An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region

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WIDECAST Technical Report No. 6
2007

For bibliographic purposes this document should be cited as:

Dow, Wendy, Karen Eckert, Michael Palmer and Philip Kramer. 2007. An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy. WIDECAST Technical Report No. 6. Beaufort, North Carolina. 267 pages, plus electronic Appendices.

ISSN: 1930-3025

Cover photo: Kim Maison (Levera National Park, Grenada)

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WIDECAST
Wider Caribbean Sea Turtle Conservation Network

Wendy Dow
Karen Eckert

The Nature Conservancy
Protecting nature. Preserving life.

Michael Palmer
Philip Kramer

2007

Generously supported by:

Caribbean Environment Programme

Pegasus Foundation

U.S. Fish & Wildlife Service

Preface and Intent

For more than 25 years the Wider Caribbean Sea Turtle Conservation Network (WIDECAST), with Country Coordinators in more than 40 Caribbean nations and territories, has linked scientists, conservationists, natural resource users and managers, policy-makers, industry groups, educators, and other stakeholders together in a collective effort to develop a unified management framework, and to promote a region-wide capacity to design and implement scientifically sound sea turtle conservation programs.

As a Partner Organization of the UNEP Caribbean Environment Programme and its Regional Programme for Specially Protected Areas and Wildlife (SPAW), WIDECAST is designed to address research and management priorities at national and regional levels, both for sea turtles and for the habitats upon which they depend. We focus on bringing the best available science to bear on contemporary management and conservation issues, empowering stakeholders to make effective use of that science in the policy-making process, and providing an operational mechanism and a framework for cooperation at all levels, both within and among nations.

Network participants are committed to working collaboratively to develop their collective capacity to manage shared sea turtle populations. By bringing people together and encouraging inclusive management planning, WIDECAST is helping to ensure that utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term.

This Technical Report asks a deceptively simple question: *"Where do sea turtles nest in the Wider Caribbean Region?"* An accurate answer is critical to the recovery of depleted populations in that it relates directly to the setting of priorities for national and international conservation action, population monitoring and habitat protection, as well as larger issues of coastal zone management and land use policy. Taking advantage of modern spatial analysis methods, as well as the unique expertise (and patience) of more than 120 Caribbean Data Providers and other experts, we have created the first regional maps of the distribution and abundance of the annual reproductive effort for all six Caribbean-nesting sea turtles.

This landmark database – a collaborative effort between WIDECAST and The Nature Conservancy – identifies all known sea turtle nesting sites in the Wider Caribbean Region (inclusive of Bermuda and Brazil); 1,311 beaches in all. Because some sites host nesting by multiple species, 2,535 species-specific sites are named. In no case were data simply absorbed from other regional synthesis efforts. We traced each data point to its original source for verification and rating, discarding many existing records that did not meet our criteria. As a result, data characterized as "Low" quality comprise less than 11% of the database and improving information in these areas is an ongoing priority.

The database significantly expands our understanding of habitat use, while at the same time facilitates the creation of operational frameworks to census populations, monitor stock recovery, and safeguard habitat in ways that have not been possible before. The entire database, available for interactive uses, is accessible through OBIS-SEAMAP at http://seamap.env.duke.edu/ and at www.widecast.org. Our sincere gratitude is extended to the hundreds of colleagues (Data Providers and others) who made this project possible, and we hope it sets an example for other geographic regions to follow.

Karen L. Eckert, Ph.D.
Executive Director
WIDECAST

Acknowledgements

A regional assessment of this magnitude could not have been accomplished without the support and active participation of the Wider Caribbean Region's sea turtle researchers, conservationists, and marine managers. In-depth, collaborative data exercises like this one are possible in our region because of mutual trust and established partnerships among sea turtle workers, a reality defined and nurtured by the WIDECAST network for more than 25 years. The concept of a network is eloquently described by Meadows and colleagues in *Beyond the Limits* (1992), as "a web of connections among equals" held together not by force, obligation, material incentive, or social contract, "but rather shared values and the understanding that some tasks can be accomplished together that could never be accomplished separately." This database is a superb example of such an accomplishment.

We are deeply grateful to the more than 120 Data Providers in 43 nations and territories who participated in this project, generously offering both their time and their expertise, principal among them being the following:

Anguilla (GB): James Gumbs (Department of Fisheries and Marine Resources); **Antigua and Barbuda:** Cheryl Appleton and Tricia Lovell (Fisheries Division), James Richardson and Peri Mason (Jumby Bay Hawksbill Project); **Aruba (NL):** Richard van der Wal and Edith van der Wal (Turtugaruba Foundation); **Bahamas:** Eleanor Phillips (The Nature Conservancy), Alan Bolten and Karen Bjorndal (Archie Carr Center for Sea Turtle Research, University of Florida); **Barbados:** Julia Horrocks (Barbados Sea Turtle Project, University of the West Indies), Jennifer Beggs (Mote Marine Laboratory); **Belize:** Renison Enriquez (Glover Marine Research Reserve), Isaias Majil (Fisheries Department), Janet Gibson (Wildlife Conservation Society); **Bermuda (GB):** Jennifer Gray (Bermuda Turtle Project, Department of Conservation Services); **Bonaire (AN):** Kalli De Meyer (Dutch Caribbean Nature Alliance), Imre Esser and Mabel Nava (Sea Turtle Conservation Bonaire); **Brazil:** Maria Marcovaldi, Luciano Soares, Alexandro Santos, Cláudio Belllini, Augusto Cesar Coelho Dias da Silva, Gustave Lopez, João Carlos Thomé, Eron Paes e Lima, Antonio 'Tonim' de Papua Almeida (Fundaçao Pró-TAMAR); **British Virgin Islands (GB):** Bertrand Lettsome, Mervin Hastings and Shannon Gore (Conservation and Fisheries Department); **Cayman Islands (GB):** Gina Ebanks-Petrie, Janice Blumenthal and Joni Solomon (Dept. Environment); **Colombia:** Elizabeth Taylor and Zunilda Baldonado (CORALINA), Claudia Ceballos (Iowa State University) and Instituto de Investigaciones Marinas y Costeras (INVEMAR); **Costa Rica:** Didiher Chacón C. (WIDECAST), Caribbean Conservation Corporation, ASTOP, Estación Las Tortugas, Tortuga Feliz; **Cuba:** Félix Moncada G. (Programa de Tortugas Marinas, CIP), Julia Azanza Ricardo (Universidad de La Habana), Rubén Blanco (Ministerio de Ciencia, Tecnología y Medio Ambiente, Isla de la Juventud), Fernando Hernandez (Empresa Nacional para la Conservación de la Flora y Fauna); **Curaçao (AN):** Brian Leysner (Curaçao Underwater Park, CARMABI); **Dominica:** Seth Stapleton and Rowan Byrne (Rosalie Sea Turtle Initiative-RoSTI), Stephen Durand (Forestry, Wildlife and Parks Division); **Dominican Republic:** Yolanda León (Grupo Jaragua, Univ. Autónoma de Santo Domingo, INTEC), Jesus Tomas (University of Valencia); **French Guiana (FR):** Benoit de Thoisy (Association Kwata), Laurent Kelle (Coordinateur Océans/Côtes, WWF Guianas), Amana Nature Reserve, Association Kulalasi, Association Sépanguy; **Grenada:** Carl Lloyd and Rebecca King

(Ocean Spirits), Marina Fastigi (KIDO Foundation), Gregg Moore (Univ. New Hampshire); **Guadeloupe (FR):** Eric Delcroix (Réseau Tortues Marines Guadeloupe), Office National de Forêts, L'Association Titè, L'Association Kap'Natirel, L'Association Eco-Lambda, Conservatoire du Littoral, La commune de Terre-de-Haut, Office National de la Chasse et de la Faune Sauvage, L'Association Evasion Tropicale, Association Le Gaïac, Le Parc National; **Guatemala:** Colum Muccio (ARCAS), Anabella Barrios (RCA Guatemala), Ana Beatriz Rivas (Fundary Manabique), Wilma Katz (Coastal Wildlife Club, Florida); **Guyana:** Annette Arjoon and Michelle Kalamandeen (Guyana Marine Turtle Conservation Society), Peter C. H. Pritchard (Chelonian Research Institute); **Haiti:** Jean Wiener (Foundation pour la Protection de la Biodiversitie Marine); **Honduras:** Carlos Molinero (MOPAWI); **Jamaica:** Andrea Donaldson (National Environment and Planning Agency), Rhema Kerr Bjorkland (Center for Marine Conservation, Duke University); **Martinique (FR):** Sévérino Raigné and Jean-claude Nicolas (SEPANMAR), Claire Cayol (VCAT ONCFS Réseau Tortues Marines), KAWAN Association, AMEPAS, ONF, Mairie de SAINTE-ANNE, MAIRIE du DIAMANT; **México:** F. Alberto Abreu G. (Unidad Académica Mazatlán, UNAM), Vicente Guzmán Hernández (Dirección del Área de Protección de Flora y Fauna "Laguna de Términos" (CONANP), Ciudad del Carmen, Camp.), Eduardo Cuevas (Pronatura Península de Yucatán, A.C, Mérida, Yucatán), Laura Sarti and René Kantún (Comision Nacional de Areas Naturales Protegidas), Patrick Burchfield and Luis Jamie Peña (Gladys Porter Zoo), Augusto Segovia (Yucatán Environment Ministry), Alejandro Arenas, Iñaky Iturbe and Roberto Herrera (Flora Fauna y Cultura de México, A.C., El Colegio de la Frontera Sur), US Fish and Wildlife Service, NOAA National Marine Fisheries Service, Texas Parks and Wildlife Department, Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), Instituto Nacional de Pesca, Laguna de Términos Área de Protección de Flora y Fauna, Marea Azul, Ecología, Grupo Ecologista Quelonios A.C., Universidad Autónoma de Campeche, PEP-UPMP, La Universidad Autónoma del Carmen, Enlaces con tu Entorno, Ría Lagartos Reserva de la Biosfera, Centro Ecológico Akumal; **Montserrat (GB):** John Jeffers (Min. Agriculture, Trade and Environment); **Nicaragua:** Cynthia Lagueux and Cathi Campbell (Wildlife Conservation Society); **Panama:** Argelis Ruiz (Smithsonian Tropical Research Inst.), Anne Meylan (Florida Fish and Wildlife Conservation Commission); **Puerto Rico (US):** Carlos Diez and Hector Horta (Dept. Natural and Environmental Resources), Lesbia Montero (Univ. Puerto Rico Sea Grant Program); **Saba (AN):** Jan den Dulk and Susan Hurrell (Saba Marine Park); **Sint Maarten (AN):** Andy Caballero, Dominique Vissenberg and Beverly Nisbeth (Nature Foundation of Sint Maarten); **Sint Eustatius (AN):** Nicole Esteban and Arturo Herrera (St. Eustatius National and Marine Parks), Emma Harrison (Caribbean Conservation Corporation); **St. Kitts and Nevis:** Emile Pemberton (Department of Fisheries), Kimberly Stewart (Ross University), Kate Orchard (St. Christopher Heritage Society); **St. Lucia:** Dawn Pierre-Nathoniel (Department of Fisheries); **St. Vincent and the Grenadines:** Lucine Edwards (Fisheries Division); **Suriname:** Maartje Hilterman (IUCN National Committee of the Netherlands), Edo Goverse (Universiteit van Amsterdam), Marie-Louise Felix (WWF Marine Turtle Program Office - Guianas); **Trinidad and Tobago:** Dennis Sammy (Nature Seekers), Tanya Clovis (SOS Tobago), Stephen Poon (Wildlife Section-Forestry Div.), Scott Eckert (WIDECAST), Suzanne Livingstone (IUCN Global Marine Species Assessment Programme); **Turks and Caicos (GB):** Judith Garland-Campbell (Ministry of Natural Resources), Michelle Fulford-Gardiner (Dept. Environment and Coastal Resources), Lorna Slade (Providenciales Marine Turtle Monitoring Project); **USA:** Barbara Schroeder (NOAA National Marine Fisheries Service), Sandra MacPherson (US Fish and Wildlife Service), Anne Meylan (Florida Fish and Wildlife Conservation Commission), Donna Shaver (NPS Padre Island National Seashore), Jerome Phillips (Bon Secour National Wildlife Refuge); **United States Virgin Islands (US):** Rafe Boulon (NPS Virgin Islands National Park), Steve Garner (WIMARCS), Raquel Seybert (The Nature Conservancy), Amy Mackay (St. Croix Marine Turtle Conservation Project), Zandy Hillis (US National Park Service); **Venezuela:** Hedelvy J. Guada (CICTMAR), Vicente Vera (Ministry of Environment).

These data and their assembled results and significance remain the property of the Data Providers who, in collaboration with staff, volunteers and supporters, are the sole reason these maps could be produced and shared for the benefit of us all. For further information, including Data Use Agreements, please contact the Data Provider(s) directly. Contact information is provided in Appendix I of this Technical Report and is also available through the database host, OBIS-SEAMAP, at http://seamap.env.duke.edu/.

Finally, no progress would have been made without generous and timely financial support from The Nature Conservancy's Caribbean Marine Program, Pegasus Foundation, U.S. Fish and Wildlife Service's *Marine Turtle Conservation Fund*, and the UNEP-CEP Regional Programme for Specially Protected Areas and Wildlife (SPAW), enabled by a grant from the U.S. Department of State (Bureau of Oceans and International Environmental and Scientific Affairs). World Wildlife Fund (Latin America and Caribbean Program) supported the development of electronic appendices and online availability. We are also grateful for the expertise and partnership of Duke University's OBIS-SEAMAP (Ocean Biogeographic Information System – Spatial Ecological Analysis of Megavertebrate Populations) program, which serves as the database host.

Monitoring leatherback sea turtle populations at **Querepare Beach, Venezuela** (*photo by* Mariana Malaver) and **Matura Beach, Trinidad** (*photo by* Scott A. Eckert); and Kemp's ridleys at **Rancho Nuevo, Mexico** (photo by Jaime Pena)

Executive Summary

Six species of sea turtle nest in the Wider Caribbean Region (WCR). In partnership with more than 120 Data Providers, the spatial database of nesting habitat herein assembled is the most comprehensive for any region of the world, with 1,311 nesting beaches identified in 43 WCR nations and territories, inclusive of Bermuda to the north and Brazil to the south. Because some sites host nesting by multiple species, 2,535 species-specific sites are named. Of these, 77% are categorized in terms of abundance: <25, 25-100, 100-500, 500-1,000, or >1,000 nesting crawls per year. Hawksbill and green turtles are the least known, with 33% and 24%, respectively, of all known nesting sites associated with unknown crawl abundances.

Large nesting colonies are rare. Nesting grounds receiving more than 1,000 crawls per year range from 0.4% (hawksbill) to 7.0% (Kemp's ridley) of all known species-specific sites. For any species, roughly half of all known nesting sites support fewer than 25 crawls (fewer than 10 reproductively active females) per year. While some nations are making exemplary progress in identifying and monitoring nesting stocks, consistent sea turtle population monitoring effort is still lacking in most areas and recent data are scarce in some jurisdictions; two archipelagic States (Bahamas, St. Vincent and the Grenadines) and Hispaniola (Dominican Republic, Haiti) have never been completely assessed.

The regulatory landscape is fragmented. Thirty (69.8%) nations and territories prohibit sea turtle exploitation year-around: 29 of 43 jurisdictions mandate indefinite protection (eight of these allow exemptions for 'traditional' exploitation), while Anguilla has adopted a moratorium set to expire in 2020. With the exception of the Cayman Islands, legal sea turtle fisheries are based on minimum size limits (by weight or shell length), targeting large juveniles and adults in contradistinction to the best available science on management and recovery.

Threats matrices characterizing a range of risk factors, including those that result in the loss or degradation of critical habitat, reveal that beach erosion, nest loss to predators or physical factors, artificial beachfront lighting, direct exploitation of turtles and eggs, and pollution threaten the survival of sea turtles at their nesting grounds in more than 75% of all WCR nations and territories. With regard to factors potentially hindering population recovery at foraging grounds, more than 75% of Caribbean nations and territories cite pollution, fisheries bycatch, entanglement, coral reef and/or seagrass degradation, and losses to hunters, poachers and natural predators as threatening the survival of sea turtles at sea.

The data collected and assembled will allow for further research and analysis of sea turtle abundance (including population trends at index sites) and habitat use; for example, in conjunction with other datasets to determine areas of high biodiversity or areas in need of urgent protection. The database, archived and displayed online by OBIS-SEAMAP (http://seamap.env.duke.edu/), will be updated regularly and used to establish conservation and management priorities, and to inform and improve policy at national and regional levels. Future goals of the project are to research and incorporate seagrass and coral reef data to determine nationally and regionally significant foraging areas, thus identifying marine areas in need of management attention and contributing to the development of a network of population monitoring programs, including juvenile and adult age classes, at index sites.

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Introduction

Sea turtles are late-maturing and long-lived, and are among the most migratory of all Caribbean fauna. Threats accumulate over long periods of time and can occur anywhere in a population's range; thus population declines have typically resulted from a combination of factors, both domestic and foreign. In addition to centuries of largely unmanaged and unsustainable exploitation, sea turtles are accidentally captured in active or abandoned fishing gear, resulting in death to some tens (and perhaps hundreds) of thousands of turtles annually. Moreover, reef and seagrass degradation, oil spills, chemical waste, persistent plastic and other marine debris, high density coastal development, and an increase in ocean-based tourism have damaged or eliminated many Caribbean nesting beaches and feeding grounds.

Six sea turtle species are indigenous to the Wider Caribbean Region (WCR).[1] All are classified by the World Conservation Union as "Endangered" or "Critically Endangered" (IUCN 2004). All six species are listed on Annex II (full protection) of the Protocol concerning Specially Protected Areas and Wildlife (SPAW Protocol) to the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention); Appendix I (full protection) of the Convention on Migratory Species (CMS); Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); and, most recently, recognized as being in need of "protection, conservation and recovery" throughout the hemisphere by the Inter-American Convention for the Protection and Conservation of Sea Turtles (Hykle 1999, Wold 2002).

In general, and notwithstanding welcome signs of population increase at some protected nesting grounds (*Leatherback*: Dutton et al. 2005, *Green Turtle*: Troëng and Rankin 2005; *Hawksbill*: Krueger et al. 2003, Richardson et al. 2004, Diez and van Dam, Chelonia Inc., unpubl. data; *Kemp's Ridley*: Márquez et al. 1999), sea turtle populations throughout the WCR are so severely reduced from historical levels (Carr 1955, Parsons 1962, Rebel 1974, King 1982, Groombridge and Luxmoore 1989, Ross et al. 1989, Reichart 1993, Jackson 1997, Meylan and Donnelly 1999, Fleming 2001, Bjorndal and Bolten 2003, Godley et al. 2004, Bräutigam and Eckert 2006) as to be considered by Bjorndal and Jackson (2003) "virtually extinct" from the standpoint of their role in Caribbean marine ecosystems. Once considered inexhaustible, some of the largest nesting colonies in the hemisphere, including those of green turtles in the Cayman Islands (Lewis 1940, Aiken et al. 2001) and hawksbill turtles in Chiriquí, Panama (Carr 1956, Meylan 1999), have all but vanished.

Intergovernmental meetings devoted to addressing shared management concerns have been convening in the region for more than two decades (e.g. Bacon et al. 1984, Ogren 1989, Eckert and Abreu Grobois 2001, IUCN 2002). In November 1999, resource managers and scientists

[1] The Wider Caribbean Region (see Figure 1) is defined as comprising the States and territories of the insular Caribbean (including the Bahamas), the north-eastern sector of South America (Colombia, Venezuela, the Guianas), Central America, Mexico and the USA to 30ºN latitude, including the waters of the Caribbean Sea, the Gulf of Mexico, and the Atlantic Ocean adjacent to these States and territories (UNEP 1983). Because of shared sea turtle stocks, WIDECAST (and thus this report) also embraces Bermuda to the north and Brazil to the south (Frazer 1985).

from 29 WCR nations and territories met in the Dominican Republic and unanimously recommended that "appropriate authorities, organizations, civic groups and other stakeholders promote scientific research, assessment and monitoring of marine turtles and their habitats, and standardize methods of data collection and analysis." To this end, delegates agreed *inter alia* on the need to "identify (locate), characterize, and rank (as to intensity of use and importance for management) marine turtle nesting and foraging sites", and to "identify, evaluate and rank threats to marine turtles and their habitats – both domestic and, to the extent practicable, throughout their ranges" (*Santo Domingo Declaration*: Eckert and Abreu Grobois 2001: *vi, viii*).

The fundamental need to identify habitat necessary for the survival of the region's sea turtles has long been recognized, yet the coastal zone remains one of the least protected environments in the region and unchecked shoreline development is a serious obstacle to sea turtle conservation in many areas. Emphasizing local partnerships and data-sharing opportunities enabled by the WIDECAST network, and taking advantage of modern spatial analysis methods, we have developed the region's first digital landscape of sea turtle nesting beaches. The landscape and supporting databases identify, characterize and rank sites based on only the most up-to-date information, including an exhaustive literature search and nearly two years of intensive collaboration with more than 120 Data Providers in 43 nations and territories.

In addition to unobstructed sandy beaches for egg-laying, sea turtles need healthy coral reef, seagrass and hard-bottom habitats for food and refuge, as well as safe passage through complex migratory corridors. These habitats are also at risk, mainly due to intense pressures arising from changes in water quality, patterns of coastal development and land use, and fisheries and other extractive industries (e.g. UNEP 1989, 2005, Sullivan Sealey and Bustamante 1999, Eckert and Abreu Grobois 2001, Fleming 2001, Godley et al. 2004, UNEP/GPA/CATHALAC 2004, Bräutigam and Eckert 2006, UNEP/GPA 2006). Notwithstanding, quantitative data on the status and distribution of marine habitat types are scarce, presenting a significant gap in the management framework of endangered species, such as sea turtles, that rely on them.

With an aim to definitively "identify, characterize, and rank" nesting habitat across this large region, and to lay the groundwork for doing the same with foraging habitat, we have developed National Reports, including maps and constituent data, for each of 43 countries and territories in the WCR (see Appendix III). These National Reports are also inventoried and available for public access at www.widecast.org, as well as in an interactive format at Duke University's OBIS-SEAMAP (Ocean Biogeographic Information System – Spatial Ecological Analysis of Megavertebrate Populations, Halpin et al. 2006) website: http:// seamap.env.duke.edu/.

Goals and Objectives

Recognizing that depleted and/or declining sea turtle stocks are in need of management and conservation attention is one thing; reversing population declines and monitoring sustained population recovery is another. Because sea turtles are highly migratory during all life history stages, they rely on critical habitats in many nations and territories for dispersal, forage, refuge, mating, migration, and nesting. Consequently, what appears as a decline or a recovery in a local population may be a direct consequence of the activities of people living hundreds or

thousands of kilometers away – so that effective management must occur cooperatively and collaboratively across range States.

Information gaps at local, national and regional levels can have significant consequences to management policy and conservation success at all levels. Chief among these gaps has been reliable and updated information concerning the location and status of critical habitat, as well as the distribution and abundance of the annual breeding effort. In the absence of such information, inter-jurisdictional collaboration in the conservation of shared sea turtle stocks – including attempts to cooperatively monitor the success of conservation actions by evaluating, in an integrated way, population trends at regionally important sites – is hindered.

Seeking to address key recommendations of the *Santo Domingo Declaration* (Eckert and Abreu Grobois 2001) and to promote the survival of Caribbean sea turtles by increasing our understanding of population abundance and habitat use, the objectives of this study were to:

- Generate the first standardized and geographically comprehensive spatial database of active sea turtle nesting beaches in the central western Atlantic Ocean;

- Inform policy-making regarding the protection of critical habitat, in particular nesting habitat, by making population and spatial databases, including information on contemporary threats to sea turtle survival, publicly available in print and electronic formats;

- Contribute essential species and habitat data to the ecoregional planning processes of international organizations and intergovernmental entities; and

- Promote implementation of regional agreements that protect sea turtles and their habitat: Convention for the Protection and Development of the Wider Caribbean Region, and the Inter-American Convention for the Protection and Conservation of Sea Turtles.

Methods

We utilized data from several different sources to generate the database. The primary sources of information were bilingual (English, Spanish) questionnaires completed by professional sea turtle researchers, government officials, conservationists, and informed community leaders in 43 nations and territories.[2]

The questionnaire was circulated to WIDECAST Country Coordinators and other potential Data Providers by WIDECAST and The Nature Conservancy (TNC) Caribbean Marine Programme Office in 2002, and then re-circulated to capture updated information in May 2006. The ques-

[2] Nesting sites were not documented north of 30°N latitude, the northern boundary of the Wider Caribbean Region (UNEP 1983), meaning that, in the case of USA, nesting north of Florida was not included for any species. Loggerhead turtle, *Caretta caretta*, nests deposited north of Florida comprise less than 10% of the nation's nesting each year (NOAA and FWS 2007a); nesting by other species north of Florida ranges from extremely rare to occasional.

tionnaire asked the Data Provider to identify (name) the nesting beaches for each species of sea turtle known to nest in the country, the location and length of those nesting beaches, the number of nesting crawls (binned to 'X' [unknown abundance], <25, 25-100, 100-500, 500-1000 and >1000) made by each species per nesting beach per year,[3] and the extent to which the nesting beach is monitored for sea turtle egg-laying and/or hatching activity.

Nesting sites for the purposes of this analysis are defined as operational management units, rather than strict geographic entities. The reason for this is that nesting sites are defined and monitored differently in different locations. Sometimes small beaches, proximal but physically separated, are viewed as a single "nesting beach" or management unit. Conversely, extensive beach strands, extending hundreds of kilometers in some cases, are oftentimes segmented (e.g. because of limited human resources or the logistics of beach access) for the purpose of monitoring and management. In the former case multiple, typically small, habitats might be coalesced; in the latter case, extensive shorelines might be divided. We worked closely with Data Providers to be as consistent, as realistic, and as accurate as possible in every case.

To ensure a comparable landscape we focused on a binned average of nesting crawls per year – namely, fewer than 25 crawls per year, on average; 25 to 100 crawls per year, on average; and so on. Not all sea turtle population monitoring efforts differentiate between successful and unsuccessful nesting, so standardizing on "crawls" (embracing both successful egg-laying and failed attempts) ensured that all countries could participate in a region-wide assessment. Moreover, we did not want to impose on Data Providers for proprietary details on exactly how many nests are laid each year, knowing that in many cases these carefully collected numbers are more suitable for peer-reviewed publication.

> *Important note*: Depending on location, the number of nesting crawls may be 2 to 10 times higher than the number of actual nests. The number of these nests may, in turn, be 2 to 10 times higher than the number of individual females. Therefore, the number of crawls is a baseline metric not to be confused with the number of clutches laid, nor with the always much smaller number of reproductively active individuals.

We compiled a list of governmental and non-governmental Data Providers, including WIDECAST Country Coordinators and other experts (see Appendix I), developed a relationship with each Data Provider, and kept in close contact with Data Providers in order to assemble the best available information during the project timeline. In addition to estimating annual crawl abundance, we asked each Data Provider to provide new (or verify existing) information about sea turtle status, protection policies, and nesting and foraging threats within the jurisdiction of their nation or territory. We telephoned each Data Provider in early June 2006 to collect detailed information about sea turtle threats and to answer any remaining questions. Those who could not be contacted by telephone received a standardized survey (see Appendix II) by mail or e-mail.

We encouraged Data Providers to supply geographic coordinates for nesting beaches. When these data were not available, we located nesting beaches from national maps or other sources. Data from all sources were compiled and annotated in a single Excel™ file with a separate worksheet for each country or territory. Finally, a thorough literature review was conducted to compile nesting site location information and analyze data from peer-reviewed literature, project reports, national recovery plans, regional assessments, and unpublished manuscripts.

[3] The project focused on nesting crawls, including both successful and unsuccessful nesting attempts, as the common metric to characterize habitat use and estimate population size.

The spatial organization of the data follows the concept of "Ecoregions" as defined by The Nature Conservancy (cf. Spalding et al. 2007) (Figure 1). For each country and territory the dataset includes nesting site data (beach name, latitude and longitude, approximate length, number of crawls for each species present, activity status [confirming that the nesting beach is currently active; historical nesting beaches no longer in use were excluded], beach monitoring status [confirming whether nesting activity is recorded daily, weekly, irregularly, etc.], and the time period over which the data were collected), Data Provider information, detailed notes on data points, and references for sources of data other than the primary Data Providers.

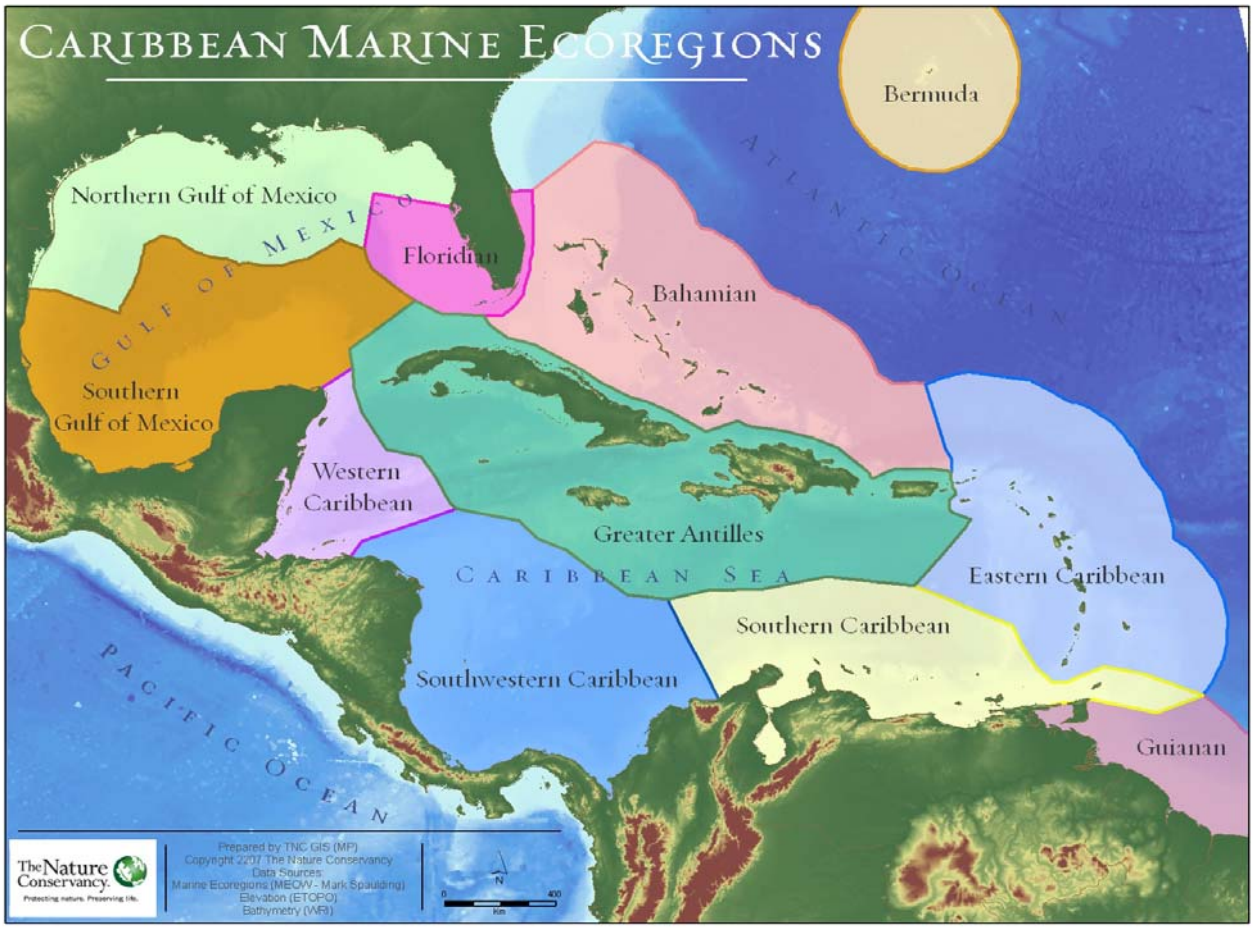


Figure 1. Caribbean Marine Ecoregions (adapted from Spalding et al. 2007).

Each data point was given a confidence rating of High, Moderate or Low. A High rating was assigned to data received and verified directly from WIDECAST Country Coordinators, active researchers, or other local experts, and to datasets derived from peer-reviewed published literature or published project reports less than 10 years old. A Moderate rating was assigned to datasets for which we were not personally familiar with the data source or how the data were collected, as well as to datasets 10 to 20 years old. A Low rating was given to datasets derived from non-expert or opportunistic observations, and to datasets more than 20 years old. In this way we were able to include the most recent nesting data available, while also identifying areas characterized by outdated information that would benefit from population monitoring efforts.

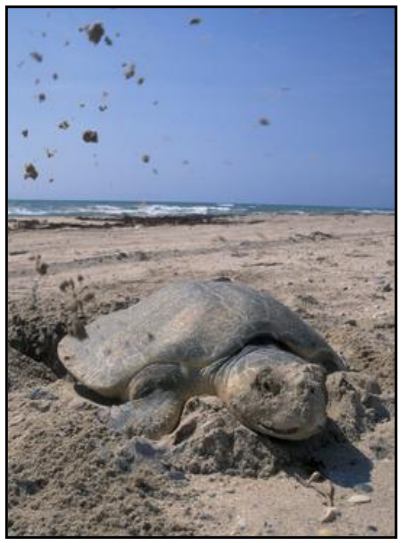
Data for individual countries and territories were combined to generate regional point and line shapefiles for nesting habitat using ESRI ArcGIS™ version 9.1. Point shapefiles were generated using latitude and longitude coordinates for each nesting beach. When locations were known, such as from GPS-based studies, these latitudes and longitudes were used. When locations were not known, they were estimated with the assistance of Data Providers and local maps. Nesting site coordinates should be considered approximate, as beach boundaries may change within and between years. Coordinates are located at the approximate midpoint of each beach. Line shapefiles were created using nesting beach start and end coordinates, generating a box around the beach, and clipping the beach from the GSHHS (Global, Self-consistent, Hierarchical, High-Resolution Shoreline) (Wessel and Smith 1996) shoreline shapefile. The GSHHS shoreline shapefile has varying resolution depending on geographic location, as it was generated by combining data in the World Data Bank (resolutions between 500-5000m) and the World Vector Shoreline (resolutions between 50-500m) (Wessel and Smith 1996). All shapefiles are projected using the World Geodetic System, Datum 1984 and are in units of decimal degrees.

Inevitably more information was available for some countries than for others. Supplemental data were often collected through literature reviews, but in some cases (e.g. Haiti, St. Vincent and the Grenadines) relevant data are extremely scarce from any source. Supplemental data were also collected through literature reviews to complete the protection policies and threats matrices when a full suite of information was not available from local Data Providers.

After assembling and organizing all available data, draft maps, reports and database tables were closely reviewed by the Data Providers. Each National Report (see Appendix III) features maps of all known sea turtle nesting sites, including species-specific landscapes (historical nesting beaches are not included if nesting no longer occurs), and tables representing sea turtle status, protection policies, and contemporary threats to nesting and foraging turtles and habitat.

National Reports (and summary tables) are organized by Ecoregion (TNC 2003, Spalding et al. 2007) and presented as follows: Bahamian, Greater Antilles, Eastern Caribbean, Guianan, Southern Caribbean, Southwestern Caribbean, Western Caribbean, Southern Gulf of Mexico, Northern Gulf of Mexico, and Floridian, followed by Bermuda and Brazil. Uniquely coded Beach Identification Numbers correspond to the underlying database compiled for each country.

Monitoring green turtles on **Mona Island, Puerto Rico** (*photo by* Scott Eckert, WIDECAST), Kemp's ridley turtles at **Padre Island National Seashore, USA** (*photo by* Jaime Pena, GPZ), and hawksbill turtles at **Carriacou, Grenada** *(photo by* KIDO Foundation).


Results

Species Distribution: Summary of Findings

The assessment involved nearly two years of collaboration with more than 120 Data Providers and local experts, resulting in a digital inventory of all known sea turtle nesting sites, including geographic location, colony size, the degree of legal protection afforded nesting females and their young, and contemporary threats to population survival. Six species nest seasonally on the continental and island shorelines of the WCR (Table 1). Hawksbills and green turtles nest in virtually every country, followed by leatherbacks, loggerheads, olive ridleys and Kemp's ridleys, the latter restricted to nesting sites in the USA and Mexico. In total, 1,311 discrete nesting sites are identified in 43 countries and territories extending from Bermuda, a British Overseas Territory in the North Atlantic, south to Brazil (Figure 2). Because discrete sites are sometimes associated with multiple species, Table 2 reflects a total of 2,535 species-specific nesting sites.

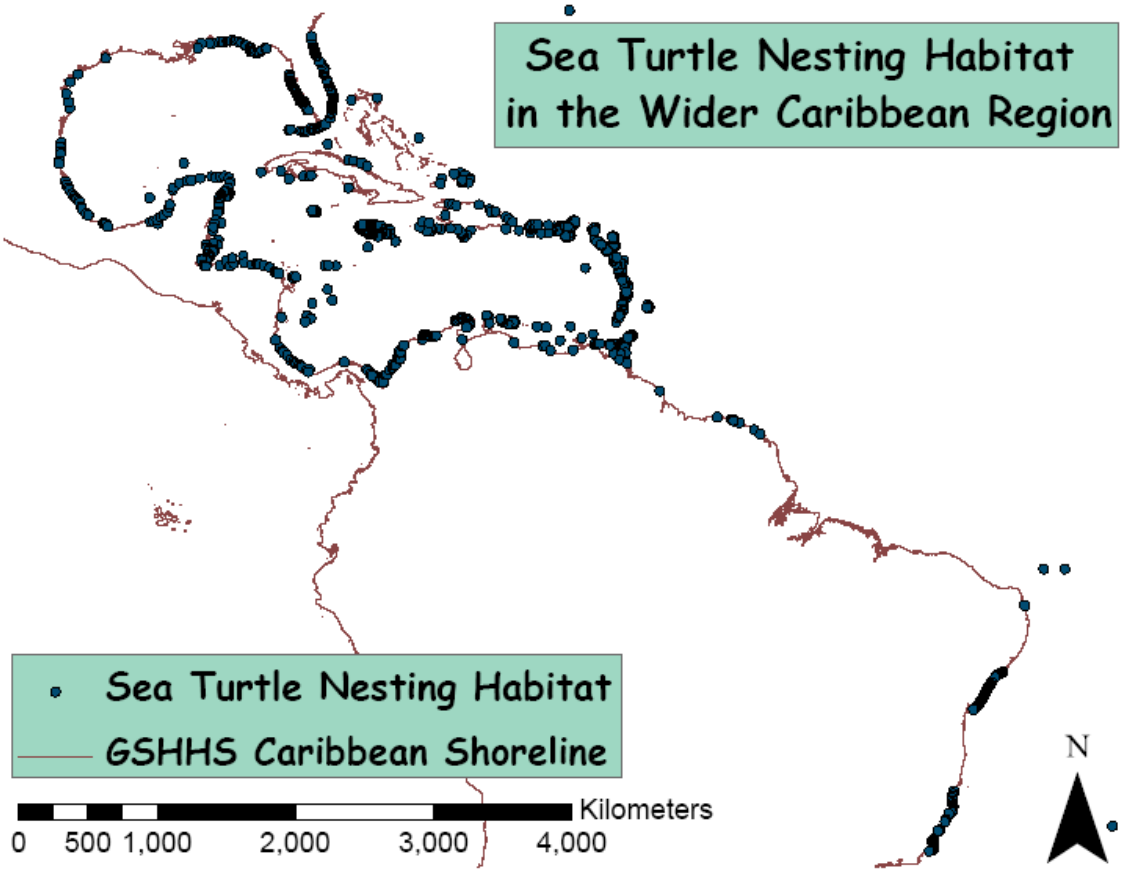


Figure 2. Sea turtles nest seasonally at 1,311 sites in 43 countries and territories of the Wider Caribbean Region, and including Bermuda and Brazil.

Table 1. Presence of sea turtles in the Wider Caribbean Region.

Marine Ecoregions with Countries/Territories	Loggerhead Turtle *Caretta caretta*	Green Turtle *Chelonia mydas*	Leatherback Turtle *Dermochelys coriacea*	Hawksbill Turtle *Eretmochelys imbricata*	Kemp's Ridley Turtle *Lepidochelys kempii*	Olive Ridley Turtle *Lepidochelys olivacea*
Bahamian						
Bahamas	N, F	N, F	N	N, F	A	I
Turks & Caicos Islands (GB)	N, IF	N, F	I	N, F	A?	A?
Greater Antilles						
Cuba	N, F	N, F	IN, IF	N, F	A	I
Cayman Islands (GB)	N, IF	N, F	A	F	A	A
Jamaica	N, IF	N, F	N	N, F	A?	A
Haiti	N, F	N, F	N, F?	N, F	A	A
Dominican Republic	N, I	N, F	N	N, F	A	A
Puerto Rico (US)	I	N, F	N, F	N, F	A	I
Eastern Caribbean						
British Virgin Islands (GB)	IN, IF	N, F	N	N, F	A	A
US Virgin Islands (US)	I	N, F	N	N, F	A	A
Anguilla (GB)	F	N, F	N	N, F	A	A
Sint Maarten (AN)	I	N, F	N	N, F	A	A
Saba (AN)	I	IN, F	I	IN, F	A	A
Sint Eustatius (AN)	IN	N, F	N	N, F	A	A
Saint Kitts & Nevis	I	N, F	N	N, F	A	A
Antigua & Barbuda	I	N, F	N	N, F	A	A
Montserrat (GB)	IN, F?	N, F	IN, F?	N, F	A	A
Guadeloupe (FR)	F	N, F	N, IF	N, F	A	I
Dominica	I	N, F	N	N, F	A	A
Martinique (FR)	F	IN, F	N, F?	N, F	A	I
Saint Lucia	I	N, F	N	N, F	A	A
Barbados	I, F?	N, F	N	N, F	A	A
Saint Vincent & Grenadines	I	N, F	N	N, F	A	A
Grenada	F	F	N	N, F	A	I
Guianan						
French Guiana (FR)	I	N, F	N	IN	A	N
Suriname	IF	N	N	N	A	N, F
Guyana	I	N, F	N	N	A	I
Southern Caribbean						
Trinidad & Tobago	I	N, F	N, F	N, F	A	IN, IF
Venezuela	N, F	N, F	N, F	N, F	A	A
Bonaire (AN)	N	N, F	I	N, F	A	A
Curacao (AN)	N, F	N, F	N, IF	N, F	A	I
Aruba (NL)	N, IF	N, F	N	N, F	A	I
Southwestern Caribbean						
Colombia	N, F	N, F	N, F?	N, F	A	I
Panama	IN, F	IN, F	N	N, F	A	A
Costa Rica	N, F	N, F	N	N, F	A	A
Nicaragua	F	N, F	N, IF	N, F	A	A
Western Caribbean, Gulf of Mexico and Florida						
Honduras	N, F	N, F	N	N, F	A	A
Guatemala	N, F	N, F	N	N, F	A	A
Belize	N, F	N, F	I	N, F	A?	A
Mexico	N, F	N, F	N, F	N, F	N, F	A
USA	N, F	N, F	N, F	IN, F	N, F	A
Bermuda						
Bermuda (GB)	IN, IF	IN, F	IF	F	I	A
Brazilian						
Brazil	N, F	N, F	N, F?	N, F	A	N, F

N = Nesting; F = Foraging; IN = Infrequent Nesting; IF = Infrequent Foraging; I = Infrequent (further detail unavailable); A = Absent

Large nesting colonies are rare. Sites receiving more than 500 crawls per year comprise between <1% and 8% of species-specific totals (Table 2). The largest majority of sites host extremely small colonies characterized by fewer than 25 crawls per year (perhaps 3-10 individual turtles). A variable number (0% - 33%) of sites for each species are known to support nesting, but reliable census data pertaining to colony size are not presently available (Table 2).

Table 2. Number of identified nesting sites in the Wider Caribbean Region, and including Bermuda and Brazil.

Species	Total	Number of crawls per year (proportion of total)					
		X	<25	25-100	100-500	500-1000	>1000
Loggerhead Turtle (*Caretta caretta*)	**552**	76 (.14)	228 (.41)	121 (.22)	87 (.16)	14 (.03)	26 (.05)
Green Turtle (*Chelonia mydas*)	**593**	142 (.24)	308 (.52)	66 (.11)	45 (.08)	17 (.03)	15 (.03)
Leatherback Turtle (*Dermochelys coriacea*)	**470**	101 (.21)	271 (.58)	60 (.13)	24 (.05)	4 (.01)	10 (.02)
Hawksbill Turtle (*Eretmochelys imbricata*)	**817**	268 (.33)	423 (.52)	90 (.11)	22 (.03)	11 (.01)	3 (.004)
Kemp's Ridley Turtle (*Lepidochelys kempii*)	**41**	0 (.00)	25 (.61)	2 (.05)	11 (.27)	0 (.00)	3 (.07)
Olive Ridley Turtle (*Lepidochelys olivacea*)	**62**	5 (.08)	28 (.45)	13 (.21)	13 (.21)	2 (.03)	1 (.02)

X = Presence, but unknown crawl abundance

Collectively, one-third of the identified species-specific nesting sites support hawksbill sea turtles, while approximately 20% support loggerhead, green, or leatherback sea turtles. In contrast, comparatively few sites support nesting by Kemp's ridley or olive ridley sea turtles (Figure 3).

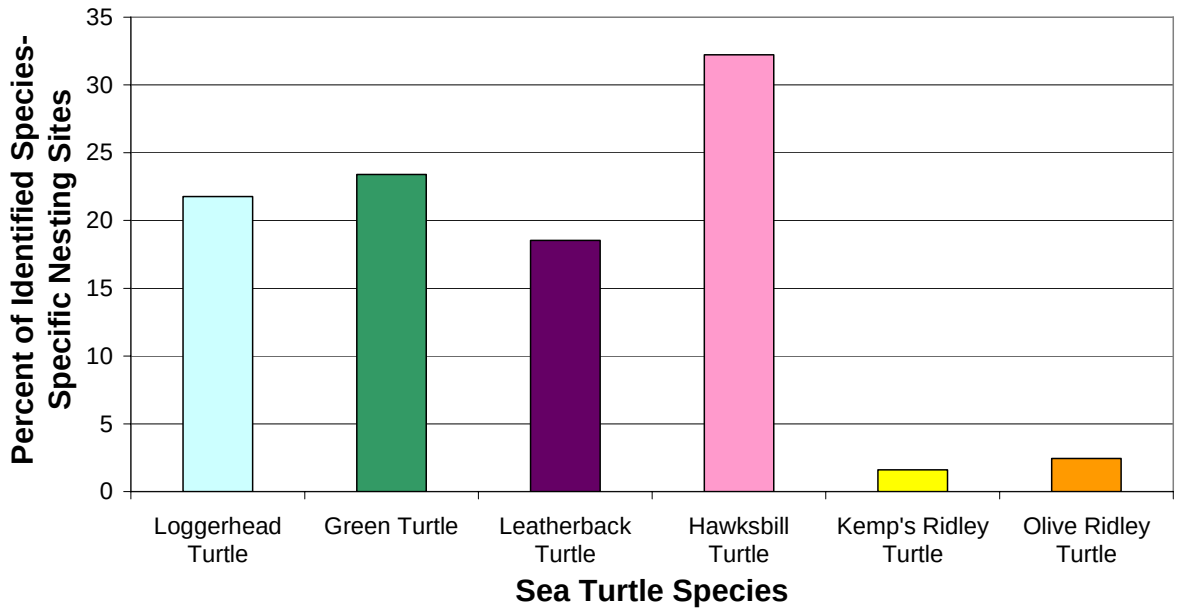


Figure 3. Frequency distribution of sea turtle species associated with the 2,535 species-specific nesting sites in the Wider Caribbean Region, and including Bermuda and Brazil.

Loggerhead sea turtles (*Caretta caretta*) generally nest in more temperate latitudes than do other Caribbean sea turtle species. The majority of nesting in the Wider Caribbean Region occurs in the USA (Florida)[4], where all but 1 of 40 beaches identified as having greater than 500 crawls per year are located (the other is located in Brazil) (Figure 4). Sites reporting between 100 and 500 crawls per year follow the same pattern, being clustered in the northern (Bahamas, Cuba, Mexico, USA) and southern (Brazil) extremes of the region. Forty-one percent of all known nesting beaches support fewer than 25 crawls per year; in 14% of sites, data are insufficient to estimate annual crawl abundance.[5] Refer to Table 1 and Table 2 for additional detail, and the National Reports (see Appendix III) for the distribution and abundance of the annual nesting effort in individual Caribbean nations and territories.

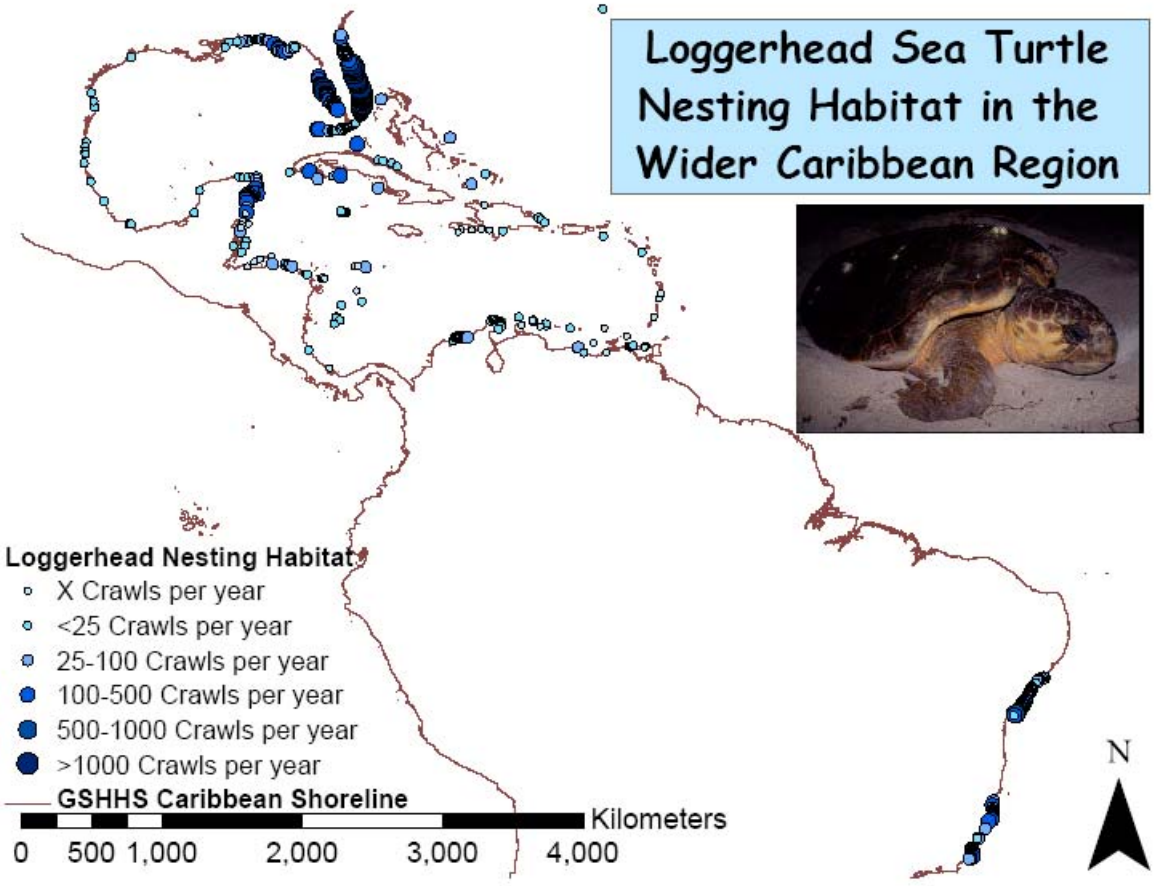


Figure 4. All known nesting sites (n=552) for loggerhead sea turtles (*Caretta caretta*) in the Wider Caribbean Region, and including Bermuda and Brazil.

[4] In all cases (Figures 4-9), in keeping with the defined northern boundary (30°N latitude) of the Wider Caribbean Region (UNEP 1983), only nesting beaches in Texas, Louisiana, Mississippi, Alabama and Florida were mapped and included in analyses. Nests deposited north of Florida comprise less than 10% of the nation's loggerhead sea turtle nesting each year (NOAA and FWS 2007a).

[5] The general view of local experts is that beaches where nesting is known to occur but where data are insufficient to estimate colony size (e.g. number of crawls per year), are low density sites most likely to fall in the "fewer than 25 crawls per year" category.

Green sea turtles (*Chelonia mydas*) nest throughout the Wider Caribbean Region (Figure 5). Tortuguero Beach in Costa Rica recorded over 50,000 crawls during the 2005 nesting season (de Haro and Troëng 2006a) and is by far the largest nesting colony of green turtles in the region. The 32 beaches reporting more than 500 crawls per year are broadly distributed along the continental margins of Brazil, Costa Rica, French Guiana, Mexico, Suriname, and the USA (Florida)[6]; the only insular sites in this category are in Venezuela (Aves Island) and Cuba. More than half (52%) of all known nesting beaches support fewer than 25 crawls per year; in 24% of sites, data are insufficient to estimate annual crawl abundance.[7] Refer to Table 1 and Table 2 for additional detail, and the National Reports (see Appendix III) for the distribution and abundance of the annual nesting effort in individual Caribbean nations and territories.

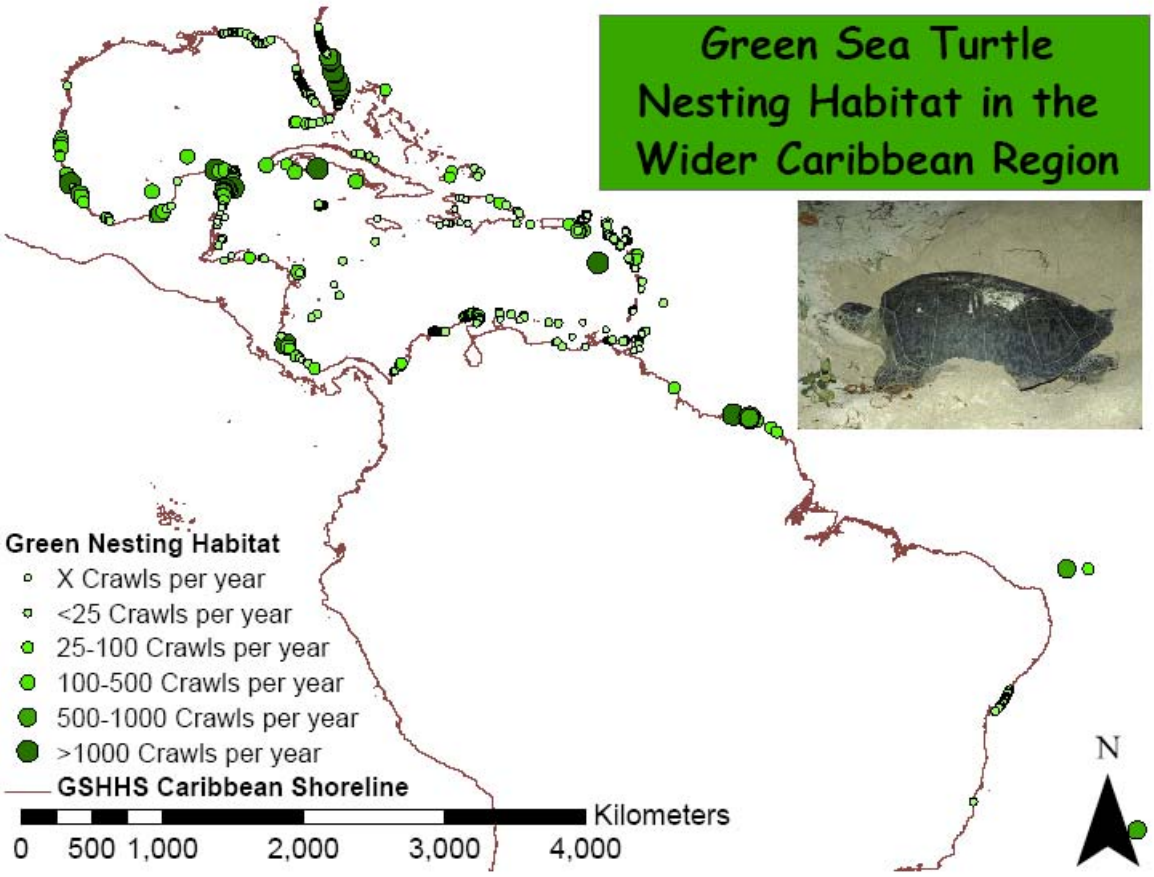


Figure 5. All known nesting sites (n=593) for green sea turtles (*Chelonia mydas*) in the Wider Caribbean Region, and including Bermuda and Brazil.

[6] In keeping with the defined northern boundary (30°N latitude) of the Wider Caribbean Region (UNEP 1983), only nesting beaches in Texas, Louisiana, Mississippi, Alabama and Florida were mapped and included in analyses. Nesting is rarely reported north of Florida (Woodson and Webster 1999, Williams et al. 2006).

[7] The general view of local experts is that beaches where nesting is known to occur but where data are insufficient to estimate colony size (e.g. number of crawls per year), are low density sites most likely to fall in the "fewer than 25 crawls per year" category.

Many of the largest leatherback sea turtle (*Dermochelys coriacea*) nesting colonies in the world are found in the Wider Caribbean Region. Ten colonies with more than 1,000 crawls per year are clustered in the southern (and mostly southeastern) sector of the region (Panama, Trinidad, Suriname, French Guiana). Four additional sites report between 500 and 1,000 crawls per year and are more broadly distributed, located in Costa Rica, Guyana, Suriname, and the US Virgin Islands (Figure 6).[8] More than half (58%) of all known nesting beaches support very small colonies, fewer than 25 crawls per year, and 21% have unknown crawl abundances.[9] Refer to Table 1 and Table 2 for additional detail, and the National Reports (see Appendix III) for the distribution and abundance of the annual nesting effort in individual Caribbean nations and territories.

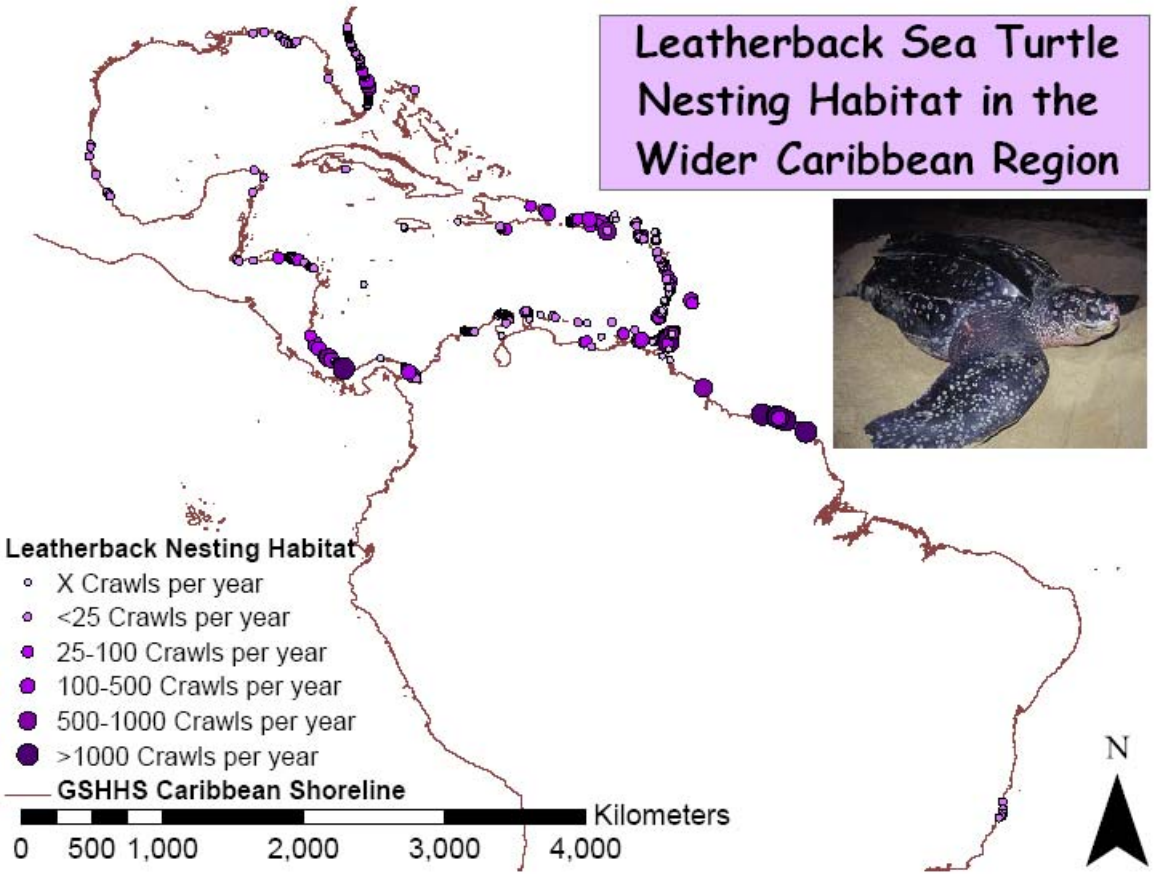


Figure 6. All known nesting sites (n=470) for leatherback sea turtles (*Dermochelys coriacea*) in the Wider Caribbean Region, and including Bermuda and Brazil.

[8] In keeping with the defined northern boundary (30°N latitude) of the Wider Caribbean Region (UNEP 1983), only nesting beaches in Texas, Louisiana, Mississippi, Alabama and Florida were mapped and included in analyses. Occasional nesting is also reported in Georgia, South Carolina and North Carolina and a single nesting is known from Assateague Island National Seashore in Maryland (Rabon et al. 2003).

[9] The general view of local experts is that beaches where nesting is known to occur but where data are insufficient to estimate colony size (e.g. number of crawls per year), are low density sites most likely to fall in the "fewer than 25 crawls per year" category.

Hawksbill sea turtles (*Eretmochelys imbricata*) nest in typically low densities throughout the Wider Caribbean Region and nesting does not occur north of Florida in the USA (Meylan and Redlow 2006). Only three sites – Mona Island (Puerto Rico), the west coast of Barbados, and Punta Xen (Mexico) – support more than 1,000 crawls per year (Figure 7). Five countries report nesting beaches with between 500 and 1,000 crawls per year, half of these sites are situated along the Yucatan Peninsula in Mexico and the others are located in Barbados, Panama, and the US Virgin Islands. Thirty-six of 817 (4.4%) nesting beaches support more than 100 crawls per year, in contrast, 52% receive fewer than 25 crawls per year and 33% have unknown crawl abundances.[10] Refer to Table 1 and Table 2 for additional detail, and the National Reports (see Appendix III) for the distribution and abundance of the annual nesting effort in individual Caribbean nations and territories.

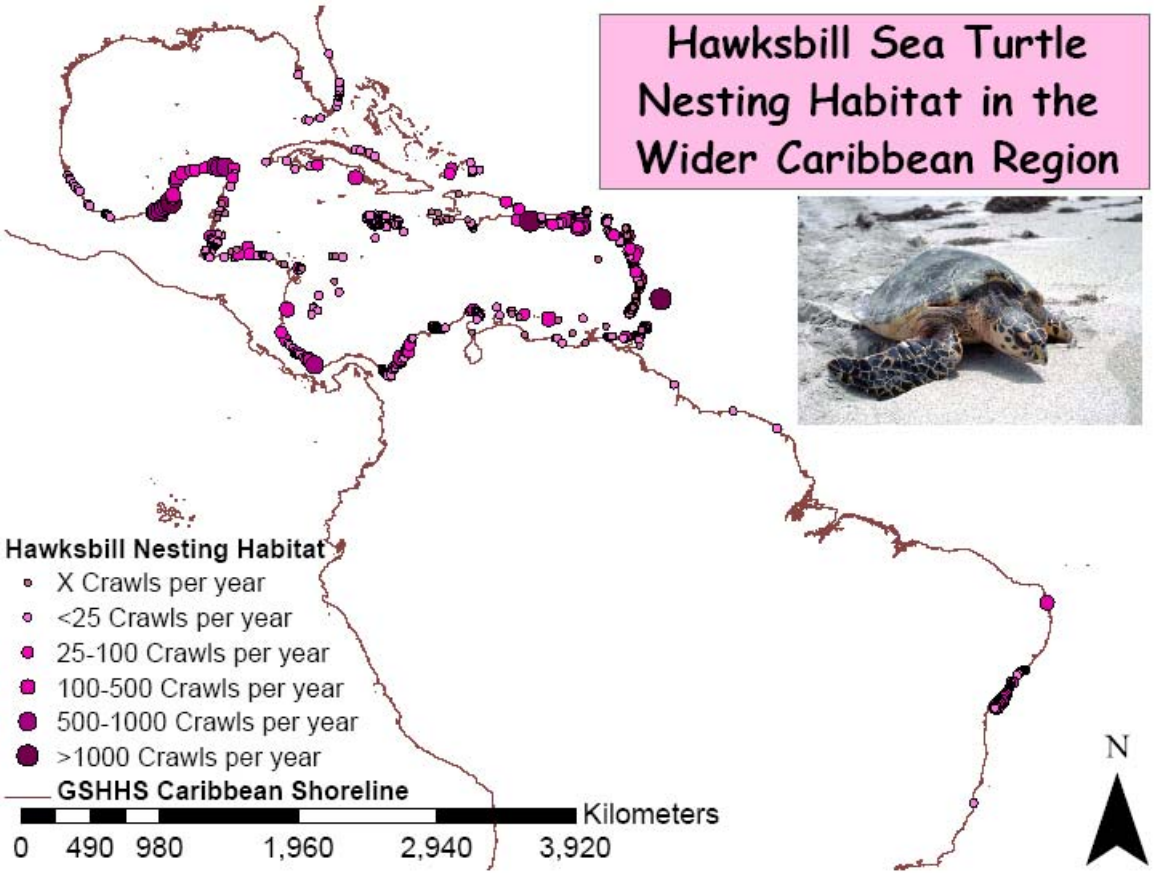


Figure 7. All known nesting sites (n=817) for hawksbill sea turtles (*Eretmochelys imbricata*) in the Wider Caribbean Region, and including Bermuda and Brazil.

[10] The general view of local experts is that beaches where nesting is known to occur but where data are insufficient to estimate colony size (e.g. number of crawls per year), are low density sites most likely to fall in the "fewer than 25 crawls per year" category.

Kemp's ridley sea turtles (*Lepidochelys kempii*) nest exclusively in the northern latitudes of the Wider Caribbean Region (Figure 8), primarily in Mexico and secondarily in the USA (Texas and Florida).[11] As is the case with the hawksbill turtle (Figure 7), there are only three sites known to receive more than 1,000 crawls per year. These sites are all located in the state of Tamaulipas, Mexico; the largest of these – Rancho Nuevo – received approximately 7,866 nests in 2006 (NOAA and FWS 2007b). Every known nesting site can be characterized in terms of an estimated number of crawls per year; the majority (61%) receive fewer than 25 crawls per year, but many small colonies are reported to be increasing. Refer to Table 1 and Table 2 for additional detail, and the National Reports (see Appendix III) for the distribution and abundance of the annual nesting effort in individual Caribbean nations and territories.

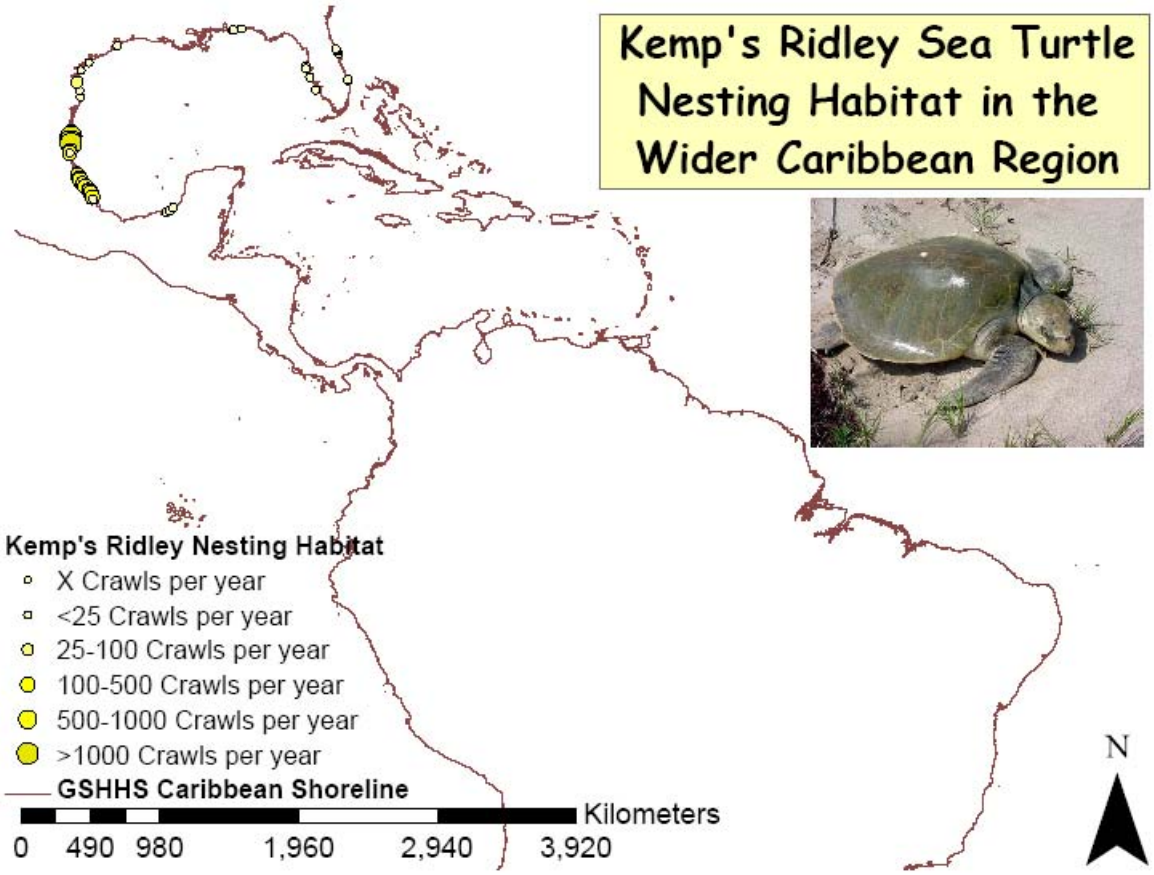


Figure 8. All known nesting sites (n=41) for Kemp's ridley sea turtles (*Lepidochelys kempii*) in the Wider Caribbean Region, and including Bermuda and Brazil.

[11] In keeping with the defined northern boundary (30°N latitude) of the Wider Caribbean Region (UNEP 1983), only nesting beaches in Texas, Louisiana, Mississippi, Alabama and Florida were mapped and included in analyses. It is worth noting, in the context of the restricted reproductive range of this species, that nesting, while extremely rare, also occurs in Alabama, Georgia, South Carolina and North Carolina ("eight total nests recorded between them": Donna Shaver, Chief, Division of Sea Turtle Science and Recovery, Padre Island National Seashore, US National Park Service, in litt. 29 October 2007).

Olive ridley sea turtles (*Lepidochelys olivacea*) nest primarily in the Guianas, with the largest nesting colonies located in Brazil, French Guiana, and Suriname (Figure 9). Relatively minor nesting occurs in Guyana and occasional nesting is reported in Trinidad and Tobago, Curaçao, and other southern Caribbean locations. Nearly half (45%) of all nesting sites support fewer than 25 crawls per year; only 8% of sites are associated with unknown crawl abundances.[12] A decline of more than 90% in the number of breeding-age adults in Suriname, until recently the region's largest olive ridley nesting colony, is attributed to fisheries interactions (summarized by Reichart and Fretey 1993, Reichart et al. 2003). Refer to Table 1 and Table 2 for additional detail, and the National Reports (see Appendix III) for the distribution and abundance of the annual nesting effort in individual Caribbean nations and territories.

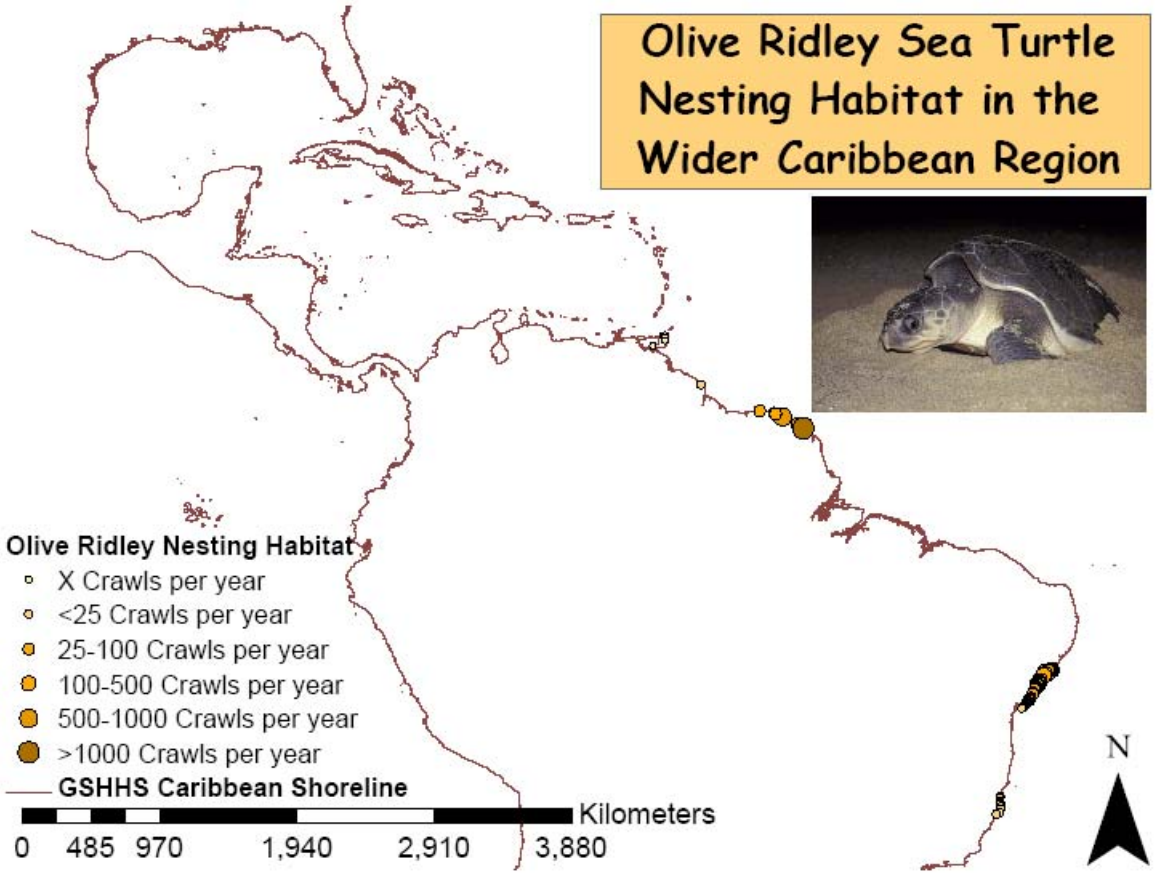


Figure 9. All known nesting sites (n=62) for olive ridley sea turtles (*Lepidochelys olivacea*) in the Wider Caribbean Region, and including Bermuda and Brazil.

[12] The general view of local experts is that beaches where nesting is known to occur but where data are insufficient to estimate colony size (e.g. number of crawls per year), are low density sites most likely to fall in the "fewer than 25 crawls per year" category.

In summary, a large majority (50.6%) of nesting sites receive fewer than 25 crawls per year by any particular species. In contrast, 13.9%, 8.0%, 1.9% and 2.3% receive an estimated 25 to 100, 100 to 500, 500 to 1,000 or more than 1,000 crawls per year, respectively (Figure 10). Approximately one in four (23.4%) sites cannot, with the information available, be characterized and ranked by colony size. These are unlikely to be high density nesting grounds. The frequency distribution for individual species illustrates a similar pattern, although species specific differences are evident (Figure 11).

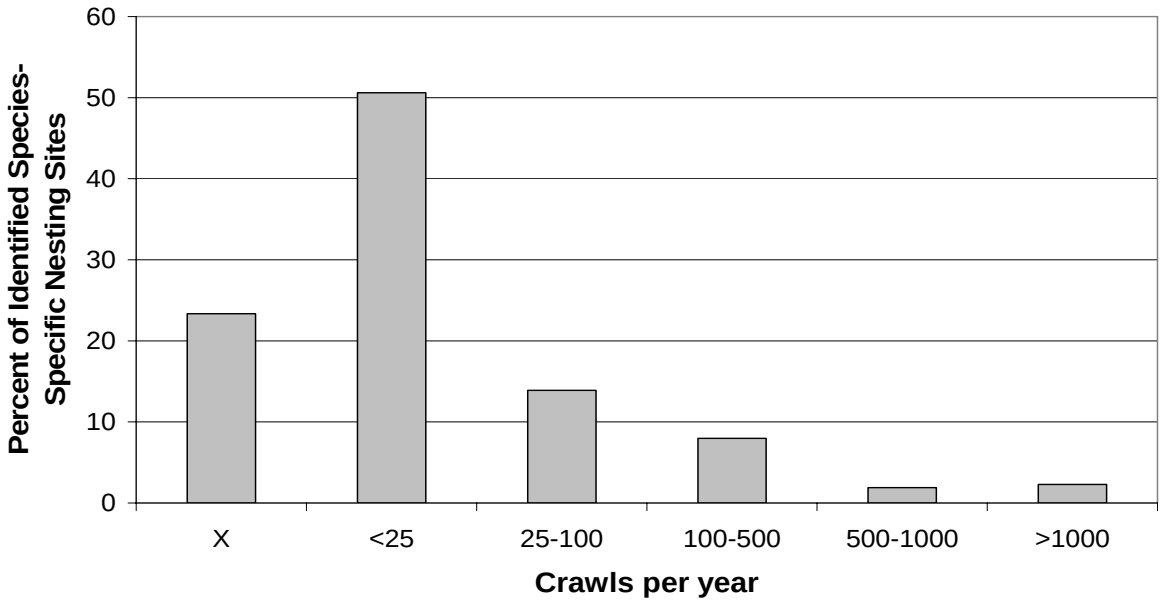


Figure 10. Frequency distribution of the number of crawls per year among the 2,535 identified species-specific nesting sites for sea turtles in the Wider Caribbean Region.

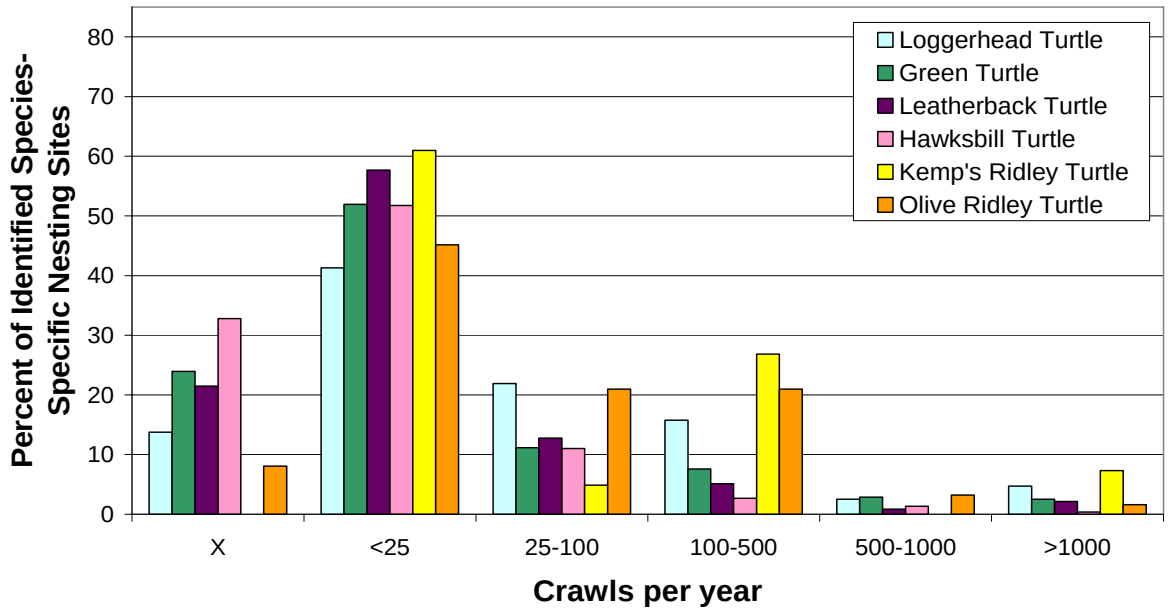


Figure 11. Frequency distribution of the number of crawls per species per year for the 2,535 identified species-specific nesting sites for sea turtle in the Wider Caribbean Region.

Active Threats and Protection Policies: Summary of Findings

Of the 43 nations and territories examined, 29 have legislated indefinite complete protection for sea turtles; in addition to these, Anguilla has adopted a moratorium set to expire in 2020 (Figure 12, Table 4). Eight of the 30 nations and territories, including Anguilla, where sea turtles are protected year-around, provide for exceptions relating to "traditional" or "subsistence" exploitation. Of these 30 jurisdictions, 22 report the taking of turtles on the nesting beach, 21 report the taking of turtles at sea, and 22 report the collection of eggs, all in contravention of existing law; only five describe enforcement of sea turtle protection laws as "adequate".

Thirteen nations and territories operate under regulatory regimes that leave one or more species seasonally subject to exploitation; with the singular exception of the Cayman Islands (which recently legislated maximum size limits for the sea turtle fishery), minimum size limits are the norm.

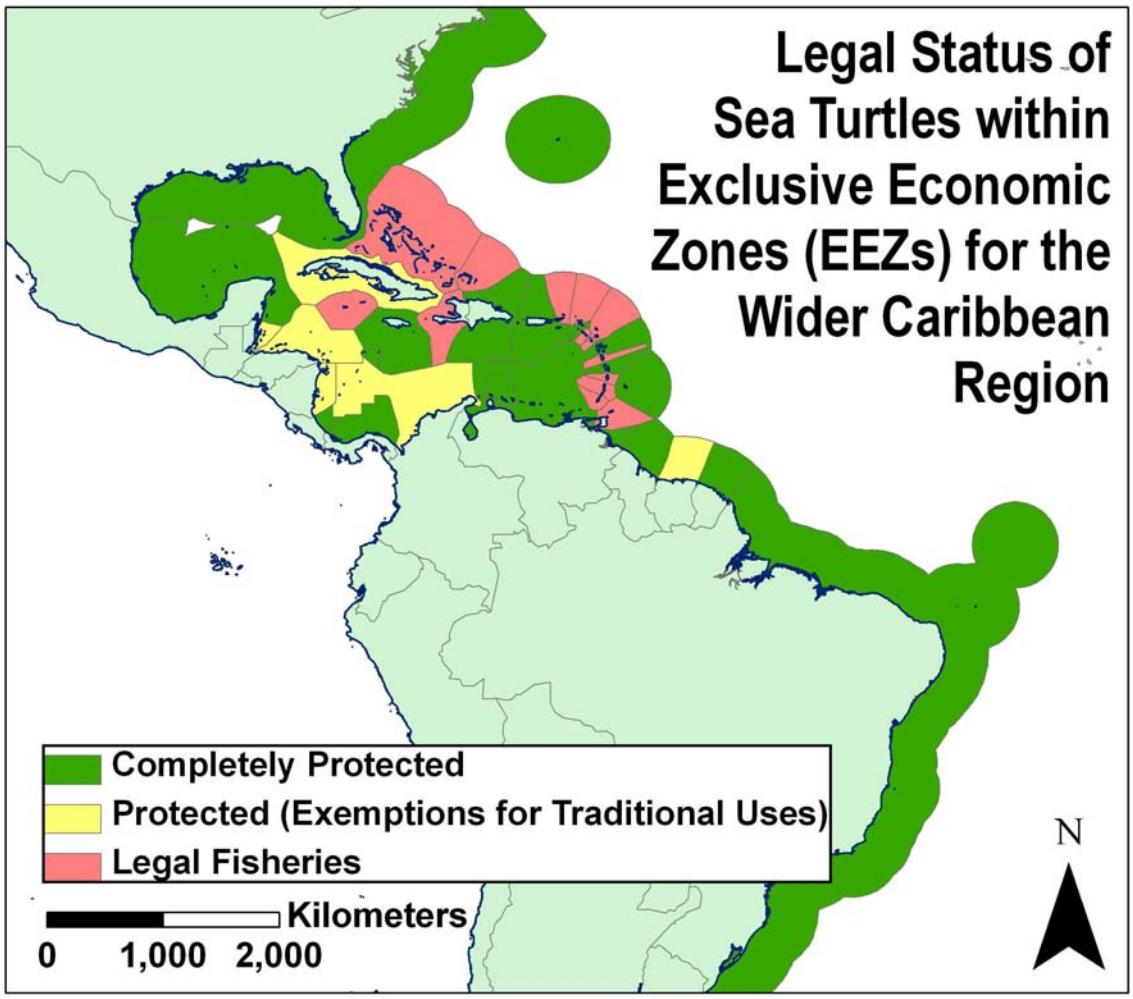


Figure 12. Summary of legal regimes protecting sea turtles in the Wider Caribbean Region, and including Bermuda and Brazil.

In addition to the legal and illegal exploitation of sea turtles and eggs, habitat loss (e.g. beach erosion, coral reef degradation, artificial beachfront lighting, pollution) and fisheries interactions

top a long list of factors (see Table 3) that threaten the survival of Caribbean sea turtles at their nesting (Table 5) and foraging (Table 6) grounds. From a region-wide perspective, mechanized beach cleaning, beach rebuilding (nourishment), offshore lighting, and power plant entrapment would appear to be least threatening to sea turtle populations.

Table 3. The proportion of Wider Caribbean nations and territories (n=41 in the case of nesting beaches, nesting being insignificant in Bermuda and Saba; n=43 in the case of foraging grounds) citing the factor as both present and constituting a threat to sea turtles. Data were assembled from responses to a standardized survey (see Appendix II) completed by local experts in each jurisdiction. The proportion of nations and territories characterizing the threat as "Frequent" appears in parentheses; this proportion does not differentiate between "Frequent" (F) on a national scale and "Frequent in Some Areas" (FA).

Threats to sea turtles on the beach (nesting/hatching) in the Wider Caribbean Region.	
Beach Erosion/Accretion	.95 (.21)
Nest Loss to Abiotic Factors	.95 (.18)
Artificial Lighting	.85 (.46)
Egg Collection by Humans	.85 (.37)
Killing of Nesting Females by Humans	.83 (.24)
Pollution	.83 (.21)
Nest Loss to Predators	.78 (.19)
Exotic (or Loss of Native) Vegetation	.68 (.43)
Recreational Beach Equipment and/or Other Obstacles	.68 (.39)
Beach Vehicular Use	.68 (.39)
Sand Mining	.68 (.36)
Harassment Due to Increased Human Presence	.66 (.19)
Beach Armouring/Stabilization Structures	.59 (.17)
Livestock Presence on the Beach	.56 (.13)
Mechanized Beach Cleaning	.39 (.31)
Beach Nourishment	.34 (.07)
Killing of Nesting Females by Predators	.32 (.15)

Threats to sea turtles in water (foraging/migration) in the Wider Caribbean Region.	
Pollution	.93 (.13)
Fisheries Bycatch	.91 (.38)
Entanglement	.91 (.26)
Coral Reef Degradation	.88 (.13)
Hunting/Poaching	.79 (.38)
Predators	.77 (.03)
Seagrass Degradation	.77 (.09)
Boat/Personal Water Craft Collisions	.67 (.07)
Disease/Parasites	.67 (.03)
Harassment Due to Increased Human Presence	.65 (.14)
Marina and Dock Development	.56 (.42)
Dredging	.42 (.11)
Oil and Gas Exploration, Development, Transportation	.40 (.00)
Offshore Artificial Lighting	.21 (.00)
Power Plant Entrapment	.14 (.00)

Table 4. National policy for the protection of sea turtles in the Wider Caribbean Region.

Marine Ecoregions with Countries/Territories	Complete (indefinite) protection	Moratorium (fixed period)	Prohibition(s) on take	Closed season	Minimum size limits	Maximum size limits	Annual quota
Bahamian							
Bahamas	No	No	E, NF, HB	Yes	Yes	No	No
Turks & Caicos Islands (GB)	No	No	E, N, NF	No	Yes	No	No
Greater Antilles							
Cuba	Yes*	–	E, N, NF	Yes	Yes	No	Yes
Cayman Islands (GB)	No*	No	E, N, NF	Yes	No	Yes	Yes
Jamaica	Yes	–	–	–	–	–	–
Haiti	No	No	E, NF	Yes	No	No	No
Dominican Republic	Yes	–	–	–	–	–	–
Puerto Rico (US)	Yes	–	–	–	–	–	–
Eastern Caribbean							
British Virgin Islands (GB)	No	Yes (LB & LG)	E, LB, LG	Yes	Yes	No	No
US Virgin Islands (US)	Yes	–	–	–	–	–	–
Anguilla (GB)	No	Yes (until 2020)	–	–	–	–	–
Sint Maarten (AN)	Yes	–	–	–	–	–	–
Saba (AN)	Yes	–	–	–	–	–	–
Sint Eustatius (AN)	Yes	–	–	–	–	–	–
Saint Kitts & Nevis	No	No	E, N, NF	Yes	Yes	No	No
Antigua & Barbuda	No	No	E, N	Yes	Yes	No	No
Montserrat (GB)	No	No	No	Yes	Yes	No	No
Guadeloupe (FR)	Yes	–	–	–	–	–	–
Dominica	No	No	E, N, NF	Yes	Yes	No	No
Martinique (FR)	Yes	–	–	–	–	–	–
Saint Lucia	No	No*	E, N, NF	Yes	Yes	No	No
Barbados	Yes	–	–	–	–	–	–
Saint Vincent & Grenadines	No	No	E, N	Yes	Yes	No	No
Grenada	No	No	E, N, NF, LB	Yes	Yes	No	No
Guianan							
French Guiana (FR)	Yes	–	–	–	–	–	–
Suriname	Yes*	–	–	–	–	–	–
Guyana	Yes	–	–	–	–	–	–
Southern Caribbean							
Trinidad & Tobago	No	No	E	Yes	No	No	No
Venezuela	Yes	–	–	–	–	–	–
Bonaire (AN)	Yes	–	–	–	–	–	–
Curacao (AN)	Yes	–	–	–	–	–	–
Aruba (NL)	Yes	–	–	–	–	–	–
Southwestern Caribbean							
Colombia	Yes*	–	HB	No	No	No	No
Panama	Yes	–	–	–	–	–	–
Costa Rica	Yes*	–	–	–	–	–	–
Nicaragua	Yes*	–	No	Yes	No	No	No
Western Caribbean, Gulf of Mexico and Florida							
Honduras	Yes*	–	No	No	No	No	No
Guatemala	Yes*	–	–	No	No	No	No
Belize	Yes*	–	–	No	No	No	No
Mexico	Yes	–	–	–	–	–	–
USA	Yes	–	–	–	–	–	–
Bermuda							
Bermuda (GB)	Yes	–	–	–	–	–	–
Brazilian							
Brazil	Yes	–	–	–	–	–	–

E = Eggs; N = Nests; NF = Nesting Females; HB = Hawksbill; LB = Leatherback; LG = Loggerhead; I = Insufficient; * See Note(s) in Country Report

Table 4. National policy for the protection of sea turtles in the Wider Caribbean Region.

Permits/ licenses required	Gear restrictions	Area closures	Reports of exploitation/ sale nationally	Reports of illegal trade inter-nationally	General public awareness of laws	Recent pro-secutions or penalties	Enforcement considered adequate	Penalties are an adequate deterrent
No*	Yes	Yes	Yes	Yes*	No (I)	Yes	No	No
No	No	Yes	Yes	Yes	No	No	No	Unknown
Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
–	No	Yes	Yes	No	Yes	Yes	No	No
Yes	No	No	Yes	No	No	No	No	No
–	No	Yes	Yes	Yes	No	No	No	No
Yes*	Yes	Yes	Yes	Yes*	Yes	Yes	No	No
Yes	Yes*	Yes	Yes	Yes*	Yes	Yes*	No	No
Yes*	Yes	Yes	Yes	Yes*	Yes	Yes	No	Yes*
–	Yes	No	Yes	No	Yes	No	No	Yes
–	No	No*	Yes	Yes	No	Yes	No	Yes
–	Yes	Yes	No	No	Yes	No	No	Yes
–	No	Yes	Yes	No	Yes	No	Yes	Yes
No	Yes	No	Yes	Yes	Yes	Unknown	No	Yes
Yes*	Yes*	Yes	Yes	Yes	No	No	No	Yes
No	No	No	Yes	Yes	Yes	Unknown	No	No
–	Yes	Yes	Yes	No	Yes	Yes	No	Yes
No	No	Yes	Yes	Yes	Yes	Yes	No	No
–	No	No	Yes	Unknown	Yes	Yes	No	Yes
No	Yes	Yes	Yes	Yes*	Yes	Yes	No	No
–	No	Yes	Yes	No	Yes	No	No	Yes
No	Yes	Yes	Yes	Yes	Yes	Unknown	No	Yes
Yes	Yes	No	Yes	Yes	Yes	No	No	Unknown
–	No	Yes	Yes	Yes	Yes	Yes	No (I)	Yes
No	Yes	Yes	Yes	No	Yes	Yes*	No	No
Yes	Yes	Yes	Unknown	Unknown	No (I)	Unknown	No	Unknown
No	Yes	Yes	Yes	Yes	No	Yes	No (I)	No
–	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Yes	No	Yes	Yes	No	No (I)	No	No (I)	Yes
–	No	Yes	Yes	Unknown*	Yes	No	No	Yes
–	No	No	Yes	Yes	Yes	Yes	No	Yes
No	Yes	Yes	Yes	Yes	No	Unknown	No	Unknown
Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
–	Yes	Yes	Yes	Yes	No	Yes	No	Yes
No	Yes	No	Yes	Yes	Yes	Yes	No	No
No	Yes	Yes	Yes	Yes	No	Unknown	No	Unknown
Yes*	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Yes	Yes	Yes	Yes	Yes	No (I)	Yes*	No (I)	Yes
–	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Yes*	Yes	Yes	No	No	Yes	No	Yes	Yes
–	Yes	Yes	No	No	Yes	No	Yes	Yes
–	No	Yes	Yes*	No	Yes	No	Yes	No (I)

E = Eggs; N = Nests; NF = Nesting Females; HB = Hawksbill; LB = Leatherback; LG = Loggerhead; I = Insufficient; * See Note(s) in Country Report

Table 5. Threats to sea turtles on the beach (nesting/hatching) in the Wider Caribbean Region.

Marine Ecoregions with Countries/Territories	Killing of Nesting Females by Humans	Killing of Nesting Females by Predators	Nest Loss to Predators	Nest Loss to Abiotic Factors	Egg Collection by Humans	Harassment Due to Humans	Artifical Lighting
Bahamian							
Bahamas	Yes (R)	No	No	Yes (U)	Yes (FA)	No	Yes (R)
Turks & Caicos Islands (GB)	Yes (R)	No	No	Yes (U)	Yes (R)	No	No
Greater Antilles							
Cuba	Yes (O)	No	Yes (O)	Yes (U)	Yes (O)	Yes (O)	Yes (O)
Cayman Islands (GB)	Yes (R)	No	No	Yes (R)	Yes (R)	Yes (R)	Yes (O)
Jamaica	Yes (F)	No	Yes (U)	Yes (U)	Yes (F)	No	Yes (FA)
Haiti	Yes (U)	No	No	Yes (R)	Yes (F)	No	No
Dominican Republic	Yes (O)	Yes (R)	Unknown	Unknown	Yes (U)	No	Unknown
Puerto Rico (US)	Yes (O)	No	Yes (F)	Yes (U)	Yes (O)	Yes (R)	Yes (F)
Eastern Caribbean							
British Virgin Islands (GB)	Yes (R)	No	Yes (R)	Yes (U)	Yes (R)	Yes (FA)	Yes (U)
US Virgin Islands (US)	Yes (R)	Yes (O)	Yes (O)	Yes (O)	Yes (O)	Yes (R)	Yes (F)
Anguilla (GB)	No	No	Yes (R)	Yes (O)	Yes (U)	No	Yes (F)
Sint Maarten (AN)	Yes (R)	No	No	Yes (U)	No	Yes (FA)	Yes (F)
Saba (AN)	NA	NA	NA	NA	NA	NA	NA
Sint Eustatius (AN)	No	No	No	Yes (U)	No	No	Yes (R)
Saint Kitts & Nevis	Yes (R)	No	Yes (O)	Yes (U)	Yes (R/O)	Yes (U)	Yes (U)
Antigua & Barbuda	No	No	Yes (U)	Yes (U)	Yes (O)	Yes (R)	Yes (F)
Montserrat (GB)	Yes (R)	No	Yes (U)	Yes (U)	Yes (U)	Unknown	Unknown
Guadeloupe (FR)	Yes (R)	Yes (R)	Yes (R)	Yes (R)	Yes (R)	No	Yes (F)
Dominica	Yes (F)	Yes (R)	Yes (O)	Yes (F)	Yes (F)	Yes (F)	Yes (O)
Martinique (FR)	Yes (O)	No	Yes (O)	Yes (FA)	Yes (O)	Yes (O)	Yes (F)
Saint Lucia	Yes (F)	Yes (R)	Yes (O)	Yes (O)	Yes (O)	Yes (O)	Yes (O)
Barbados	Yes (O)	Yes (O)	Yes (O)	Yes (F)	Yes (O)	Yes (R)	Yes (F)
Saint Vincent & Grenadines	Yes (O)	Unknown	Yes (U)	Yes (U)	Yes (FA)	Unknown	Yes (O)
Grenada	Yes (O/F)	No	Yes (O)	Yes (U)	Yes (F)	Yes (U)	Yes (FA)
Guianan							
French Guiana (FR)	Yes (R)	Yes (O)	Yes (O)	Yes (F)	Yes (R/O)	Yes (O)	Yes (FA)
Suriname	No	Unknown	Yes (U)	Yes (U)	Yes (U)	Yes (O)	Yes (U)
Guyana	Yes (F)	No	Yes (R)	Yes (F)	Yes (F)	Yes (R)	Yes (R)
Southern Caribbean							
Trinidad & Tobago	Yes (F)	No	Yes (R)	Yes (F)	Yes (O)	Yes (O)	Yes (O)
Venezuela	Yes (F)	Yes (O/F)	Yes (F)	Yes (U)	Yes (F)	Yes (R)	Yes (U)
Bonaire (AN)	Yes (R)	No	No	Yes (U)	No	No	Yes (R)
Curacao (AN)	No	No	No	No	No	No	No
Aruba (NL)	No	No	Yes (R)	Yes (O)	No	Yes (R)	Yes (F)
Southwestern Caribbean							
Colombia	Yes (R/O)	Yes (R)	Yes (R/O)	Yes (U)	Yes (F)	No	Yes (R/O)
Panama	Yes (O)	No	Yes (F)	Yes (F)	Yes (F)	Yes (F)	Yes (O)
Costa Rica	Yes (F)	Yes (F)	Yes (U)	Yes (U)	Yes (F)	No	No
Nicaragua	Yes (O)	No	Yes (O)	Yes (O)	Yes (F)	Yes (O)	Yes (FA)
Western Caribbean, Gulf of Mexico and Florida							
Honduras	Yes (R)	Yes (U)	Yes (F)	Yes (U)	Yes (U)	Yes (F)	Yes (FA)
Guatemala	Yes (R)	No	Yes (O)	Yes (O)	Yes (F)	Yes (O)	Yes (R)
Belize	No	Unknown	Yes (U)	Yes (U)	No	Yes (U)	Yes (U)
Mexico	Yes (O)	No	Yes (F)	Yes (O)	Yes (O)	Yes (R)	Yes (F)
USA	Yes (R)	Yes (R)	Yes (O/F)	Yes (U)	Yes (R)	Yes (R/O)	Yes (O)
Bermuda							
Bermuda (GB)	NA	NA	NA	NA	NA	NA	NA
Brazilian							
Brazil	Yes (O)	Yes (R)	Yes (O)	Yes (O)	Yes (O)	Yes (O)	Yes (FA)

Occurrence Frequency: R = Rare; O = Occasional; F = Frequent; FA = Frequent in one area; U = Unknown; NA = Not Applicable

Table 5. Threats to sea turtles on the beach (nesting/hatching) in the Wider Caribbean Region.

Pollution	Beach Erosion/ Accretion	Beach Armouring/ Stabilization Structures	Beach Nourish-ment	Beach Obstacles	Mechanized Beach Cleaning	Beach Vehicular Use	Sand Mining	Exotic (or Loss of Native) Vegetation	Live-stock on the Beach
Yes (U)	Yes (U)	Yes (FA)	No	Yes (O)	No	No	Yes (O)	Yes (U)	No
No	No	No	No	No	No	No	No	No	No
Yes (U)	Yes (U)	Unknown	Yes (FA)	Yes (FA)	Yes (O)	Yes (O)	Yes (R)	Yes (R)	Yes (O)
No	Yes (R)	No	No	Yes (R)	Yes (R)	Yes (R)	No	Yes (R)	No
No	Yes (U)	Yes (U)	No	No	No	No	Yes (U)	No	Yes (U)
Yes (U)	Yes (U)	No	No	No	No	No	No	No	No
Yes (U)	Yes (U)	Yes (O)	Yes (R)	Yes (F)	Yes (FA)	Yes (O)	Yes (FA)	Yes (F)	Yes (R)
Yes (U)	Yes (U)	Yes (R)	No	Yes (FA)	Yes (FA)	No	Yes (R)	Yes (F)	Yes (O)
Yes (U)	Yes (U)	No	No	Yes (FA)	No	Yes (R)	No	Yes (R)	Yes (R)
Yes (U)	Yes (O)	No	No	Yes (U)	No	Yes (O)	No	Yes (O)	No
No	Yes (O)	No	Yes (O)	Yes (F)	No	Yes (F)	Yes (FA)	Yes (O)	No
Yes (U)	Yes (U)	No	No	Yes (O)	No	Yes (F)	No	No	No
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yes (U)	Yes (O)	No	No	No	No	Yes (O)	Yes (R/O)	No	Yes (O)
Yes (U)	Yes (U)	Yes (U)	Yes (R)	Yes (U)	Yes (U)	Yes (F)	Yes (FA)	Yes (F)	Yes (F)
Yes (U)	Yes (U)	Yes (U)	Yes (U)	Yes (F)	Yes (R)	Yes (R)	Yes (U)	Yes (U)	Yes (R)
Unknown	Yes (U)	Unknown	Unknown	Unknown	Unknown	Unknown	Yes (U)	Yes (U)	Unknown
Yes (U)	Yes (U)	No	No	Yes (R)	Yes (O)	Yes (F)	Yes (F)	Yes (F)	No
Yes (U)	Yes (F)	Yes (O)	Yes (R)	Yes (R/O)	No	Yes (O)	Yes (O)	Yes (R)	Yes (R)
Yes (O)	Yes (FA)	Yes (F)	Unknown	No	Yes (O)	Yes (O)	Yes (O)	Yes (F)	No
Yes (U)	Yes (U)	Yes (O)	Yes (R)	Yes (O)	No	Yes (O)	Yes (O)	No	Yes (R)
Yes (U)	Yes (F)	Yes (FA)	Yes (R)	Yes (FA)	Yes (FA)	Yes (FA)	Yes (R)	Yes (F)	No
Yes (U)	Yes (U)	Yes (O)	Yes (R)	Yes (O)	Yes (R)	Yes (R)	Yes (F)	Yes (R)	Yes (R)
Yes (U)	Yes (F)	Yes (O)	No	Yes (O)	No	Yes (O/F)	Yes (F)	Yes (F)	Yes (F)
No	Yes (U)	Yes (O)	No	Yes (FA)	Yes (R/O)	Yes (R)	No	No	No
Yes (U)	Yes (U)	No	No	No	No	No	No	No	No
Yes (U)	Yes (U)	No	No	No	No	No	Yes (R)	Yes (R)	Yes (U)
Yes (F)	Yes (F)	Yes (U)	No	Yes (U)	No	Yes (O)	Yes (F)	Yes (R)	No
Yes (U)	Yes (U)	Yes (O)	Yes (R)	Yes (F)	Yes (R)	Yes (O)	Yes (O)	Yes (F)	Yes (O)
Yes (U)	Yes (U)	No	No	No	No	No	Yes (FA)	No	No
No	No	No	No	No	No	No	No	No	Yes (R)
Yes (O)	Yes (O)	Yes (O)	Yes (R)	Yes (F)	Yes (F)	Yes (F)	No	Yes (F)	No
Yes (U)	Yes (U)	Yes (R/O)	No	Yes (R)	No	Yes (U)	Yes (R)	No	Yes (U)
Yes (F)	Yes (F)	Yes (R)	No	Yes (R)	No	Yes (R)	Yes (F)	No	Yes (R)
Yes (U)	Yes (U)	No	No	No	No	Yes (O)	No	Yes (U)	No
Yes (F)	Yes (FA)	Yes (O)	No	No	No	No	Yes (FA)	Yes (FA)	Yes (FA)
Yes (F)	Yes (F)	Yes (R)	Yes (U)	Yes (R)	Yes (R)	Yes (F)	Yes (R)	Yes (F)	Yes (R)
Yes (F)	Yes (R)	No	No	Yes (R)	No	No	No	Unknown	Yes (U)
Yes (U)	Yes (U)	Yes (U)	No	No	No	No	Yes (U)	Yes (U)	No
Yes (F)	Yes (O)	Yes (F)	Yes (O)	Yes (R)	Yes (R)	Yes (FA)	Yes (R)	Yes (O)	Yes (R)
Yes (F)	Yes (U)	Yes (O)	Yes (O)	Yes (F)	Yes (F)	Yes (F)	No	Yes (FA)	Yes (R)
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Yes (U)	Yes (U)	Yes (R)	No	Yes (O)	No	Yes (FA)	Yes (R)	Yes (U)	Yes (O)

Occurrence Frequency: R = Rare; O = Occasional; F = Frequent; FA = Frequent in one area; U = Unknown; NA = Not Applicable

Table 6. Threats to sea turtles at sea (foraging and migration) in the Wider Caribbean Region.

Marine Ecoregions with Countries/Territories	Seagrass Degredation	Coral Reef Degredation	Fisheries Bycatch	Hunting/ Poaching	Pollution	Predators	Disease/ Parasites
Bahamian							
Bahamas	Yes (U)	Yes (U)	No	Yes (U)	Yes (U)	Yes (U)	Yes (U)
Turks & Caicos Islands (GB)	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (U)	Yes (U)	Yes (U)
Greater Antilles							
Cuba	No	Yes (U)	Yes (F)	Yes (F)	Yes (R)	Yes (U)	Yes (R)
Cayman Islands (GB)	Unknown	Yes (U)	Yes (O)	Yes (R)	Yes (R)	Yes (R)	Yes (R)
Jamaica	No	Yes (U)	Yes (U)	Yes (U)	Yes (U)	Unknown	No
Haiti	Yes (U)	Yes (U)	Yes (U)	Yes (U)	Yes (U)	No	Unknown
Dominican Republic	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (U)	Yes (U)	Yes (R)
Puerto Rico (US)	Yes (U)	Yes (U)	Yes (R)	Yes (O)	Yes (U)	Yes (U)	Yes (U)
Eastern Caribbean							
British Virgin Islands (GB)	Yes (U)	Yes (U)	Yes (R)	Yes (O)	Yes (U)	Yes (U)	Yes (U)
US Virgin Islands (US)	Yes (U)	Yes (U)	Yes (R)	Yes (R)	Yes (R)	Yes (U)	Yes (U)
Anguilla (GB)	Yes (O)	Yes (F)	Yes (R)	Yes (U)	Yes (R)	Yes (U)	Yes (U)
Sint Maarten (AN)	Yes (U)	Yes (U)	Yes (U)	Yes (U)	Yes (U)	No	Yes (R)
Saba (AN)	Yes (U)	Yes (U)	No	Yes (R)	Yes (U)	Unknown	Unknown
Sint Eustatius (AN)	Unknown	Yes (U)	No	No	Yes (U)	Yes (U)	No
Saint Kitts & Nevis	Yes (U)	Yes (U)	Yes (U)	Yes (F)	Yes (U)	Yes (U)	Yes (U)
Antigua & Barbuda	Yes (U)	Yes (U)	Yes (R)	Yes (U)	Yes (U)	Yes (U)	Yes (R)
Montserrat (GB)	Yes (U)	Yes (U)	Yes (R)	Yes (U)	Unknown	Yes (U)	Unknown
Guadeloupe (FR)	Yes (U)	Yes (U)	Yes (F)	Yes (R)	Yes (U)	Yes (U)	Yes (U)
Dominica	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (U)	Unknown	Unknown
Martinique (FR)	Yes (F)	Yes (F)	Yes (F)	Yes (O)	Yes (F)	Yes (U)	Yes (R)
Saint Lucia	Yes (U)	Yes (U)	Yes (R)	Yes (F)	Yes (U)	Yes (U)	Yes (R)
Barbados	Yes (U)	Yes (U)	Yes (U)	No	Yes (U)	No	Yes (R)
Saint Vincent & Grenadines	Yes (R)	Yes (R)	Yes (R)	Yes (O)	Yes (U)	Yes (U)	Unknown
Grenada	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (U)	Yes (O)	Yes (U)
Guianan							
French Guiana (FR)	No	No	Yes (F)	No	No	Yes (U)	No
Suriname	No	No	Yes (O)	No	Yes (U)	No	No
Guyana	No	No	Yes (F)	No	Unknown	Yes (U)	No
Southern Caribbean							
Trinidad & Tobago	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (U)	Yes (R)	No
Venezuela	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (U)	Yes (U)	Yes (U)
Bonaire (AN)	No	Yes (R)	Yes (R)	Yes (R)	Yes (U)	Yes (U)	Yes (U)
Curacao (AN)	No	No	Yes (U)	Yes (R)	Yes (U)	No	Yes (U)
Aruba (NL)	Yes (U)	Yes (U)	Yes (R)	No	Yes (O)	Unknown	Unknown
Southwestern Caribbean							
Colombia	Yes (U)	Yes (U)	Yes (U)	Yes (F)	Yes (U)	Yes (U)	No
Panama	Yes (U)	Yes (U)	Yes (U)	Yes (F)	Yes (F)	Yes (F)	Yes (O)
Costa Rica	Yes (U)	Yes (U)	Yes (R)	Yes (F)	Yes (U)	Yes (U)	Yes (F)
Nicaragua	Yes (F)	Yes (F)	Yes (F)	Yes (F)	Yes (U)	Yes (U)	Yes (O)
Western Caribbean, Gulf of Mexico and Florida							
Honduras	Yes (F)	Yes (F)	Yes (F)	Yes (R)	Yes (F)	Yes (U)	Yes (U)
Guatemala	Yes (U)	Yes (U)	Unknown	No	Yes (F)	Yes (U)	Unknown
Belize	Yes (U)	Yes (U)	Yes (U)	No	Yes (U)	Yes (U)	Yes (U)
Mexico	Yes (R)	Yes (U)	Yes (F)	Yes (O)	Yes (R)	Yes (U)	Yes (R)
USA	Yes (O)	Yes (F)	Yes (O)	Yes (R)	Yes (F)	Yes (U)	Yes (O)
Bermuda							
Bermuda (GB)	Yes (U)	Yes (R)	Yes (R)	No	Yes (U)	Yes (U)	Yes (U)
Brazilian							
Brazil	Unknown	Unknown	Yes (F)	Yes (O)	Yes (U)	Unknown	Yes (U)

Occurrence Frequency: R = Rare; O = Occasional; F = Frequent; FA = Frequent in one area; U = Unknown

Table 6. Threats to sea turtles at sea (foraging and migration) in the Wider Caribbean Region.

Harassment Due to Humans	Dredging	Marina & Dock Development	Boat/Personal Water Craft Collisions	Power Plant Entrapment	Oil & Gas Development	Entanglement	Offshore Artificial Lighting
No	Yes (O)	Yes (F)	Yes (R)	No	Yes (U)	Yes (R)	No
Yes (R)	Yes (U)	Yes (F)	Yes (O)	No	No	Yes (R)	No
Unknown	Yes (U)	Yes (U)	No	No	Yes (U)	Yes (U)	No
Yes (U)	No	No	Yes (R)	No	No	Yes (R)	No
No	No	No	No	No	No	Yes (U)	No
No	No	No	No	No	No	Yes (U)	No
Unknown	Yes (R)	Yes (FA)	Yes (R)	Yes (R)	Yes (R)	Yes (O)	No
Yes (F)	Yes (R)	Yes (F)	Yes (R)	No	No	Yes (F)	No
Yes (U)	Yes (O)	Yes (U)	Yes (R)	No	No	Yes (U)	No
Yes (U)	No	No	Yes (O)	No	No	Yes (U)	No
No	Yes (R)	Yes (U)	No	No	No	Yes (R)	No
Yes (R)	No	Yes (F)	Yes (U)	No	No	Yes (U)	No
Yes (O)	No	No	No	No	No	Yes (U)	No
No	No	No	Yes (R)	No	Yes (U)	No	Yes (U)
Yes (U)	Yes (R)	Yes (U)	Yes (R/O)	No	No	Yes (O)	No
Yes (U)	Yes (U)	Yes (R)	Yes (R)	No	Yes (U)	Yes (R)	Yes (R)
Unknown	Unknown	Unknown	Unknown	No	Unknown	Unknown	No
No	No	Yes (F)	No	No	Unknown	Yes (O)	No
Yes (U)	Yes (R)	No	Yes (R)	No	No	Yes (F)	No
Yes (U)	Unknown	Yes (FA)	Yes (O)	No	Yes (U)	Yes (F)	No
Yes (O)	No	Yes (U)	Yes (R)	No	No	Yes (R)	No
Yes (FA)	No	Yes (R)	Yes (R)	No	No	Yes (U)	No
Yes (O)	Yes (O)	Yes (O)	Yes (O)	No	No	Yes (R)	Yes (R)
Yes (F)	Yes (F)	Yes (F)	Yes (O)	No	No	Yes (O)	Yes (U)
No	No	No	Yes (R)	No	Yes (R)	Yes (O)	No
Yes (O)	No	No	No	No	No	Yes (O)	Yes (O)
Yes (R)	No	No	No	No	No	Yes (F)	No
No	No	No	Yes (R)	No	Yes (U)	Yes (F)	No
Yes (U)	Yes (U)	Yes (U)	Yes (U)	No	Yes (U)	Yes (O/F)	Yes (U)
No	No	Yes (U)	No	No	No	Yes (R)	No
No	No	No	No	No	No	No	No
Yes (U)	No	Yes (R)	Yes (O)	No	Yes (U)	Yes (R)	No
Yes (U)	No	No	Yes (R)	No	Unknown	Unknown	No
Yes (O)	No	Yes (R)	Yes (U)	No	Yes (O)	Yes (U)	No
Yes (U)	No	No	No	No	Yes (U)	Yes (R)	No
Yes (F)	No	Yes (FA)	No	No	Yes (U)	Yes (F)	No
Yes (O)	Yes (R)	Yes (R)	Yes (R)	Yes (R)	Yes (O)	Yes (U)	No
Yes (R)	Unknown	No	Yes (R)	No	No	Yes (F)	No
No	Yes (U)	No	No	No	No	Yes (U)	No
No	No	Yes (U)	Yes (R)	Yes (R)	Yes (U)	Yes (O)	Yes (U)
Yes (R/O)	Yes (O/F)	Yes (O/F)	Yes (O/F)	Yes (O)	Yes (O)	Yes (O)	Yes (O)
Yes (U)	Yes (U)	No	Yes (F)	Yes (R)	No	Yes (F)	Yes (R)
Yes (R)	Yes (R)	Unknown	Yes (R)	Yes (R)	Yes (U)	Yes (F)	No

Occurrence Frequency: R = Rare; O = Occasional; F = Frequent; FA = Frequent in one area; U = Unknown

Discussion and Recommendations

This assessment asks a deceptively simple question: *"Where do sea turtles nest in the Wider Caribbean Region?"* An accurate answer is critical to the recovery of depleted populations in that it relates directly to the setting of priorities for national and international conservation action, population monitoring and habitat protection, as well as to larger issues of coastal zone management and land use policy. Taking advantage of modern spatial analysis methods, and in collaboration with more than 120 Data Providers (Appendix I) and other experts, we have created the first regional maps of the distribution and abundance of the annual reproductive effort for all six species of Caribbean-nesting sea turtles.

Digital templates for collecting, organizing and representing data fundamental to conservation and management were developed to provide visual summaries of sea turtle presence (including both distribution and abundance), national protection policies, and a regional landscape of active threats. The process of developing these templates has stimulated considerable interest among Caribbean stakeholders in continuing to collaborate both to maintain the resulting databases and to use them to inform policy-making regarding the protection of critical habitat.

By collecting and collating information from field scientists, researchers, government officials, conservationists and other Data Providers, and conducting a thorough literature review, we identified areas and sources of high quality sea turtle habitat data, areas where existing information is outdated and/or inaccessible, and areas where data do not currently exist. Among the least accessible information are the geographic coordinates of coastal habitats, emphasizing the urgent need to collect baseline geospatial data on the distribution and status of important foraging habitat, including coral reef and seagrass environments.

In all, 1,311 discrete nesting sites (generally but not always coincident with natural beach boundaries, see Methods) were identified in the 43 nations and territories of the Wider Caribbean Region (WCR), inclusive of Bermuda to the north and Brazil to the south. Because some sites host nesting by multiple species, 2,535 species-specific sites were identified. In most countries the maps (see Appendix III) are deemed comprehensive, but major gaps are presumed to remain in nations (Bahamas, Dominican Republic, Haiti, St. Vincent and the Grenadines) where a national sea turtle survey has never been documented.

Our research has demonstrated that large nesting colonies are rare. Nesting grounds receiving more than 1,000 crawls per year range from 0.4% (hawksbill) to 7.0% (Kemp's ridley) of all known sites. For any species, the far majority (41%-61%, see Table 2) of nesting sites support fewer than 25 crawls per year, the equivalent of fewer than 10 reproductively active females.

Organized and consistent sea turtle population monitoring effort is still lacking in most areas and recent data (of any kind) are scarce in some jurisdictions. Two archipelagic States (Bahamas, St. Vincent and the Grenadines) and Hispaniola (Dominican Republic, Haiti) have never been completely assessed and nesting habitat data provided by local experts in these jurisdictions (as well as in Antigua and Barbuda, and St. Lucia) are, for the most part, more than a decade old. Known but unsurveyed (or inconsistently surveyed) nesting sites are marked by an "X" for "unknown abundance" in the database, identifying gaps that should be filled before a complete

landscape of critical habitat can be achieved, and before we can be assured that all major sites are included in integrated, inter-jurisdictional monitoring programs designed to characterize population trends over biologically relevant landscapes (remembering that sea turtles are migratory) and evaluate the success or failure of management investment.

It is also clear that while some nations are making exemplary progress in identifying and monitoring nesting stocks, others have barely begun and would benefit significantly from the development of standardized procedures manuals, peer-training, greater information exchange, and more consistent financial support. Of the 2,535 species-specific nesting sites identified in the 43 WCR nations and territories surveyed, 23% of these could not be categorized in the simplest terms of abundance (i.e. <25, 25-100, 100-500, 500-1,000, or >1,000 nesting crawls per year). The most noteworthy in this regard are the hawksbill and green turtles, where 33% and 24%, respectively, of known nesting sites are associated with unknown crawl abundances, providing valuable insight into data gaps and how much we still have to learn about habitat use by these species. International funding should seek to balance the undisputed value of continuing to support long-term population datasets, with the necessity of acquiring baseline data in countries (and for species) for which the least is known.

The majority (30/43 = 69.8%) of nations and territories in the Wider Caribbean Region fully protect locally occurring sea turtles, but the 'patchwork' approach is less than ideal for species, such as sea turtles, that are migratory at all life stages. To be effective, the legal framework protecting sea turtles should be consistent among range States; similarly, habitat protection policies should be geographically inclusive at the population level and embrace both nesting and foraging grounds in order to achieve conservation goals. That this is not presently the case carries consequences for individual turtles swimming between protected and unprotected jurisdictions, and, presumably, serves to diminish the effectiveness of moratoria and other conservation measures. Recent summaries of WCR sea turtle legislation are available in Fleming (2001), Chacón (2002), Reichart et al. (2003), Godley et al. (2004), and Bräutigam and Eckert (2006).

Legal fisheries typically mandate minimum size limits (by weight or shell length) – targeting large juveniles and adults in contradistinction to the best available science on population recovery. Frazer (1989) used the concept of reproductive value – a measure of the value to the population of an individual female turtle of a particular age – to emphasize the critical importance of ensuring that large turtles be protected, and noted that the regulatory framework in the WCR had been focusing sea turtle fisheries "incorrectly for over 350 years". More contemporary mathematical treatments (e.g. Crowder et al. 1994, Heppell et al. 1999, 2000, 2004) have only reinforced the conclusion that protecting large juvenile and adult turtles from exploitation is an essential component of any sustainable sea turtle management regime. While Caribbean fishery managers recognize that "understanding these [life-history] aspects is fundamental to the development of management programs" (*Santo Domingo Declaration* – Eckert and Abreu Grobois, 2001), the regulatory framework has been slow to respond.

Protection of critical habitat – nesting beaches, foraging grounds, migratory corridors – is less developed, although many of the beaches that support the region's largest remaining colonies are in managed or protected status (summarized by Eckert and Hemphill 2005). Protection at the nesting ground alone is not enough to ensure population survival, as was recently demonstrated when the world's largest leatherback nesting colony (located on the Pacific coast of Mexico, where nesting females have been protected since 1990) collapsed as a result of incidental capture and drowning in the distant gillnet fisheries of Peru and Chile (Eckert and Sarti 1997). Without first determining stock boundaries and establishing linkages between nest-

ing and foraging grounds, and then acting on this information in a policy context to create holistic management regimes, identifying and protecting important nesting sites may not be sufficient to ensure population survival.

The dataset can also be used to determine and analyze the range of threats potentially encountered by sea turtles while nesting, foraging and migrating throughout the region, and to generate a suite of index[13] nesting beach sites sufficient to monitor sea turtle populations at biologically relevant scales. Quantitative assessment and monitoring of threats at national and nesting beach scales is needed in order to determine whether current sea turtle management efforts and protection policies are measurably reducing threats to and protecting the habitat of sea turtles throughout the region. Creating a standardized regional framework and protocols for monitoring threats using sea turtles as a flagship species could also be used as a model for other managed species, including migratory species dependent on the success of inter-jurisdictional collaboration and investment.

With an aim to characterize the full range of risk factors, including those that result in the loss or degradation of critical habitat, we have constructed regionally inclusive threats matrices which, while general in nature, represent a first attempt to identify and rank the most serious potential obstacles to population recovery. The matrices broadly identify the presence or absence and relative frequency (Rare, Occasional, Frequent, Frequent in a particular Area; see Appendix II) of nesting threats in each jurisdiction.

With regard to nesting populations, more than 75% of Caribbean nations and territories acknowledge that beach erosion/accretion (and/or nest loss to other physical factors), artificial beachfront lighting, egg collection by humans, the killing of egg-bearing females, and pollution threaten the survival of sea turtles at their nesting grounds. Artificial lighting and exotic (or loss of native) vegetation would appear to be the most geographically pervasive threats, with nearly half (46% and 43%, respectively) of all countries describing them as “Frequent”.

With regard to factors potentially hindering population recovery at foraging grounds, more than 75% of Caribbean nations and territories cite pollution, fisheries bycatch, entanglement, coral reef and/or seagrass degradation, and losses to hunters, poachers and natural predators as threatening the survival of sea turtles at their foraging grounds or along migratory corridors. Marina and dock development and hunting/poaching would appear to be the most geographically pervasive threats, with 42% and 38% of all countries describing them as “Frequent”.

Conversely, mechanized beach cleaning, beach nourishment (beach rebuilding), offshore oil and gas exploration and development, offshore lighting, and power plant entrapment are cited as present (and posing a threat to sea turtles) in fewer than half of countries and territories and could be construed to be less important from a conservation investment perspective, at least on a regional scale. Fewer than 5% of countries describe at-sea predators, disease/parasites, oil and gas exploration and development, artificial offshore lighting, or power plant entrapment as a “Frequent” threat to sea turtles.

[13] According to Bräutigam and Eckert (2006), “characterizing a site, whether foraging or nesting, as an 'Index' site implies the consistent and long-term application of standardized population monitoring protocols to ensure the data are suitable for trend analysis. Survey boundaries are specifically set and adhered to from year to year, and the survey area is representative (i.e. it should attempt to represent a range of threat and protection levels, a variety of turtle life stages, and a range of turtle population densities). The emphasis of this protocol is on establishing index methods for measuring trends in relative abundance at fixed locations; therefore, the sampling strategies at each Index site should ideally be structured in a manner that allows inference to a larger area of interest.”

In summary, we achieved our objectives in generating the first standardized and geographically comprehensive spatial database of active sea turtle nesting beaches in the central western Atlantic Ocean. The data collected and assembled will allow for further research and analysis of sea turtle abundance (including population trends) and habitat use; for example, in conjunction with other datasets to determine areas of high biodiversity (e.g. through processes such as The Nature Conservancy's Ecoregional Planning) or areas in need of urgent protection.

Our hope is that the information collected during the project, and archived and displayed in the online database (http://seamap.env.duke.edu/), will be ever-improving, updated regularly by Data Providers in each country or territory, and used to establish conservation and management priorities, inform local and national land use decisions, and improve policy at national and regional levels. Through this project, all nations in the WCR have been and will continue to be encouraged to attain higher levels of data quality, completeness, and compatibility by increasing their efforts to identify and monitor nesting and foraging sites. Improvement in these areas will also strengthen implementation of regionally negotiated agreements aimed at sustainably managing shared marine resources; specifically, the Convention for the Protection and Development of the Wider Caribbean Region and the Inter-American Convention for the Protection and Conservation of Sea Turtles.

Future goals of the project are to research and incorporate seagrass and coral reef data to determine nationally and regionally significant foraging areas, thus identifying marine areas in need of management attention and contributing to the development of a network of population monitoring programs, including juvenile and adult age classes, at index sites. Similarly, there is a need to research and incorporate genetic data (cf. Bowen and Karl 1996, Encalada et al 1998, Díaz et al. 1999, Bass 1999, Dutton et al 1999, Bowen et al. 1997, 2005, 2006) into the database in order to: highlight and illustrate linkages between nesting and foraging grounds, create a dialogue on the need to ensure the survival both of large colonies and a representative landscape of genetic diversity present in widely distributed remnant stocks, and support efforts to harmonize management policies among range States.

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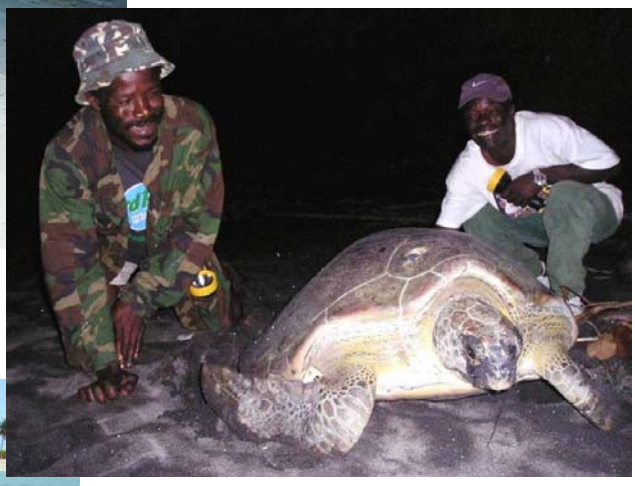

Monitoring hawksbill and green sea turtle populations at **Jumby Bay, Antigua** (*photo by* Martha Gilkes); **Rosalie Bay, Dominica** (*photo by* Rowan Byrne); and **Mona Island, Puerto Rico** (*photo by* Chelonia, Inc.)

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APPENDIX II

Sea Turtle Threats Survey

Hawksbill shell bracelets from **Bocas del Toro, Panama** (*photo by* R. Merel)

Green turtles at market in **Puerto Cabezas, Nicaragua** (*photo by* Cynthia Lagueux, Wildlife Conservation Society)

Green turtle entangled in a fishing net off the coast of **Costa Rica** (*photo by* Didiher Chacón, WIDECAST)

2006 Sea Turtle Threats Survey

Country/Territory: _____
Contact: _____
Date/Time: _____

R = Rare**, O =** Occasional**, F =** Frequent**, FA =** Frequent in a certain Area**, U =** Unknown

Nesting Threats

Killing of nesting females by humans
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Killing of nesting females by predators
Which predator species? Invasive species?

How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Nest loss to predators
Which predator species? Invasive species?

How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Nest loss to abiotic factors
What factor? Ex. flood, erosion

Egg Collection (by humans)
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Harassment due to increased presence of humans
Ex. tourists discouraging nesting

Artificial lighting
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Pollution
What type of pollution – agriculture, petroleum/tar, sewage, industrial runoff, beach litter/debris? Are these pollutants rare, occasional, frequent, or frequent in a particular area?

Beach erosion/accretion
Where? When? Caused by storm events? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Beach armoring/stabilization structures
Where? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Beach nourishment
Where? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Recreation beach equipment and/or other obstacles
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Mechanized beach cleaning
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Beach vehicular use
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Sand mining
Where? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Exotic (or loss of native) vegetation
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Livestock (presence on the beach)
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Foraging/Migration Threats

Seagrass degradation
By what? Ex. Anchor damage, pollution, sedimentation. How extensive is the problem? Rare, occasional, frequent, or frequent in a particular area?

Coral reef degradation
By what? Ex. Anchor damage, pollution, sedimentation. How extensive is the problem? Rare, occasional, frequent, or frequent in a particular area?

Fisheries
Which fisheries? Ex. Trawl, purse seine, hook and line, gill net, pound net, long line, pot/trap, dynamite/blast, chemical, “nets” – undefined.

Are takes by fisheries: Rare, occasional, frequent, or frequent in a particular area?

Hunting/Poaching
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Pollution
What type of pollution – agriculture, petroleum (oil), sewage, industrial runoff, pollution (cruise liners/yachts), marine debris, “declining water quality” - undefined

Are these pollutants rare, occasional, frequent, or frequent in a particular area?

Predators
What species? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Disease/Parasites
Which diseases or parasites? How many cases have been seen (e.g. How big of a problem is this?) Rare, occasional, frequent, or frequent in a particular area?

Harassment due to increased human presence
Ex. Snorkelers, divers, increased boat traffic. How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Dredging
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Marina and dock development
Where? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Boat/Personal Water Craft collisions
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Power Plant entrapment
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

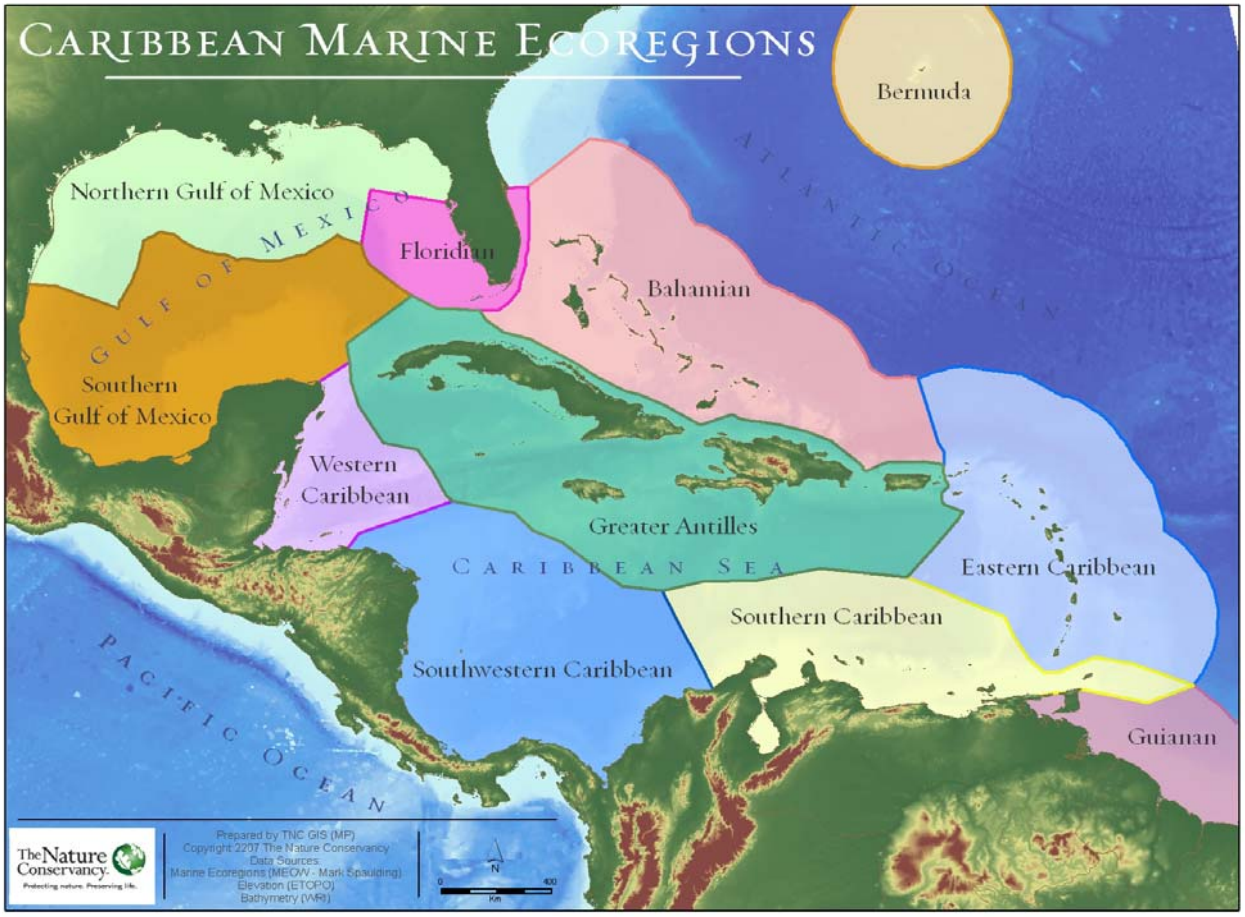
Oil and gas exploration, development, and transportation
Where? How often does this occur? Rare, occasional, frequent, or frequent in a particular area?
Entanglement (debris, abandoned gear etc.)
How often does this occur? Rare, occasional, frequent, or frequent in particular a particular area? In what do turtles become entangled?

Offshore artificial lighting
How often does this occur? Rare, occasional, frequent, or frequent in a particular area?

Other Comments

APPENDIX III

Wider Caribbean Region Sea Turtle Habitat National Reports



For ease of reference, the National Reports are presented in alphabetic order and then color-coded according to their Ecoregion (cf. Spalding et al. 2007). Brazil (not featured in Spalding et al. 2007), is color-coded in this volume as gray.

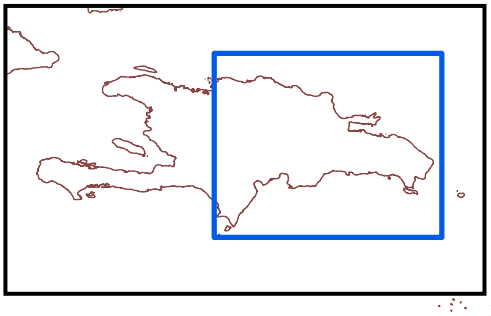
Dominican Republic Sea Turtle Habitat

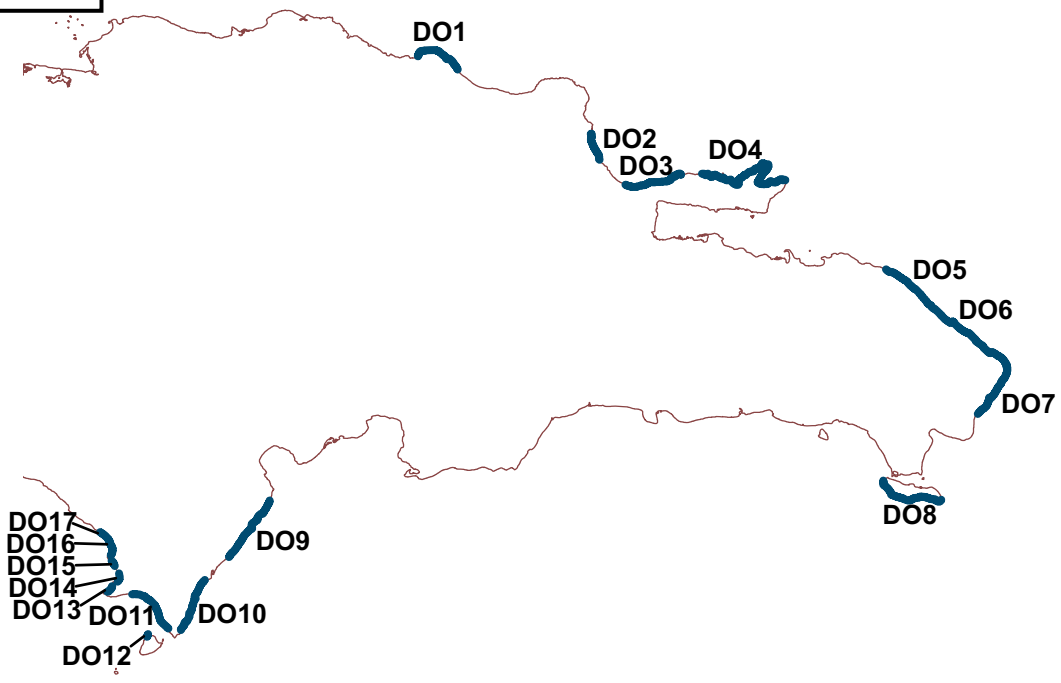
Sea Turtle Presence	
Loggerhead Turtle (*Caretta caretta*)	N, I
Green Turtle (*Chelonia mydas*)	N, F
Leatherback Turtle (*Dermochelys coriacea*)	N
Hawksbill Turtle (*Eretmochelys imbricata*)	N, F
Kemp's Ridley Turtle (*Lepidochelys kempii*)	A
Olive Ridley Turtle (*Lepidochelys olivacea*)	A

N = Nesting; F = Foraging; IN = Infrequent Nesting; IF = Infrequent Foraging; I = Infrequent (further detail unavailable); A = Absent

National Policy for the Protection of Sea Turtles	
Complete (indefinite) protection	Yes
Moratorium (fixed period)	–
Prohibition(s) on take	–
Closed season	–
Minimum size limits	–
Maximum size limits	–
Annual quota	–
Permits/licenses required	–
Gear restrictions	No
Area closures (MPA, park, reserve)	Yes
Reports of exploitation/sale nationally	Yes
Reports of illegal trade internationally	Yes
General public awareness of laws	No
Recent prosecutions or penalties	No
Enforcement considered adequate	No
Penalties are an adequate deterrent	No

E = Eggs; N = Nests; NF = Nesting Females; – = Not Applicable





Data Providers

Yolanda Leon, Jesus Tomas

Grupo Jaragua Inc.

Instituto Tecnológico de Santo Domingo

University of Valencia

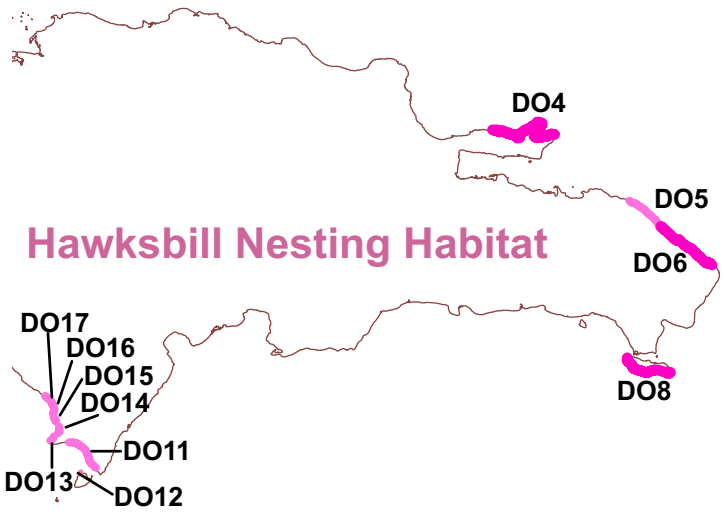
Kilometers
0 15 30 60 90 120

Sea Turtle Nesting Habitat

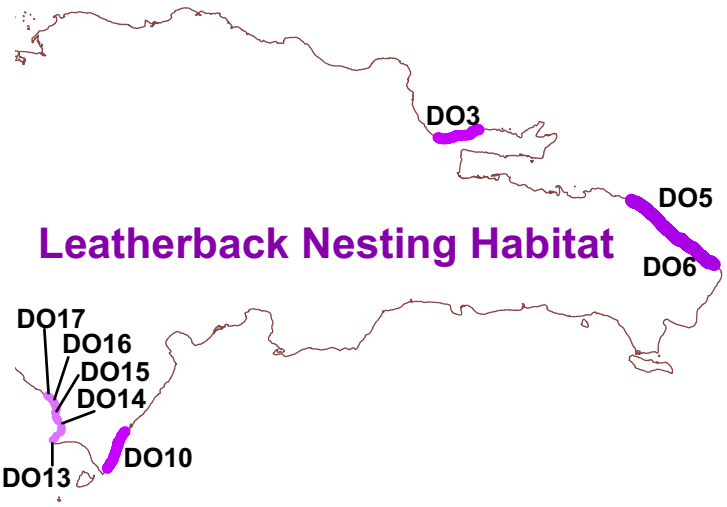
GSHHS Caribbean Shoreline

N

Dominican Republic Sea Turtle Habitat



Hawksbill Nesting Habitat



Leatherback Nesting Habitat

Green Nesting Habitat

Loggerhead Nesting Habitat

Hawksbill Nesting Habitat
- X Crawls per year
- <25 Crawls per year
- 25-100 Crawls per year

Green Nesting Habitat
- <25 Crawls per year
- 25-100 Crawls per year

Leatherback Nesting Habitat
- <25 Crawls per year
- 25-100 Crawls per year
- 100-500 Crawls per year

Loggerhead Nesting Habitat
- <25 Crawls per year

- **GSHHS Caribbean Shoreline**

Kilometers
0 30 60 120 180 240

N

Dominican Republic Sea Turtle Habitat

Threats to Sea Turtles - Nesting		
Killing of Nesting Females by Humans	Yes (O)	
Killing of Nesting Females by Predators	Yes (R)	
Nest Loss to Predators	Unknown	
Nest Loss to Abiotic Factors	Unknown	
Egg Collection by Humans	Yes (U)	
Harassment Due to Increased Human Presence	No	
Artificial Lighting	Unknown	
Pollution	Yes (U)	Beach litter/debris
Beach Erosion/Accretion	Yes (U)	Erosion
Beach Armouring/Stabilization Structures	Yes (O)	
Beach Nourishment	Yes (R)	Future project to nourish three tourist beaches
Recreational Beach Equipment and/or Other Obstacles	Yes (F)	Mostly beach chairs on hotel beaches
Mechanized Beach Cleaning	Yes (FA)	On resort beaches
Beach Vehicular Use	Yes (O)	
Sand Mining	Yes (FA)	Macao, Salinas Dunes National Park
Exotic (or Loss of Native) Vegetation	Yes (F)	Most shoreline vegetation has been replaced by coconut groves
Livestock Presence on the Beach	Yes (R)	Goats, horses and mules
Occurrence Frequency: R = Rare; O = Occasional; F = Frequent; FA = Frequent in one area; U = Unknown		

Threats to Sea Turtles - Foraging/Migration		
Seagrass Degradation	Yes (U)	Pollution and removal by development
Coral Reef Degradation	Yes (U)	Pollution, sedimentation, coral bleaching and disease
Fisheries Bycatch	Yes (F)	Purse seine, gillnet, pot/trap and hookah diving
Hunting/Poaching	Yes (F)	
Pollution	Yes (U)	Sewage and marine debris
Predators	Yes (U)	Sharks
Disease/Parasites	Yes (R)	Fibropapillomas
Harassment Due to Increased Human Presence	Unknown	
Dredging	Yes (R)	Boca Chica
Marina and Dock Development	Yes (FA)	New marinas on east and northern coasts
Boat/Personal Water Craft Collisions	Yes (R)	
Power Plant Entrapment	Yes (R)	
Oil and Gas Exploration, Development, Transportation	Yes (R)	
Entanglement	Yes (O)	Monofilament lines and nets
Offshore Artificial Lighting	No	
Occurrence Frequency: R = Rare; O = Occasional; F = Frequent; FA = Frequent in one area; U = Unknown		

Dominican Republic Sea Turtle Habitat

Beach Identification Codes with Beach Names			
DO1	Sosúa-Boca del Yásica	DO10	Playas de Oviedo (San Luis, Mosquea, Inglesa)
DO2	Nagua - Gran Estero	DO11	Cabo Beata - Cabo Falso
DO3	Boca del Estero - Las Terrenas	DO12	Isla Beata
DO4	Playa Las Terrenas - Cabo Samaná	DO13	Playas de Pedernales - Lanza Zó
DO5	Playa Nisibon - Boca del Maimon	DO14	Playas de Pedernales - Bahía de las Aguilas
DO6	Playa Macao - Cabeza de Toro	DO15	Playas de Pedernales - La Cueva
DO7	Boca del Maimon - Boca del Río Anamuya	DO16	Playas de Pedernales - Cabo Rojo
DO8	Isla Saona	DO17	Playas de Pedernales - Bucán Yé
DO9	Los Arroyos - Enriquillo		

WIDECAST

Wider Caribbean Sea Turtle Conservation Network

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

The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) is a regional coalition of experts and a Partner Organization to the U.N. Environment Programme's Caribbean Environment Programme. WIDECAST was founded in 1981 in response to a recommendation by the IUCN/CCA *Meeting of Non-Governmental Caribbean Organizations on Living Resources Conservation for Sustainable Development in the Wider Caribbean* (Santo Domingo, 26-29 August 1981) that a "Wider Caribbean Sea Turtle Recovery Action Plan should be prepared ... consistent with the Action Plan for the Caribbean Environment Programme."

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

Emphasizing initiatives that strengthen capacity within participating countries and institutions, the network develops and replicates pilot projects, provides technical assistance, enables coordination in the collection, sharing and use of information and data, and promotes strong linkages between science, policy, and public participation in the design and implementation of conservation actions. Working closely with local communities and resource managers, the network has also developed standard management guidelines and criteria that emphasize best practices and sustainability, ensuring that current utilization practices, whether consumptive or non-consumptive, do not undermine sea turtle survival over the long term.

With Country Coordinators in more than 40 Caribbean nations and territories, WIDECAST is uniquely able to facilitate complementary conservation action across range States, strengthening and harmonizing legislation, encouraging community involvement, and raising public awareness of the endangered status of the region's six species of migratory sea turtles. As a result, most Caribbean nations have adopted a national sea turtle management plan, poaching and illegal product sales have been reduced or eliminated at key sites, many of the region's largest breeding colonies are monitored on an annual basis, alternative livelihood models are increasingly available for rural areas, and citizens are mobilized in support of conservation action. You can join us! Visit www.widecast.org for more information.

WWW.WIDECAST.ORG