research and conservation, but must also include mechanisms for reducing corruption and abuse of powers at all levels of management.

3. A working group should be established within the country that develops policy recommendations that are then made to the agencies of the Central Government tasked with drafting policy for the protection and management of sea turtles in the country. Such a taskforce should be supported, in part, by the Central Government, but should remain wholly independent of government decision-makers. This taskforce should convene multiple times each year to bring together the latest data and knowledge on sea turtles and culminate in an annual draft of policy recommendations for the Central Government. Such a taskforce will also facilitate the training of new community and local government leaders and decision-makers that will better be equipped to understand the conservation needs of sea turtle populations in the region.

4. There should be a greater emphasis from both the Central Government of Honduras, and international funders on basic research that will inform conservation decision-making. While there is currently a strong emphasis by USFWS-MTCF on community-based conservation efforts, in areas such as Honduras, there is a general lack of basic research and information regarding region-specific sea turtle ecology and biology. Therefore, in Honduras, minor uncoordinated efforts at both the community and government levels are focused on sea turtle "conservation" without being adequately informed by research efforts, resulting in the allocation of scarce resources to entities that state they are undertaking conservation, but have little understanding of the species being conserved. Therefore, we recommend that both international funding agencies and the Honduran Central Government establish research on sea turtles and the ecosystems on which they depend, as a national priority.

5. A national strategic plan should be developed for coordinated national efforts toward sea turtle research, conservation, and educational outreach. At present, there is no coordinated strategy for detecting and assigning priority areas for research and conservation of sea turtles. In addition, no plan exists for increasing public awareness of the species of sea turtles in Honduran waters, their status, threats, and fates. A national strategic plan, based on a thorough national assessment, would provide the framework on which to develop sound management strategies, and measure progress toward specific management goals. Without such a plan, it will not be possible to determine if conservation efforts in the country are positively impacting sea turtle populations in the region.

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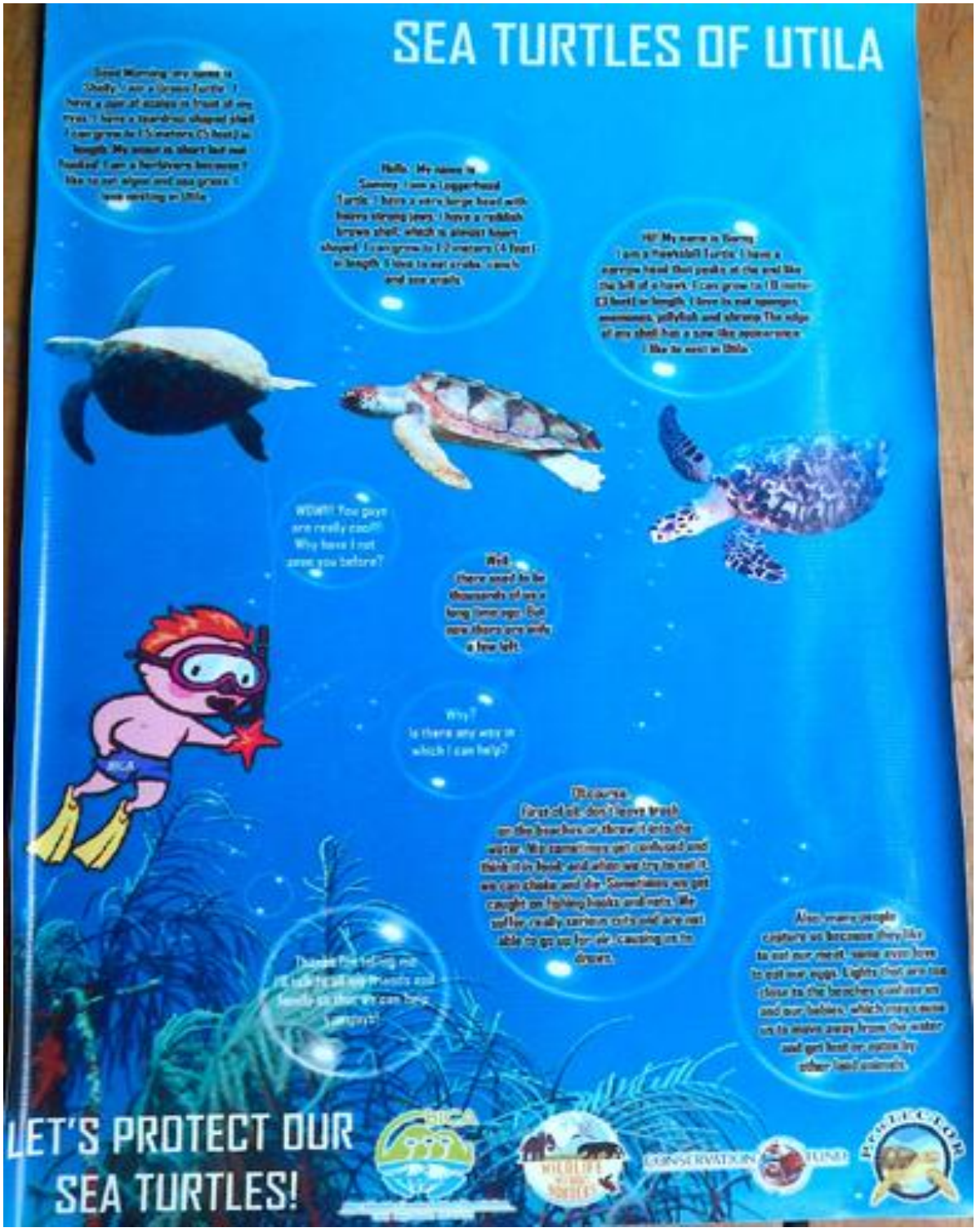
X APPENDICES

Appendix I

Posters of the ecosystems and species of the Cuero y Salado Wildlife Refuge


El Refugio de Vida Silvestre
Barras Cuero y Salado
Corredor Biológico del
Caribe Hondureño
Garza Tricolor
Egretta tricolor
Garza Tigre
Tigrisoma mexicanum
Tucan Pico de Navaja
Ramphastos sulphuratus
Mono Aullador
Alouatta pigra
Diversidad de Especies
La parte terrestre y fluvial del refugio alberga una gran diversidad de especies, dentro de las cuales han sido reportadas 184 especies de plantas (Nelson, 1991), 196 especies de aves (Thorn, 1991), 35 especies de mamíferos (Cerrato, 1991), 10 especies de anfibios, 47 especies de reptiles (Cruz, 1991), 53 familias de insectos (Martínez 2011) y 60 especies de peces asociados al río (Carrasco, 2010).
Estas especies están interrelacionadas de forma compleja y cada cual tiene un rol a desempeñar en los diferentes ecosistemas. Es por esto que la protección debe ser considerada de manera holística.
Queda mucho por investigar en la temática de la biodiversidad en el RVSBCS, poco se conoce por ejemplo sobre la diversidad marina de la zona. Además biodiversidad es una temática compleja, nuestra comprensión sobre su rol, las interrelaciones entre seres vivos debe todavía profundizarse. Por lo que es sumamente importante proteger y que no se destruya esta belleza que de manera general no conocemos y comprendemos aún.
Gavilan Pollero
Buteo magnirostris
Mono Cara Blanca
Cebus capucinos
Pizote
Nasua narica
Cryptoherus cutteri
Cocodrilo Americano
Crocodilus acutus
Tigrillo
Leopardus pardalis
Poecilia orri
Cubero Perro
Lutjanus jocu
Pargo gris
Lutjanus griseus
Manatí Antillano
Trichechus manatus manatus
Un tesoro por descubrir
CREDIA
El punto de encuentro natural
PROCORREDOR
SERNA
PROTECTOR
FALLS BROOK CENTRE

Posters of the sea turtle species of Utila



Posters publicizing sea turtle ambassadors

Appendix II

SURVEY ABOUT PRESENCE AND DISTRIBUTION OF MARINE TURTLES IN CUERO Y SALADO and UTILA

Date:_____ Community: _____ (GPS)N_____W_____

Interviewer _____

A. Informant data

1. Code Number_____2. Sex: M_____F____3.Age_____
4. Phone number_____5. Ocupation_____6. How long doing it?_____

B. Marine Turtles (MT) in waters (presence, distribution, behavior, seasonality, abundance and threats)

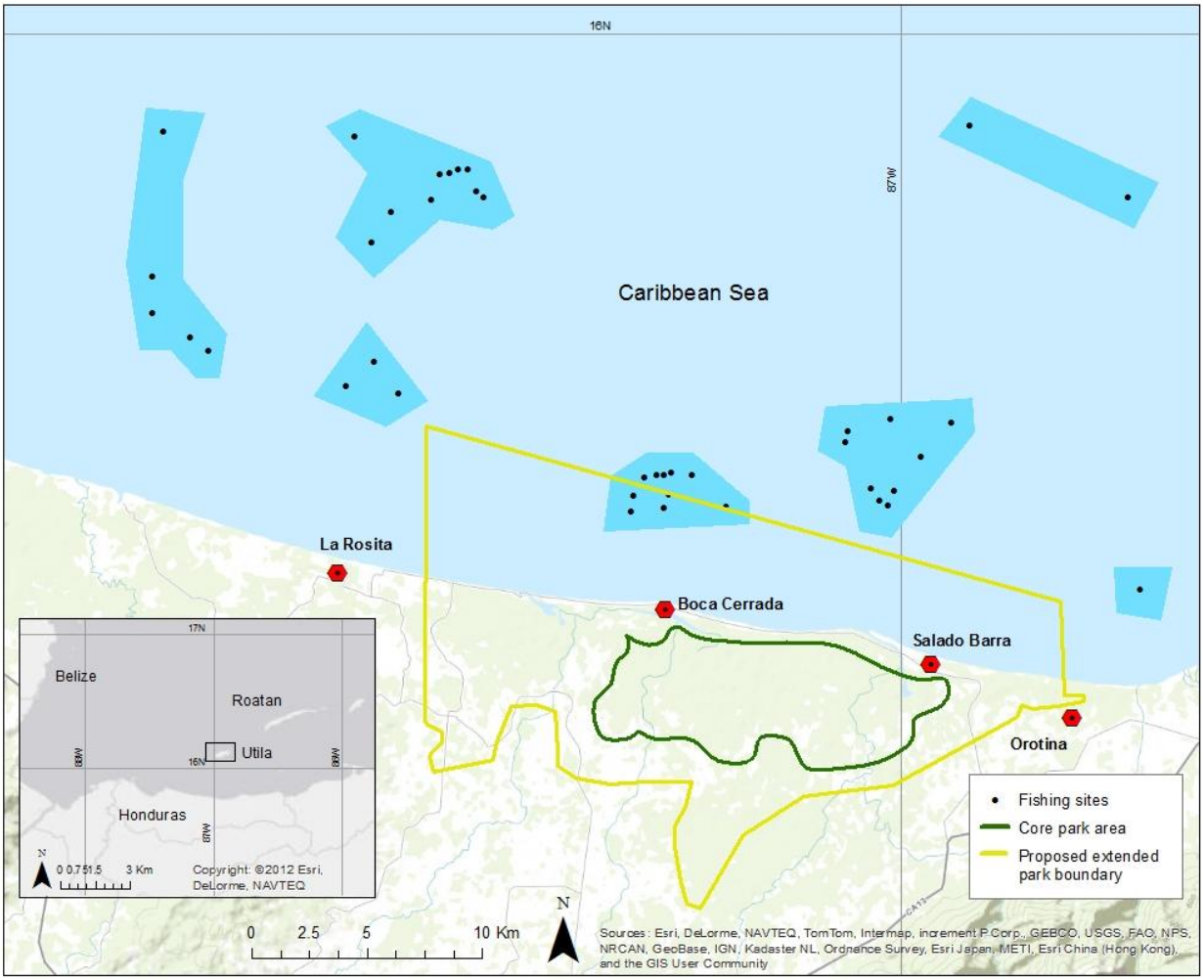
7. Have you seen marine turtles in the sea or/and the lagoons? Yes___No___ 8. Which ones? *Ei___Cc___Cm___Dc___*
(Show pictures and see which ones are correctly identified: Ei____Cc____Cm____Dc____)
9. In which area have you seen them by species? (Mark the area in the map, the habitat type and ask a brief description of the area)_____
_____
_____
10. Which estimated size (m) by species? _____
_____
_____
11. What do they do in these areas by species (feeding, breeding)? _____
_____
_____
12. In which month are they around these areas by species? _____
_____
_____
13. How often do you go fishing, per year?_____ 14. How often do you see MT when you go fishing?_____
15. When you fished here 5 years ago, were there more or less MT?_____16. 10 years ago?____17. 20 years ago?____
18. Were they in the same areas? Yes___No___ 19. If not which other ones (mark in the map)?_____
20. Which attitude do you have when you find a turtle in waters? Scared_____ Interrupt the MT ____ Kill the MT to eat it_____ Respect it _____Other_____
21. What kind of fishing nets do you use?_____
22. Are MT in the zone captured by any fishing art? Yes___No___ 23. Which arts?_____
_____
24. How often are turtles caught in nets? 0% _____25% _____50 % _____ 75% _____ 100 % _____
25. What do you do with MT once they are in the nets? Let go_____Eat_____Drown_____

C. Marine turtles in beaches (presence, distribution, seasonality, abundance and threats)

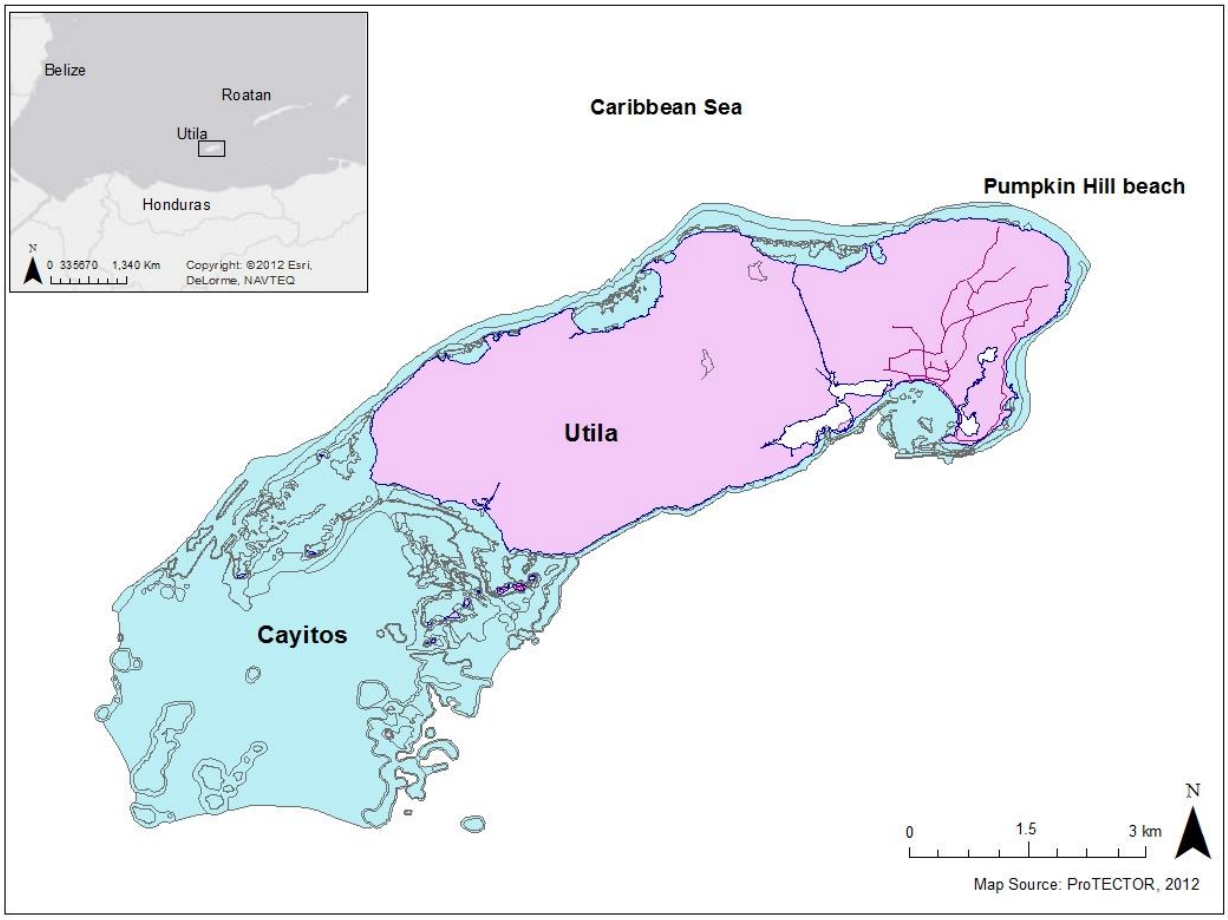
26. How many types of MT nest on beaches from your community?_____27. Which ones? *Ei____Cc____Cm___Dc___*
28. In which beaches they nest by species? (Localize them in the map) _____
_____
_____
29. In which month they nest by species? _____
_____
_____
30. How many MT by species nest per beach? _____
_____
_____
31. Which attitude do you have when you find a turtle in the beach? Scared____ Interrupt the MT ____ Kill the MT to eat it____Collect its eggs_____ Respect it _____ Other_____
32. About how many nests are looted? 0% _____25% _____50 % _____ 75% _____ 100 % _____
33. What is done in the community with the eggs collected? They are eaten_____They are sold_____Where?_____
34. 5 years ago, how many turtles nested in the beaches?_____35. 5 years ago?_____36. 10 years ago? _____
37. Which is the main threat to MT in the zone? _____

Appendix III
Maps of the Project Areas

A. *Cuero y Salado Wildlife Refuge*



B. Utila


Belize
Roatan
Utila
Honduras
N
0 335670 1,340 Km
Copyright: ©2012 Esri, DeLorme, NAVTEQ
Caribbean Sea
Pumpkin Hill beach
Utila
Cayitos
N
0
1.5
3 km
Map Source: ProTECTOR, 2012

Appendix IV
Protocols for Monitoring CSWR

Monitoring Protocol M1: Monitoring marine turtles at sea.

List of Equipment

- Monitoring Protocol M1 Data Sheets
- Pencils
- Watch
- GPS
- Replacement batteries
- Camera
- First Aid kit

Recommendations

• Plan out with the group of local fishermen, who collaborate with their time and shall make available to the boat. Present the advantages of establishing this collaboration.
• Organize to buy petrol ahead and remind fishermen commitment when the date approaches.
• Finding out whether the bar is open starting community.
• Learn about the sea state a day earlier.
• Exit preferably early in the morning when the sea is calmer.
• Perform this monitoring at least once each working community.
• Protect yourself from the sun.

Monitoring Protocol M2: Sightings of marine turtles at sea by trained fishermen.

List of Equipment

- Monitoring Protocol M1 Data Sheets
- Pencils
- Watch
- GPS
- Replacement batteries
- Camera
- First Aid kit

Recommendations

- Select a fisher that demonstrates competence in reading, writing, and basic mathematical skills in each community.
- Introduce the advantages of participating in the study.
- Provide detailed training in data collection and recording.
- Communicate regularly with each fisherman.
- Review data regularly and review the need for retraining and updating.

Monitoring Protocol M3: Monitoring for nesting turtles on the beaches.

List of Equipment

- 100 cm soft tape measure
- 60 m soft tape measure
- Measuring stick (for nest depth)
- GPS
- Data sheets (Nesting females and Tagging)
- Clipboard
- Pencils
- Razor Blade
- Sample vials
- Marker
- Flipper tags
- Tag Applicator
- Watch
- Two-way Radios
- Cell phone
- Flash light

Recommendations

- It is recommended to organize the appropriate number of groups, based on the number of beach zones that will be monitored.
- A specific monitoring distance should be selected for each beach zone that will be monitored.
- Monitoring coordinators should make every effort to work with the community and integrate interested young adults and students into the monitoring process.
- There should be enough monitoring coordinators that they are able to rotate patrol duties throughout the entire week, thus relieving a single individual from the work of monitoring on a nightly basis.
- Coordinators should be familiar with the beach and train monitors regarding sea turtle behavior during patrols. Training should be provided to all monitors and volunteers.
- Collection of information: monitors and volunteers should be trained to recognize turtle tracks. When a track or turtle is encountered, data should be collected on the data sheet marked M3.
- If the turtle is searching for a nesting location, all monitors and volunteers should be kept at a distance and trained to remain quiet. Once the female begins laying, data may be collected on the turtle and photographs of the egg laying process can be taken from behind, never in front, until the turtle has finished covering the nest.
- Flipper tag numbers should be recorded on the data sheet prior to application. A photograph should be taken of the data sheet prior to the flipper tag application. Flipper tagging should be done when the turtle has begun covering the nest. The turtle should carefully be restrained by those who have been trained to protect both the turtle and the monitors from harm. Flipper tagging may require up to 3 people. The person who will be

tagging should be wearing protective gloves and first prepare the tag, placing a small amount of Polysporin on the piercing tooth of the tag. The area of the flipper should be cleaned with Betadine. Tags are applied to the proximal scale on the trailing edge of the right front flipper. Once tagging has been completed, photographs should be taken of each side of the head, the dorsal surface of the head, and each tag, to keep a digital photographic record of each individual turtle.

- When the process has been completed, the nest location should be recorded through triangulation and GPS, and a brief evaluation of vegetation type and distance to the high tide mark should be recorded on the data sheet. Before leaving the nest, the tracks should be erased (if in an area where poaching occurs) to prevent poaching of the nest.
- If necessary (due to high poaching activity), nests should be relocated in less than an hour after nesting. Eggs should be counted and recorded, maintaining a data record link with the nesting female, nesting date and time, and the flipper tag number of the female. Nests are also associated with real GPS and triangulation points. Nests relocated to the nursery should be separated from one another by at least 1 m.

Data Sheet for Monitoring Protocol M3

Hoja de Datos para Playa de Anidación (Hembras)

Nombres del Apuntador y Asistente _____

Fecha (mm/dd/aa) __ __ / __ __ / __ __ **Hora de Postura (hh: mm)** __ __ : __ __

Nombre de la Playa _____ **Sector de la Playa**_____

Posición del Nido Lat/Long (GPS) _____

Turtle ID # (Site Code)_____ - 12

Especie **Lo** **Ei** **Cm** **Dc** **Cc**

Marcas:

NUMERO	**PRESENTE/APLICADA**	**POSITION**			**RETIRADA**	
_____	Presente/ Aplicada	Fi	Ti	Fd	Td	SI / NO
_____	Presente/ Aplicada	Fi	Ti	Fd	Td	SI / NO
_____	Presente/ Aplicada	Fi	Ti	Fd	Td	SI / NO
_____	Presente/ Aplicada	Fi	Ti	Fd	Td	SI / NO

CICATRICES DE MARCA Fi Ti Fd Td

Actividad de Anidación: ☐nido verdadero (postura) ☐intento de anidación (sin huevos)

☐regreso al mar sin intentar anidación (U-turn)

Destino del nido	□ Recolección para uso local/venta □Transferido a vivero Nido #_____
Profundidad del Nido (cm)	
Distancia del Nido al Agua (m)	
Habitat	□arena □hierba □vegetación
Número de huevos	
Número de huevos dañados	
Diámetro Huevos (mm) (10 huevos normales)	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____
Peso Huevos (g) (los mismos 10 huevos medidos arriba)	_____ _____ _____ _____ _____ _____ _____ _____ _____ _____
CCL n-n[2] (cm)	
CCL n-t[3] (cm)	
CCW[4] (cm)	
SCL n-n (cm)[5]	
SCL n-t (cm)	
SCW (cm)	

[2] Longitud Curva del Carapacho de hendidura a hendidura (notch to notch)
[3] Longitud Curva del Carapacho de hendidura frontal a punta trasera (notch to tip)
[4] Ancho Curvo del Carapacho. Tomar la medida mas ancha del animal.
[5] Longitud Recta del Carapacho (notch to notch: de hendidura a hendidura).

Fotos:

☐Cabeza dorsal ☐Cabeza derecha ☐Cabeza izquierda ☐Carapacho ☐Marcas aletas

☐Otras: _____
_____
_____
_____
_____

Muestras de tejido: SI/NO

Parte del Cuerpo:_____
Numero de muestras: _____
Vial #
_____ _____ _____ _____ _____

Muestras de sangre: SI/NO

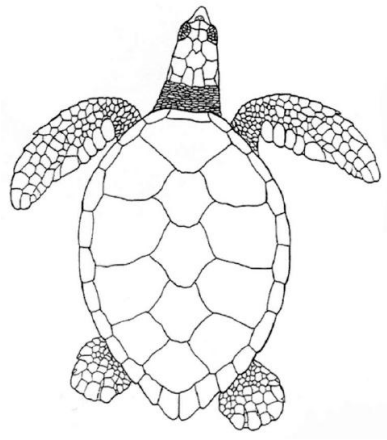
Parte del Cuerpo:_____
Numero de muestras: _____
Vial #
_____ _____ _____ _____ _____

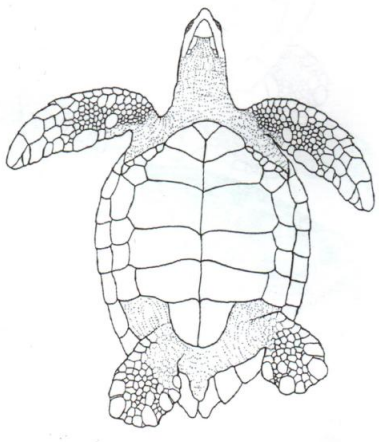
Datos ambientales:

Tiempo Atmosférico: _____
Estado del Mar: _____
Temperatura ambiental:_____
Temperatura del Agua: _____
Temperatura de la Arena:_____

Observaciones (Estado de salud general, parásitos, heridas, cicatrices, comportamiento, etc.) Describir cualquier herida, marca o rasgo peculiar y marcar su localización en los gráficos.

_____
_____
_____
_____
_____ _____





Director del Proyecto: Stephen G. Dunbar (ProTECTOR)
Coordinador del Proyecto: Lidia Salinas (ProTECTOR)

<u>Monitoring Protocol M4:</u> Monitoring for hatchling turtles on the beaches.

<u>List of Equipment</u>

- Monitoring Sheet M4
- 2 pencils
- Notepad
- Watch
- GPS
- Replacement Batteries
- Disinfectants and Wipes
- First Aid Kit

<u>Recommendations</u>

- This activity should be done in the evenings before sunset and the date should be chosen based on the information for each nest incubation period.
- This type of monitoring can be combined with nest monitoring but should also continue after the nesting season has ended.
- It is essential to count the number of hatchlings and their release date. Successful hatchings can then be used to stimulate participation in local conservation programs.
- The proportion of eggs that successfully hatch and the number of hatchlings that are safely returned to the sea should be recorded. Hatching success can be calculated by dividing the proportion of live hatchlings by the total number of hatched eggs, unhatched eggs, undeveloped eggs, infertile eggs, and those that hatched, but died in the nest.

Data Sheet for Monitoring Protocol M4

Fecha: _____ _____Número del nido: _____

Hora de Primer Emergencia: _____Hora de última emergencia: _____

Nombre de la playa: _____ Lat/Long (GPS): _____

Especie: _____# ID de la hembra: _____

Personas colectando datos: _____

Fecha del desove	
# Neonatos vivos	
# Huevos rotos	
# Huevos vivos	
# Huevos muertos	
# Neonatos muertos	
Comentarios adicionales	

Appendix V

List of Materials for the Rapid Description of the Beach

- GPS
- Note Pad
- Pencils
- Level
- PVC pipe with 1 m tape measure attached
- 60 m soft tape measure
- 1 m soft tape measure
- String
- Camera

List of Materials for the Detailed Description of the Beach

- 2 PVC tubes with integrated level
- String marked at 0 m, 5 m and 10 m points
- 1 PVC tube with attached level and attached 1 m tape measure
- Level
- GPS
- Note Pad
- Pencils
- 60 m soft tape measure
- 1 m soft tape measure
- Field balance
- Camera

Appendix VI
Substrate and Vegetation Types Encountered on Salado Bar Beach at Cuero y Salado Wildlife Refuge

Sand (S) y Grass (G)

Sea Grape (*Coccoloba uvifera*) (SG)

Beach Hícaco (*Chrysobalanus icaco*) (C. ica)

Euphorbia hyssopifolia (E. hys)

Croton punctatus (C. pun)

Ipomoea pes-caprae (I. pes)

Phyla nodiflora (P. nod)

U.V. (unidentified vegetation)

Dalbergia ecastaphyllum (D. eca)

Chamaecrista nictitans (C. nic)

Fimbristilis sp. (F. sp.)

Desmodium barbatus (D. bar)

Canavalia maritima (C. mar)