Determining the factors affecting distribution, size, and abundance of green sea turtles, *Chelonia mydas*, in Half Sound, Eleuthera

George Crawford, Helena Janulis, Sarah Taft, Maria Springs, James Boelkins, and Tiger Henderson

Introduction:

Threats

Figure 1: Example of direct harvest

Many different factors have contributed to a substantial decline in the global turtle population. Threats include direct harvest (Figure 1), fisheries bycatch, habitat destruction, illness and injury, pollution and marine debris, and climate change. As threats continue to bring sea turtle populations closer to extinction, government action is required to stop the decline. In 2009, The Bahamas passed legislation against the direct harvest of turtles. Although bans like these are placed, they are not heavily enforced.

Life Cycle

As seen in Figure 2, sea turtles begin their lives as hatchlings, where they move from their nests on land to the ocean's pelagic zone. They then go into their "lost years", a 2-5 year period in which there is a considerable knowledge gap. Turtles then enter foraging grounds where they grow until they are sexually mature and then return to the beach at which they were born, a process called natal homing.

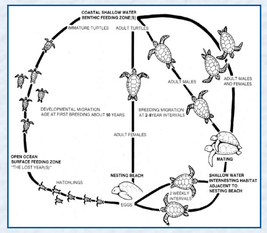

Figure 2: Life cycle Map

Habitat and Foraging Ground

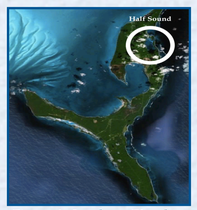

Figure 3: Southern Eleuthera

During the developmental stage, foraging grounds provide an abundance of food as well as protection from major threats and predators. Tiger sharks are one of the major predators for sea turtles and affect the way that they use their habitat. (Heithaus et al 2005). While in the foraging stage, turtles act as lawn mowers, in that they help maintain healthy levels of sea grass beds (Figure 4). This ecological role is extremely important when looking at trophic interactions because many other marine species heavily rely on the sea grass for food and habitats.

Half Sound, Eleuthera (Figure 3) is an example of a foraging ground its healthy abundance of sea grass beds for food and mangroves for protection. It is very important that we closely study the Half Sound foraging ground habitat. This will help us grasp a better understanding on why the turtles are there and how we can help conserve and provide more protection similar to those on an international scale.

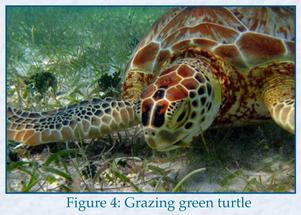

Figure 4: Grazing green turtle

Purpose:

To determine the major factors that influence green sea turtles' preference of foraging grounds and habitat in order to further protect these habitats and support future international conservation attempts.

Hypothesis:

Green sea turtles will be most heavily populated in areas with an abundance of seagrass beds, mangroves, and relative absence of predators.

Results:

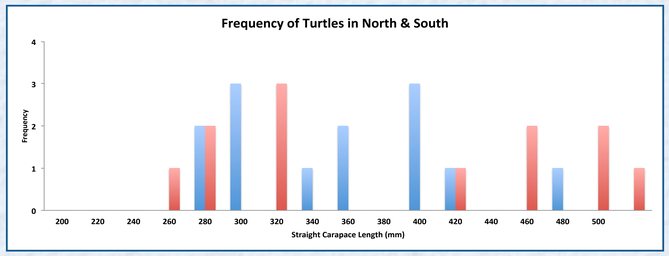

Figure 11: Frequency of size classes in North (blue) and South (red)

Figure 14: Perimeter Survey Results from average field day

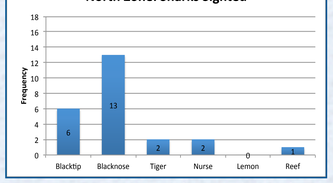

Figure 12: Large number of sharks in the North Zone

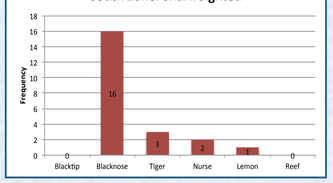

Figure 13: Large number of sharks in the South Zone

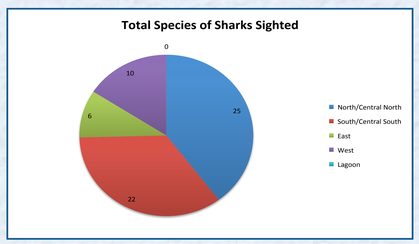

Figure 15: Majority of sharks sighted in North & South

Key Findings:

- North: n = 13 ; South: n = 12
- p-value = 0.89 from ANOVA test on the frequency of size class of turtles between the north and south (Figure 11)
- Mean count on a perimeter survey = 90 turtles
- Frequency of larger turtles in the south is higher than in any other zone.

Discussion:

Factors Affecting Data

From visual recognition during perimeter surveys, we've been able to determine that the frequency of larger turtles in the south is higher than in any other zone; the largest turtle captured during the study was in the south (Figure 11). The high P-value from the data depicts no correlation between the distribution of sea turtle populations between the north and south ends of Half Sound. This semester is the first attempt at capturing turtles in the south for data analysis, and more information would be able to provide numerical significance. Larger turtles could be captured more frequently in the north due to the fact that data collection in this area can only happen during high tide, which allows turtles of all sizes to swim into the northern creek system.

Figure 16: Creek in North end

Figure 17: Southern end

Predator Correlation & Distribution

As past studies have demonstrated, many organisms will change their diet and habitat in response to the presence of predators (Werner & Gilliam 1983). Observing a higher frequency of larger turtles in the southern end implies that the green sea turtles might be responding to predation risk. The north is a naturally protected area; mangroves line the walls and the shallow water helps keep the turtles safe from sharks. The smallest sea turtles are able to seek refuge in the north, where predators cannot travel into during low tide. Larger turtles can coexist in the south end where the predation risk is higher, but the chance of being subjected to predation is lower. In the presence of a predator, the larger size class is less subject to predation, thus putting smaller turtles at a higher risk in the south and opting for refuge in the north (Werner & Gilliam 1983). This predator-prey correlation is further exemplified on the eastern and western sides. Few turtles were seen in the eastern side while almost none were seen on the western side (See Figures 12, 13 and 14). We can infer that the high percentage of sharks and the rocky western coastline repel the turtles from being since there is minimal shoreline protection.

Future Implications

This research will help shed light on the lack of data on this important life stage of a sea turtle's life, the time spent in foraging grounds. Sea turtles have many habitats throughout their life and all must be protected to prevent drastic decreases in the global sea turtle populations. Information on what factors determine sea turtle distributions will be crucial in establishing effective international conservation attempts for the future, in both foraging and nesting grounds.

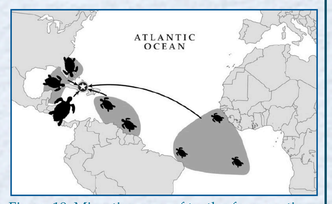

Figure 18: Migration map of turtles from nesting sites to the foraging ground in The Bahamas

Methods:

Figure 5: To determine the population abundance and distribution, we conduct perimeter surveys. This is when we follow the coast of Half Sound counting and marking on a GPS all of the turtles we see from the boat.

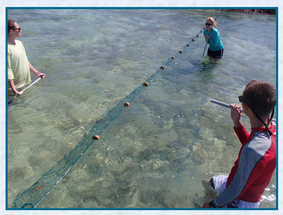

Figure 6: One of the methods that we use to catch the turtles is by herding them into a seine net.

Figure 7: The second method we use to catch turtles is by following then capturing the turtle from a boat.

Figures 8 & 9: After catching a turtle we then measure, weigh, tag, and then release it back into the wild.

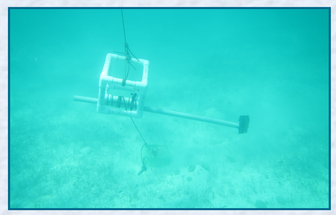

Figure 10: To determine the predator effects on sea turtles in Half Sound we use BRUVS (Baited Remote Underwater Video Surveys).

Acknowledgements & Literature Cited:

We would like to acknowledge and thank our two research advisors, Taylor Hoffman and Rachael LaBella. We would also like to acknowledge the Archie Carr Center for Sea Turtle Research for providing us with all of our tagging equipment. We'd like to thank The Island School and the Cape Eleuthera Institute for all their support. In addition, we credit our knowledge on sea turtles to these sources:

Bjorndal, K.A., A.B. Bolten. 1988. Growth Rates of Immature Green Turtles, *Chelonia mydas*, on Feeding Grounds in the Southern Bahamas. Copeia Vol. 3: 555-564; Bjorndal K.A., A.B. Bolten. 2009. Policy Changes Protect Sea Turtles in the Bahamas: Long-term Effects Rewarded. SeaTurtlesStatus.org :17; Bjorndal K.A., A.B. Bolten, M.Y. Chaloupka. 2005. Evaluating Trends in Abundance of Immature Green Turtles, *Chelonia mydas*, in the Greer Caribbean. Ecological Applications Vol. 15: 304-314; Hamann M, Godfrey MH, Seninoff JA, Arthur K et al (2010) Global Research Priorities for Sea Turtles: Informing Management and Conservation in the 21st Century. Endang Species Res Vol.11: 245-269; Heithaus MR, Frid A, Wirsing AJ, Bejder L, Dill LM (2005) Biology of Sea Turtles Under Risk From Tiger Sharks at a Foraging Ground. Mar Ecol Prog Ser Vol. 288: 285-294; Moran KL, Bjorndal KA. 2005. Simulated Green Turtle Grazing Affects Structure and Productivity of Seagrass Pastures. Mar Ecol Prog Ser Vol.305: 235-247