

# Genetic Testing to Measure Sea Turtle Conservation Success

**Researchers from University of Groningen recently used genetic testing to identify the geographical birthplaces of green sea turtles foraging within Lac Bay, Bonaire. This study compared population composition between 2006-2007 and 2015-2016. There was an overall increase in juvenile green turtles from the north-western Caribbean and a general decrease in population recruitments from both eastern Caribbean and southern Atlantic.**

These results give researchers insight into the success rates of conservation efforts throughout the entire Caribbean and south Atlantic areas. Understanding how sea turtles move within the Caribbean is crucial for developing holistic conservation plans. Although sea turtles may have hatched from different breeding grounds, known as rookeries, throughout the Caribbean, their migratory journeys lead them to congregate within just a few key foraging areas (Bowen et al., 2005). A recent study investigated shifts in juvenile population compositions between the years 2006-2007 and 2015-2016 within Lac Bay, Bonaire (van der Zee et al., 2019). By combining this information with rookery recovery rates, researchers can estimate how population shifts are affected by adult female abundance and variation in nesting sizes.

## Threats

Sea turtle migration patterns can be affected by a variety of different factors. Ocean currents and temperature changes can influence the early life stages of turtles, leading to changes in the population's composition (Bjorndal & Bolton, 2008). Humans can also directly affect local populations, whether through detrimental acts such as contributing to habitat loss and decreased water quality or through conservation efforts, leading to an increase in juvenile recruitment (Kubis et al, 2009).

The Caribbean green sea turtle (*Chelonia mydas*) is a particularly good example of how populations can change drastically over time. Present populations of this species are just one percent of their historical values, prior to human exploitation and deteriorating environmental conditions (McClenachan et al., 2006). Fortunately, recent conservation efforts are leading to a slow recovery in the number of these turtles (Weber et al, 2014; Tröng & Rankin, 2005; Garcia-Cruz, 2014; Mazaris et al., 2017).

## Overall Trends

Recent data shows green sea turtle populations seem to be on the rise. Scientists have reported increases in nesting trends as high as 14% for Florida

and around 5% within the eastern Caribbean, on Aves Island, Venezuela (Chaloupka et al., 2008; Mazaris et al., 2017; García-Cruz et al., 2014). Although green sea turtles hatch throughout the Caribbean, there are a few key habitats where juveniles forage. One of these popular foraging grounds is located in Lac Bay, Bonaire.

## Genetic Markers

Researchers were hoping to gain insight in how these variations in recovery rates of sea turtle populations affected the overall genetic diversity within Lac Bay. Using mitochondrial DNA (mtDNA) from juveniles, researchers can identify the geographical regions where each turtle hatched (Bowen et al., 2005).

Between 2006 and 2016, tissue samples from 332 juvenile green sea turtles were collected, from which a fragment of the mitochondrial DNA was sequenced. Researchers were able to divide the sea turtles as coming from rookeries in four geographical areas: north-western Caribbean, south-western Caribbean, eastern Caribbean and southern Atlantic. Overall, there was a significant shift in the genetic makeup over the length of the study, with an overall increase in juvenile recruitment from

the north-western Caribbean (from 12% to 38%), and a general decrease in population recruitments from both eastern Caribbean (from 46% - 20%) and southern Atlantic (5% - 2%; van der Zee et al., 2019).

## The Results

Overall, researchers were able to show that the genetic makeup of green sea turtles within Lac Bay demonstrated an increase in populations originating from the north-western Caribbean. Interestingly, overall juvenile green turtle populations did not significantly increase within Lac Bay throughout this study period. The stability of the Lac Bay turtle population could mean that this foraging area is nearing or at carrying capacity. If at carrying capacity, the competition for resources may lead some sea turtles to find other foraging areas. On the other hand, another research group found a positive trend for green turtles within Lac Bay between 2003-2018, fluctuating between the lower and upper limits of carrying capacity with a mean abundance of 350 individuals (Rivera-Milán et al., 2019).

It is also important to note that generalizing the differences in nesting trends and recruitment within feeding grounds can be extremely difficult. There are many factors which can contribute to population shifts since hatchling mortality and nest productions can vary significantly from year to year (Bjorndal & Bolten, 2008; Broderick et al, 2001). Furthermore, the average age of foraging turtles within Lac Bay is between 6 and 10 years (Kubis et al., 2009; Bjorndal et al., 2000). Therefore, there is an expected time lag of nearly a decade between changes in nesting successes and population shifts within the bay.

Recent conservation efforts have helped Suriname increase green sea turtle nesting, which could result in an increase in the eastern Caribbean sea turtle population within Lac Bay in the upcoming years. In addition, scientists believe turtles may shift foraging grounds as they develop due to their natal homing capabilities (Naro-Maciel et al., 2016). This could explain why, in Lac Bay, recruitment from south-western Caribbean was high when studying the entire population, however, if only smaller juveniles were analyzed, recruitment from north-western and eastern Caribbean were proportionately higher. This shift could represent

larger juveniles leaving Lac Bay to return to their birth rookeries.

#### The Future of Sea Turtles

This study highlights the success of current efforts to protect sea turtle nesting beaches by demonstrating the increase in juveniles originating in areas with successful conservation efforts. This study also demonstrates how genetic testing can be an effective way to monitor trends within populations.

Conservation efforts that protect hatch sites is critical but only effective for a small portion of a sea turtle's life cycle and therefore a more holistic approach needs to be taken to conserve this critical species. Many environmental changes, such as sand temperature, water quality and habitat loss could have a significant impact on these populations as well (Laloë et al., 2016). Understanding the relationship between environmental factors, sea turtle life cycles and rehabilitation of sea turtle populations will be critical in designing effective management strategies for this species in the future. The researchers are very thankful for the support with collecting data and to conduct conservation activities by Sea Turtle Conservation Bonaire.



Green Sea Turtle. Photo by: © Marion Haarsma

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