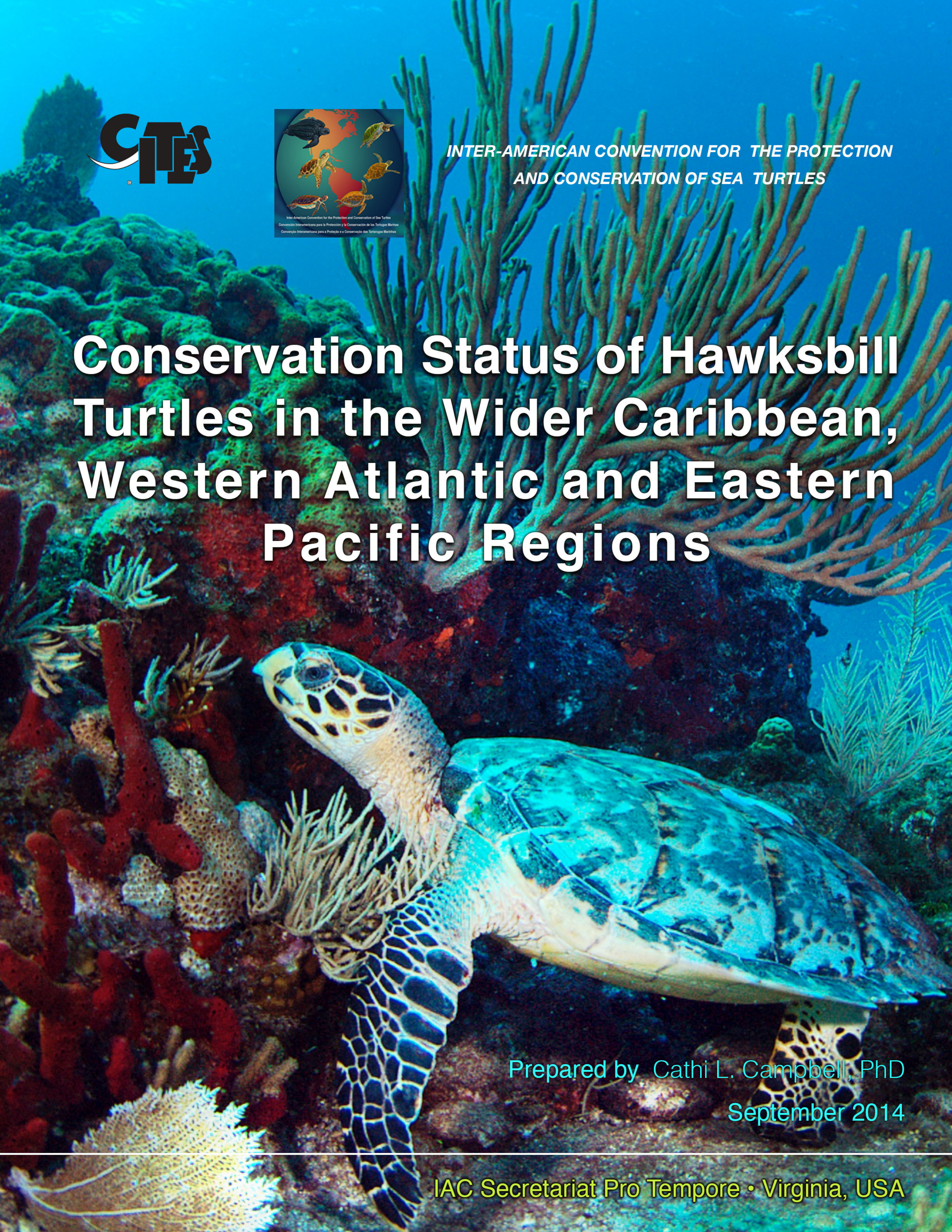

INTER-AMERICAN CONVENTION FOR THE PROTECTION AND CONSERVATION OF SEA TURTLES

Conservation Status of Hawksbill Turtles in the Wider Caribbean, Western Atlantic and Eastern Pacific Regions

Prepared by Cathi L. Campbell, PhD

September 2014

IAC Secretariat Pro Tempore • Virginia, USA

Inter-American Convention for the Protection and Conservation of Sea Turtles

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Hawksbill turtle in the waters of Saint Barthelemy, French West Indies. © Franck Mazéas.

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Hawksbill hatchlings on Crawl Cay in the Pearl Cays, Nicaragua. © Victor Huertas

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EXECUTIVE SUMMARY

Interest in and concern for the conservation and recovery of the hawksbill sea turtle (*Eretmochelys imbricata*) was heightened when the species was included in the most threatened category of the International Union for the Conservation of Nature (IUCN) Red List in 1968 and later (1977) listed on Appendix I ["species threatened with extinction which are or may be affected by trade"] of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). More recently, the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) expressed concern for the species by adopting a resolution "Conservation of the Hawksbill Turtle" in 2006 (COP3/2006/R-1). As hawksbill populations continue to decline in many parts of its global range, the IAC has placed a high priority on keeping its member States updated regarding the biological status of this species in the Wider Caribbean/Western Atlantic, and Eastern Pacific regions in order to prioritize and guide actions needed to ensure the full recovery of hawksbills in these regions. To that end, this report compiles recent information (since 2009) on the status of the species including nesting populations and foraging aggregations, aspects of their biology and life history, population trends, fisheries impacts and other threats. Also included are recent changes in protective legislation, mitigation measures and a set of recommendations for further research and other needed actions.

A review of population trends shows that a number of Wider Caribbean/Western Atlantic populations are increasing or stable, while others are declining from continued exploitation and other threats, such as fisheries bycatch. Monitoring at many of the principal remaining rookeries in the Wider Caribbean is not only providing important information on nesting population status, but also provides *de facto* protection in many cases. Recent increased efforts in the eastern Pacific have greatly improved our understanding of the status of hawksbills in this region. It is becoming more apparent that hawksbills in the eastern Pacific, while rare, are still present in many coastal and nearshore areas, and exhibit some differences in habitat use by adults compared to hawksbills in other regions.

Recent research in hawksbill biology, nesting ecology, growth, movements and genetics, among others, is providing much needed information to better understand the species at local, regional, and ocean basin scales. Regional scale assessments indicate that hawksbill rookeries in the southwest Atlantic are located in protected areas at a higher proportion than in the Wider Caribbean; while eastern Pacific rookeries are among the least included in protected areas. Furthermore, the eastern Pacific and southwest Atlantic may be the least resilient to climate change. Studies on hawksbill biology show a wide range of growth rates and, to a lesser extent, variability in feeding habits. Genetic, tagging, and tracking studies demonstrate how wide ranging hawksbills can be, with movements and habitat shifts of more than 2,000 km in the Caribbean region, although in the eastern Pacific movements may be more restricted. Increased knowledge from these studies is vital to our efforts to conserve and recover the species.

Among the recommendations provided in this document are the need for: **1)** increased compliance with existing regulations protecting hawksbills, including illegal trade of hawksbill products within and between countries; **2)** educational campaigns designed to increase awareness of and compliance with existing regulations, combined with stakeholder participation to develop solutions to decrease hawksbill mortality, and develop alternative sources for income and food; **3)** a thorough, quantitative threats assessment in order to focus efforts on those threats that have the greatest impact on population growth and recovery; **4)** recognizing the rights of each nation to implement their own legislation, a review and possible amendment of protective legal frameworks to ensure a consistent approach to hawksbill turtle conservation within published regional management units, including legally binding instruments at regional and global levels, so that existing protective measures are not negated or negatively impacted by ongoing take in other countries; **5)** efforts to better quantify and mitigate fisheries bycatch of hawksbills; **6)** increased protection of important foraging and nesting habitats, **7)** additional research and monitoring to better assess population trends and better understand population dynamics; and **8)** further expansion of research on climate change impacts and identification of appropriate mitigation measures.

Although much work is still needed to better understand hawksbill ecology and what is needed to recover their populations, we are clearly making progress with several populations indicating upward trends; however, gaps in the regulatory framework remain and many populations are in decline or remain unassessed; thus, concerted efforts on protection and mitigation measures are needed at local, national, and regional levels. Finally, while hawksbills show some signs of being able to adapt to changing conditions, a significant effort will be needed to mitigate the threat of climate change and drastically reduce the gauntlet of other threats the species faces. The synergistic effects of continuing to study, share our knowledge and find solutions together to optimize positive outcomes and minimize negative impacts on this long-lived species will be needed to ensure that hawksbills are able to fulfill their ecological roles in coral reef, seagrass, and mangrove ecosystems in perpetuity.

INTRODUCTION

Purpose – The Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) provide their respective member States with updated information on the conservation status of sea turtles, based on the best available scientific evidence. To promote the conservation and recovery of hawksbill sea turtles (*Eretmochelys imbricata*), the IAC, in collaboration with and financial support from CITES, has commissioned this document to review the current status of hawksbills in the Americas, including the Wider Caribbean/Western Atlantic and Eastern Pacific regions (see Appendix I). Hawksbill turtles are of particular interest to the IAC and CITES because of the species' critically endangered status due to severe reductions in populations globally resulting from human activities. In response to widespread population declines, conservation efforts increased in the latter half of the 20th century at local, national, and international levels, and this effort has continued to the present. Thus, it is important to reassess the status of hawksbills on a regular basis in order to evaluate and adapt conservation and management actions.

Objectives – Provide an overview of recent (since 2009) research results and conservation efforts towards the recovery of hawksbill turtles in two regions: the Wider Caribbean and Western Atlantic (WC/WA), and the Eastern Pacific (EP). Also, provide information on remaining gaps in our knowledge and recommendations for future research and conservation efforts.

Geographic Context – The Wider Caribbean includes the islands of the Caribbean (including The Bahamas), the Gulf of Mexico (including the United States (US), and Mexico), and the coastal areas of the eastern Central American isthmus (Figure 1a). This diverse region includes nesting beaches, coral reef ecosystems, fringing and patch reef habitats, and associated seagrass habitats that are important environments for breeding, developing and foraging hawksbill turtles. The western Caribbean contains the second largest barrier reef in the world (Mesoamerican Great Barrier Reef, located off Belize and Yucatán, Mexico), and the region hosts highly productive nesting beaches on both mainland and island coastal shores. The Western Atlantic includes the eastern coastal US (primarily nearshore waters), Bermuda, and the east coast of South America, south to Uruguay (Figure 1a).

The Eastern Pacific includes coastal areas from southern California (US) to Peru (Figure 1a). Environmental conditions in this region are highly variable and unpredictable, but particularly important to hawksbills are the shallow coastal habitats where adult hawksbills often reside in mangrove estuaries (Gaos et al. 2011), unlike their counterparts in the rest of the world that are more closely tied to coral reef habitats (e.g., Plotkin 2003).

Regional management units (RMU) for sea turtles, including hawksbills, were developed and reported in Wallace et al. (2010). The RMUs were based on a compilation of data on marine turtle biogeography (nesting sites, population abundance and trends), population genetics, and satellite telemetry. Relevant to this report are three RMUs: the "Atlantic, Western Caribbean/USA"; the "Atlantic, Southwest"; and "Pacific, East" (Figure 1b).

Figure 1a. General map showing most countries included in report, with inset of eastern Caribbean islands. Missing from the map is Bermuda off the east coast of the United States.

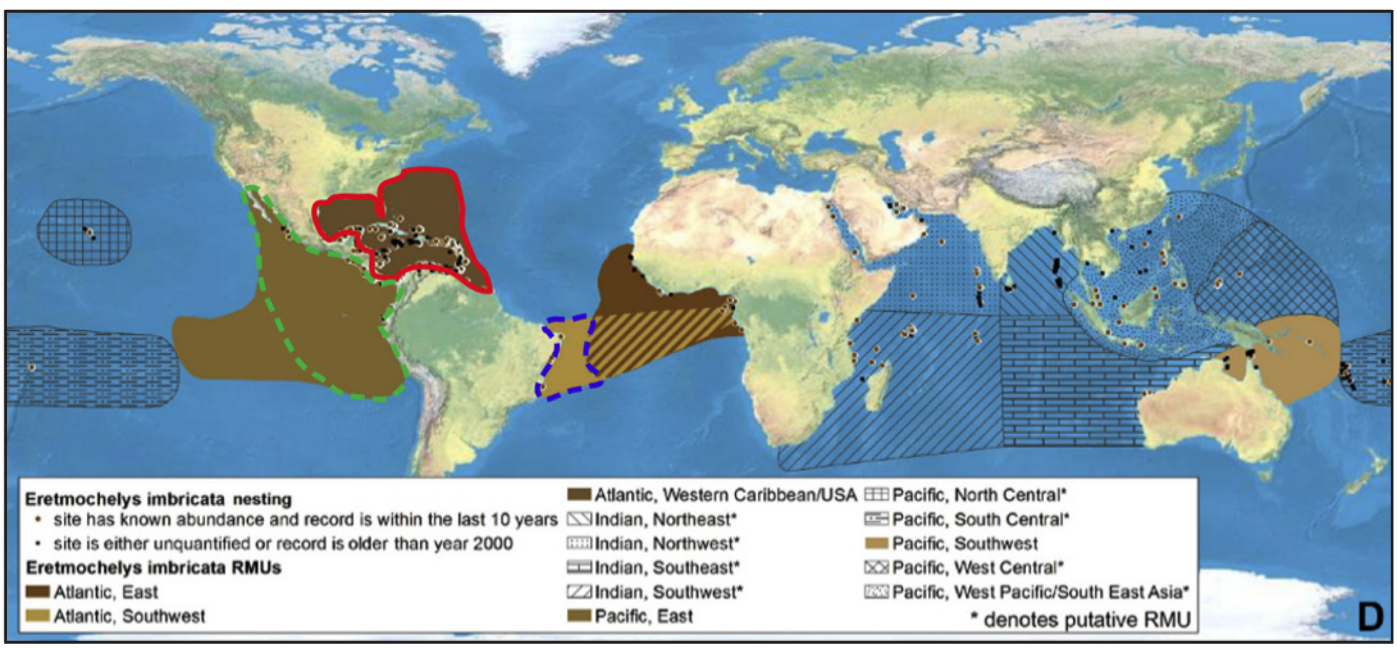

Figure 1b. Regional management units (RMU) for hawksbill turtles from Wallace et al. (2010). There are three RMUs relevant to this report; they include the Atlantic, Western Caribbean/USA (outlined in red), the Atlantic, Southwest (partially outlined in blue, does not include the east Atlantic), and Pacific, East (partially outlined in green, does not include the entire RMU). Outlined areas added to show the general areas being covered in this report.

WIDER CARIBBEAN AND WESTERN ATLANTIC REGION

Distribution

Nesting

The distribution of hawksbill nesting in the WC/WA has been described by Dow et al. (2007) in the most comprehensive dataset to date. Nesting is widespread throughout the region, from across the Caribbean (insular and mainland) and into South America, as far south as the state of Espírito Santo on the south-central coast of Brazil (Marcovaldi et al. 2007). Dow Piniak and Eckert (2011) reported that of 43 countries and territories surveyed, only two (Bermuda, Cayman Islands) reported no hawksbill nesting, and three sites (French Guiana, Saba, and US) reported infrequent nesting activity. Nesting density remains unquantified at more than one-third of hawksbill nesting beaches, although most of these are believed to have fewer than 25 crawls/yr. These sites, together with 51% of sites known to support fewer than 25 crawls/yr represent more than 80% of all nesting in the region (Dow et al. 2007). There are no new additions to hawksbill nesting distribution; however, the status of some known rookeries may have changed and these changes are summarized below.

Priority Nesting Sites

Information on nesting abundance of hawksbills in the WC/WA has been outlined in Dow et al. (2007), and more recently by National Marine Fisheries Service and U.S. Fish and Wildlife Service (2013) in the hawksbill five-year review. In both of these reviews, it is clear that the principal nesting beaches for hawksbills in the WC/WA region are located in Mexico (Yucatán peninsula beaches), Barbados, Panama (Bocas del Toro), Puerto Rico (Mona Island), and Brazil. New information on estimates of hawksbill nesting from Delcroix et al. (2013) suggests that Guadeloupe (all beaches in the archipelago combined) is also a principal nesting area in the region. National Marine Fisheries Service and US Fish and Wildlife Service (2013) reported that of 33 nesting sites in the Atlantic with some recent trend data, 10 are increasing, none are stable, and 10 are declining. Nesting trends for the remaining 13 sites were listed as unknown. Included below is a summary of recent information on some of the principal nesting sites and, where available, information about recent nesting population trends and annual clutch and/or female counts.

Mexico – The Yucatán Peninsula continues to provide a number of important beaches for hawksbill nesting. The highest nesting activity occurs at Punta Xen in Campeche, followed by two other important sites, El Cuyo (Yucatán) and Holbox Island (Quintana Roo), although there are numerous other nesting sites in the Yucatán Peninsula. Overall nesting in the state of Campeche appears to be stable but fluctuating since about 2004 (see Guzmán Hernández and García Alvarado 2014), and has not yet returned to the higher nesting levels recorded in the mid 1990s and early 2000s. In the northern Yucatán Peninsula, including both states (Yucatán and Quintana Roo), there is an apparent overall increasing trend in nesting since about 2004 (Figure 2, although data are from an informal and unpublished assessment), with recent estimates of approximately 1,500-2,000 clutches laid annually, which is similar to 1998 and 2000 levels (see reference in figure legend).

Barbados – With two genetically distinct populations (Browne et al. 2010), the island of Barbados hosts one of the most abundant hawksbill nesting areas in the region. Beggs et al. (2007) reported increased nesting in Barbados, both at index sites and island-wide, from 1997-2004 (>2,000 clutches in 2003 and 2004). More recent population trend data are not yet published, but nest counts exceeded 3,200 in 2013 (J. Horrocks, pers. comm.).

Guadeloupe – A recent study to assess monitoring methods and provide better estimates of sea turtle nesting in the archipelago concluded that hawksbill nesting on 45 beaches in 2007 and 59 beaches in 2008 ranged from an estimated 1,925 to 6,415 clutches and 1,435 to 4,742 clutches, respectively (Delcroix et al. 2013). These recent estimates suggest that the Guadeloupe archipelago, with more than 150 potential nesting beaches, may be one of the most important nesting areas in the WC/WA region; however, caution is warranted due to limitations in data collection and wide confidence intervals of their estimates. Analysis of long-term monitoring at Trois Ilets from 2000-2008 shows an increasing trend (Delcroix et al. 2013).

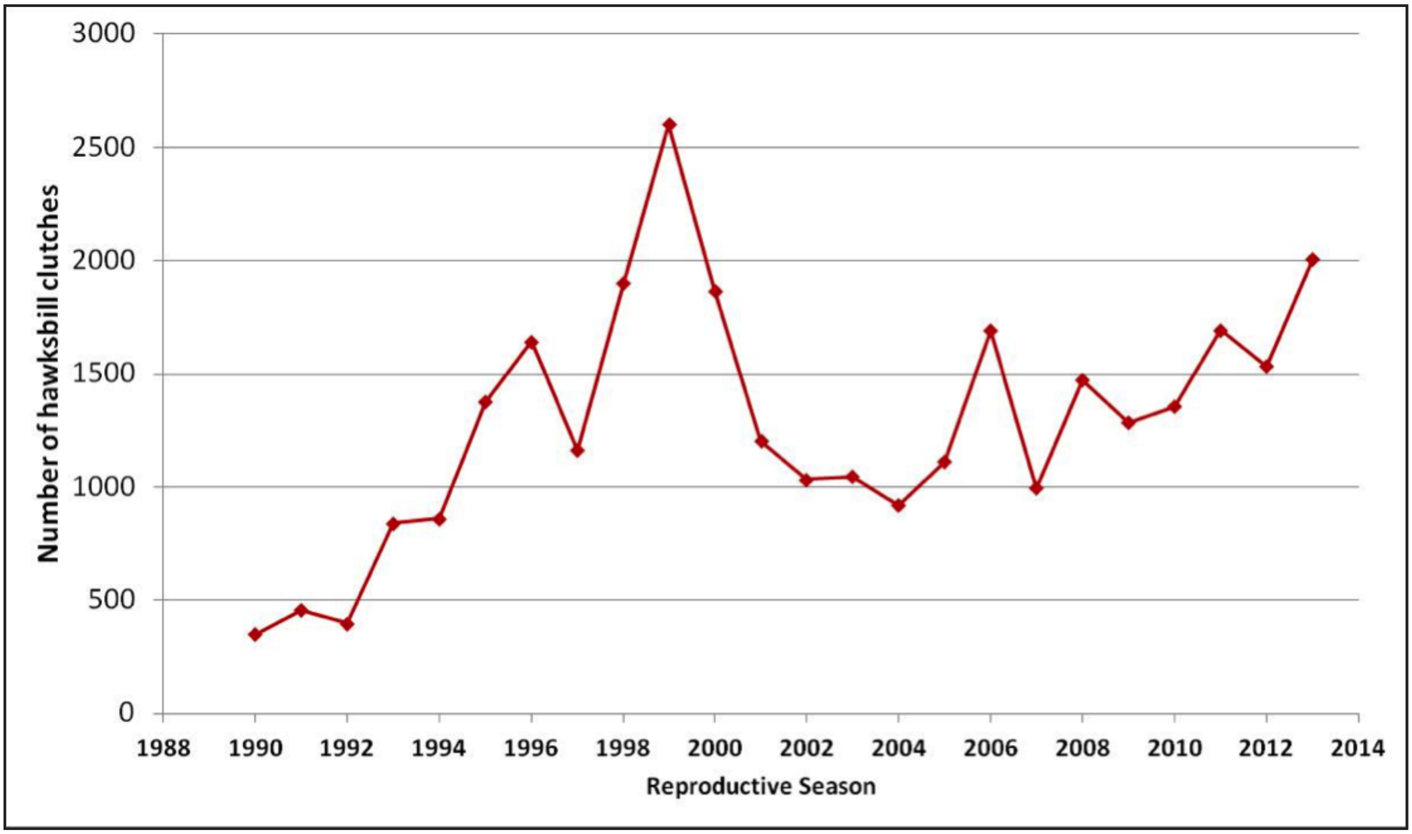

Figure 2. Combined nesting activity for the northern Yucatán Peninsula, from 1990 to 2013, graph compiled by E. Cuevas (unpubl. data). Data sources: Pronatura Península de Yucatán, A. C., Reserva de la Biosfera Ría Lagartos-CONANP; Reserva de la Biosfera Ría Celestún-CONANP; Área de Protección de Flora y Fauna Yum Balam-CONANP, 2014.

Panamá – With more than 1,500 hawksbill nests/yr in recent years, nesting beaches in the Bocas del Toro area rank among the highest for hawksbill nesting (Meylan et al. 2013) in the WC/WA region. This area serves not only as an important nesting area, but also is used as mating habitat and for reproductive migrations (Meylan et al. 2013). Nesting in the Bocas del Toro area is increasing based on monitoring data presented at the 34th Symposium on Sea Turtle Biology and Conservation, New Orleans, US in April 2014 (A. Meylan pers. comm.).

Puerto Rico – Mona Island hosts a relatively large and increasing hawksbill rookery in the region with more than 1,500 clutches laid in 2013 (Diez and van Dam 2014, unpubl. report). Nesting at the index beach has more than doubled in the past decade, and for all Mona beaches combined has steadily increased over the past decade or more. With consistent and complete coverage of all beaches on Mona Island since 1996, it is clear that overall nesting has more than quadrupled over the past 18 years. Other sites in Puerto Rico also host nesting hawksbills, among those are two secondary sites: Vieques Island with 264 and 117 clutches observed during the 2012 and 2013 seasons, respectively; and Maunabo (mainland Puerto Rico) with 131 and 101 clutches during the 2012 and 2013 seasons, respectively (Diez 2014, unpubl. report).

Brazil – Santos et al. (2013) reported that hawksbill nesting in the state of Rio Grande do Norte is stable with approximately 190 clutches/yr at index sites along 9 km of beach. Nesting on the 42 km of total nesting beach monitored in this area averages 840 clutches annually based on the 2010/11 to 2013/14 nesting seasons (Projecto TAMAR, unpubl. data). However, this area is secondary to the primary beaches located in the states of Bahia (northern coast) and Sergipe. Nesting at these primary beaches continues to increase from that reported in Marcovaldi et al. (2007), with annual estimates exceeding 1,500 clutches/yr in recent years (Projecto TAMAR unpubl. data, N. Marcovaldi pers. comm.). Although the most recent trends are unpublished, the data have been statistically analyzed and provides good evidence of a continued increase at these principal beaches. There is also nesting in the state of Paraiba (~140 clutches/yr along 7 km of beach, R. Mascarenhas pers. comm.) and Pernambuco (~115 clutches/yr along 12 km of beach, Moura et al. 2012), although no trend for these sites has been reported.

Recent information on other, less abundant, but important sites in the region include:
Doce Leguas (located in the Jardines de la Reina National Park), Cuba with approximately 150-250 clutches/yr (Moncada et al. 2010, 2011a), no trend information is available.

Pearl Cays (located in the Cayos Perlas Refugio Vida Silvestre), Nicaragua with approximately 290 clutches/yr in recent years; and based on close monitoring for more than a decade, there is an increasing trend with more than double the clutches laid in recent years than recorded in earlier years of monitoring (Lagueux et al. 2013).

Saona Island (located in Del Este National Park), Dominican Republic with approximately 100 clutches/yr (2007-2010, Revuelta et al. 2013) appears to be stable, although these results are from relatively short-term monitoring. Additional unpublished data shows a possible increase beginning in 2010 (Y. León unpubl. data).

Jumby Bay, Antigua with 71 nesting females and 247 clutches in 2012 (Pahlas and Braman 2012) at this long-term, closely monitored site, continues to show a gradal increasing trend, although no recent formal trend assessment has been conducted; and

Buck Island Reef National Monument, Saint Croix, US Virgin Islands, shows an increasing trend (I. Lundgren cited in National Marine Fisheries Service and US Fish and Wildlife Service 2013).

Two areas with remnant nesting have been reported to show declines in nesting, including beaches in the Dominican Republic outside of the Saona Island rookery (Revuelta et al. 2012), located primarily around the Jaragua-Bahoruco-Enriquillo Biosphere Reserve (based on relatively short-term monitoring); and in Antigua and Barbuda outside of the Jumby Bay rookery (Levasseur et al. In press, cited in National Marine Fisheries Service and US Fish and Wildlife Service 2013).

A potential important gap in knowledge of hawksbill nesting occurs in The Bahamas, where there are hundreds of islands and possible widespread hawksbill nesting beach habitat. There is no empirical information on nesting abundance or trends despite previous reports of 500-1,000 clutches/yr (Mortimer and Donnelly 2008), and hence surveys of potential nesting sites are needed to determine the importance of this area to the regional hawksbill population.

In summary, there is evidence, with varying levels of monitoring and analysis (i.e., confidence), of increasing trends at nine area/site(s) (Antigua - Jumby Bay, Barbados, Brazil - Bahia / Sergipe, Guadeloupe - Trois Ilets, Mexico – northern Yucatán Peninsula, Nicaragua - Pearl Cays, Panama – Bocas del Toro area, Puerto Rico – Mona Island, and US Virgin Islands – Buck Island Reef National Monument). There is also evidence of stable populations in three area/site(s) (Mexico - Campeche, Brazil - Rio Grande do Norte, and Dominican Republic - Saona Island). Evidence for declines was found in two areas (Dominican Republic beaches outside of the Saona Island rookery, and Antigua and Barbuda beaches outside of the Jumby Bay rookery).

It should be noted that trend data are woefully lacking overall and that there is little information on many areas where hawksbill nesting occurs or may occur throughout the region (Dow Piniak and Eckert 2011). Also noteworthy is that increasing trends in nesting are primarily from well-monitored and often protected sites, thus our information is biased towards areas that receive some protection through conservation efforts and/or law enforcement.

Foraging

Hawksbills can be found foraging throughout the WC/WA and are principally associated with reef and other hard-bottom habitats in this region, although recent studies have also documented their presence in seagrass habitats (e.g., Bjorndal and Bolten 2010, Richardson et al. 2009). Based on efforts by Dow-Piniak and Eckert (2011) only three countries/territories (French Guiana, Guyana, and Suriname) in the Wider Caribbean reported an absence of foraging hawksbills. Hawksbills can be found in waters as far south as Uruguay (Estrades et al. 2013), and one hawksbill was reported captured in fisheries in Argentina (Bruno and Albareda 2009). Hawksbill presence in foraging areas where humans encounter them is widespread; however, most of these aggregations have not been studied. Studies of turtle abundance in foraging areas are logistically more challenging and often cost-prohibitive, and thus there are many fewer studies of in-water aggregations than of nesting populations. Furthermore, where in-water studies do occur, field methods can vary greatly, complicating comparisons among sites.

Nevertheless, increased monitoring and research in foraging areas has occurred in recent years, helping to identify valuable habitats and providing information on their ecology, habitat use, movements, genetic composition, feeding habits, among others. Table 1 presents recent publications or reports on in-water aggregations, some of which describe population structure from monitoring programs that focus on estimating trends and/or abundance. In addition, genetic stock composition, feeding preferences and habit use, migrations, and growth rates of various size classes are often also studied.

In reviewing satellite tracking and tag return information presented in the previous hawksbill update by Chacón (2009), it has become evident that important foraging areas occur throughout the region; however, a particularly important foraging area has been identified off the coasts of Caribbean Nicaragua and Honduras. Further recent evidence highlighting the importance of this area for Caribbean hawksbills was presented by Carreras et al. (2013), Hawkes et al. (2012), Horrocks et al. (2011), Kamel and Delcroix (2009), Lagueux et al. (2014), Moncada et al. (2012), and Nava and van Dam (2011). In light of the growing evidence on the importance of this area for hawksbills, the lack of life history and ecological data on hawksbills, and the significant threats due to intense fishing pressure, especially in this region (e.g., Campbell and Lagueux 2005, Lagueux 1998, Lagueux et al. 2014), sea turtles and their habitats are at high risk. Thus, further studies and assessments are needed of this foraging area, including a threat assessment and studies of hawksbill habitat use patterns and habitat mapping, in order to determine conservation and management actions needed.

Recent work in the Turks and Caicos Islands (TCI) suggested that this area remains an important developmental habitat for juvenile hawksbills and possibly adults (Richardson et al. 2009, Stringell et al. 2013), although further in-water studies are needed. In Mexico's Yucatán Peninsula, there are important feeding areas, particularly for adult female populations, off the northeast and northwest coasts (Cuevas et al. 2011-12). In addition, important developmental habitat with high juvenile hawksbill densities occur in the state of Campeche, Mexico; no recent data have been published, but monitoring studies are ongoing (V. Guzmán unpubl. data, pers. comm., for earlier work see Guzmán et al. 2008). Cuba undoubtedly provides important foraging habitat for both juveniles and adults based on past studies, its extensive shallow fringing reefs and historical and recent turtle exploitation records; however, there is little empirical data available that provides more recent evidence (but see Moncada et al. 2012). In the Bocas del Toro area of Panama, in addition to juvenile developmental habitat, the area is also used as a migratory corridor and mating area for adult hawksbills (Meylan et al. 2013). In the Dominican Republic, important foraging areas are reported and continue to be studied in the Jaragua-Bahoruco-Enriquillo Biosphere Reserve area (León et al. 2010). The foraging stock at one site in Culebra, Puerto Rico appears relatively high with catch rates as high as three turtles/hr (Rincon-Diaz 2011b), which is similar to other recent studies.

Knowledge gaps regarding the abundance and/or densities of hawksbills in foraging areas are widespread. For example, given the coral reef habitats and extensive shallow waters surrounding The Bahamas, this archipelago is most likely an important foraging ground for hawksbill populations in the WC/WA region, but few studies (Bjorndal and Bolten 2010) and/or population monitoring occurs here. Thus, this archipelago represents an important knowledge gap for hawksbills in the region. Furthermore, following the turtle harvest ban in 2009, direct observations and anecdotal reports are that abundance of green turtles and perhaps hawksbills has increased (K. Bjorndal pers. comm.); however, ongoing capture-recapture studies are needed to determine local population trends.

Protection Status

Hawksbills are legally protected in most WC/WA nations and territories. Recent changes in legislation include complete protection for hawksbills since 2008 in Cuba (República de Cuba 2008), 2011 in Trinidad and Tobago (Republic of Trinidad and Tobago 2011), 2013 in Antigua and Barbuda (Antigua and Barbuda, The Fisheries Regulations 2013), 2014 in the Cayman Islands (Cayman Islands 2014), and an extended closed season (August-March) with minimum and maximum size limits in the TCI since July 2014 (Turks and Caicos Islands 2014). In the Cayman Islands, five marine turtle species (including hawksbills) are now listed on Part 1 of Schedule

Table 1. Selected recent (since 2009) publications (reports in some cases) on foraging aggregations or that identify foraging areas of hawksbill turtles in the WC/WA. Some studies are ongoing, while others were time limited; however, all represent important efforts to identify or study hawksbills in foraging areas.

Country/Territory	Location/Island	Citation
The Bahamas	Union Creek, Great Inagua	Bjorndal and Bolten (2010)
Barbados	Multiple sites on south and west coast reefs	Browne et al. (2010), Krueger et al (2011), Walcott et al. (2012, 2013)
Belize	1-Lighthouse Reef 2-Glover's Reef Marine Reserve	1-Scales et al. (2011) 2-Coleman, Strindberg, and Campbell (in prep.)
Bonaire	Klein Bonaire and Bonaire	Sea Turtle Conservation Bonaire (2012)
Brasil	1-East and North coast 2-Fernando de Noronha Marine National Park Biological Reserve of Rocas Atoll 3-Abrolhos Marine National Park and others 4-Anchieta Island State Park	1-Marcovaldi et al. (2012) 2-Vilaça et al. (2013) 3-Proietti et al. (2012) 4-Leite et al. (2013)
British Virgin Islands	Anegada	McGowen et al. (2008), Hawkes et al. (2013, 2014)
Cayman Islands	Multiple sites	Blumenthal et al. (2009a, b, c)
Colombia	Islas Corales del Rosario and San Bernardo National Natural Park; Cabo de la Vela	Trujillo-Arias et al. (2014)
Cuba		Moncada et al. (2012)
Dominican Republic	Jaragua-Bahoruco-Enriquillo Biosphere Reserve area	Leon et al. (2010, unpubl. report)
Florida, USA	Dry Tortugas	Hart et al. (2013)
Honduras	Roatan	Berube et al. (2012)
Mexico	Campeche – various sites	Guzmán Hernández and García Alvarado (2014, unpubl. report)
Nicaragua	Pearl Cays	Lagueux et al. (2013), Campbell and Lagueux unpubl. data)
Panama	Bocas del Toro region	Meylan et al. (2013)
Puerto Rico	1-Culebra 2-Mona and Monito Islands	1-Rincon-Diaz (2011a, 2011b) 2-Diez and van Dam (2012, unpubl. report)
Turks and Caicos Islands	Multiple sites	Richardson et al. (2009), Stringell et al. (2013)
US Virgin Islands	Buck Island Reef National Monument	Hart et al. (2013)
Venezuela	Los Roques Archipelago National Park	Hunt (2009)

1, which indicates these species are "Species Protected at All Times" (Cayman Islands 2014). Prior to this there was a prohibition on hawksbill take in the Cayman Islands (Cayman Islands 2007); however, the prohibition on hawksbill take at that time was not explicitly stated in the amendment to the Marine Conservation Law, but rather was implemented as a licensing condition on the permit to take other turtle species. This new legislation ("The National Conservation Law, 2013") provides stronger protection for hawksbills in the Cayman Islands.

Enforcement of existing restrictions, including these recent changes, is mixed. The killing of nesting turtles and harvest at sea continues in Trinidad and Tobago, despite the new regulations (Save Our Sea Turtles 2014), and this is a common characterization in many WC/WA countries (Bräutigam and Eckert 2006, Chacón 2009, Mortimer and Donnelly 2008). In Antigua & Barbuda, the Fisheries Department reports no cases of non-compliance; however, it acknowledges difficulty with enforcement due to their dependence on the Coast Guard for enforcement actions (T. Lovell pers. comm., Senior Fisheries Officer, Ministry of Agriculture, Lands, Marine Resources, and Aqua-Industries).

Countries/territories that continue to have seasonally legal turtle fisheries that allow take of hawksbills include the United Kingdom (UK) overseas territories of the British Virgin Islands (BVI), Montserrat, and TCI, and the independent island nations of Dominica, Grenada, Haiti, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines. As noted above, the TCI recently passed increased restrictions on hawksbill (and green) turtle take through new fishery regulations (http://www.gov.tc/pressoffice/?q=latest-news/new-turtle-and-conch-regulations-take-effect-1-july-2014), effective 1 July 2014, that include minimum (18 in) and maximum (24 in) size restrictions, an annual closed season from 1 August to 31 March (which coincides with the lobster fishery when hawksbill take increases, Stringell et al. 2013), a prohibition on the export of turtles or turtle products (with an exception for exports for scientific purposes), and a prohibition on keeping turtles in captivity (except for rescue or rehabilitation) and requires that all turtles captured be landed alive (to confirm they are within the size restrictions, otherwise they may be released). It is expected that an additional restriction will be added later that will limit captures to captures by hand only (K. Wood pers. comm., former Director of the TCI Department of Environment and Coastal Resources).

Efforts to understand the opinions of stakeholders and socio-economic issues surrounding the TCI turtle fishery have been recently studied (Richardson et al. 2009, Stringell et al. 2013), and recommendations from these studies were the basis for new TCI regulations. These new fishery regulations will undoubtedly make an important contribution towards reducing hawksbill mortality in the TCI legal fishery, and the government should be commended for taking this significant step. However, as a signatory of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), under which hawksbills are an Appendix I listed species due full protection, it is in question whether the TCI is in compliance with their obligations under the CMS agreement by continuing to allow legal take of this species.

Furthermore, without a monitoring protocol and a science-based harvest regime for the TCI fishery, it is difficult to determine the sustainability of the fishery, and perhaps a complete ban on hawksbill take should be considered in the near future. A fishery moratorium sufficient to provide for the collection of data necessary to determine a sustainable take would be a useful interim measure. Such a ban should coincide with a plan to assist turtle fishers economically as they transition away from dependence on hawksbill harvesting, educational campaigns, and stakeholder participation in development of possible alternative livelihoods and affordable protein sources. Without a ban, TCI fishers will continue to harvest and kill critically endangered (cf. IUCN Red List) hawksbill turtles that are the direct result of conservation and recovery efforts of many people and governments around the region, and will continue to adversely impact already depleted local rookeries due to reduced recruitment of adults in the coming years. The same is true for other jurisdictions that continue to sanction an annual hawksbill harvest.

Harris and Harris (2014) reported that recent efforts to reduce the open season on sea turtle take and increase fines for poaching have been made in Dominica; however, these proposed changes have not yet been adopted. Harris and Harris (2014) also reported that turtle poaching continues on the nesting beaches, despite protective legislation (Forestry and Wildlife Act, Chapter 60:02, Section 21, Ninth Schedule) and diminished nesting, with only 23 and 14 clutches observed in 2012 and 2013, respectively. Recently, however, through increased awareness and collaboration among the public, trained patrollers, and law enforcement to improve enforcement of existing regulations, the first prosecution of a turtle poacher (who was charged and fined) occurred in 2013 (Harris and Harris 2014).

In summary, legal protection for hawksbills in the WC/WA region has significantly improved in recent years with vast marine territories, especially in the northeastern Caribbean (e.g., Cuba, TCI), coming under new regulations. Notwithstanding, there are additional countries and territories that continue to allow take without the implementation of sustainable management practices, or monitoring programs. It is clear that, based on genetic and tagging studies, hawksbill take in legal turtle fisheries affects breeding populations of other nations. Of course, legislation is only part of the solution to reducing intentional take of hawksbills, and since enforcement of existing laws is lacking it is imperative that measures, such as a region-wide plan of action, be taken to increase compliance. Greater stakeholder participation to reduce directed illegal take is needed; including educational activities to better inform resource users and a collaborative enforcement approach among the public, conservationists, and law enforcement. Involving resource users in developing solutions to reduce illegal and unintentional take and to assist with development of alternative livelihoods to meet local needs, combined with increased enforcement, may be a more successful strategy to reducing hawksbill mortality.

Recent Research

Biology

Ditmer and Stapleton (2012) analyzed several years of hatch success data from Jumby Bay, Antigua, incorporating individual turtle and habitat information into model analysis. The authors reported a relatively high hatch rate of 78.6% (± 21.2%), although this estimate may be biased high due to the elimination of washout nests from the analysis. They also found an inverse relationship between vegetation cover and hatch success. This result is contrary to what is expected since vegetation cover is known to be an important component in hawksbill nest site selection, and thus warrants further investigation to determine the influence of different plant species and vegetation structure on hatch success, nest temperatures and sex ratios. The authors also found that individual identity, clutch size, sand composition (grain size and organic content), nest number and deposition date influenced hatch success, which reflects the complexities of factors that should be considered when evaluating hatch success.

Goldberg et al. (2013) investigated the levels of leptin (an appetite-suppressing protein hormone), ghrelin (a hunger-stimulating peptide hormone) and other physiological and nutritional parameters in nesting hawksbill sea turtles in Rio Grande do Norte State, Brazil, by collecting consecutive blood samples during separate nesting events. The results showed that levels of serum leptin decreased over the nesting season, which potentially relaxed suppression of food intake and stimulated females to begin foraging either during or after the post-nesting migration. Concurrently, they showed an increasing trend in ghrelin, which may have stimulated food intake towards the end of the nesting season. Both findings are consistent with the prediction that post-nesting females will begin to forage, either during or immediately after their post-nesting migration. The observed downward trends in general serum biochemistry levels were probably due to the physiological demands of vitellogenesis and nesting, in addition to limited energy resources and probable fasting. An improved understanding of the interaction between food intake/energy stores and reproduction will help to inform potential conservation and management of globally endangered sea turtles.

Hawkes et al. (2013) reported female biased sex ratios of juvenile hawksbills foraging in Anegada, BVI waters. These results were similar to other studies; however, there were relatively more males in this study, suggesting a possible buffer against climate change effects. Furthermore, testosterone levels were correlated with date and sea surface temperature, suggesting testosterone levels vary across seasons, and thus using threshold values to assign sex should be done cautiously. In addition, sampling throughout the year may be necessary to more accurately estimate sex ratios. These authors suggest that efforts to understand the seasonality of hormone changes is important to better understand hawksbill ecology, and that climate change effects can only be predicted with estimates of secondary sex ratios of foraging aggregations and identification of source rookeries.

Joseph and Shaw (2011) reported that hawksbill turtles exhibit multiple paternity, albeit at relatively low levels, in the Sabah Turtle Islands, Malaysia. Although this study was not conducted in the regions included in this report, it is the first documentation of multiple paternity in hawksbills, confirming they exhibit the same mating system as other sea turtle species with sperm storage for sequential egg fertilization of clutches laid throughout a nesting season.

Kamel (2013) studied hawksbill clutches on Trois Ilets, Guadeloupe, to determine if individual nests vary in their thermal properties in relation to overstory vegetation cover and to identify the link between the two to assess if temperature is a potential cue for nesting females and a means to predict sex ratios. Nests under high vegetation cover were significantly cooler than those with low vegetation cover and/or open sand. Metabolic heating during the thermosensitive period of sexual differentiation was negatively correlated with percent overstory cover. Nesting in forested sites had a reduced impact on metabolic temperature and resulted in higher production of males, suggesting a potential buffer against loss of male hatchling production due to warming temperatures. Since females have been shown to have specific microhabitat preferences, individuals are consistently producing the same offspring sex ratios, but longer term monitoring is needed to determine if females can alter their nesting locations in relation to climatic changes. The author emphasized that Guadeloupe may be an important source of male turtles for the region as climate warming progresses and the importance of maintaining natural vegetation cover at nesting beaches as a valuable conservation measure for the species.

Meylan et al. (2011) found support for a smaller minimum size at maturity for hawksbills than was previously reported at 67 cm minimum straight carapace length. However, the authors emphasized that in using this smaller cut-off size to estimate the number of mature vs immature animals will overestimate the adult population since many animals do not mature at the minimum size.

Santos et al. (2013) reported on the population and reproductive ecology of hawksbill turtles nesting in the Rio Grande do Norte beaches of Brazil. Although this nesting area is secondary to the principal nesting beaches in the northern Bahia/Sergipe beaches in Brazil, it has the highest density of hawksbill nesting in the South Atlantic with 21.1 clutches/km and 20.7 clutches/km on the index and protected area beaches, respectively, although some sections were as high as 37.5 clutches/km and 38.5 clutches/km, respectively. In addition, they reported an average remigration interval of 2.1 years and a clutch frequency of 2.3 to 2.6 clutches/female/yr. With an average of 190 clutches/yr at the index beach and several hundred on protected area beaches, this is an important nesting area for hawksbills in the southern reaches of the WC/WA region. Beach patrols have only recently increased on the protected area beaches, and thus continued monitoring will reveal better estimates of nesting abundance and trends.

Climate Change (also see **Principal Threats, 5-Climate Change)**

Marcovaldi et al. (2014) inferred sex ratios of hawksbill clutches based on incubation duration for Bahia (BA) and Rio Grande do Norte (RN) rookeries over the last 27 years. A strong female bias was estimated at all beaches, with 96% and 89% average female sex ratios produced in BA and RN, respectively. Both inter-annual (BA, 88 to 99%; RN, 75 to 96% female) and inter-beach (BA, 92% to 97%; RN, 81% to 92% female) variability in mean offspring sex ratio was observed. Information on historical and optimal sex ratios is needed to inform and guide management decisions in Brazil in light of increasing temperatures from climate change.

Fisheries (also see **Principal Threats, 1-Fisheries Bycatch and 2-Turtle Fishing**)

Ciudad Iglesias (2013) conducted an indirect assessment of sea turtle bycatch in the northeast area of the Yucatán peninsula. The principal fishing gear used in the area were assessed in relation to spatial and temporal variation and turtle bycatch rates. There was a higher intensity of gillnet fishing vs longline, however, longline fishing had a slightly higher bycatch per unit effort. There was a high degree of correlation between fishing effort and bycatch. Longline fishing was more temporally limited than gillnet fishing, and spatial distribution for fishing effort by fishing type was integrated with bycatch, which showed different hot spots for gillnet vs longline bycatch. This study confirmed that gillnet and longline fishing were the greatest bycatch threat to sea turtles and that gillnets were used more than longlines.

Finkbeiner et al. (2011) reported that there is little evidence of hawksbill bycatch in US fisheries ssnce implementation of fisheries-specific bycatch mitigation measures, with only a few mortality events annually. The author also reports that prior to implementation of fisheries specific bycatch mitigation however, hawksbills interacted with several Atlantic fisheries (including Atlantic pelagic longline and Mid-Atlantic bottom trawl fisheries) with about 20 deaths annually from these US fisheries interactions, hence mitigation measures have apparently contributed to reducing hawksbill mortality.

Horrocks et al. (2011) reported that Saint Lucia and Saint Vincent combined made up 74.6% (n=47) of the returns for hawksbills tagged in the eastern Caribbean (primarily Barbados), all of which resulted in death due to fisheries interactions (intentional or unintentional). In total, 87.3% (n=55) of tag returns were due to fisheries interactions. Most of the tag returns were from countries with legal turtle fisheries and the turtles were taken less than 200 km from their nesting beach, which is a much shorter distance than is typical between hawksbill nesting and foraging grounds. The authors concurred with previous studies that have highlighted the inconsistent regulatory framework, which poses serious challenges to migratory turtles.

Humber et al. (2014) reported that 6 of 11 countries that have the highest legal hawksbill take worldwide were found in the Caribbean (Figure 3). Colombia (Atlantic coast) reportedly has the second highest take in the world, with an estimate of over 600 turtles/yr, and Saint Vincent and the Grenadines had the fourth highest legal take with an estimated ~300 turtles/yr. Hawksbills were explicitly protected in Colombia since 1977 (Resolución No 1032 de 9 de agosto 1977), and therefore the legal take reported by Humber et al. (2014) is incorrect, since there is no legal take allowed in Colombia (D. Amorocho pers. comm.). Nevertheless, the take of >600 hawksbills annually in Colombia, where protective legislation exists needs further assessment and mitigation. As stated by Humber et al. (2014) and others (e.g., Bräutigam and Eckert 2006), legal take is often not monitored, and information on illegal take is difficult to obtain, due in part to its clandestine nature. Thus, illegal take and bycatch are expected to be far greater than legal take.

Lima et al. (2010) reported the incidental capture of sea turtles in the lobster fishery at three locations on the Ceará coast of Brazil from 2004-2006. Hawksbills were reported captured in all three years, 21, 11, and 29 turtles, respectively. Since surveys were conducted on only a portion of the boat masters each year, these interactions are only a portion of the total catch. Fortunately, the Brazil government banned the use of lobster nets beginning in 2007, however, efforts to quantify interactions with the lobster net fishery prior to the ban provided an opportunity to not only obtain valuable data but also to develop positive relationships with coastal fishers for future efforts to reduce sea turtle interactions with fisheries on Brazil's coast. Although there is general compliance with the ban on lobster net fishing, the authors suggested there were still fishers using lobster nets and increased enforcement is needed. Also, there is a need to provide incentives to change gears to lobster traps, to assist the fishers in development of alternative fishing activities, and to create exclusion zones to lobster fishing.

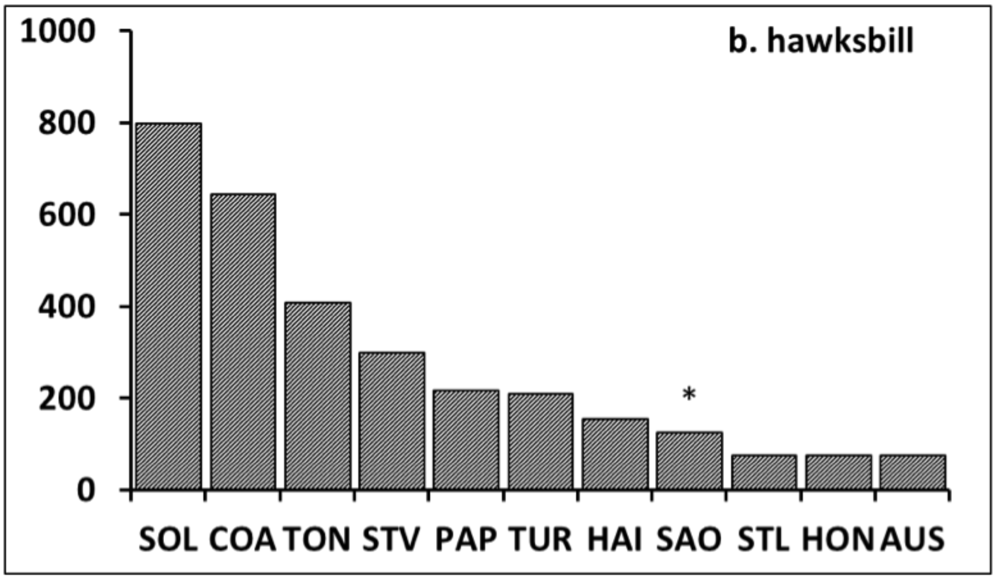

Figure 3. Top countries or territories for current estimated annual legal take of hawksbill turtles. Graph taken from Figure S4 (b) in Humber et al. (2014). Country abbreviations are (countries in parentheses indicate dependency): AUS = Australia; COA = Colombia (Atlantic coast); HAI = Haiti; HON = Honduras; PAP = Papua New Guinea; SOL = Solomon Islands; SAO = São Tomé and Principe; TON = Tonga; STL = Saint Lucia; STV = Saint Vincent and the Grenadines; TON = Tonga; TUR = Turks and Caicos (UK). *Principe legislation prohibits take since 2009.

Moncada et al. (2011b) reported on the hawksbill fishery at Cocodrilo (southwest) and Nuevitas (northeast), Cuba. New regulations to limit take to 500 turtles/yr were implemented in 1995, which restricted fishing to two sites and imposed a closed season and minimum size. From 1995 – 2006, the total annual take varied from 155 to 526 turtles, with an average of 361, for a total of 4,332 hawksbills captured in the 12 yr period (of these, 61 turtles were tagged and released). Sex ratios at both sites were heavily female biased (74% and 84% females, respectively) and this bias increased over time. Juveniles and adults were captured at both sites and size remained stable over time. The authors suggested that the controlled fishery did not have a negative impact over time since size remained stable.

Richardson et al. (2009) reported an estimated annual minimum of 186 hawksbills captured in the legal turtle fishery in Turks and Caicos based on fisher interviews, with indications that they targeted larger turtles. Furthermore, the actual take of turtles (including hawksbills) is believed to be much higher due to the small proportion of fishers included in the study, and is likely several hundred turtles annually, and thus hawksbill take would also be higher than estimated. Subsequently, Stringell et al. (2013) reported hawksbill take, based on direct surveys, ranging from a minimum of 114 to 277 hawksbills/yr.

Genetics

Based on a mtDNA stock assessment, Blumenthal et al. (2009c) reported a relatively diverse group of immature hawksbills in the Cayman Islands. Many-to-many mixed stock analysis estimated that Barbados and Cuba are the principal contributing rookeries to the Cayman Islands foraging aggregations. Results from hatchling drift models found a significant correlation between foraging stock genetic profiles and particle distributions. These results suggest that ocean currents play an important role in genetic structure of foraging stocks in the Caribbean region.

Browne et al. (2010) re-examined mtDNA from Barbados hawksbill rookeries using larger sample sizes and longer sequences. They determined that there are two distinct rookeries on the nesting on the island, separated spatially by only 30 km. The leeward rookery on Barbados is more closely related to the Cuban rookery and the windward rookery is more closely related to the western (Belize and Costa Rica) and northern Caribbean rookeries (US Virgin Islands and Puerto Rico). They also estimated the most significant contribution of the combined rookeries to the foraging ground in the Dominican Republic. These results provide an important caution against describing an entire population based on sampling from a single site, but also show the importance of using newer technologies to better identify populations in order to appropriately manage and preserve existing genetic diversity.

Carreras et al. (2013) reported that the two remaining principal rookeries of the Dominican Republic (DR), at Saona Island and Jaragua National Park, are genetically distinct, with eight haplotypes present among them. In addition, these rookeries are genetically isolated from almost all others in the region. Based on a rookery-centered analysis, juveniles from these two rookeries are likely dispersed across the Caribbean region. The mixed stock-centered analysis showed the contribution of juveniles from these two rookeries across the region to be very low, however, there was a relatively high contribution from these rookeries to the adult male aggregation in Puerto Rico. The highest contribution to the DR foraging stock was estimated to be from the Barbados leeward rookery. Satellite tracking data showed that almost all post-nesting turtles from the DR moved southwest and many settled in the area off Nicaragua and Honduras. Dispersal patterns of passive drifter buoys were different for the two nesting beaches, and did not support the results from the rookery-centered analysis. This study supports previous work that hawksbills exhibit fine scale population structure, and hence recommend finer scale sampling efforts to reveal genetic richness allowing for management at smaller scales than typically used. Loss of genetic variability from population reductions appears to be relatively low in these remnant rookeries since they are similar in diversity to larger populations in the region, however, the authors recommend the use of bi-parentally inherited markers to better assess impacts of population reduction on genetic variability, and to determine the existence of male mediated gene flow.

LeRoux et al. (2012) re-examined the population structure of Caribbean hawksbills, including additional previously unstudied sites in the region, using longer mtDNA sequences. The use of longer sequences (740 base pairs, bp) allowed for higher resolution of stock structure than was possible with the shorter sequences previously presented, and new haplotypes were also identified. Two important improvements were the ability to assay Guadeloupe as a distinct demographic unit and the identification of three haplotype variants in place of the previously single Q haplotype, which allowed distinction among the various Mexican rookeries. Costa Rica (0.655), Nicaragua (0.612) and Puerto Rico (0.600) showed the highest haplotype diversities among the 11 sites. There was significant structuring among populations, suggesting two phylogroups and three clades, with two of these clades being widely distributed across the region. Genetic relationships using the 740bp showed the following groupings: **1)** Puerto Rico, Nicaragua, Costa Rica, US Virgin Islands, and Barbados-Windward, **2)** Mexico, **3)** Barbados-Leeward, Brazil, and Cuba, **4)** Antigua, and **5)** Guadeloupe. Mismatch analysis showed the occurrence of a population bottleneck between 100,000 to 300,000 years ago. The authors recommended a minimum of 740 bp sequences be used for all future analysis, and that hawksbill rookeries be treated as distinct management units for the purpose of species conservation.

Proietti et al. (2014) reported on the foraging population structure at multiple Brazilian feeding grounds, which are made up of hawksbills from primarily local rookeries, but also with contributions from the northern and eastern Caribbean, and West Africa. In addition, the authors investigated the potential dispersal of turtles using drifter data from several Atlantic rookeries, these data showed dispersal to Brazil from local and Principe rookeries, but did not show dispersal from Caribbean rookeries. However, when genetics and oceanographic data were combined with rookery sizes there was a high correlation between genetic and drifter profiles, showing that both influence haplotype distribution in Brazilian foraging areas. Compared to Caribbean foraging aggregations (most sites $h>0.60$), haplotype diversity is fairly low ($h=0.41$) on Brazilian foraging grounds, which may be the result of contributions from fewer and less diverse rookeries. These results support the hypothesis that ocean currents influence haplotype diversity since higher diversity was found at foraging grounds influenced by more than one current system. Further sampling is needed to identify the origin of two orphan haplotypes reported in Brazil. The authors recommend more studies that identify the longer haplotype sequences for better resolution and population structure detection, and further, they suggest restricting the analysis to smaller sized animals which may provide a better correlation between currents and natal origins, however in order to conduct these type of meta-analysis researchers need to publish their individual size/haplotype data.

Richardson et al. (2009) reported results from mixed stock analysis of hawksbills in Turks and Caicos Islands, with contributions likely from Mexico, US Virgin Islands, Antigua, Puerto Rico, and Cuba. These results were based on truncated sequences (384 bp) used in earlier sea turtle genetic research because their analysis was done prior to the Caribbean hawksbill rookery genetic stock re-examination conducted by LeRoux et al. (2012), which used longer sequences (740 bp). Thus, conclusions based on results from the shorter sequences used by Richardson et al. (2009) may change if the foraging stock is re-examined using the longer sequences.

Trujillo-Arias et al. (2014) reported on the genetic composition of the rookery at Cabo de la Vela, Colombia, and a small sample of juveniles at one foraging site (Corales del Rosario and San Bernardo National Park, CRNP) in Caribbean Colombia. The authors identified a total of seven haplotypes at the two Caribbean sites; five haplotypes from the Cabo de la Vela rookery with a haplotype diversity of 0.64 (n=29), and five haplotypes from juveniles at CRNP with a high haplotype diversity of 0.93 (n=6). Also, based on a small sample (n=9) from the eastern Pacific foraging sites (see Eastern Pacific section), the authors suggested that the separation between Atlantic and Pacific-Indian Ocean hawksbills occurred more than 7 million years ago.

Growth

Bjorndal and Bolten (2010) reported highly variable growth rates from 2.3 to 15.6 cm/yr, with an average of 6.0 cm/yr for hawksbills on seagrass pastures in the southern Bahamas. Two growth rates were the highest reported thus far and occurred in seagrass habitat, which is considered a peripheral habitat for hawksbills. The authors suggested that this fast growth may occur during a period of compensatory growth.

Blumenthal et al. (2009b) reported slow growth rates of on average 3.0 cm/yr for immature hawksbills in the Cayman Islands; however, body condition was relatively high.

Hart et al. (2013) reported that growth rates of juvenile hawksbills at Buck Island Reef National Monument were similar to previous studies (mean curved carapace length = 4.1 cm/yr, range = 0.0-9.5 cm), as was the variation in growth by size class. Growth rates varied by size class and generally declined with increasing size; and male and female growth rates were similar. A lower growth rate for the smallest size class (20-29 cm) suggested an adjustment period to new habitat.

Hawkes et al. (2014) reported growth rates for hawksbills in Anegada, BVI, which are among the highest growth rates reported thus far for juvenile hawksbill turtles. Turtles grew on average 9.3 cm/yr (range = 2.3-20.3 cm). The authors also provided comparisons by 10 cm size increments with previous studies to show the differences in growth rates between size groups and among foraging aggregations. As in other studies, growth rates decrease significantly with body size, however mass gain increases with body size. The authors concluded that with the growth rates found in this study it may be possible for hawksbills to grow from 22 to 60 cm curved carapace length in less than 5 years. Furthermore, they suggested turtles could grow from hatchling size to 67 cm in less than 8 years; however, they caution that further study is needed to verify the model used in this study, which included some short recapture intervals and lacks possible seasonal variation in growth. Compensatory growth (for turtles that may recruit at larger sizes) was given as a possible explanation for some of the very high growth rate estimates found. In addition, the high variability in hawksbill growth rates is likely due to variable environmental conditions, and thus understanding those conditions in Anegada may help explain the higher growth rates observed there.

Krueger et al. (2011) reported average somatic growth rates of 2.03 cm/yr (range = -0.31 to 7.19) from a large sample of foraging hawksbills in Barbados. As with most other recent hawksbill growth rate studies, growth varied by size, with larger turtles growing much more slowly than smaller turtles. They also found that growth varied by year. They did not find that growth interval, sex, or sponge density were significant predictors of growth. The authors suggested that the slower growth observed for the smallest hawksbill turtles (compared to the next size class) may reflect a species specific difference between green and hawksbill turtles regarding adjustment to new diets and varying availability of sponges compared to seagrasses, since this trait has not been observed in juvenile green turtles, and has been observed in multiple growth studies of hawksbills. The authors also suggested that reduced habitat quality during the study period likely contributed to declining growth rates and that seagrass habitat may become more important for hawksbills as coral reef habitats degrade (as suggested by Bjorndal and Bolten 2010), and thus protecting both habitat types will be very important to ensure long-term recovery of hawksbill populations.

Richardson et al. (2009) reported growth rates of a relatively small sample of juvenile hawksbills in the waters of the Turks and Caicos Islands. Growth rates averaged 4.9 cm/yr (range = 1.5-8.6) for turtles ranging in size from 24-49.6 cm CCL (curved carapace length notch to tip), although some intervals were relatively short (range = 3.1-49.7 mo).

Habitat Use & Feeding Habits

Berube et al. (2012) reported home ranges of 0.15 to 0.55 km2 for juvenile hawksbills in the Honduras Bay Islands. These small home ranges are possibly due to high abundance of food resources and resting places in the Port Royal area. Common prey items were sponges and octocorals, with the most prevalent sponge species being *Melophlus ruber* and *Chondrilla caribensis* (formerly *C. nucula*). This is the first study to find *M. ru ber* as a prey species of hawksbills, and it was the most common dietary component found in this study.

Bjorndal and Bolten (2010) reported on the success of immature hawksbills using seagrass pastures in Union Creek, The Bahamas. Hawksbills can be similarly abundant over seagrass habitat as they are over reef and hard-bottom habitats. Body condition results showed that hawksbills in seagrass habitat were within the range of those reported for hawksbills from hard-bottom habitats. Growth rates were in the upper range of those previously reported in hard-bottom habitats. The authors suggested that as coral reefs degrade, seagrass habitats may become increasingly more important habitat for hawksbills.

Blumenthal et al. (2009a) reported daily patterns of diurnal activity and nocturnal rest for immature hawksbills in coral reef habitat in the Cayman Islands. Dive depths averaged 8 m during the day and 5 m at night, with larger individuals exhibiting longer dives. There is evidence for vertical habitat partitioning by size, which may reduce intra-specific competition and decrease degradation of shallow habitats. The authors also suggested that these results reflect a broad ecological footprint for hawksbills over a variety of depths.

Blumenthal et al. (2009b) reported small home ranges for immature hawksbills in the Cayman Islands based on average recapture distance of 545 m ± 514 m. Behavior varied by habitat type, with resting activity associated with uncolonized hard-bottom habitat. Turtles were most commonly observed foraging on sponges (primarily *Geodia neptuni*), and occasionally on jellyfish. Apparent commensal feeding relationships were observed with three species of angelfish. Also, a significant, but variable, correlation was observed between turtle size and depth at capture.

Cuevas et al. (2010) reported that hawksbills nesting at El Cuyo in the northern Yucatán Peninsula, Mexico may have higher plasticity in their nesting habitat requirements, showing a higher variability in beach slope and width than green turtles. Nesting in shaded areas, however, continues to be a consistent preference for this species.

Hart et al. (2012) reported core use areas of three subadult hawksbills monitored using an acoustic array in the Dry Tortugas National Park (DRTO), Florida, US. While turtles were resident, their core use areas ranged from 9.2 km2 to 21.5 km2, and the core use areas of all three turtles overlapped with a multiple human use zone. These core use areas are larger than most previously reported home ranges for hawksbills, and may be due in part to the larger size of individuals studied. These home ranges are similar to those reported for adult hawksbills in the Caribbean. Habitat type where the acoustic receivers were located was also recorded and turtle detections showed a high occurrence in areas with seagrass, suggesting either they were feeding in or moving through this area regularly, although the authors caution that turtles may have been in a more mixed habitat since receiver detection encompassed a circumference of 200 m. More detailed studies are needed on habitat use to better determine hawksbill habitat use in the DRTO, including a detailed geo-referenced habitat map with acoustic and accelerometer data.

Hart et al. (2013) reported an association between juvenile hawksbills and high zoanthid coral cover, and that these organisms were the primary food source for hawksbills in the Buck Island Reef National Monument, US Virgin Islands. A high number of prey items, however, were also observed. This study supports the increasing evidence that hawksbills have a more varied diet than previously thought. Further, juveniles were found in higher densities in the most structurally diverse habitats.

Hunt (2009) created a benthic habitat map of the Parque Nacional Archipiélago de Los Roques, Venezuela, and characterized sea turtle occupancy and patterns of habitat use in the area. Based on 46 observations of hawksbills (20 juveniles and 26 adults), coral reefs were the most important habitat for hawksbills and the area was primarily used by adult females and juveniles. The author identified the principal areas of hawksbill occurrence in the archipelago the area around Dos Mosquises and near Cayo de Agua and Cayo Bequeve. Activity by habitat type was also reported, with coral reefs used primarily for foraging, sand habitat used primarily for swimming and resting, as was the vegetation habitat. Also, resting depths were 66% deeper than foraging depths, and 47% deeper than swimming depths.

After decades of studying sea turtles at two foraging grounds and multiple capture sites (Panama and Bermuda), Meylan et al. (2011) provided further evidence for the developmental hypothesis for cheloniid sea turtles, including hawksbills. The developmental hypothesis indicates that turtles during the developmental stage of benthic feeding forage in separate habitat from adult turtles. In addition, the authors provided evidence that maturation occurs on the adult foraging grounds rather than on the developmental foraging grounds. They concluded that the population could benefit by reducing competition for resources between smaller immature turtles and adults, thereby increasing growth rates and decreasing age to maturity.

Richardson et al. (2009) reported hawksbills using both reef and seagrass habitat in the Turks and Caicos Islands, providing important developmental habitat for the species.

Rincón-Díaz et al. (2011a) reported that hawksbill diets are not constrained by food abundance, but rather that both preference and abundance were important factors in juvenile hawksbill diets in the Culebra, Puerto Rico archipelago. The chicken liver sponge Chondrilla nucula and the corallimorph Ricordea florida were important prey items for juvenile hawksbills in this area. Although C. nucula was a common prey item, they did not show a strong preference for it.

Rincón-Díaz et al. (2011b) reported habitat features related to distribution and abundance of hawksbill turtles in the Culebra, Puerto Rico archipelago. They found no evidence that food availability alone could explain the variability in abundance of turtles at different foraging sites. Sites with high abundance of quality foods were not the highest in turtle density. However, benthic habitat features were found to be important to turtle abundance. Sites with high cover of gorgonians and stony corals showed greater abundance of juvenile hawksbills. As has been suggested in previous work, areas composed of stony corals and gorgonians are important habitat for feeding and shelter. In light of habitat degradation occurring in shallow areas, studies on changes in abundance and feeding ecology in inshore habitats, and conservation alternatives to protect turtles and their habitats are needed.

Walcott et al. (2012, 2013) described inter-nesting movements, habitat use and dive patterns of adult female hawksbills during reproductive seasons in Barbados. These adults were rarely seen outside the nesting season and thus food resources were likely inadequate to sustain them during non-reproductive seasons. They found evidence that turtles exhibit behavioral patterns that reduce or maximize energy use, including lodging under reef ledges. Pre-emergence (to the nesting beach) high use areas were identified. Resident areas between nesting emergences were small, ranging from 0.01 to 0.40 km2 and distances from those resident areas to the nesting beach ranged from 0.7 to 21.2 km, with most <7 km, and all resident areas were on the south side of the island. Turtles spent an average of 9.8 days at resident areas and based on dive patterns do not appear to be feeding in those areas. Turtles also showed a high degree of site fidelity to resident areas between multiple nesting emergences. Movements to and from nesting areas were also correlated with reef habitat. Turtles used the area immediately in front of the nesting beach for 1-3 days prior to nesting, highlighting the importance of protecting this habitat for nesting turtles as well as the nesting habitat.

Migration/Movements

Preliminary results from satellite tracking of post-nesting hawksbills in Caribbean Honduras showed two females migrated to foraging grounds in Belize and Mexico (Dunbar et al. 2013).

Hart et al. (2012) also reported migratory movements of three subadult hawksbills following residency in the Dry Tortugas National Park. Two turtles migrated to the coastal waters of northwestern Cuba, where they ceased transmitting, both sending land location signals of high quality for several days prior to complete loss of transmission. Both turtles were suspected to have been taken in local Cuban fisheries. The authors also suggested these turtles may have been documented during their first nesting attempts. However, according to data presented by Moncada et al. (2011a) hawksbill nesting beaches on the northern coast of Cuba are farther east and are of very low density, thus it seems more likely these turtles were captured in Cuban fisheries and taken to shore. The third turtle ceased transmitting only a few days after beginning its migration, which was towards Key West, Florida. The authors stressed the need for international conservation efforts for effective protection of the species.

Horrocks et al. (2011) reported on tag returns for adult female hawksbills tagged by 12 projects primarily in the eastern Caribbean, with almost 80% having been tagged in Barbados. Of the 63 tag returns, 58 (92%) were from the eastern Caribbean, and the remaining five were from long-distance movements (Cuba, Dominican Republic, Honduras, and Nicaragua). The longest movements were by two females from Barbados to Nicaragua, a minimum of 2,600+ km, the longest migration reported in the region thus far.

Marcovaldi et al. (2012) satellite tracked 15 hawksbills from nesting beaches in Bahia. Post-nesting migrations were performed mostly over the continental shelf. Genetic analyses showed that six of the individuals, characterized morphologically as hawksbills, were actually hawksbill-loggerhead hybrids. Foraging destinations of hawksbills were situated along the eastern coast of Brazil (9°S to 17.5°S), while most of the hybrid turtles (except one) migrated to distant foraging areas located on the northern coast of Brazil (0° to 5°S), in areas previously reported as loggerhead foraging grounds.

Moncada et al. (2012) report on movements of juvenile and adult hawksbill turtles flipper tagged and satellite tracked in Cuba, and hawksbills tagged in other countries and recaptured in Cuba. Over the 20-yr study period, they received 143 recaptures of Cuban tagged hawksbills, including adults and juveniles. All adult recaptures occurred within Cuba, while 4 of 59 juveniles were recaptured outside of Cuban waters (2 in Nicaragua, 1 in Colombia, and 1 in US). Interestingly, those juveniles that departed from the south coast were recaptured south of Cuba and likewise for the north coast. Of the 16 satellite tracked adults reported on, including nesting and non-nesting adult females and one male, 31% (n=5) departed Cuban waters. These turtles traveled through 12 Caribbean nations, traversed deep oceanic waters and most were tracked to coastal shelves. Since most hawksbills tagged and tracked in Cuba remained in Cuban waters, combined with evidence from previous genetic data, the authors suggested that hawksbills from Cuba forage more closely to home than other stocks, remaining in Cuban waters for extended periods (although not exclusively). They further suggested that other rookeries do not contribute a high proportion of turtles to the Cuban foraging stock, and recent increases of other populations in the region are more likely due to local protection measures rather than closure of Cuba's turtle harvest. Countries where hawksbills were tagged and later recaptured in Cuba include Mexico (n=4), Bahamas (n=3), Barbados (n=2), US Virgin Islands (n=2), Puerto Rico (n=1), US (n=1), and Venezuela (n=1).

Nava and van Dam (2011) reported the migratory movements of post-breeding hawksbills, 11 females and two males, from Bonaire during 2003 to 2010 nesting seasons. Five of the 11 females moved to foraging grounds where Honduras, Nicaragua, and Colombia waters converge, highlighting the importance of this area for Bonaire turtles. The remaining hawksbills were widely dispersed on foraging grounds throughout the Caribbean region. Additional recent tracking information about Bonaire sea turtles (including hawksbills) was reported in Stapleton et al. (2013) and other field reports (http://www.bonaireturtles.org/explore/publications, also see http://www.bonaireturtles.org/what-we-do/satellite-tracking).

Other

Leighton et al. (2010) reported that human activity on nesting beaches in Barbados was an effective deterrent to predation of hawksbill nests by mongooses. Results from this study indicated that mongoose responded to human activity on nesting beaches (even at low levels) by changing their space use, regardless of nest density, and thereby reducing nest predation considerably.

Organizing human activities on beaches where nests are most vulnerable to predators during critical times of predator activity can provide a clear benefit by indirectly reducing predation; however, there are inevitable trade-offs that can have negative impacts, thus, a balance is needed to maximize benefits from activities that displace nest predators, while at the same time minimize negative impacts to nests and beach habitat. Models could be used to help regulate use and balance the negative and positive impacts of recreational use.

Hawksbill nesting in the southern Gulf of Mexico (specifically the Yucatán Peninsula, Mexico) is correlated with a quasi-decadal environmental fluctuation in sea surface temperature, and may be influenced by trophic conditions (del Monte-Luna et al. 2012). The cycles in both sea surface temperature (SST) and proportional change in hawksbill nesting are driven by a basin-wide environmental component of a specific 8-yr periodicity related to the Atlantic Multidecadal Oscillation. The authors reported that this relationship tracks the proportional change in hawksbill nesting in the region and recommended that conservation planning focus on potential effects of linear increases in SST as expected from global warming, and natural environmental variability. They caution that sea level rise and human encroachment are reducing the carrying capacity of hawksbill nesting beaches, which exacerbate the effects of increased sea surface temperatures and hurricane activity.

Principal Threats

Threats to hawksbill turtles in the WC/WA are extensive, as with other sea turtle species and in other regions; however, there is general agreement by expert groups on the principal threats in this region. The most important threats identified by the previous hawksbill update included collection of eggs and take of individuals (legal and illegal), habitat loss (primarily from coastal development), and bycatch (Chacón 2009). In 2009, during the IAC Regional Hawksbill Workshop held in Puerto Morales, Mexico, more specific threats were put forth as shown in Table 2 (IAC Secretariat 2010). The workshop ranked a set of threats; however, the rankings were based on a qualitative assessment only and should be viewed with this in mind. Although there was not a consensus within some of the IAC Regional Hawksbill Workshop working groups regarding the rankings that were assigned to the threats and their source(s), this does provide a basis from which to quantitatively assess their impacts to hawksbills.

Table 2. Principal threats as identified by expert working groups participating in the IAC Regional Hawksbill Workshop (page 17, IAC Secretariat 2010).

Threats	Source Of Threat	Ranking
Directed take: targeted fisheries, opportunistic fisheries (Group 1)	(1) Turtle fishing	Medium
	(2) Other fisheries (opportunistic and combined take)	Medium
Incidental catches in gillnets and entanglement in ghost nets (Group 2)	(3) Gillnet	High
	(4) Lost fishing gear	High
Habitat deterioration: Infrastructure, lighting, vegetation removal (Group 3)	(5) Beach infrastructure	High
	(6) Lights	Medium
Habitat deterioration: pollution and non-natural predation (Group 4)	(7) Non-native mammals (raccoons, dogs, cats, mongoose, pigs)	High
	(8) Oil spills and response	High
Threats related to inadequate regional policies and climate change (Group 5)	(9) Lack of community collaboration incentives for conservation	Very High
	(10) Change in open ocean conditions (temperature, currents, etc)	Very High

More recently, the National Fish and Wildlife Foundation (NFWF), as part of their strategic plan for rebuilding Caribbean hawksbill populations, conducted a threat assessment. Some of the summary results from this assessment are presented here, with permission. The NFWF threats assessment was based on initial input from an expert working group who identified a set of priority threats similar to those in Table 2 (NFWF unpubl. data). This was followed by input (in the form of a survey) on each of those principal threats by a larger group (comprised of country coordinators and affiliates of the Wider Caribbean Sea Turtle Conservation Network (WIDECAST)) that spanned the Wider Caribbean region, including Bermuda (UK) and Brazil.

These participants quantified each threat to an order of magnitude category based on their local (and in some cases regional) knowledge of threats to hawksbills. Estimated mortality for each broad life stage category was converted to an estimated nesting female equivalent (NF) in order to make comparisons across the region and across life stages, and to broadly quantify mortality associated with each threat. The detailed results of the threats assessment were not included in the online Executive Summary (http://www.nfwf.org/seaturtles/Documents/rebuilding.caribbean.Hhwksbill.populations.pdf); however, Table 3 provides the"ballpark" estimates of NF mortality from those results.

Based on the NFWF expert working group, the principal threats to hawksbills in the Wider Caribbean region are *Bycatch* in set nets (unintentional take) and *Turtle Fishing* (intentional take in nets and by divers), followed by *Terrestrial Habitat Loss/Deterioration*, and *Killing Nesting Females* (Table 3) (NFWF unpubl. data). By far, NF mortality was estimated to be the highest for *Bycatch* and *Turtle Fishing*. Priority geographies (and gaps) were also identified based on the information provided by the participants (see Table 3). While *Bycatch* and *Turtle Fishing* should be a high priority for conservation action, simultaneous efforts to further investigate habitat threats and the extent of direct killing of nesting females are important stressors that must also be mitigated.

Threats related to climate change were, in part, incorporated into the *Terrestrial Habitat Loss/Deterioration* threat category (e.g., beach erosion and nest loss due to rising sea level), and although threats to in-water habitats were also of concern to the expert group there was insufficient information on the extent of the threatand therefore it was not included in the final assessment (NFWF unpubl. data). The extent to which hawksbill populations are threatened by a warming climate in both terrestrial and marine habitats is also important but not yet well understood; however, information to date is reviewed in **5-Climate Change** below.

Another effort to assess threats for each sea turtle species and region was conducted by Donlan et al. (2010). This study was based on expert opinion using a ranking system. Coastal Development was ranked the highest for Caribbean hawksbills, followed by Direct Take, Fisheries Bycatch and Pollution, Nest Predation, Global Warming, and Pathogens. With the exception of the last two threats categories, all were considered of medium impact for the region, although the cumulative impact of all threats to Caribbean hawksbills was second only to Olive ridleys (*Lepidochelys olivacea*). Similarly, the National Marine Fisheries Service and US Fish and Wildlife Service (2013) concluded that hawksbills remain in danger of extinction due to the following threats: habitat destruction/ modification/curtailment; overutilization for commercial purposes; inadequacy of existing regulatory mechanisms; as well as climate change, fisheries bycatch (artisanal and industrial), oil spills and oil pollution, and ingestion and entanglement of marine debris.

Fortunately, there is considerable overlap among recent efforts to assess threats to hawksbills in the WC/WA – but there is limited quantitative information to assess these threats on this broad geographic scale. In addition, impacts of some threats may be highly variable across the region, i.e., some are more site-specific than others. It would be useful to undertake a detailed analysis similar to that used to assess threats to Northwest Atlantic loggerhead turtles (*Caretta caretta*) (see Bolten et al. 2010) with an aim to increase confidence in prioritizing conservation actions based on their relative impact on hawksbill population recovery in the region.

In the summary that follows, results from the NFWF threats assessment (see Table 3), as well as results from other recent threats assessments, are annotated.

Table 3. Rankings, relative mortality estimates and geographies for Key Threats to Caribbean hawksbills identified and quantified to an order of magnitude by experts representing 39 of the 41 countries and territories where hawksbill sea turtles occur in the Wider Caribbean Region (National Fish and Wildlife Foundation, unpubl. data). Respondents binned estimated mortality of life stages on an order of magnitude scale, or actual estimates when available. Mortality estimates by threat were summed and converted to an estimated nesting female equivalent (NF). NF conversions were based on: eggs/ hatchlings = 0.004NF, neritic juveniles = 0.235NF, neritic adults = 0.789NF, and nesting females = 1.0, National Marine Fisheries Service and US Fish and Wildlife Service (2008).

Key Threat (in rank order)	Description	Est. Relative NF Mortality/yr	Geographical "Hot Spots"	Investigation Needed
1-Bycatch (set-nets)	Unintentional capture of hawksbills when targeting other species through the use of Set Net gear.	5,168 – 17,352	Tier I Priorities: Dominican Republic Haiti México Tier II Priority: Nicaragua[a]	The Bahamas Jamaica Panama
2-Turtle Fishing (includes dive fishing)	Intentional (direct or opportunistic) take of hawksbills (could be legal or illegal).	3,810 – 12,792	Tier I Priority: Panama (BINMP[b]) Tier II Priorities: Colombia Cuba Dominican Republic (Saona Island) Grenada (Levera) Haiti Honduras (Cayos Cochinos) Nicaragua St. Kitts St. Lucia Panama Tobago Turks & Caicos, Venezuela (Los Roques)	
3-Terrestrial Habitat Loss/ Deterioration	Loss of beach productivity through reduced nesting beach quantity or quality (i.e., coastal armoring - e.g., seawalls; infrastructure – e.g., buildings, roads, recreational facilities; vegetation loss or alteration; lighting; sand mining; and/or beach erosion - e.g., seasonal beach loss, storm damage, sea level rise).	1,069	Tier I Priorities: Barbados Mexico Panama Tier II Priorities: Aruba Belize Carriacou/P. Martinique/ Grenadines Guadeloupe Haiti Nicaragua Turks & Caicos US Puerto Rico US Virgin Islands	Top 14c nesting beaches need further investigation into more specific causes of mortality from this broad threat category.
4-Killing Nesting Females	Adult females killed on the beach by humans.	1,012	Widespread – Needs further assessment	The Bahamas

a Nicaragua was identified as an additional geography of concern due its high use by hawksbills from across the region and potentially high bycatch in fishing activities (e.g., gillnet fishing).

b Bastimentos Island National Marine Park.

c Top 14 nesting beaches were located in Barbados, Mexico, Panama, Puerto Rico-US, and US Virgin Islands (Dow et al. 2007).

Summary of information on Principal Threats

1-Fisheries Bycatch (hawksbill turtles are not the target species)
Bycatch of hawksbill turtles in various fisheries is a widespread problem in the WC/WA (see Bjorkland 2011). According to the NFWF threats assessment (NFWF unpubl. data) as well as other sources (e.g., Mortimer and Donnelly 2008), particularly important for hawksbills are set nets, such as gillnets. Gillnets are commonly used by local fishers throughout the region, however, few data are available to quantify this threat on a regional scale.

Survey results from the NFWF threats assessment revealed that only six (15.4%) of 39 WC/WA countries or territories reported no hawksbill mortality from bycatch in set net fisheries. In contrast, nine countries or territories reported that "100 to <1,000" hawksbills were killed in set nets each year, and three others reported mortality due to set nets in the "1,000 to <10,000" range. Seven additional sites had no information on set net fishery mortality and thus represent data gaps. In addition, 26 of 27 respondents indicated that they expected this threat to remain the same (n=18) or to increase (n=8). These results indicate that fisheries bycatch from set nets is not only a significant threat to hawksbills in the region, but that it will continue assuming no further actions are taken (survey conducted in June/July 2011); i.e., conditions remain. Based on the NFWF survey results, Dominican Republic, Haiti, Mexico, and Nicaragua were the priority bycatch hotspots (see Table 3). In addition, The Bahamas, Jamaica, and Panama were listed as areas where information gaps occur and need further investigation.

Wallace et al. (2013) compiled global bycatch data according to regional management units (RMU) and gear type (net, trawl, and longline), allowing for an impact prioritization by species, RMU, and gear type. For hawksbills in the "Atlantic, Western Caribbean/ USA" RMU, bycatch impact was considered medium, along a low-medium-high continuum, for longline fishing effort in the Gulf of Mexico, and net and trawl fishing effort in the southeastern US and southeastern Caribbean (see Wallace et al. 2013 for mapped locations). However, the authors caution that there are numerous data gaps and thus not all areas where bycatch occurs were (or can be) evaluated. One example of such a gap is the lack of information from small-scale local fisheries, such as occurs in Nicaragua, where hawksbill turtles are often captured in entanglement nets set for green turtles in a legal green turtle fishery conducted by indigenous and ethnic coastal communities (see Lagueux 1998), as well as in gill nets (Lagueux and Campbell unpubl. data). This area is regionally important based on tag returns and satellite tracking of hawksbills from around the region, and hawksbill mortality on this vast continental shelf remains largely unquantified. More recently, Lagueux and Campbell (unpubl. data) reported in the NFWF threats assessment survey that "100 to < 1,000" hawksbills are killed in Nicaragua each year resulting from bycatch in set nets. Coastal, artisanal fisheries are widespread and are the dominant fishing effort in the Caribbean (Dunn et al. 2010).

Bjorkland (2011) reported that hawksbills are susceptible to industrial longlines, other hook and line gear, trawls, gillnets, and traps. She also reported that bottom-set gillnets are more likely to entangle hawksbills and greens, which are more likely to occur in the same habitat as the target species (demersal finfish, lobster and conch). Cuevas et al. (2009) estimated 557-1651 hawksbills were captured annually in gillnet fisheries in Campeche, Mexico.

Additional anecdotal information from a recent study of satellite tracked hawksbills in the Dry Tortugas in southern Florida (US) showed that 2 of 3 tracked subadult hawksbill turtles were very likely captured in Cuban fisheries (see Hart et al. 2012) shortly after reaching northern Cuban waters. Although this is a very small sample, it suggests that fisheries bycatch in Cuban waters may be a significant source of mortality for hawksbills in that area.

2-Turtle Fishing
Turtle fishing typically involves the use of entanglement nets that are set in areas of known sea turtle occurrence, but also includes the capture of turtles by hand and by harpoon. Scuba or free divers may specifically target sea turtles, or they may be targeting lobster, fish, sea cucumber, or other marine resources, but anticipate the additional take of hawksbills for consumption or to sell their shell. Both net fishing and diving methods involve the intentional take of turtles.

Seven countries and territories reported in the NFWF survey to have from "1,000 to <10,000" (n=1) or "100 to < 1,000" (n=6) hawksbills killed by dive fishers each year (NFWF unpubl. data). In addition, 19 countries/territories reported "1 to <100" hawksbills killed by dive fishers. Similar results were reported for turtle fishing with entanglement nets, "1,000 to <10,000" (n=1), "100 to <1,000" (n=8), and "1 to <100" (n=14). Countries of particular concern with regard to high mortality from this intentional take are Panama (dive fishing) and Trinidad (net fishing). Other countries and territories of concern are Cuba, Dominican Republic, Grenada, The Grenadines (Saint Vincent and the Grenadines), Haiti, Nicaragua, Saint Kitts, Saint Lucia, Tobago, Turks and Caicos, and Venezuela. Hawksbill mortality in these areas is cause for concern and needs further assessment and conservation action.

Meylan et al. (2013) reported that turtle fishing continues to be a threat to hawksbills in the Bocas del Toro region of Panama, where hawksbills were captured in nets and by divers, however, no estimates were provided. Richardson et al. (2009) reported an average of 186 hawksbills are killed each year by turtle fishers in the TCI, however, the authors acknowledge that since their information is based on a small proportion of TCI turtle fishers, the actual number harvested each year is much higher. Furthermore, the size of hawksbills captured suggests the fishery targets larger turtles and this is of conservation concern for local stocks. Stringell et al. (2013) later reported on direct surveys of turtle harvest in TCI from late 2008 to late 2010, with estimates of 114 to 277 hawksbills harvested/yr, although some areas were not surveyed, and thus the actual take is expected to be higher for the entire archipelago. The authors reported that hawksbills captured in the fishery ranged from size classes 30-35 cm to 90-95 cm curved carapace length (CCL), with 33% below the current legal minimum CCL of >51 cm, although the focus is on larger animals.

As reported earlier, Humber et al. (2014) provided information on the take of more than 1,000 hawksbills annually in several Caribbean countries (Colombia, Haiti, Honduras, Saint Lucia, Saint Vincent and the Grenadines, TCI), much of which is most likely from turtle fishing activities. In Trinidad and Tobago (TT), although largely unquantified, turtle fishing (primarily hawksbill and green turtles) was common and take levels are expected to be quite high (Forestry Division et al. 2010). In addition, they reported that the size of turtles captured has decreased, suggesting an overexploited population. While protective legislation was recently adopted (Republic of Trinidad and Tobago 2011), law enforcement remains an issue (Save Our Sea Turtles 2014).

3-Killing Nesting Females

Nesting females continue to be killed on many beaches when they come up to lay their eggs, whether or not protective legislation exists. In most cases where legal take of hawksbills still occurs, it is prohibited to kill nesting females; however, this legal protection is an inadequate deterrent to the killing of this valuable segment of the population.

According to surveys during the NFWF threats assessment, this threat is widespread, with the majority (25 of 38 responses) of countries and territories reporting take of nesting females from "1 to <100" turtles annually, and two reporting "100 to <1,000" (NFWF unpubl. data). Only nine countries/territories reported zero take of nesting females, and two additional responses (Anguilla and The Bahamas) had no information, representing a data gap; however, it was reported by Broderick et al. (2004) that taking nesting females on Anguilla beaches has stopped. In addition, 26 of 27 responses indicated that this threat was likely to remain the same (n=15) or increase (n=11) based on conditions at time of the survey. NFWF determined that this threat needed further assessment in order to prioritize geographies for future actions.

Nesting females were taken at two sites in Nicaragua, the Pearl Cays and at El Cocal (e.g., Lagueux et al. 2012, Lagueux et al. 2013). This threat has been highly reduced in the Pearl Cays through community engagement, participation and incentives (pers. obs.), however, mortality at El Cocal has increased in recent years due to an influx of migrants from other parts of Nicaragua taking up residence on or near this nesting beach (Lagueux et al. 2012). This increased mortality threatens the potential recovery of hawksbills at that site. Meylan et al. (2013) also reported the take of nesting females as an important threat on nesting beaches in the Bocas del Toro area of Panama, including in protected areas. Barbados has recently seen a rise in turtle poaching on their nesting beaches based on media sources, although no quantitative information was available. In Trinidad and Tobago, nesting females are often taken from local beaches for local consumption (Forestry Division et al. 2010). In the Dominican Republic, nesting females continue to be killed (Revuelta et al. 2012, 2013).

4-Terrestrial Habitat Loss/Deterioration

Terrestrial habitat degradation and loss, generally as a result of human development, is an important and widespread threat to hawksbill nesting grounds. Mazaris et al. (2014) assessed gaps in protection coverage of sea turtle nesting habitats, by species and RMU. Globally, 24.2% of hawksbill nesting sites are in existing protected areas and 70.9% of those are strictly protected; thus, only about 17% of the total 1,346 hawksbill nesting sites assessed are considered strictly protected. Based on their regional assessment, hawksbills receive the least habitat protection in the WC/WA (26.5%) compared to the southwest Atlantic (66.7%, including only Brazil's nesting sites) and eastern Pacific (47.8%) (Figure 4).

Mazaris et al. (2014) also assessed terrestrial habitat protection coverage by country, which includes additional nesting sites not used in the RMU designations by Wallace et al. (2010). Based on those results, coverage is relatively high (>65%) for Brazil, Cuba, Dominican Republic, French Guiana, Guatemala, and Suriname. Except for Brazil and possibly Cuba, the remaining countries listed have generally small rookeries. In contrast, terrestrial habitat protection coverage is relatively low at some of the important remaining rookeries, including: Guadeloupe (55.6%), Mexico (61.7%), Panama (38.5%), and Puerto Rico (28.6%); and researchers in most of these countries have reported that coastal development is an important threat to breeding hawksbills.

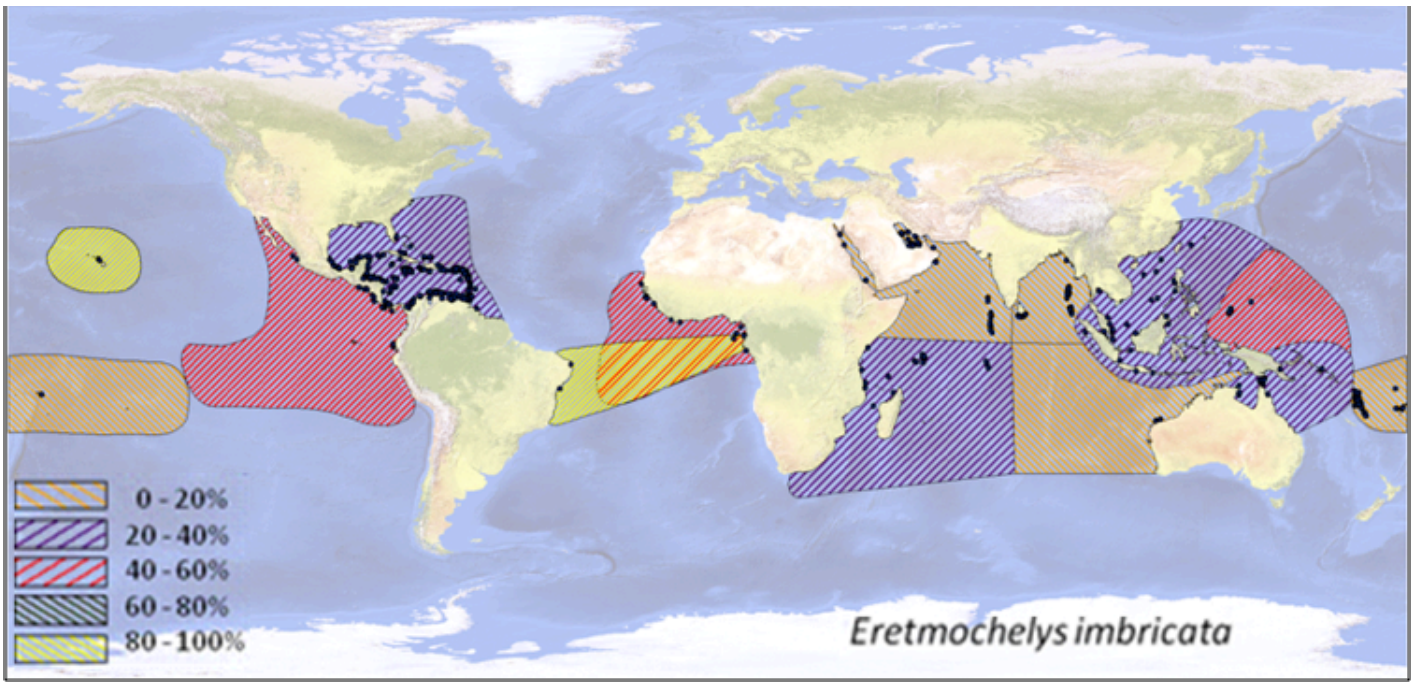

Figure 4. Proportion of hawksbill nesting sites receiving some habitat protection within each regional management unit (RMU). Among the three RMUs covered in this report, the Southwest Atlantic RMU has the highest proportion with 66.7% coverage of nesting sites in Brazil within protected areas, followed by the east Pacific with 47.8%, and West Atlantic (includes Caribbean) with only 26.5%. Map and data are from Figure A1 by Mazaris et al. (2014), RMU designations follow Wallace et al. (2010).

Terrestrial habitat loss/deterioration encompasses threats from a wide variety of sources, including habitat modifications such as coastal armoring (e.g., seawalls), infrastructure (e.g., buildings, roads, recreational facilities), vegetation loss or alteration, sand mining, beach erosion (e.g., seasonal beach loss, storm damage, sea level rise), and general issues associated with increased access (e.g., lights, dogs, litter, foot and vehicular traffic). Based on the NFWF threat assessment, well over 100,000 eggs and/or hatchlings are lost each year to this threat, and most of this loss occurs at the region's largest nesting grounds (Barbados, Mexico and Panama) (NFWF unpubl. data). Eight additional countries and territories reported high losses of eggs and/or hatchlings, including Aruba, Belize, Grenada (Grenadines), Guadeloupe, Haiti, Nicaragua, Turks and Caicos, and US Virgin Islands. Adults and juveniles were also estimated to have mortality associated with this threat. Furthermore, of 26 responses, 20 indicated that this threat is increasing and the remaining six thought that it would remain the same.

An example of a site where tourism development poses a serious threat to sea turtles is Bocas del Toro, Panama. Meylan et al. (2013) reported there is a proposal to develop Playa Chiriquí into a resort area, threatening the recovery potential of this beach for hawksbills. The authors also reported that other development projects have already begun at some beaches in Panama (Isla Bastimentos, Punta Anton, and Playa Bluff).

In addition to terrestrial habitat degradation/loss, in-water habitats are also deteriorating from a variety of sources. In selecting the principal threats during the NFWF threats assessment, about half of the experts indicated that in-water habitat threats were important (NFWF unpubl. data). Carpenter et al. (2008) reported that many coral reef species have a high extinction risk globally, and particularly high is the proportion of corals of high extinction risk categories in the Caribbean. The authors suggested that both direct human impacts (e.g., sewage discharge, coastal development, increased sedimentation from poor land-use and watershed management) and impacts of climate change (rising sea surface temperatures and acidification) are principal causes of these declines and high extinction risks. Since hawksbills are closely associated with coral reef habitat in the Wider Caribbean region, deterioration of this habitat is a serious threat to hawksbills, although data quantifying this threat to hawksbills are lacking and need further assessment.

Without the necessary habitat protection and/or strict coastal development regulations, quality and quantity of nesting habitat will continue to decline as human populations increase and efforts to increase economies through tourism development grows. A thorough assessment of threats to terrestrial habitat is needed, as site specific interventions will be needed to address this broad threat category; however, it is apparent that development is an important threat in many areas across the region and needs more detailed assessment.

5-Climate Change

Climate change has the potential to impact sea turtles, including hawksbills, in a variety of ways during several life stages. Sex ratios of hatchlings may shift due to changes in incubation temperatures resulting from higher air temperatures, or in some cases decreased sand temperatures due to increased rainfall in some areas. Nesting habitat may be reduced by sea level rise, coastal squeeze, and coastal erosion due to increased severity and frequency of storms (see review by Hawkes et al. 2014).

Fuentes et al. (2013) assessed the resilience of marine turtle species to climate change, for each regional management unit (RMU), based on six criteria. Resilience criteria included qualitative characteristics (relative population size, rookery vulnerability, and genetic diversity) as well as non-climate-related threats (fisheries, take, coastal development, and pollution/pathogens). Hawksbills in the West Atlantic RMU were determined to be in the most resilient group according to their resilience index (RI) (RI=1.23, most resilient index range was $0.76 \leq RI \leq 1.26$), although near the upper limit (Figure 5). However, the Southwest RMU was considered in the least resilient group (RI=1.85, least resilient index range was $1.77 \leq RI \leq 2.28$). This analysis did not consider a number of factors that might also be important, including: primary and secondary sex ratios, survival rates, responses to changes in food availability, physiological plasticity, etc., and the authors recommended further analysis should include these variables. Data gaps prohibited the use of some RMUs in the analysis.

Hamann et al. (2013) reviewed the literature on climate change impacts to sea turtles and conducted a series of model analyses related to the 11 RMUs considered by Wallace et al. (2011) to be most threatened. The Caribbean and Western Atlantic RMU was not among these 11 RMUs; however, one of the important gaps that need to be studied is the adaptive capacity of sea turtles and their habitats to climate changes. Climate models vary in their predictions, however, changes in air and sea surface temperatures, while variable on both spatial and temporal scales, are showing an increasing trend. The authors recommended incorporating climate change scenarios and adaptive strategies into all levels of marine turtle and environmental management, at all management levels, including from local communities to national government.

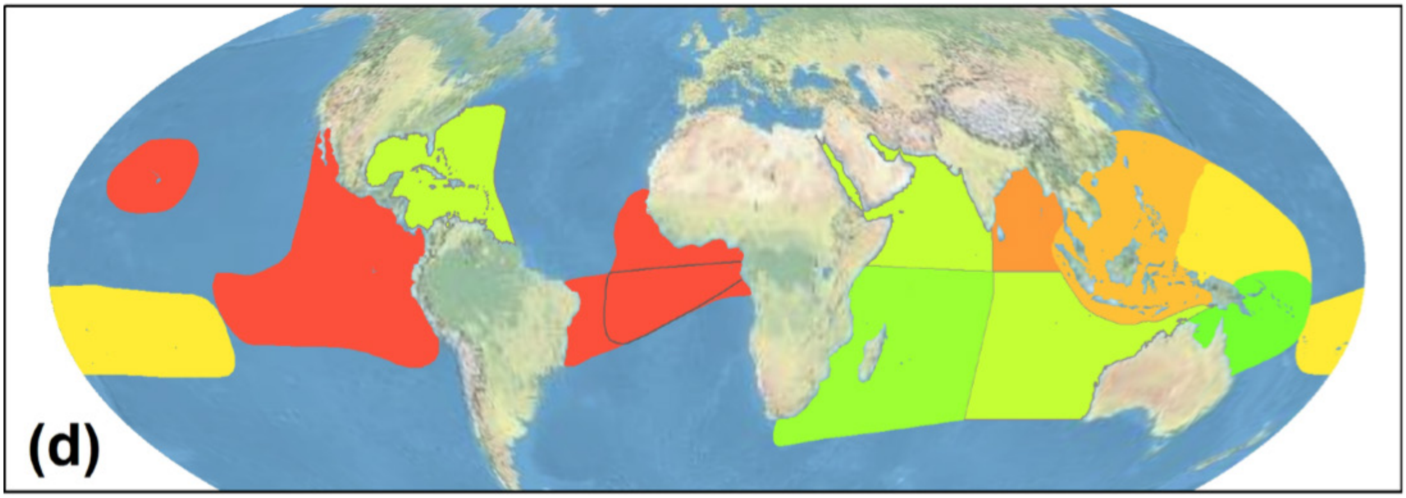

Figure 5. Resilience of hawksbill sea turtles to climate change by RMU, map taken from Figure 1d in Fuentes et al. (2013). Western Atlantic hawksbills were categorized as most resilient (green), although the resilience index for WC/WA was on the upper end of the category. In contrast, the SW Atlantic and EP were categorized as least resilient (red), see text for resilience index ranges.

Hawkes et al. (2009) provided the following recommendations for future research on climate change impacts to marine turtles: **1)** effects on key habitats on which hawksbills depend, **2)** factors that influence nest site selection by hawksbills, **3)** consequences of skewed primary sex ratios, and **4)** effects on turtles at sea, such as range shifts and dietary breadth.

Hawkes et al. (2014) reviewed potential impacts of climate change on reproductive success. They point out that while there is much uncertainty in understanding the effects of climate change on sea turtles, they are already showing some evidence of adaptation to climate change; e.g., changes observed in the onset and duration of the reproductive season, and colonization of new beaches. Increases in temperature may open new nesting areas (at higher latitudes and/or temporally shifting the nesting season), while other areas may be lost to sea level rise. Of particular concern is coastal development, which reduces habitat resiliency in ways that restrict adaptation options for sea turtles (e.g., does not allow for natural fluctuations in beach habitat, results in severe erosion).

Hulin et al. (2009) evaluated the effect of both the pivotal temperature (P) and the transitional range of temperatures (TRT) in determining mixed sex clutches in species of turtles with temperature-dependent sex determination (TSD). The TRT, where both sexes are produced, is positively correlated with proportion of mixed-sex clutches in turtles, thus it should be included with P in studies estimating sex ratios. In addition, lower TRT values may be an indication of higher extinction risk since climate change will increase temperatures. They did not assess hawksbills specifically, and thus further investigation is needed to determine if hawksbills are at higher or lower risk of extinction based on these parameters.

Moncada et al. (2011c) reported evidence of climate change impacts in Cuba. In particular, the impacts of hurricanes to nesting beaches and nest success were quite severe in some years.

6-Other Threats – (e.g., oil exploration and pollution, egg collection)
Egg poaching continues to be a threat on many beaches across the region; e.g., Barbados (reported by J. Horrocks to NFWF, NFWF unpubl. data), Cuba (reported by F. Moncada to NFWF, NFWF unpubl. data), Dominican Republic (Revuelta et al. 2012, 2013), Nicaragua (Lagueux et al. 2013), Panama (Meylan et al. 2013), Martinique (reported by R. LeScao to NFWF, NFWF unpubl. data), and Turks and Caicos Islands (Richardson et al. 2009). National sea turtle recovery action plans developed for WC/WA countries uniformly cite egg collection as among the contemporary threats to sea turtle populations, and the threat is particularly difficult to mitigate because of its clandestine and decentralized nature.

Petroleum contamination can be lethal to sea turtles. Typical mitigation targets include a national oil spill contingency plan; close collaboration amongst environmental agencies and petroleum companies during exploration, drilling and/or transport; community awareness and involvement; and support for regional treaties such as the Cartagena Convention and its Protocol Concerning Cooperation in Combating Oil Spills in the Wider Caribbean Region (e.g., summarized for Trinidad and Tobago in Forestry Division et al. 2010).

Cuevas Flores (2009) and Guzmán Hernández and Cuevas Flores (2012) have reported on the threat to hawksbills from oil exploration, specifically the pneumatic pistons in seismological studies, which overlap with important hawksbill foraging areas and migration routes in the Yucatán Peninsula area of Mexico. Further investigations are needed to determine the extent of this threat, particularly since the Yucatán is a highly important nesting and foraging area for hawksbills in the region.

Two important threats are looming in Caribbean Nicaragua, oil exploration in offshore waters and development of a mega canal to traverse between Atlantic and Pacific oceans. Both of these projects pose a threat to Caribbean and east Pacific hawksbills. On the Caribbean side, numerous satellite tracking projects have tracked hawksbills to Nicaragua foraging grounds from, inter alia, Costa Rica, Barbados, Puerto Rico, Bonaire, and the Dominican Republic. Foraging grounds in Nicaragua show a high genetic diversity of hawksbills as well (Campbell and Lagueux unpubl. data), showing that hawksbills from rookeries across the Caribbean depend on food resources found on the expansive continental shelf off Nicaragua's Caribbean coast. Furthermore, two important hawksbill rookeries are located nearby, the Pearl Cays (Lagueux et al. 2003, Lagueux et al. 2013) and El Cocal (Lagueux and Campbell 2005, Lagueux et al. 2012), and both have been identified as CITES index sites (see www.cites.org/eng/prog/hbt/dialogue2/E-HT2-8.pdf). Potential impacts include disruption of migratory routes and feeding areas from offshore oil drilling and dredging for canal construction; habitat contamination in the water and on the nesting beaches from construction and bilge dumping; degradation of beach and reef/seagrass habitats, to name a few.

There is also a threat in Venezuela to the second most important hawksbill nesting area in the country from an offshore gas project located at the southern tip of the Peninsula de Paria National Park (H. Guada pers. comm., Director of Centro de Investigación y Conservatión de Tortugas Marinas). A pipeline was constructed across the park and prevents hawksbill nesting on one of the nesting beaches. Threats will increase to several hawksbill nesting beaches from this project when it becomes fully operational with shipping, maintenance, and several other activities occurring that are typical of offshore activities. Although nests are protected in this important nesting area, there are no long-term tagging efforts being conducted and no information on the foraging grounds used by nesting turtles when they leave the nesting area (H. Guada pers. comm).

Mitigation Measures

In 2009, during the IAC workshop discussions regarding threats to hawksbills in the Wider Caribbean region, working groups proposed the following four important issues that needed to be immediately addressed (IAC Secretariat 2010):

1) Reduction of by-catch of hawksbills throughout the Wider Caribbean Region,
2) Reduction of directed take of hawksbill turtles and their products in the Wider Caribbean,
3) Identification of hawksbill population units in the Wider Caribbean region, and
4) Harmonization of laws, regulations, and policies for the conservation of hawksbills in the Wider Caribbean.

Bycatch of hawksbills is considered widespread throughout the region; although it remains that few quantitative data are available to determine trends related to mitigations. Based on the information provided in Table 3, estimates of bycatch mortality in the Wider Caribbean were between 5,000 and 17,000 hawksbills annually (NFWF unpubl. data). Some countries and territories are monitoring or investigating sea turtle bycatch, and efforts have increased in recent years. In general, mitigations for sea turtle bycatch have been recently investigated (e.g., Wang et al. 2010, 2013) by the scientific/conservation community and guidelines for bycatch reduction techniques (BRTs) for various gear types have been presented by the FAO (2010) (Table 4, Figure 6), and by Gillman et al. (2010) for coastal passive net fisheries. BRTs for sea turtle bycatch in gillnets, which is believed to have the greatest impact on hawksbill turtles, include various methods to illuminate nets and some have resulted in significant reductions during study trials. For example, Wang et al. (2010, 2013) tested LED lights, chemical lightsticks, and UV LED lights, all showing significant reductions in turtle bycatch (40%, 59%, and 39.7%, respectively). In addition, tests to determine the impact of these illumination methods on target species showed that none were significantly reduced. While some net illumination methods show promise, much more work is needed to further reduce turtle bycatch and implement BRTs where most appropriate. Furthermore, these studies were not conducted on hawksbill turtles, and thus studies specifically targeted to assess reduction in hawksbill bycatch are needed.

Table 4. Summary of principal methods recommended to reduce sea turtle interactions and increase the likelihood of turtles surviving interactions with marine capture fisheries. Table taken from: Table 1, FAO (2010). The efficacy of these measures to reduce hawksbill capture and/or mortality is unclear.

Summarized listing of main mitigation measures	
1. Management measures	**Applicable to fisheries/gear**
• area closures • seasonal closures • effort limitations • access limitations • TAC/quotas on non-target species • avoiding bycatch hotspots • bycatch fees and other methods of compensation	All fisheries
2. Technical measures	
• setting nets perpendicular to the shore to reduce interactions with nesting females • using deterrents, including sonic "pingers", shark silhouettes, lights or chemical repellents • deeper setting, avoiding the upper water column where turtles are most abundant • renunciation of "tie-down" ropes • use of lower nets	Set gillnets, drifting gillnets
• using wide circle hooks • using fish rather than squid for bait • setting hooks deeper than turtle abundant depths (40–100 m). • single-hooking fish bait rather than threading the hook through the bait multiple times • reducing gear soak time and retrieving gear during daytime	Pelagic longlines, bottom-set longlines
• use of TEDs	Trawl fisheries
• avoid the encirclement of sea turtles	Purse seine
• if encircled, hooked or entangled, take all possible measures to release turtles safely	All fisheries

Figure 6a. Gillnet equipped with tie-downs (turtles can become entangled)

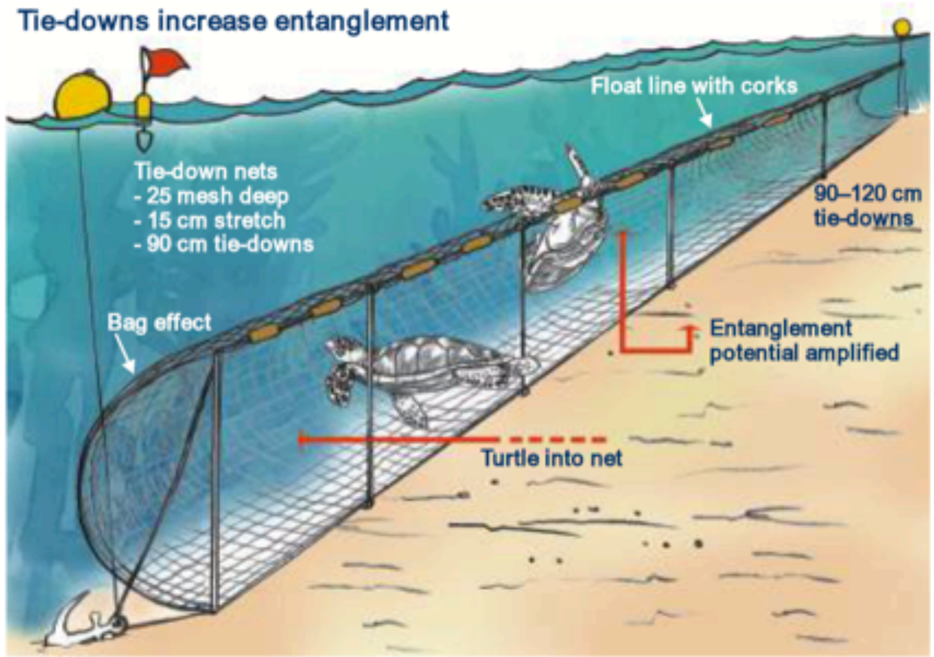

Figure 6b. Gillnet with longer tie-downs (turtles can escape more easily)

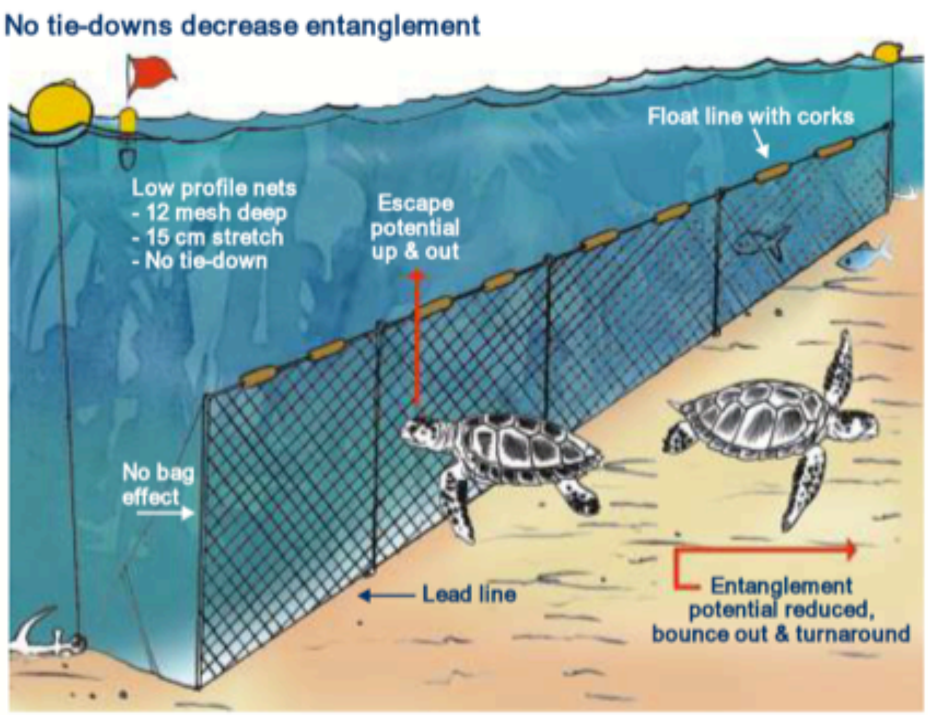

Figure 6. Illustration of mitigation recommendation to reduce sea turtle bycatch in bottom-set gillnet by elimination of tie-downs. Figure taken from: Figure 6, FAO (2010) and also found in Gillman et al. (2010), Figure 1.

In addition to net illumination techniques, Wang et al. (2010) investigated the use of a shark shape alongside gillnets to determine its potential for reducing turtle bycatch. This method was highly successful, reducing turtle bycatch by over 50%; however, target fish species were also significantly reduced (45%) and thus this modification may not be viable.

The feasibility of using BRTs in small-scale fisheries is an important consideration as well, since increased costs and dependence on volunteer adoption of techniques might limit their use. However, understanding the extent of reductions in sea turtle bycatch levels and effects on target species captures is the first step in developing new technologies to address this important threat to hawksbills. In the FAO (2010) guidelines, the following research needs were identified: **a)** determine the degree of sea turtle interactions in specific fisheries, **b)** better understand turtle behavior and interactions with fishing gear, **c)** improve post-release mortality estimates, **d)** test gear modifications to make them effective and viable, and **e)** standardize hook nomenclature.

Empirical data on *Directed Take* of hawksbills are scarce due in part to the clandestine nature of take since turtles are legally protected in most countries. The recent passing of protective legislation that bans hawksbill take in three additional countries (Antigua and Barbuda, Cuba, and Trinidad and Tobago), the renewal of the moratorium on turtle take in Anguilla until 2020, and significant new restrictions designed to protect large juveniles and adults in TCI are important steps towards complete region-wide protection. However, it is clear that adequate enforcement is lacking, due in part to limited resources, logistical challenges of enforcement agencies, and in some cases lack of political will (e.g., summarized by Bräutigam and Eckert 2006). Furthermore, nine countries and territories maintain legal take of hawksbills as mentioned previously, and monitoring this take is not being carried out; therefore it is difficult to assess the effectiveness of mitigations. Reports of confiscated turtles and/or prosecutions are difficult to obtain, and thus it is recommended that organizations working on sea turtle conservation collect this information in order for future assessment of trends. Harris and Harris (2014) reported the first prosecution of illegal turtle poaching in Dominica in 2013, which presumably will be a deterrent for future would-be poachers. Some other recent prosecutions have occurred in Costa Rica, Puerto Rico, and US (see Appendix III for links to examples of recent prosecutions).

Nesting beach monitoring by NGOs or other conservation groups is widespread and often affords important protection against egg poaching and killing nesting females (Bräutigam and Eckert 2006, Mortimer and Donnelly 2008, Kamel and Delcroix 2009, Lagueux et al. 2013). However, there are many gaps (e.g., hundreds of islands and keys in The Bahamas and Cuba are un- or under-monitored), and conservationists are in some cases at great risk to would-be poachers. The continued presence of these groups as well as concerted efforts to raise awareness and educate coastal communities about sea turtle conservation needs is vital to reducing this threat. Unfortunately, as conservation funding has become more limited in recent years, some conservation groups are finding it more difficult to maintain monitoring programs. Patrols by enforcement authorities are much less common but do occur at some sites, particularly in protected areas such as in Belize (e.g., Sapodilla Cayes and Bacalar-Chico) and Costa Rica (Tortuguero and Cahuita).

Identification of hawksbill population units in the Wider Caribbean region. Wallace et al. (2010) identified regional management units for hawksbills, with the “Atlantic, Western Caribbean/USA” region as a single management unit. Hawksbills in Brazil were identified as a separate management unit “Atlantic, Southwest”. However, based on recent hawksbill genetic research by LeRoux et al. (2012), relatedness is patchy in the Wider Caribbean region and connectivity is found among geographically distant rookeries, although a few rookeries in close proximity are genetically similar. There was significant structuring among populations, suggesting two phylogroups and three clades, with two of these clades being widely distributed across the region. As mentioned previously, genetic relationships using 740 bp showed the following groupings: **1)** Puerto Rico, Nicaragua, Costa Rica, US Virgin Islands, and Barbados-Windward, **2)** Mexico, **3)** Barbados-Leeward, Brazil, and Cuba, **4)** Antigua, and **5)** Guadeloupe. Mismatch analysis showed the occurrence of a population bottleneck between 100,000 to 300,000 years ago.

Harmonization of laws, regulations policies for the conservation of hawksbills in the Wider Caribbean. As mentioned previously, four additional countries in the region have recently passed protective regulations that protect hawksbills (Antigua and Barbuda, The Bahamas, Cuba, and Trinidad and Tobago), and one country (Anguilla) renewed a moratorium on hawksbill take. These measures are an important contribution to a region-wide goal of legal protection; however, nine countries continue to allow take, and as has been previously reported elsewhere management of take levels is essentially non-existent (e.g., Turks and Caicos (TCI) - Richardson et al. 2009).

Information is scant on efforts to change legislation in the other eight countries and territories (excluding TCI) where hawksbill take remains legal, and further assessment of hawksbill conservation efforts at these locations is needed. Furthermore, there remain inconsistencies in protection measures across the region and a thorough assessment of existing protection measures is needed.

IAC Member Country Annual Reports - Mitigations

Information on specific mitigation measures to reduce hawksbill mortality and improve their conservation outlook is readily available online at www.widecast.org, including tagging and population monitoring, care of sick and injured turtles, education and outreach, and solutions to a wide variety of threats, including habitat degradation. Notwithstanding, tailoring best practices to specific sites can be challenging, and therefore the information provided in IAC Member Country Annual Reports, where member countries report on their activities in compliance with the IAC resolution on hawksbill conservation (COP3/2006/R-1, http://www.iacseaturtle.org/eng-docs/resolucionesCOP3CT/COP3-2006-R1-Hawksbill-Res.pdf), is highly valuable in that they present a range of mitigations successfully (and sometimes unsuccessfully) implemented as summarized below.

Belize (2013) – Gillnet use is now regulated, although methods are not described, and trawling has been banned countrywide. They are not currently monitoring or researching fisheries interactions with hawksbills. The government is strengthening protection of nesting and feeding areas through establishing protected areas, and conducting marine patrols. The government has adopted the use of circle hooks in 10% of the Belize high seas fishing fleet, and requires the release of any live captured turtles from longline fishing, as well as reporting all turtle captures. There is currently no observer program; however, there are plans to implement one. The government has been working with non-government and educational institutions to increase awareness and promote conservation of sea turtles. Indirect mitigation measures related to climate change include ongoing habitat monitoring and collaboration on workshops to build capacity on monitoring techniques, however, no specific mitigation measures have been implemented.

Brazil (2014) – Monitoring impacts of fisheries interactions (quantitative and qualitative), including longline, bottom trawls, and some types of gillnets, corrals, and pound nets, is being conducted. The government also implemented an observer program on some fisheries and is strengthening protection of nesting and foraging habitats through the establishment of protected areas. Extensive research on fisheries interactions in collaboration with other groups is ongoing. They have implemented use of circle hooks in longline fisheries, including line cutters and dehookers, although none are mandatory; however, they are strongly encouraging the use of these mitigations and are receiving some voluntary compliance.

Caribbean Netherlands (2012) – The government has established marine protected areas around all islands, which protect both in-water and beach habitats. Research on genetics, movements, and foraging habitats are being conducted. No incidental capture or illegal take of hawksbills occurs. The use of circle hooks in artisanal and recreational pelagic trolling in Bonaire has been introduced. Climate change adaptation is being monitored and they are partnering with Sea Turtle Conservation Bonaire to work on this issue. Principal threats to hawksbills are coastal development and climate change, and they are protecting nesting beaches to mitigate these threats.

Costa Rica (2014) – There are numerous protected areas, and research and monitoring programs conducted in collaboration with institutions, NGOs and local communities. Shrimp fishing with trawl nets is no longer permitted, once current permits expire. Training has been provided to law enforcement agents to mitigate illegal trade in hawksbill products and efforts are being made to enforce protection laws. Important nesting and foraging habitat is now being protected in Cahuita National Park.

Curaçao (2014) – Enforcement of local laws is implemented by the coast guard, police and customs officers. They have developed research and monitoring of foraging and nesting sites. Their index nesting beach is located within a protected area. There is a lack of information on bycatch, especially for gillnets, to evaluate impacts. The government established a ban on gillnet use in lagoons and on coral reefs. They are promoting environmental and nature education and recently established a national sea turtle network among government and NGOs. Principal threats to hawksbills are coastal development, incidental capture and direct use.

Guatemala (2012, 2013) – There is a moratorium on the sale of hawksbill eggs, and hatcheries are used to mitigate increased temperatures on nesting beaches from climate change. A Sea Turtle Advisory Group has been created. Nesting and foraging habitats are protected (La Graciosa Bay Wildlife Refuge). Mitigations for fisheries bycatch have been put into place for longline, gillnets, and trawling; however, no specific mitigation measures were provided. They have conducted a campaign to raise awareness of new regulations about turtle egg collection, and have increased patrols on land. They enforce Turtle Excluder Device (TED) regulations through inspections at ports of all fishing vessels and inspections at high seas. Their principal threat is direct use, which is being addressed through a prohibition on the sale of eggs. It is unclear if there are differences between Caribbean and Pacific coasts regarding mitigation measures related to hatcheries and increased awareness.

Honduras (2013) – They are evaluating incidental capture of sea turtles in fisheries and taking actions to mitigate their capture in trawl fisheries. They have increased nesting and foraging habitat protection with the declaration of two new RAMSAR sites. Research on genetics, nesting habitats, and migratory behavior are being conducted. The government is in the process of creating a national sea turtle committee/network. As part of a national strategy for climate change, coastal marine systems have been prioritized, including efforts to conserve and restore mangroves in bays, estuaries, and islands; and to prevent and reduce impacts to coral reef ecosystems, as well as restore and conserve these systems in the face of climate change, including adaptation measures. The principal threats to hawksbills include coastal development and climate change.

Mexico (2012) – The government has recently established and/or revised a number of laws relevant to hawksbills, among them are: revisions to General Law of Ecological Balance and Environment that improves biodiversity and species protection; a General Fisheries and Sustainable Aquiculture Law to ensure conservation, preservation and rational use of fisheries resources and coordinate measures to protect sea turtles, marine mammals and aquatic species with protection status; and revisions to the federal penal code to impose sanctions for capture or harm of any sea turtle or marine mammal, or their products. The country has promoted working with other conventions/treaties and international organizations towards the management and conservation of hawksbills, e.g., drawing attention to the decline in hawksbills in Caribbean Mexico and participating in and helping coordinate the IAC/CITES/SEMARNAT workshop in 2009. The government conducts inspections and monitors markets, beaches and marine habitats. Egg poaching has been reduced to less than 20% at the majority of beaches as a result, although there remains a high demand for turtle products. Research in the Yucatán Peninsula has been conducted on migratory behavior, identification and conservation status of foraging habitats, foraging population dynamics (including recording fisheries bycatch), and integrity of nesting habitats (including levels of artificial light). Regarding incidental capture, they have onboard observer programs and evaluate observer reports and fishing logbooks. Protection of some nesting beaches and foraging areas occurs in several protected areas of the Yucatán Peninsula. Research has been conducted on TEDs and longline fishing in the Gulf of Mexico and Caribbean Sea. Specific mitigations include mandatory use of circular hooks in specific areas, restrictions on gillnets that prohibits their use in front of nesting beaches during the nesting season, restrictions on trawling that require various components to reduce turtle bycatch, and seasonal closures along the Gulf of Mexico coastline. Training and education have also been conducted to decrease fisheries interactions with sea turtles. A climate change strategy has been developed that includes strategies to mitigate impacts to coastal and marine ecosystems, and sea turtle conservation action plans include habitat protection measures and monitoring.

Panama (2013) – The government has established additional protected areas where there is important hawksbill nesting (e.g., Paisaje Protegido Isla Escudo de Veraguas-Dego) and has increased monitoring of illegal use and trade of hawksbills and their products. Product seizures have been made of hawksbill products at the international airport and some markets. The government works with communities to increase compliance, through reporting illegal activities to authorities. They have implemented an awareness campaign to inform the public about the status of marine turtles in Panama and applicable regulations and mechanisms to report illegal activities. The Aquatic Resources Division of Panama plans to develop and implement an observer program to assist with monitoring bycatch. They conduct inspections for bycatch and to enforce the use of TEDs. The government has also imposed some restrictions on longline fishing and established a closed season for shrimp trawling (1 Feb - 11 Apr, and 1 Sep - 11 Oct) for industrial and artisanal fisheries, which may reduce hawksbill mortality. They have also conducted training courses for inspectors and have conducted inspections of the proper use of TEDs. They are in the process of developing a national committee for sea turtle conservation and protection. There are efforts by various groups to relocate nests in danger from erosion as a mitigation measure to impacts from climate change.

United States (2013) – The government published a Five-year Review of Hawksbills in 2013 (National Marine Fisheries Service and US Fish and Wildlife Service 2013) and has assisted with addressing illegal hawksbill trade in the Dominican Republic. They continue to enforce the Endangered Species Act, which legally protects hawksbill turtles nationally. Research is being conducted on genetics, migratory behavior, foraging habitats, prey species, foraging populations, nesting habitats (supporting surveys and nest protection at two principal sites – Mona Island, Puerto Rico and Buck Island Reef National Monument, US Virgin Islands, both of which are protected. They continue to support a fisheries observer program and all hawksbill encounters are reported, although there are many fewer reports than for other species. The US is implementing a number of bycatch reduction strategies that not only will benefit the principal turtle species being captured but will also likely benefit hawksbills. As well, the US government continues to support the Marine Turtle Conservation Act, which provides funding each year to international projects conducting research and conservation activities of high priority.

Venezuela (2012) – The government has increased monitoring of illegal use and enforcement of the prohibition on trade in hawksbill products. A prohibition on industrial trawl fishing has been imposed countrywide. A few studies are, or have been carried out on genetics, migratory behavior, status of foraging habitats, trends in foraging populations, status of nesting habitats, and prey species. Environmental impact studies are required for activities such as seismic exploration that may damage foraging and nesting habitats. As part of the coastal zone management plan these habitats are monitored.

Non-Member Countries and Non-Governmental Mitigations

In addition to mitigation measures implemented by the IAC member countries, other non-member countries have also implemented mitigation measures. For example, in 2010, Cuba established the Jardines de la Reina National Park. If protected area regulations are enforced, this would be an important mitigation measure for hawksbills in southern Cuba where the most significant hawksbill nesting beaches in the country occur. Also in 2010, Nicaragua established the Refugio de Vida Silvestre Cayos Perlas (Pearl Cays Wildlife Refuge), another important nesting and foraging site for hawksbills. In addition, it has been reported by numerous monitoring programs that the presence of conservation and/or researchers on nesting beaches is an important mitigation measure that results in reduced poaching in many cases (e.g., Dominican Republic, Nicaragua). Unfortunately, these programs often depend on short-term funding sources, which can result in discontinuous monitoring and reduction of de facto mitigation measures.

Efforts to provide informative guidelines to mitigate impacts on sea turtle nesting beaches have also occurred. WIDECAST developed a set of guidelines to mitigate various impacts on sea turtle nesting beaches (Choi and Eckert 2009). The document includes recommendations on construction setbacks, beachfront lighting, sand mining, beach maintenance, protection of coastal habitats, use of boats and personal watercraft, among others. Furthermore, an assessment of beachfront lighting in Barbados resulted in recommendations for reducing threats to sea turtles on their beaches (Knowles et al. 2009) and another assessment on lighting with recommendations was conducted for the government of Anguilla (Lake and Eckert 2009).

As part of the Sea Turtle Trauma Response Corps created by WIDECAST, a complementary document to their original trauma response manual for sea turtles in crisis was developed to address the care of turtles in need of rescue and supervised rehabilitation (Bluvias and Eckert 2010). The manual provides guidelines for sea turtle husbandry, including best practices for human health and safety, sea turtle handling and transport, facility design and requirements, diet and feeding, enrichment, emergency procedures, and release.

It is expected that many of these mitigation measures have resulted in reduced mortality of hawksbills; however, there is little empirical data to evaluate their effectiveness, except in some cases where monitoring of nesting beaches with prior mortality data has occurred.

EASTERN PACIFIC

Distribution

It has been previously reported that hawksbills occur in the eastern Pacific (EP) from the US to Peru (Mortimer and Donnelly 2008). Hawksbills in the EP are sparse and until recently were thought to be nearly extinct in the region. While hawksbill populations in the EP, like elsewhere, have been severely diminished due to the harvest of eggs, and animals for meat and tortoiseshell, it is unclear if their low numbers might also be due in part to the lack of coral reefs in the region (Seminoff et al. 2012).

Based on information compiled from January 2007 to May 2009, by the Iniciativa Carey del Pacífico Oriental (ICAPO) network, Gaos et al. (2010) reported nesting from Mexico to Ecuador, with the exception of Honduras, Panama, and Colombia (no information was available from these three countries). The authors also reported in-water observations from Mexico to Peru, with the exception of Guatemala, Honduras and Panama due to lack of information. Since 2009, additional efforts to survey and monitor beaches and record in-water observations of hawksbills by the ICAPO network collaborators have been made, and thus, the most recent information available is included in the Nesting and Foraging sections below.

Nesting

Based on unpublished data provided in 2014 by ICAPO (A. Gaos, Executive Director of ICAPO; see Appendix II for list of data contributors), hawksbill nesting has recently been confirmed from Mexico to Ecuador, except Guatemala (Table 5). A total of 37 nesting beaches were confirmed, and the total number of clutches/yr was estimated to be 436-830. The most significant remaining rookeries occur in El Salvador and Nicaragua, with recent annual clutch counts of 189-330 and 180-315, respectively. The individual sites where the majority of nesting occurs are Bahia Jiquilisco, El Salvador and Estero Padre Ramos, Nicaragua, each with 151-250 clutches/yr. Other nesting beaches of relative importance (from 26-50 clutches/yr) include Los Cobanos, El Salvador; Aserradores, Nicaragua; and La Playita, Ecuador. Nesting is sparse in Mexico, with 11-25 clutches/yr from six beaches. Only 1-2 nesting sites have been identified in Honduras and Colombia, each with from 1-5 clutches/yr.

Foraging

It has recently been determined that hawksbills, although sparse in most areas, occur in the nearshore waters along much of the eastern Pacific coast of the Americas from Mexico to Peru. Seminoff et al. (2003a) reported hawksbills in the neritic foraging habitats at sites on both coasts of the Baja California peninsula. The sizes of turtles observed suggested that the area is used by foraging juveniles and subadults, with some larger turtles observed in the Gulf of California (34.4-74.2 cm straight carapace length, SCL) compared to the Pacific coast of Baja California (35.4-52.2 cm SCL). Since then, the ICAPO network, with assistance from local fishers, has found a number of additional in-water sites used by hawksbills in these waters. According to unpublished data provided by ICAPO (compiled by A. Gaos, see Appendix II for list of data contributors), observations of hawksbills in nearshore waters include multiple sites in all countries from Mexico to Peru (Table 5). Mexico has the greatest number of sites among the reported observations, followed by Costa Rica; combined they make up 50% of observations.

Table 5. Most recent estimated number of hawksbill clutches/yr in 10 countries in the Eastern Pacific region, and observations of life stages of foraging hawksbills found in each country. Unpublished data provided by the ICAPO network (compiled by A. Goas), see Appendix II for data contributors. J=juvenile life stage, A=adult life stage.

Country	Clutches/yr (# of beaches)	Foraging (# sites)
Mexico	11-25 (6)	J, A - (22)
Guatemala	N/A, 1 from 2007-2009 in Gaos et al. (2010)	J, A - (3)
El Salvador	189-330 (4), Bahia Jiquilisco = 151-250/yr	J, A - (5)
Honduras	1-5 (1)	J, A - (4)
Nicaragua	180-315 (5), Estero Padre Ramos = 151-250/yr	J, A - (7)
Costa Rica	24-80 (14)	J, A - (17)
Panama	2-10 (2)	J - (5)
Colombia	1-5 (1)	J - (3)
Ecuador	29-65 (4)	J, A - (8)
Peru	0	J - (4)

Higher densities of observations thus far indicate that important foraging areas occur in Mexico at Espíritu Santo and Centro Norte de Sinaloa; El Salvador at Bahia Jiquilisco and El Maculis; Costa Rica at Matapalito, Playa Blanca, and Punta Coyote; Panama at Golfo de Chiriqui; Colombia at Gorgona and Guapi; and Ecuador at Machalilla and Galapagos Islands. Each of these areas ranged from 11-25 or 26-50 hawksbill observations/yr. Foraging data are more limited due to the opportunistic nature of observational data collection in inshore and nearshore marine areas, and thus, there are likely additional sites of importance that have not yet been observed. Quantitative assessments in coastal and nearshore waters are needed to better determine their distribution and identify priority foraging areas in this region in order to focus conservation mitigations. Additional recent accounts of hawksbills at specific sites follow.

Colombia – Amorocho and Reina (2007) reported that small juvenile hawksbills occur around the coral reefs of the southeast side of Gorgona National Park. In addition to Gorgona, hawksbills are reported to occur in the reefs of Utría National Park at Chocó (Amorocho 2009).

Mexico – Nichols (2003) reported that hawksbills are rare in the Baja California Peninsula, and only juveniles were found there. Hawksbills were most frequently encountered in coastal waters feeding in rocky reef areas. An assessment of stranded and consumed turtles showed the size ranged from 35.4-52.2 cm SCL. Also, the author provided evidence that hawksbills were once much more abundant in the area and were reduced by a fishery targeting the turtles for their shell, and reported that sea turtles continue to be illegally hunted and captured incidentally in local fisheries. The author provided an account of a single restaurant in Loreto, Baja California with approximately 15 small hawksbill shells hanging on the wall, ranging in size from 35-45 cm SCL. Seminoff et al. (2003a) provided a size range of 34.4-74.2 cm SCL (includes those reported by Nichols 2003) for the occurrence of live captures and observations of dead hawksbills on both the Pacific and Gulf of California coasts. Through the examination of stomach contents of some of the dead stranded turtles it was evident that they were foraging in the area. Castellanos-Michel et al. (2006) later reported that many juvenile hawksbills are observed in the waters of the Jalisco coast, indicating it may be an important foraging area for the species. The authors also reported that humans are the principal predators of hawksbills and government intervention is needed. Recently, in-water monitoring efforts in the southern Gulf of California have shown significant numbers of small and large juvenile hawksbills (A. Gaos unpubl. data), and this species is the second most common sea turtle in the area (to green turtles).

Peru – Quiñones et al. (2011) reported the occurrence of hawksbills in central and southern Peru, the southernmost extent of the species. Prior to this, reports of hawksbills were limited primarily to northern Peru (e.g., Alfaro-Shigueto et al. 2011), however, while hawksbills are rare in this area, the majority of occurrences in this southern area coincided with an El Niño event in 1987 when warmer waters extended southward. All observations were based on turtles captured in coastal gillnets in the San Andrés area. This area may be important for hawksbills during “warm” years, and increased monitoring and conservation is needed in this area of Peru since illegal captures continue to occur despite being legally protected since 1995.

While numerous gaps still remain in the distribution of EP hawksbills, for both nesting and foraging sites, Gaos and Yañez (2012) reported that preliminary surveys conducted of Pacific Panama showed promise for the occurrence of both nesting and foraging hawksbills. However, this area needs further study to determine hawksbill distribution and abundance. In addition, the Darien Gap region shared between Panama and Colombia is completely unexplored.

Protection Status

Hawksbills are legally protected to varying degrees in all countries where they occur that border the east Pacific Ocean. Legal protection in each of the 11 countries where they occur is summarized in Table 6. Fortunately, hawksbills are nationally protected in the two countries with the most productive remaining beaches (El Salvador and Nicaragua), and in countries with important known foraging areas (e.g., Costa Rica, Mexico). On the contrary, nesting beach programs are the principal means for protection against poaching, without which nearly 100% of clutches would be poached (J. Seminoff pers. comm.).

Recent Research

Genetics

Information on eastern Pacific hawksbill genetics is in its infancy. Zúñiga Marroquín et al. (2007) reported that Pacific hawksbills separated from Atlantic hawksbills 1.6-3.9 million years ago. The authors also found sufficient differentiation between the groups for them to be considered at least separate subspecies. Zúñiga Marroquín et al. (In press) later reported finding nine haplotypes from Mexican Pacific (MP) hawksbills using longer sequences. Using the shorter sequences and comparing global samples, Zúñiga Marroquín et al. (In press) found a close relationship between the MP hawksbills and Japanese hawksbills, although high differentiation was found between MP hawksbills and both Pacific and Atlantic clades. Information provided by these two studies is a summary from abstract proceedings and thus a more comprehensive understanding of results may be forthcoming. In addition, the same author presented an additional abstract on genetic characterization; however, the summary did not provide sufficient detail to report here, but detailed results may also be forthcoming.

Table 6. National protection status for hawksbills in each of the east Pacific countries, including information on principal international instruments important to sea turtles. CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora, CMS = Convention on the Conservation of Migratory Species, IAC=Inter-American Convention for the Protection and Conservation of Sea Turtles, IATTC= Inter-American Tropical Tuna Commission, Lima=Lima Convention (The Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific), and Ramsar = Convention on Wetlands of International Importance.

Country	National Protection	International Instruments	Gaps
United States	Yes (although rarely occurs in US waters of the east Pacific)	CITES, IAC, IATTC, Ramsar	CMS
Mexico	Yes	CITES, IAC, IATTC, Ramsar	CMS
Guatemala	Yes, ban on egg collection currently in affect (15 October 2012 to 15 October 2017)	CITES, IAC, IATTC, Ramsar	CMS
El Salvador	Yes, since 2009 (República de El Salvador 2009)	CITES, IATTC, Ramsar	CMS, IAC
Honduras	Yes	CITES, CMS, IAC, Ramsar	CMS, IATTC
Nicaragua	Yes	CITES, IATTC, Ramsar	CMS, IAC
Costa Rica	Yes	CITES, CMS, IAC, IATTC, Ramsar	
Panama	Yes	CITES, CMS, IAC, IATTC, Lima, Ramsar	
Colombia	Yes	CITES, IATTC, Lima, Ramsar	CMS, IAC
Ecuador	Yes	CITES, CMS, IAC, IATTC, Lima, Ramsar	
Peru	Yes	CITES, CMS, IAC, IATTC, Lima, Ramsar	

Seminoff et al. (2003b) reported the first hybridization record of a green-hawksbill turtle in Mexico. The turtle proved to be a cross between a hawksbill female and green turtle male, with mtDNA from the female being a common Pacific haplotype also found in places like Australia.

Trujillo-Arias et al. (2014) also presented results of haplotypes from Pacific Colombia (primarily Gorgona National Park, GNP), which indicated a relatively low heterogeneity (h=0.286). This low diversity at GNP may be due to the small sample size (n=7 from Gorgona National Park), severe exploitation of turtles in the area, and/or the relatively recent colonization of the EP as indicated by phylogeographic genetic analysis by Bowen and Karl (2007). Two additional sites were sampled, although only one sample was analyzed from each. A total of three haplotypes were identified from all nine foraging samples analyzed, two haplotypes from Gorgona National Park and one haplotype from Sanquianga and Utría National Parks. Interestingly, two haplotypes matched haplotypes from Japan (EiJ5 and EiJ8), although these were matched to the 520bp length, leaving out additional polymorphic sites; and one haplotype (Iran-3) was found to be registered in the Persian Gulf. A more complete analysis of eastern Pacific hawksbill genetics is needed.

Habitat Use, Feeding Habits, Migrations & Movements

Brittian et al. (2012) reported the presence of small juvenile hawksbills in coastal and mangrove habitat along the southeastern coast of Pacific Guatemala. They reported on the entanglement of two juvenile hawksbills (36.0 and 38.5 cm curved carapace length, CCL), one turtle was stranded on a beach in a discarded rice sack and the other was captured in a gillnet. The authors suggested that the extensive mangrove networks of the southeastern coastal waters may provide important habitat for juveniles. The entanglement of these turtles also provides insights into potentially important threats to hawksbills in the area.

Carrión-Cortez et al. (2013) reported the diet and habitat preferences of juvenile hawksbills in the Nicoya Peninsula (Punta Coyote), Costa Rica. Hawksbills ranged in size from 38 – 70 cm CCL and used primarily the rocky reef habitat in waters of average 7.6 ± 3.3 m depth. Home ranges averaged 67.2 ± 2.2 ha, which overlapped very little with the nearby protected area (Caletas-Arío National Wildlife Refuge, CANWR). The aggregation showed a high degree of fidelity to the foraging site. Turtles fed primarily on sponges (*Geodia* sp.) and tunicates (*Rhopalaea birkelandi*). During surveys in the Nicoya Peninsula they observed at least 5 discrete rocky reefs with the presence of hawksbills, all were likely juveniles and many were small juveniles. The authors suggested an ontogenetic divergence in habitat types in light of their study results and the prevalence of adult hawksbills in inshore estuary mangrove forest habitat reported by Gaos et al. (2011). The authors recommended extending the existing CANWR or creating a new protected area to reduce hawksbill overlap with fisheries. In addition, further studies to elucidate the role of hawksbills in coastal ecosystems and identify critical habitat to improve conservation and management policy in the area were recommended.

Carr (1952) initially commented on the use of mangrove-bordered bays, lagoons, and estuaries (usually mud-bottomed) of EP hawksbills, ranging into small narrow creeks and passes. Gaos et al. (2011) confirmed the use of similar habitat in an extensive tracking study of post-nesting females along the coasts of El Salvador, Nicaragua and Ecuador. Use of this habitat type by adults is a departure from the more commonly known foraging in coral reef areas and hard bottom habitats typical of hawksbills in other parts of the world, e.g., Caribbean (Leon and Bjorndal 2002, Meylan 1988). Gaos et al. (2011) reported two patterns of habitat use, inshore waterways (83.3%) and near-shore areas (16.7%). The three most common coastal habitat features were mangrove saltwater forest (mean=62.9% ±34.5%), cleared fields (mean=5.8% ±20.7%) and shrimp ponds (mean=9.5% ±18.9%). These results indicate that hawksbills show variability in their life-history strategies and highlight the importance of understanding this variability from an ecological and management perspective.

Gaos et al. (2012a) also reported on the spatio-temporal movements of adult female hawksbills. During the inter-nesting phase, turtles traveled an average distance of 7 km from their nesting sites, but was variable. They averaged 1 km distance from the coast, and used an area of about 16 km in length along the coast. The turtles used primarily nearshore inter-nesting home ranges (71.4%), with their 90% utilization distribution (UD) home ranges an average of 31.2 km2 (±33 km2), and 50% UD home ranges were 5.1 km2 (±5.5 km2). Post-nesting migratory movements were relatively short averaging 113 km, although the shortest distance was 18 km and the longest was 283 km, and the turtles remained close to shore during these migrations (average=1.7 km, ±1.3 km). Several turtles shared foraging areas, indicating particularly important sites in Bahía Jiquilisco (El Salvador) and Gulf of Fonseca (Honduras). The 90% UDs and 50% UDs were considerably smaller at foraging sites than their inter-nesting areas, mean=6.95 ± 8.5 km2 and 1.47 ± 1.7 km2, respectively, although inshore home ranges where the majority of turtles foraged was smaller. More than 65% of the time turtle location points were located inside protected areas, however, enforcement and monitoring are lacking at many of these sites. Threats to their populations may be more severe due to their restricted habitat use, such as overlap with coastal fisheries, habitat degradation and catastrophic events. However, the authors also pointed out that this restricted habitat use provides opportunities for conservation, e.g., smaller target areas for conservation measures and less variation in legal protections. The authors concluded that stronger protection for mangrove estuaries and protected area management, and increased research and conservation of hawksbills in the region are needed.

Gaos et al. (2012b) reported on the dive behavior of adult female hawksbills in Mexico (n=1), El Salvador (n=1), and Ecuador (n=3). Adult females made primarily shallow dives (≤ 10 m), and spent almost all their time at depth (89.4%) compared to less than 3% of their time at the surface. Most turtles showed a bimodal dive duration pattern with dives generally lasting either ≤5 min, or >20 min. Although variable, turtles spent most of their time in waters from 25° C to 30° C, but one turtle spent about 3% of its time in waters from 16 to 18° C. Dive patterns during three movement phases of two turtles that nested in Ecuador showed similar post-nesting migration routes. Although there were similarities during the interesting phase in the maximum dive depths being more common at ≤5 m, there were individual differences in all dive categories. While migrating, dive depth and time spent at depths ≤5 m and ≤10 m were similar for both turtles, and dives were more often >20 m. During the foraging phase, dive depths were variable except that dives were also more often >20 m for the two turtles. Generally, diel behavior was more similar among two of three turtles where diel pattern was assessed. These two turtles both inhabited nearshore open-coast habitat, while a third turtle inhabited inshore estuary habitat. The nearshore turtles used a greater range of depths, deeper dives, and longer dives during the day. The inshore turtle took longer dives at night and none were ≤5 m, and depth range was similar between diel periods. Overall, their results demonstrated that EP adult hawksbills were almost always found within 10 m of the surface and, as reported in other dive studies, were most often at depths ≤10 m, rarely diving deeper than 20 m. In addition, diel patterns of EP hawksbills suggested the possibility of more activity at night than previously thought. The authors recommended additional dive research at various colonies across multiple seasons, using dive profile technology, to better understand dive behavior and facilitate management and conservation of EP hawksbills.

Seminoff et al. (2003a) reported the presence of sponges in the gut contents of two hawksbills in the Gulf of California. Based on the size range found in the area (34.4-74.2 cm straight carapace length) the authors reported that turtles recruited from the epipelagic phase at similar sizes reported at other Pacific Ocean sites. They recommended genetic studies to determine the origin of juvenile hawksbills foraging in this area.

Fisheries

There are no apparent fisheries targeting hawksbills legal or illegal; however, there has been evidence reported by researchers in Mexico (e.g., Koch et al. 2006, Seminoff et al. 2003a) that there is take of sea turtles on both sides of the Baja California peninsula), including hawksbills. Whether the take is directed, intentional take or opportunistic is not completely clear and needs further assessment. Quiñones et al. (2011) also reported continued take of sea turtles, including hawksbills in Peru. Fisheries bycatch is reviewed below in **Principal Threats.**

Nesting Biology

Liles et al. (2011) reported on the characteristics of hawksbills nesting at the three principal nesting areas in El Salvador (Los Cóbanos Reef Marine Protected Area, Bahía de Jiquilisco-Xiriualtique Biosphere Reserve, and Punta Amapala), each area containing multiple beaches. The majority of nesting occurred at Bahía (61.9%), and mean nesting density was 6 nests/km, but was highly variable. Mean clutch size was 142.7 ± 30 eggs (range=117-200), although some clutches were likely incomplete due to the likelihood that partial clutches were sold to the hatchery program during some periods. Hatching success was 66.4% overall for relocated clutches. Nesting females ranged from 74 to 88 cm curved carapace length. The authors estimated that the 310 clutches observed represented 52-78 individual females based on a clutch frequency of 4-6 clutches observed in the Caribbean. More than 10,000 hatchlings emerged from all three (25 nesting beaches) monitored sites combined.

Other

Liles et al. (2014) reported on sea turtle conservation efforts and local realities in El Salvador. Using an ethnographic methodology, they used a naturalistic approach to study the discrepancies between the needs of local resource users and international conservation priorities for hawksbill turtles. Semi-structured interviews were conducted with local hawksbill egg collectors that worked at the three principal hawksbill nesting beaches to understand their perspective on how they use hawksbills and on conservation efforts in El Salvador. Three themes that emerged from the interviews were: **1)** informants valued hawksbills for the income from egg sales, and many also alluded to a deeper cultural connection with them, **2)** they valued the purchase of eggs by hatcheries as a unifying strategy for both nest protection and human well-being, and **3)** they were limited in opportunities to contribute to decision-making regarding sea turtle conservation, but rather biased towards elite interests, and suggested that efforts to involve local residents should be increased. The economic value of hawksbill eggs is driven by the widespread poverty that occurs along the Salvadoran coast and coastal residents are highly dependent on local resources such as hawksbills. Hawksbill clutches were more highly sought after because their clutches are larger than the other species, and thus provide greater benefit. However, there does appear to be deeper appreciation for the turtles, some expressing a concern for their conservation and tension they experience in their decision making about collecting eggs to satisfy their economic needs. All informants expressed that hatcheries were a socially just conservation strategy. Informants in some areas expressed that the moratorium created an economic hardship for them in the absence of hatchery operations and all expressed the need for alternative sources of income. Some informants acknowledged that law enforcement was unable to protect hawksbills and that the presence of hatcheries (where eggs are purchased from egg collectors) is the only way the eggs will be protected. Local participation in conservation (including design and implementation) may result in negotiated measures that have a better chance of success than conservation measures that are dictated to local resource users, and promotes joint ownership and resource stewardship. Informants also wanted the government to focus efforts on reducing bycatch of adults in industrial fisheries, and this would have a greater impact on turtle populations than the egg harvest. The authors pointed out that international and local priorities diverge with respect to hawksbill use and conservation in El Salvador, with the international conservation community focused on hawksbill biology and their needs, while local priorities are focused around socio-economic realities and the needs of human populations. The coexistence of humans and turtles, rather than the exclusion of resource users should be the focus of conservation efforts in low-income regions. According to the authors, the long-term conservation of hawksbills in El Salvador depends on the integration of both local needs and conservation priorities, allowing egg collectors to become part of the conservation effort, in this case, by continuing a system of hatcheries for egg protection and income for local egg collectors for those eggs.

Principal Threats

A general assessment of eastern Pacific hawksbills was conducted by the ICAPO network (Gaos et al. 2010), using guidelines outlined by the IAC. Gaos et al. (2010) reported that fisheries bycatch, egg harvest and habitat destruction were the most immediate threats (Table 7). Other important threats were a lack of basic information, insufficient policy/regulation, direct capture, and commercialization of products. Country-specific threats included ghost nets (Mexico and Columbia), lack of information (Guatemala and Nicaragua), dynamite fishing (El Salvador and Nicaragua), trawl fisheries (Costa Rica, although shrimp trawling is now banned once current permits expire, see Costa Rica's IAC annual report summary in WC/WA Mitigation Measures section), and gill-net fisheries and boat collisions (Ecuador). The need to identify critical habitat for the species in the region was considered a high priority. No representative from Honduras or Panama participated in the ICAPO network assessment, thus information from those countries was lacking for this assessment.

Carrión-Cortez et al (2013) reported that fishermen in the Nicoya Peninsula area, Costa Rica, consider the main threats to hawksbills to be shrimp trawling, long-term set nets at rocky reefs, and opportunistic capture by hookah divers. Also, the authors suggested that boat strikes may be a concern due to fishing and recreational activities overlapping with coastal neritic areas where hawksbills occur.

Table 7. Threat assessment prioritization by ICAPO network for EP hawksbills, taken from Table 2, Gaos et al. (2010).

TABLE 2 Prioritization of threats to hawksbill turtles in the eastern Pacific based on a 1–5 scale following the guidelines outlined by the Inter-American Convention for the Conservation of Marine Turtles (IAC Secretariat, 2004).

Threats[1]	Contribution	Breadth	Irreversibility	Severity	*Total*
Bycatch (D)[2]	5	5	3	5	18
Egg extraction (D)	5	5	3	5	18
Habitat alteration (I)[3]	5	4	4	5	18
Lack of basic information (I)	5	4	2	2	13
Lack of or insufficient policy & regulation (I)	4	4	3	2	13
Direct capture & take (D)	3	3	3	3	12
Commercialization of products (I)	3	3	2	3	11

[1]D, direct threat; I, indirect threat
[2]Dynamite fishing
[3]Coastal development and solid and liquid wastes

In recent years, conservation and research efforts to better understand and find solutions to these principal threats has focused largely on fisheries bycatch, and to a lesser extent on egg extraction and habitat issues. Nevertheless, Seminoff et al. (2012) reported that sea turtle bycatch in small-scale fisheries is largely unknown in the region, and that rigorous assessment is needed due to the widespread nature of these fisheries. Lack of basic information is a knowledge gap and although significant efforts are being made since the establishment of the ICAPO network to increase knowledge of EP hawksbills (including habitat use, feeding ecology, identification of important nesting and foraging areas, and monitoring nesting beaches), much more work is needed. Although information is limited, below is a summary of recent information on the threats that are considered of highest priority.

1. Fisheries Bycatch

Wallace et al. (2013) compiled global bycatch data according to regional management units (RMU) and gear types (among 3 types – longline, net, and trawl fishing gear). This allowed for a ranking of impacts by species, RMU, and gear type. For hawksbills in the "Pacific, East" RMU, bycatch impact was considered high, along a low-medium-high continuum, for longline fishing along the northwest coast of South America. Also, to a lesser extent, net and longline fishing impact hawksbills in roughly the same area (see Wallace et al. 2013 for mapped locations). However, the authors caution that there are numerous data gaps and only those areas with sufficient bycatch data were evaluated, thus it is important for bycatch data to be gathered and included in further analyses.
Information on specific countries where some information on bycatch was available is provided below.

Mexico – Koch et al. (2006) reported sea turtle mortality from 2000 to 2003 due to fishing events in the Bahía Magdalena Bay on the west coast of Baja California, Mexico. The authors reported that sea turtles were incidentally captured as well as hunted in this area despite national protective legislation. While hawksbills were not the principal turtle captured in this area (only 1%), the authors reported that at least 83% of dead hawksbills observed were considered killed for consumption, and 100% of all dead hawksbills observed were juveniles. The demand for sea turtle meat was high in this region and legal protection and law enforcement were reportedly inadequate to stop sea turtle consumption. More recent studies in the area are needed to determine if this trend continues.

El Salvador – Liles et al. (2011) reported mortality of hawksbills at two sites (Jiquilisco and Los Cóbanos) in El Salvador from 2004 to 2008. Of a total of 32 hawksbills observed dead, at least 18 were killed from blast fishing and 8 from bottom-set gillnets (all in 2008), and for 6 additional hawksbills the cause of death was unknown. The size of hawksbills killed in bottom-set gillnets was 35-50 cm curved carapace length (CCL), and from known blast fishing mortalities were hawksbills that were >70 cm (CCL). The authors reported that mortality from blast fishing and bottom-set gillnets were among the most serious threats to hawksbill survival at the primary nesting sites in El Salvador. The heavy use of blast fishing in the Jiquilisco area threatens the nesting populations in the area; particularly since according to Gaos et al. (2012a) adults often use foraging areas near their nesting beaches. While the government has recently taken legal measures to protect hawksbill eggs, conservation action is needed to mitigate mortality of sub-adult and adult hawksbills in artisanal fisheries, including blast fishing. Additional studies on the human dimensions of turtle conservation in El Salvador are also recommended to aid in efforts to conserve the species.

Peru – Bycatch of hawksbills in Peruvian artisanal fisheries was reported by Alfaro-Shigueto et al. (2010). Although hawksbills are uncommon in Peru, these waters appear to be the southernmost limit of the species distribution in the southeastern Pacific, with reports of occurrence from Punta Mapelo to Pisco, although the authors mention that they have not been reported recently from the latter location. Bycatch information is based on eight fishing ports from (north to south) Mancora to Ilo between July 2000 to November 2005, and opportunistically from 2006 to 2009. A total of 18 hawksbill interactions with fisheries were reported in the northern three sites, primarily in spring and summer (September through March). All hawksbills were juveniles (28.3-49.0 cm curved carapace length) and were caught in coastal gillnets. These turtles were all captured within two nautical miles from shore and generally close to mangrove habitat. Although this does not represent a large bycatch in Peru, this mortality may be significant considering the highly endangered state of hawksbills in the EP. Fisheries observation programs can aid in elucidating information on the distribution and abundance of this rare species, as well as information on the extent to which fisheries bycatch may be impacting the species. The authors recommended in-water studies in the EP and an updated status assessment, including stock origin, abundance, and distribution in the region to aid in management plan development and implementation. In light of the challenges to conducting in-water studies on hawksbills, the author suggested that fisheries observer programs can provide important information about hawksbills in Peru. In a separate study, Alfaro-Shiqueto et al. (2011) reported no bycatch of hawksbills in a fisheries onboard observer program in Peru for four key fisheries (bottom set nets, driftnets, and two longline fisheries) in a total of 264 fishing trips observed.

Quiñones et al. (2011) reported on landings and observations of hawksbills in central southern Peru (San Andrés and surrounding areas, just south of Pisco) in 1987 and 2010. Of 1,040 turtles recorded from landings surveys in 1987 only five were hawksbills, two of which measured 45.5 and 46 cm curved carapace length (CCL). All five hawksbills were captured in coastal gillnets in the San Andrés area. They found evidence of the occurrence of smaller hawksbills in a tourist shop in Tumbes that measured 23 and 35 cm CCL. Other carapaces were found at various sites in the region, and of the total 13 carapaces, most (n=10) were from in the San Andrés area. As previously mentioned most captures occurred in 1987 during an El Niño (EN) event, when warmer water temperatures are thought to increase the presence of sea turtles in this more southerly habitat. However, only one hawksbill was reported during an EN event in 1997-98 in the San Andrés area. The explanation may be that there was reduced fishing effort due to government enforcing a ban on the capture of marine turtles. The authors contend that illegal capture continues to be an issue, especially in the San Andrés area, and they recommended increased monitoring and conservation measures to protect turtles in this important turtle habitat in Peru.

2. Egg Extraction

Intensive egg extraction occurs on the principal hawksbill nesting beaches in El Salvador. Liles et al. (2014) reported on an egg-buying program from local egg collectors that were reburied in established hatcheries to reduce egg mortality from human consumption. Since the government ban on egg collection in 2009, with the exception being for conservation purposes, the hatchery program has become a vital source of income for local egg collectors, however, eggs are still sold for consumption and the egg-buying program is highly dependent on unstable financial support. An assessment of the hatchery program may be needed in order to identify gaps and ensure consistent coverage of important nesting areas, while simultaneously investigating potential options for reducing the impact of the egg collection ban on local egg collectors in low-income areas and reducing dependency on egg collection.

3. Habitat Alteration

Development on nesting beaches has been widely reported. Gaos et al. (2010) listed habitat destruction as one of the most immediate threats to EP hawksbills; however, specific details on this threat have not been found. Further investigation is needed to determine the magnitude of this threat and identify conservation actions needed.

4. Climate Change

Based on climate change model assessments by Hamann et al. (2013) on the 11 RMUs identified as most threatened by Wallace et al. (2011), EP hawksbills will likely experience moderate to high consistent increases in air and sea surface temperatures. The rate of change of sea surface temperatures is also expected to be moderate.

Fuentes et al. (2013), as previously mentioned in the WC/WA Climate Change section, assessed the resilience of marine turtle species to climate change, for each RMU based on six criteria. The EP hawksbill RMU was among the least resilient (RI=1.91, least resilient index range was $1.77 \leq RI \leq 2.28$) (see Figure 5). An overlapping threat for many of the least resilient RMUs is the high threat from fisheries bycatch. This analysis did not consider a number of factors that might also be important, including: primary and secondary sex ratios, survival rates, responses to changes in food availability, physiological plasticity, etc., and the authors recommended further analysis should include these variables.

See WC/WA section 5-Climate Change for additional information on climate change impacts by Hawkes et al. (2009, 2014) and Hulin et al. (2009) applicable to all regions.

5. Direct Capture and Take

It is unclear how large a threat directed take is to hawksbill turtles in the region, possibly in part due to the overwhelming issue of fisheries bycatch and if some of the bycatch is opportunistically taken and consumed or used. Intentional take of hawksbills has been mentioned by some researchers in Costa Rica (Carrión-Cortez et al. 2013), Mexico (Koch et al. 2006, Seminoff et al. 2003a) and Peru (Quiñones et al. 2011) as a potentially ongoing issue. It is likely that the problem is more widespread but has not been explicitly reported on, thus this threat needs further investigation and assessment in order to quantify intentional take (and distinguish between directed and opportunistic take) and identify conservation actions.

Mitigation Measures

Mitigations in the EP are similar to those in the WC/WA region, which range widely in scope, from educational campaigns, to legislative measures, to research into bycatch reduction, among others. For example, to assess alternatives to lobster gillnets, which capture hawksbills in the coastal EP, Gaos et al. (In press) reported results from initial trials using traps as an alternative capture method. The traps were unsuccessful at capturing lobster; however, testing different bait types, and in different months is needed to confirm if traps may be a viable alternative. Other bycatch mitigation measures reported in the WC/WA section are also used in the EP. Mitigation measures reported by IAC member countries in their annual reports are summarized below.

IAC Member Country Annual Reports - Mitigations

The summaries below from IAC member countries include only those mitigation measures not previously listed in the member country summaries of the WC/WA region that host sea turtles in both the WC/WA and EP regions, and thus additional mitigations can be found in the WC/WA section where applicable.

Costa Rica (2014) – The government recently established protected areas in the EP that increase protection for hawksbills, Camaronal Wildlife Refuge and Playa Caletas-Ario National Wildlife Refuge. Research is being conducted by NGOs on the Pacific coast, including genetic sampling from various sites (e.g., Isla del Coca, Playa Coyote, and Dulce Gulf), migratory behavior, habitat use, diet, prey abundance, and foraging aggregations.

Ecuador (2013) – The government has implemented a conservation research and enforcement program for six years at Machalilla National Park (MNP), where hawksbill foraging and nesting occurs. Research is being conducted on incidental capture of turtles in the tuna fishery and standards have developed for turtle releases. Also, the use of TEDs is required with monthly follow-ups. The government continues a fishing hook exchange program and prohibits the importation of “J” hooks into the country. They have implemented observer programs for fishing fleets, and a project to avoid entanglement of marine turtles in buoy ropes. In 2012, a marine reserve (El Pelado) was established where hawksbills occur, and cleaning activities in marine areas was also conducted. A campaign for the conservation of marine turtles in coastal provinces, and a campaign to raise awareness about garbage were implemented. Monitoring and research on genetics, migratory behavior, foraging areas, nesting areas, and mark-recapture of juveniles and subadults is supported by the government. A National Strategy for Climate Change was established and is in the process of implementation, including components for MNP and Galápagos Island National Park. Coastal development, incidental capture, direct use, contamination, pathogens and climate change are the threats to hawksbill turtles in Ecuador.

Guatemala (2012, 2013) – In addition to the moratorium on hawksbill egg collection and a campaign to raise awareness about the moratorium, a non-government group has been working in the La Barrona community to implement a hatchery program, including providing training and involving community members in egg relocation and track counts.

Honduras (2013) – The National Strategy for Climate Change has prioritized coastal marine systems as an important sector for establishing adaptation guidelines, which include: mangrove conservation and restoration in bays, estuaries and islands; strengthen socio-economic sustainability of human populations dependent on these ecosystems; and prevent and reduce damage to coral reef ecosystems, promote their restoration and conservation (including guidelines for each adaptation measure).

Mexico (2012) – Research has been conducted on sea turtle/artisanal fisheries interactions in the Pacific, Gulf of Ulloa and seasonal closures of shrimp trawl fisheries on the Pacific coastline have been implemented. Training workshops have been conducted with fishing co-ops to implement techniques (including TED modifications) that decrease turtle bycatch. Educational programs have been conducted with schools in some areas to teach students about the environment. Research on the foraging ecology of four species of turtles (including hawksbills) was permitted in the Baja California Peninsula.

Panama (2013) – The government reported the establishment of additional protected areas in the Pacific that will likely benefit hawksbills.

Peru (2013) – NGOs are monitoring fisheries interactions and strandings, and conducting research on genetics, and foraging populations (which is also being researched by the government). An NGO is investigating mitigations to fisheries bycatch and the government conducts an onboard observer program. In collaboration with an NGO, the government is working to establish two protected areas that will protect foraging areas where hawksbills occur. An NGO is experimenting with the use of LED lights with gillnets to reduce turtle bycatch. Training and education are being conducted in targeted communities by various institutions and NGOs. The local government in Pisco is monitoring illegal captures of turtles to mitigate this threat. Principal threats include coastal development, incidental capture in fisheries, direct use, contamination, and climate change.

RECOMMENDATIONS AND PRIORITY CONSERVATION ACTIONS

Important gains have been made in recent years that provide us with a better understanding of hawksbill turtles and their conservation needs. We have increased our knowledge about the status of some populations, environmental factors that may affect their habitat use and distribution, their habitat and feeding preferences, and have an improved understanding of the principal threats they face, to name a few. A review of these gains also helps us to identify important knowledge gaps relevant to their recovery, so that we may focus our immediate efforts on both filling those gaps and taking actions that will have the greatest impact on population recovery. To that end, Table 8 provides a set of recommendations that highlight the need for further assessments in some areas, and specific actions that can be taken to address other areas of immediate concern. These recommendations have been grouped by topics that coincide with sections in the document and, where more than one recommendation occurs that is relevant to a particular section, letters are used to distinguish them. The recommendations have also been suggested according to the three RMUs presented by Wallace et al. (2010) in order to emphasize those areas where the specific recommendations are most applicable.

Table 8. Conclusions and recommendations for hawksbill turtle conservation in the Americas. WC/WA=Wider Caribbean and Western Atlantic, SWA=Southwest Atlantic, EP=Eastern Pacific. Convention acronyms CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora, CMS = Convention on the Conservation of Migratory Species, IAC = Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC), SPAW = Protocol Concerning Specially Protected Areas and Wildlife.

Conclusions/Recommendations	Region		
	WC/WA	SWA	EP
Protection Status – A. Hawksbill mortality could be greatly reduced by improving compliance with existing national regulations, since lack of enforcement continues to be a widespread threat to hawksbills. Bräutigam and Eckert (2006) recommended development and implementation of a compliance strategy for the Wider Caribbean, which is still needed in that region. Strengthening collaborations with local stakeholders is vital to improving compliance. The socio-economic aspects of reduced hawksbill take (primarily for local trade) should be assessed to identify locations/communities where alternative livelihoods and protein sources are needed, which will improve conditions and facilitate compliance. Education and raising awareness will also be an important component of a compliance strategy. In addition, capacity building and training to monitor illegal activities are also needed. Specific locations in the WC/WA where these efforts may have a greater impact on reducing illegal take of hawksbills are Colombia, Cuba, Nicaragua, Panama, Trinidad and Tobago, and Venezuela. In the EP, El Salvador and Mexico may be among the countries with the most immediate need.	X		X
Protection Status – B. An important knowledge gap is the current status of trade in hawksbill products, particularly trade between countries. Concern for the impact of this threat has been widely expressed; however, no recent assessment has been conducted to determine the severity of this threat currently. The ongoing threat of international trade in hawksbill products is congruous with the need for improving compliance with existing instruments, particularly CITES, under which hawksbills are an Appendix I species. In light of recent efforts in some countries to curtail trafficking of hawksbill products, an updated assessment is warranted to determine the extent of trade and to identify target areas where immediate mitigation efforts may be needed.	X		X

Protection Status – C. Conduct a thorough review of protective legislation and inconsistencies within regions. One area of concern is the need to assess compliance of United Kingdom (UK) overseas territories (BVI, Montserrat, TCI) with CMS where hawksbills are an Appendix I species; these territories have no reservations with CMS that would allow the legal take of hawksbills or other sea turtles. Another area of concern is potential lack of compliance with the SPAW Protocol, where party States that continue to allow legal fisheries may be in violation, i.e., BVI, Grenada, Saint Lucia, and Saint Vincent & Grenadines.	X		
Protection Status – D. Improve protective legislation in countries/territories where take is legal and does not violate agreements such as SPAW and CMS. Efforts are needed to ensure that any legal exploitation is controlled using the principals of sustainability, which include science-based management plans and monitoring take levels and turtle populations.	X		
Protection Status – E. Continue communications and coordinated efforts among CITES, CMS, IAC, SPAW Protocol, and Ramsar conventions to share information about hawksbills in order to identify conservation activities as a team and to capitalize on synergies and optimize resources.	X	X	X
Principal Threats – Conduct a comprehensive, quantitative threats assessment, similar to the assessment conducted by Bolten et al. (2010) for North Atlantic loggerhead turtles.	X		X
Fisheries Bycatch – Need empirical data on fisheries bycatch of hawksbills to better understand the severity of this threat, particularly from small-scale coastal fisheries, which likely have the greatest impact on hawksbills (particularly set-net and dive fisheries). Principal target areas for research and implementation of mitigation measures should be identified. Target areas (areas considered to be of particular concern) suggested during the NFWF threat assessment were Dominican Republic, Haiti, Mexico, and Nicaragua; with further investigation recommended for The Bahamas, Jamaica, and Panama (NFWF unpubl. data). This is a widespread problem in the EP nearshore and inshore areas, and thus areas of higher known observations may be the most immediate areas for further assessment; e.g., Costa Rica and Mexico.	X	X	X
Habitat Loss/Degradation – Assess top nesting beaches (see Table 3 for WC/WA, and Table 5 for EP) for specific threats to terrestrial and nearshore habitats and develop mitigation strategies. Of particular concern for some sites is uncontrolled (or unregulated) coastal development on or near nesting beaches and nearshore foraging habitats, as well as impacts from oil exploration and extraction; e.g., in the WC/WA: Barbados, Guadeloupe, Panama, and Mexico's Yucatán Peninsula; and in the EP: Ecuador, El Salvador, and Nicaragua.	X	X	X
Climate Change – Impacts from climate change should be assessed on a regional scale to determine where knowledge and mitigation gaps exist and ensure that standard protocols are being implemented to monitor beach sand temperatures on all index beaches. Protection measures should be taken to preserve natural sex ratios and protect nesting and foraging habitat. There is also a need to better understand synergistic impacts from multiple stressors on sea turtle resilience to changing climate, and identify and implement mitigation measures for the most vulnerable nesting populations to climate change impacts by RMU.	X	X	X
Research – Studies on hawksbill life history and ecology are still needed, especially for EP hawksbills where little is known. The WC/WA research needs are more varied, with numerous nesting beach studies and to a much lesser extent studies of in-water foraging aggregations. Additional studies are needed on hawksbill population ecology (e.g., survival and growth rates, especially of the large juvenile/subadult stage); feeding ecology, habitat needs, and their influence on foraging habitats; developmental stages (especially the oceanic phase); movements and migrations; population genetics, among others.	X	X	X
Population Status – More information is needed on long-term population trends on nesting populations and particularly on in-water aggregations. Review and expand, where necessary, monitoring efforts to ensure consistency at index beaches and elsewhere, using Minimum Data Standards (SWOT Scientific Advisory Board 2011), region-wide. Monitoring should include efforts to estimate remigration intervals and clutch frequencies of nesting populations, and changes in condition and abundance of foraging aggregations, which will allow for better assessment of population changes over time.	X	X	X
Habitat Use/Movements – A. Compile and analyze satellite tracking and tag recovery data at a regional level to have a more comprehensive understanding of regional habitat use patterns, identify hot spots, and identify important gaps in protection. These efforts will help identify and provide information on important developmental habitats in nearshore waters, where human interactions are more likely, in order to target areas for conservation assessment and action. One area of particular interest and concern is the foraging habitat off the Caribbean coasts of Honduras and Nicaragua.	X		
Habitat Use/Movements – B. Continue efforts to identify and protect critical foraging habitats for hawksbills.	X		X
Habitat Use/Movements – C. Develop and maintain a database for in-water studies on hawksbills in the WC/WA and EP regions to monitor activities across regions and provide a central location for managers, scientists and conservationist to obtain information, similar to what has been done by the state of Florida, US (Eaton et al. 2008). This will facilitate access to information, information exchange, and identification of knowledge gaps for managers, scientists, and others.	X	X	X

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Appendix I.

Countries or territories by region included in this report.

Wider Caribbean/Western Atlantic

Anguilla
Antigua & Barbuda
Aruba
The Bahamas
Barbados
Belize
Bermuda
Bonaire
Brazil
British Virgin Islands
Cayman Islands
Colombia
Costa Rica
Cuba
Curaçao
Dominica
Dominican Republic
French Guiana
Grenada
Guadeloupe & Saint Martin
Guatemala
Guyana
Haiti
Honduras
Jamaica
Martinique
Mexico
Montserrat
Nicaragua
Panama
Puerto Rico
Saba Island
Saint Eustatius
Saint Kitts & Nevis
Saint Lucia
Saint Vincent & Grenadines
Sint Maarten
Suriname
Trinidad & Tobago
Turks & Caicos islands
United States (US)
US Virgin Islands
Venezuela

East Pacific Region
Colombia
Costa Rica
Ecuador
El Salvador
Guatemala
Honduras
Mexico
Nicaragua
Panama
Peru
United States

Appendix II.

Contributors of the ICAPO network who provided unpublished data used in the Eastern Pacific section on nesting and foraging distributions:

Área de Conservación Guanacaste
Asociación Conservacionista de Playa Malena
Akazul
Amigos de la Carey del Pacífico
Amigos para la Conservación de Cabo Pulmo
Asociación de Rescate y Conservacion de Animales Silvestres
Asociación de Voluntarios
Campamento Tortuguero Don Manuel Antonio
Campamento Tortuguero Mayto
Campamento Tortuguero San Blas
Centro de Conservación e Investigación de la Tortuga Marina El Venado
Centro de Investigación en Alimentación y Desarrollo, A.C.
Programa de Protección y Conservación de Vida Silvestre del Departamento de Medio Ambiente del Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional en el Estado de Sinaloa, México (CIIDIR-IPN SINALOA) y forma parte del Instituto Politécnico Nacional.
Centro de Investigación para el Manejo Ambiental y el Desarrollo
Comisión Nacional de Áreas Naturales Protegidas
Equilibrio Azul
ecOceánica
Fauna & Flora Internacional
Fundación Osa
Fundación Tierra y Mar/Peace Corps
Fundación para la Protección del Arrecife de Los Cobanos
Fundación Zoológica de El Salvador
Galapagos Science Center
Grupo Tortuguero, A.C.
Grupo Tortuguero Comcåac
Hotel Latitud 10
Iniciativa Carey del Pacifico Oriental
Instituto del Mar de Perú
Latin American Sea Turtles

The Leatherback Trust
Marina del Sol
Ministerio del Ambiente y los Recursos Naturales
Niparaja
Parque Nacional Utría
Parque Nacional Galapagos
Parque Nacional Machalilla
Paso Pacífico
Programa Restauración de Tortugas Marinas
ProDelphinus
ProTortugas
Rancho Burica
Red Tortuguera, A.C.
Rotney Piedra
School for Field Studies
Sea Turtles Forever
University of North Carolina at Chapel Hill
Universidad San Francisco de Quito

Appendix III.

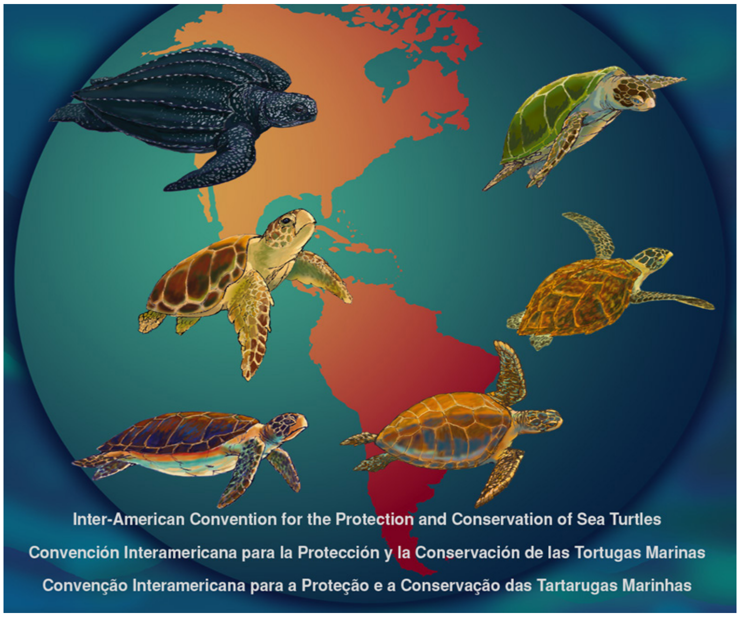
Links to websites reporting recent prosecution of turtle poachers in the Caribbean region.

Costa Rica:
http://www.ticotimes.net/2014/05/22/police-have-saved-2276-eggs-from-poachers-on-costa-ricas-caribbean
http://news.co.cr/coast-guard-costa-rica-detains-sea-turtle-butchers-rescues-eggs/11064/

Dominica:
http://dominicanewsonline.com/news/homepage/news/crime-court-law/man-charged-for-slaughtered-turtle/

Puerto Rico:
http://www.nmfs.noaa.gov/ole/slider_stories/2014/27_022714_sea_turtle_case.html

United States:
http://www.noanimalpoaching.org/animal-poaching-news-2014/man-convicted-of-poaching-sea-turtle-eggs-again-gets-two-years-in-prison



Inter-American Convention for the Protection and Conservation of Sea Turtles

For more information visit:
www.iacseaturtle.org

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