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

Green Turtle (*Chelonia mydas*) Nesting Trends in the Eastern Pacific Ocean: Status Update and Conservation Priorities

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Developed by the IAC Scientific Committee Delegates

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Executive Summary

In 2018, the Scientific Committee of the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC) developed a technical document entitled IAC Index Nesting Beach Data Analysis (2009-2018). This is an update to an earlier nesting beach report that provided data from 2009-2013 (CIT-CC11-2014-Tec.7). Here we summarize nesting trends at three regions in the eastern Pacific (Mexico, Costa Rica, and Galapagos) and we elaborate on conservation priorities for these areas. In Mexico, the area with the longest nesting time-series datasets available (starting in 1981) green turtle nesting has significantly increased during the last three decades and is perhaps one of the best sea turtle conservation success stories in the world. In Costa Rica, fewer data are available, and although it appears that declines may be present, it is unclear if this is a true decline or the result if decreased ocean productivity (and resultant nesting). At the Galapagos Islands, Ecuador, initial examination suggested a substantial decline; however, a more recent evaluation of existing data indicates that such declines are not present. Considering the variable nesting trends throughout the region, we encourage continued nesting beach monitoring and protection and recommend that efforts be made to standardize monitoring protocols and data collection across all nesting sites, to quantify bycatch, and to implement management measures to minimize sea turtle mortality due to interactions with fisheries throughout the region.

INTRODUCTION

The green turtle is globally distributed throughout the tropical, subtropical, and temperate regions of the Atlantic, Pacific, and Indian Oceans and the Mediterranean Sea (Seminoff *et al.* 2015). Green turtles in the eastern Pacific Region have been defined as a distinct genetic stock that is separate from green turtles in other areas of the Pacific; such stocks have been referred to as regional management units (RMUs; Wallace *et al.* 2010) and distinct population segments (DPSs; Seminoff *et al.* 2015). Green turtles in the eastern Pacific are listed as Threatened on the U.S. Endangered Species List and Endangered on the IUCN Red List.

Within the Eastern Pacific region, green turtles have been documented nesting in Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Mexico, Nicaragua, Panama, and Peru (Seminoff *et al.* 2015; Fig. 1). Green turtles from the East Pacific RMU have been documented in coastal waters of all countries within this geographical region, and have been uncommonly observed in the Central Pacific high seas (Parker *et al.* 2011) and coastal waters of several countries ranging from Japan to New Zealand in the Western Pacific (e.g., Godoy *et al.* 2012, Okamoto and Kamezaki 2014).

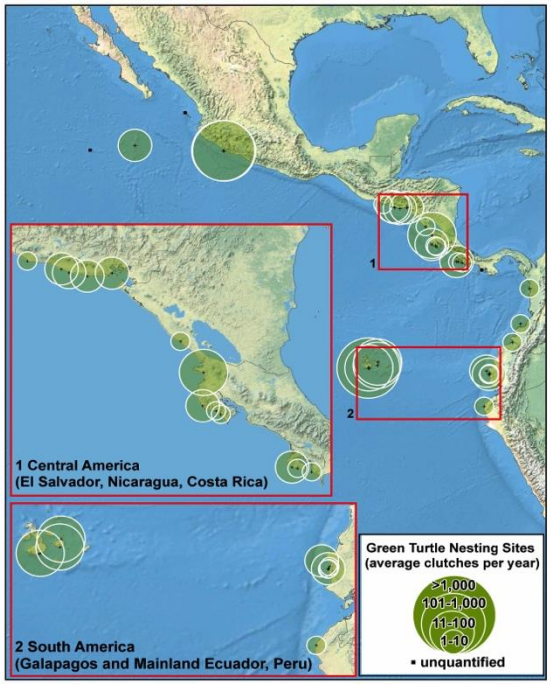

Figure 1. Nesting sites for green turtles in the Eastern Pacific (Seminoff and Wallace 2012).

There are eight countries in which nesting has been documented in the eastern Pacific (39 total sites; Seminoff *et al.* 2015). Long-term (≥10 years) time series nesting beach data are available only for Colola Beach, Michoacán, Mexico that has 38 consecutive years (1981–2018) of data as well as a historic estimate for 1970 (Fig. 2). In addition, there are several independent data sets for Galapagos Islands, Ecuador spanning 39 years; however, these data represent different beaches over different time frames (e.g. 1979–1982, 2001–2005, 2009–2017; Fig. 3) and variable monitoring effort (Fig. 4). Nesting beach monitoring efforts have also been conducted along the Pacific coast of Costa Rica (Fig. 5), indicating that this region is also a stronghold for green turtle nesting in the eastern Pacific, especially in the northwestern state of Guanacaste, where over the last decade several green turtle nesting beaches have been monitored for the first time (Blanco et al. 2012, Santidrián-Tomillo et al. 2015, Fonseca et al. 2018, P. Santidrián-Tomillo, unpubl. data).

GREEN TURTLE NESTING TRENDS IN THE EASTERN PACIFIC

Current data on nesting trends within the region suggest that nesting trends are variable throughout the region. For example, whereas green turtles at Colola Beach, Mexico have shown a strong recovering trend (Fig. 2), their counterparts in the Galapagos Islands have been relatively

stable (Figs. 3). Costa Rican beaches have seen an apparent decline in green turtle nesting activity, but too few years of data collection have been conducted to determine the true nesting trend (Fig. 5). These trends are further discussed below.

Colola Beach, Mexico

In Mexico, the primary information on nesting abundance comes from Colola Beach in the state of Michoacán. Here, researchers and conservationists from NGOs and the University of San Nicholas Hidalgo have been protecting the beach since 1981. Prior to this, poaching of eggs and adults on and adjacent to Colola Beach was widespread; and even after the onset of nesting beach conservation at Colola, turtles, and eggs were taken in large numbers in unprotected areas throughout Mexico. There was also a major legal green turtle fishery throughout northwestern Mexico that landed thousands of green turtles each year (Early-Capistrán et al. 2018). A presidential decree in 1990 (DOF 1990) created a moratorium that outlawed the use of sea turtles for any purpose; and since then there have been encouraging signs of recovery at nesting beaches and foraging areas throughout the country (Delgado-Trejo and Alvarado-Díaz 2012, J. Seminoff unpubl. data).

The steady increase in green turtle nesting in Michoacán is an encouraging sign for a population once considered threatened with extinction. Annual nesting beach data from Colola show that the population went from 229 females/year in the early-to-mid 1980s (1983–1986) to 7,618 females/year from 2014–2017, which amounts to a greater than 3,000% increase in the last three decades. The scale of this increase becomes very apparent considering a report from Dr. Carlos Delgado-Trejo, the leader of the University of Michoacán green turtle nesting beach program at Colola: On 14 September 2014, more than 1,000 green turtles nested in a single night (in litt. to Mr. Earl Possardt of the U.S. Fish & Wildlife Service). The observed increases in the eastern Pacific green turtle population are likely due to increased protection at nesting beaches, minimized threats to sea turtles in foraging areas, and advances in sea turtle fisheries bycatch reduction in the eastern Pacific Ocean (Senko et al. 2011, Seminoff et al 2015).

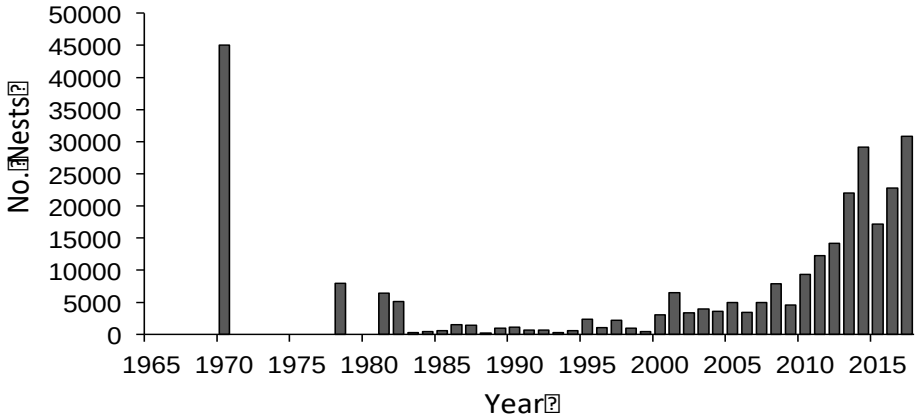

Figure 2. 47-year trend (1970–2018) of number of green turtle nests in Colola, Michoacán, Mexico. 1970 baseline estimated by Cliffton et al. (1982). All other data from Delgado-Trejo and Alvarado-Díaz (2012) and C. Delgado-Trejo (unpubl. data).

Galapagos Islands, Ecuador

In the Galapagos Islands (Ecuador) green turtle nesting at the four primary nesting sites has been monitored by various groups since the mid-1970s (Quinta Playa and Barahona beaches on Isabela Island, Las Bachas beach on Santa Cruz Island, and Las Salinas beach on Baltras Island). When looking at Figure 3, it should be noted that the data represent information collected by three different research groups, and do not constitute one contiguous data set with equal monitoring effort across all years. From 1979–1982, Hurtado (1984) reported a mean total annual nesting abundance for the four index beaches of ~1,400 females/year. From 2001–2005, a mean of 1,657 females/year nested among these index beaches (Zárate et al. 2006). More recent data are available for Quinta Playa and Las Bachas only, and here we provide annual nest counts from 2001–2002 to 2007–08 nesting season (P. Zárate, unpubl. data) and the 2009–18 nesting season for Quinta Playa (courtesy of Ecuadorian government). From these data it is apparent that nesting was relatively consistent from the 2001–02 to the 2015–2016 nesting seasons. The most recent three years of data (since 2016-17) are lower than previous years; however, information about monitoring effort indicates that significantly fewer nights were monitored these two years (Fig. 4), likely resulting in the lower nest counts.

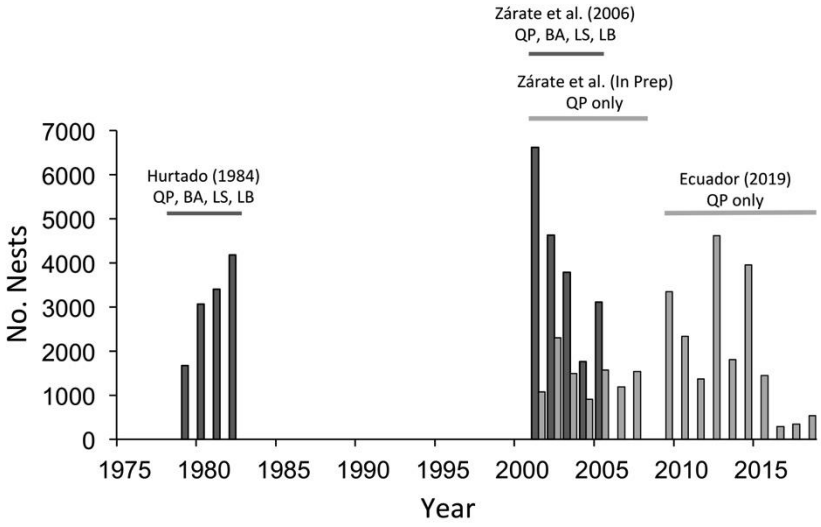

Figure 3. Annual number of green turtle nests at the Galapagos Islands. Data sets are for three different periods, with varying monitoring effort. QP – Quinta Playa, BA – Barahona, LS – Las Salinas, LB – Las Bachas.

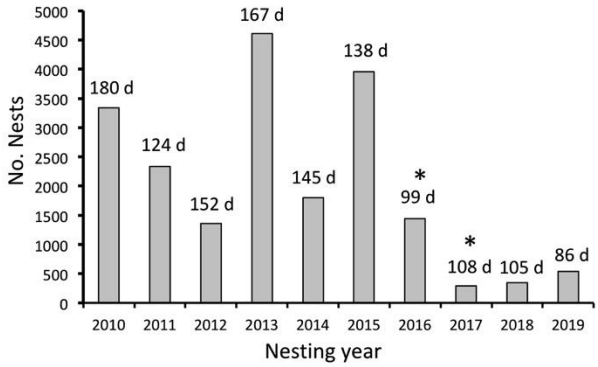

Figure 4. Number of nests at Quinta Playa, Galapagos Islands Ecuador, with number of nights of monitoring effort each season. * Data provided by the Ecuadorian government explicitly state that monitoring effort was lesser during these years due to lack of personnel and flipper tags. The reasons for reduced monitoring effort during 2017-18 and 2018-19 are unclear.

Costa Rica

Costa Rica has numerous green turtle nesting beaches, especially in the northwestern state of Guanacaste. Green turtle nesting activity has been documented since the late 1970s (Cornelius 1982), but in the last decade there has been increased focus on green turtles in the region (e.g. Blanco et al. 2012, Santidrián-Tomillo et al. 2015), and the discovery of at least one major green turtle nesting beach (at Isla San Jose, Fonseca et al. 2018). According to Dutton et al (2014) Costa Rica´s nesting population is genetically linked to the Galapagos population. They indicate that the presence of endemic ancestral haplotypes suggest stable nesting throughout extended periods.

Long-term data are not available for any green turtle beaches in Pacific Costa Rica; however, time-series data on the number of females are available for three beaches in Guanacaste (Playa Nombre de Jesús since the 2010–11 season, Isla San Jose since the 2012–13 season, and Playa Cabuyal since the 2011–12 season; Fig. 5). The relatively few nests counted during the initial years of these data sets are likely due to lesser monitoring effort while the monitoring projects were getting started. Interestingly, declines in the number of females start during the 2015–16 nesting season at all three sites, and were apparently widespread in Costa Rica during this period (P. Santidrián-Tomillo, pers. comm.), suggesting that declines at any one beach were not likely a result of turtles switching beaches. Of course, this is too short of a time frame to draw conclusions, but the recent declining trend in Costa Rica draws attention. The potential causes for these declines are discussed below.

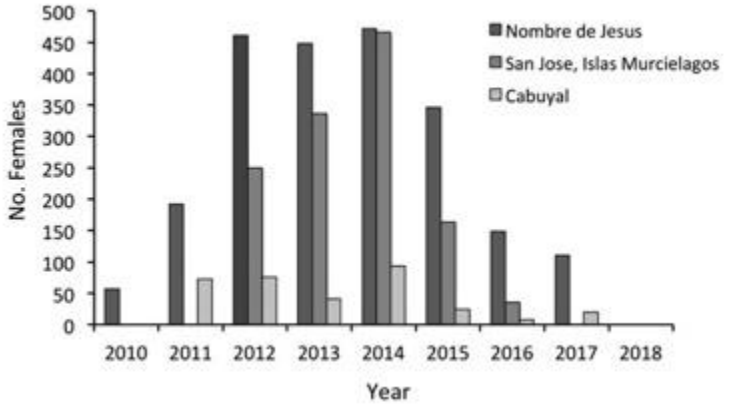

Figure 5. Annual number of green turtle nests at three sites in Pacific Costa Rica. Data from IAC Index Beach Report (2018), Santidrián-Tomillo, unpubl. data, Fonseca et al. (2018).

ONGOING THREATS

Green turtles in the eastern Pacific, like other regions for the species, are impacted by anthropogenic threats during all life stages: from eggs to adults. These include egg harvest, the killing of females on nesting beaches, directed hunting of green turtles in foraging areas, and retention of bycaught turtles during fishing operations. In addition, climate change and habitat loss/ degradation affect all life stages.

Except for Colola and Maruata beaches in Michoacan, amajor threat to green turtles insome sites of the region is the intentional harvest of eggs from nesting beaches. This is a large problem at many continental (i.e., non-insular) nesting sites in virtually all countries in the region in which green turtles nest (Seminoff et al. 2015). This harvest occurs on multiple scales, from

single families collecting eggs for subsistence use to commercial collectors whose eggs are ultimately sold at the market. In some countries and localities, egg harvest has been legal, while in others it is illegal but persistent due to lack of enforcement.

The taking of green turtles at foraging areas, either via retained bycatch or directed hunting, continues throughout the region, but particularly in areas of northwest Mexico despite legal protection (Delgado-Trejo Alvarado-Diaz 2012, Hart et al. 2015, Grupo Tortuguero, unpubl. data, 2018); These activities impact both juvenile and adult turtles of both sexes.

Fisheries bycatch is arguably the biggest threat to the survival of green turtles in the Eastern Pacific Ocean. The fisheries impacting green turtles include artisanal and industrial drift-net, long-line, gill-net, and trawl fisheries (Mancini *et al*. 2012, Ortiz *et al.* 2016, Pingo et al. 2017, Quiñones et al. 2017, Alfaro-Shigueto *et al.* 2018). However, along the Peruvian coast bycatch is mainly due to gill-nets, particularly near Pisco where there was a traditional sea turtle fishery in the '60s, '70s, and '80s, and at the beginning of the '90s (Hays-Brown & Brown, 1982, Aranda & Chandler, 1989). Currently, directed and incidental captures still occur, and from 2009-2015 one thousand sea turtles were recorded dead in Pisco landfills, 98% of which were consumed, and more than 85% were green turtles (Quiñones et al., 2017).

Sea turtles interact with this type of fishing gear in different ways, including mortality by choking, or by injuries in their fins, jaws, and esophagus among other body parts. To date, these causes of death have been poorly quantified in the region. Moreover, the implementation of bycatch mitigation measures reflected revealed a lack of information about sea turtle – fishery interactions in some countries within the region.

Climate change is another factor that has the potential to greatly affect green turtles. Potential impacts of climate change to green turtles in the eastern Pacific include beach erosion from rising sea levels, repeated inundation of nests, and abrupt disruption of ocean currents used for natural dispersal during the complex life cycle (Lettrich et al. In Prep). Perhaps the greatest threat from climate change relates to progressive feminization in green turtle populations due to global warming (Allen *et al.* 2015, Jensen *et al*. 2018). Although not yet quantified, increasing incubation temperatures may also result in heightened egg and hatchling mortality. Impacts from global climate change induced by human activities are likely to become more apparent in future years (Intergovernmental Panel on Climate Change (IPCC 2014)).

CONCLUSIONS

Nesting beach monitoring data indicate that green turtles in Mexico have shown a strong recovering trend (Fig. 2), whereas green turtles in the Galapagos have remained relatively stable (Fig. 3), and those in Costa Rica have shown a slight decline in recent years (Fig. 5). The potential causes that may influence nesting abundance and result in decreasing trends include increases in remigration intervals, decreases in annual nest frequency for nesting females, as well as mortality due to a variety of threats including fisheries bycatch, illegal consumption, depredation by sea lions (in northern Chile and the south-center of Peru), red tides, and impacts from climate change. Further research on these potential factors and/or progress in actions to reduce interactions between sea turtles and fisheries is recommended.

RECOMMENDATIONS

Based on the present analysis, and considering ongoing threats to green turtles in the region we recommend the following actions be taken:

1. Maintain consistent monitoring effort (number of nights/hours monitored, beaches length) at the index beaches over the course of the entire green turtle nesting season.
2. Characterize and standardize monitoring effort (e.g. start date/finish date) for all nesting seasons and all beaches in the region.
3. Maximize nest success and hatching production at all beaches. Strategies to achieve this include mitigation of interactions with predators such as the use of fences and nets where it is feasible to place them, as well as possible shading to achieve optimal incubation temperatures.
4. Implement local efforts (regulations and enforcement) to reduce consumption by humans near the main foraging areas in the southeastern Pacific. Such efforts should be intensified in areas that overlap with local gillnet fisheries and should take into account the local social specific particularities.
5. Implement or increase local efforts (regulations and control) to reduce egg extraction in nesting beaches.
6. Determine the extent to which decreases in marine productivity (via increased frequency of ENSO and climate change) may be responsible for delayed reproduction in green turtles.
7. Conduct an assessment of plastic ingestion by green turtles in foraging areas throughout the eastern Pacific.
8. Study interesting interval and clutch frequency of green turtles via tagging programs to monitor changes in these demographic parameters over time.
9. Study the impact of red tides on green turtles. Make use of existing conservation networks to promote rapid collection and analysis of tissues from turtles thought to be killed by red tide intoxication
10. Conduct monitoring at foraging areas to provide an additional metric for detecting changes in population abundance.
11. Diagnose and support the efforts by countries with feeding grounds important to this species including research on biological and population aspects. Also, study the threats including habitat pollution and modification (rivers associated with feeding grounds) using an ecosystem-based approach.
12. Implement or increase efforts to quantify green turtle bycatch in artisanal and commercial fisheries via monitoring programs.
13. To consider fishing pressure on feeding grounds which is causing the reduction of food sources for top predators in these areas. For instance, common sea lions from the north of Chile (Arica) and the center-south of Peru (Paracas) have modified their diet and are predating on sea turtles.
14. Develop programs to implement green sea turtle bycatch mitigation measures in artisanal and commercial fisheries.

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