Homing Behavior of Displaced Juvenile Green Sea Turtles (*Chelonia mydas*)

Advisors: Jessica Rudd and Christian Daniell

By: Emmett de Kanter, Keenan McMorrow, Brad Stanton, Julia Forman, Megan Long, Michael Freeman and Ellie Adams

Introduction

Green sea turtles (*Chelonia mydas*) play an essential role in seagrass ecosystems by modifying the structure, palatability, and quality of the seagrass beds. Seagrass ecosystems harbor a number of commercially important juvenile fish as well as provide coastal protection services (lal et. al. 2010). Due to multiple threats including overexploitation, by catch, and habitat destruction, turtle populations have decreased to 3-7 % of their original size and are now listed as an endangered species (McClenachan et. al. 2016). However, the species is endangered due to anthropogenic threats, such as bycatch[1], oil spills[2], and the loss of their habitats. Habitat loss is especially destructive to turtles because they exhibit philopatry and remain in specific home ranges, despite the deteriorating state or condition of their environment.

In an attempt to increase the depleted turtle population, past studies have researched the homing behaviors of adult green sea turtles to test if turtle relocation is a feasible conservation method[3]. Adult turtles have been found to return to their home ranges from up to 120 km away and after a year and a half in captivity (Shimada et. Al. 2016) by orienting themselves using physical cues and the inclination angle and intensity of geomagnetic fields[5]. Therefore, turtle relocation among adults has been found ineffective. However, little is known on juvenile turtles' homing ability and whether this is affected by the quality of the habitat in which they have been displaced.

Because The Bahamas is a hotspot for juvenile green sea turtles, long term population monitoring of the turtles has revealed high site fidelity to small home ranges. Focusing research on juvenile green sea turtles is essential because it will provide significant findings to aid future conservation efforts for the data deficient species.

Research Questions

1. **Is there a relationship between juvenile turtles homing behavior and their foraging habitats?**
2. **Do relocated juvenile green turtles return to their home creek?**
3. **How does the behavior of displaced individuals vary from that of the controls?**

Study Sites

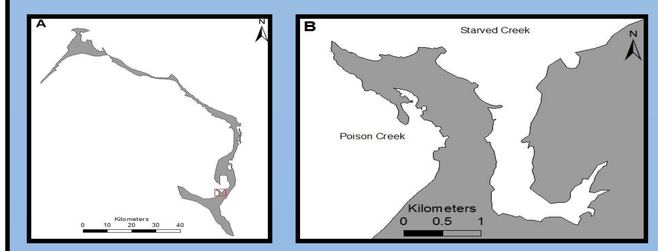


Fig 1.) A.) Eleuthera, an island in The Bahamas where the study was conducted. B.) Starved Creek and Poison Creek, located approximately 4km apart

Methods

Fig 2. The relative habitat qualities of the creeks were assessed by measuring…
-depth
-sediment type
-percent coverage of seagrass and macroalgae.

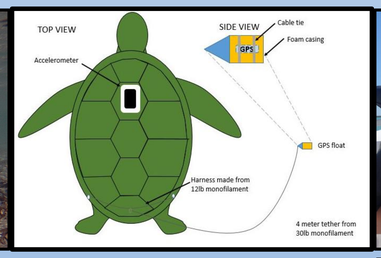


Fig 3.) Ten juvenile green turtles were captured for the study. Morphometric measurements including…
-weight
-curved and straight carapace lengths
-body depth

Fig 4.) Turtles were tagged with an accelerometer on their second central scute, and a GPS tracker connected to the carapace by a 3 meter tether. Half of the individuals were used as controls and released into their home creeks, while the other half were displaced into the opposite creek.

Results

Habitat Quality

- Hot Spot analyses indicated similar sea grass density in both study sites
- Correlations between depth and temperature were found between creeks, although Starved Creek was shown to be narrower and endowed with greater mangrove coverage

Behavior

- Turtles were tracked for an average of 32 hours and 33 minutes, with a range between 12 hours and 72 hours
- During the tracking period, individuals were found to travel and average of 15.5 km ± 11.5 km
- Of the ten turtles studied, movement data has been collected from three experimental and two control turtles due to difficulties retrieving tags

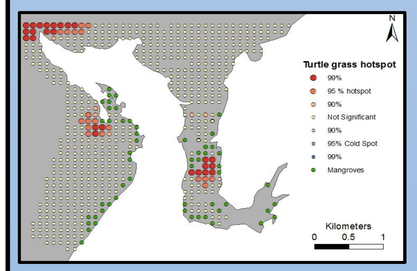
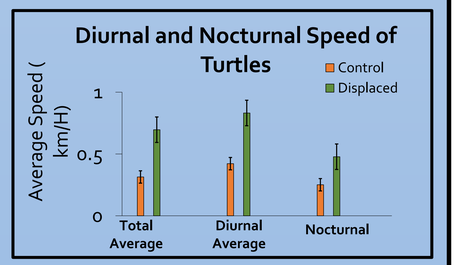


Fig 5.) (Left) Result of hotspot analysis showed that both creeks were similar in seagrass cover

Fig 6.) (Right) Displaced turtles were more active than controls during both day and night. ANOVA $F_{2,9} = 7.29$ $P > 0.05$



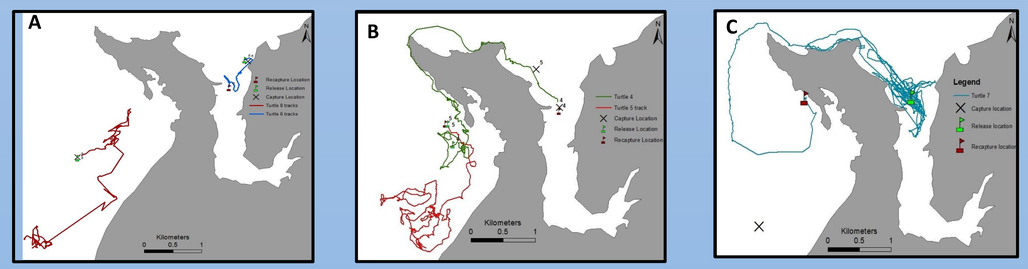


Fig 7.) Tracks of A.) controls, B.) turtles displaced from Starved Creek to Poison Creek, and C.) individuals displaced from Poison Creek to Starved Creek.

Discussion

- Similar seagrass cover in both creeks suggested no difference in habitat quality.
- Unlike the control turtles, the displaced turtles were equally active during the day and night, travelling almost twice as fast as controls
- Differences in movement were attributed to difficulty orienting and exploring new habitats.
- Extra exertion of energy could lead to an increased risk of predation as the turtle has no knowledge of shelter and will tire more easily.
- Once the turtles successfully oriented themselves, they were able to rehome in just a few hours. These results support similar findings in adults[4].

Implications

- Results collected undermine the potential reliability of conservation by relocation
- The study suggested that juvenile green sea turtles can be expected to rehome after being held in rehabilitation centers[6].
- In the future, turtles could be tracked for longer periods of time with more reliable GPS tags to increase understanding of homing behaviors.

Acknowledgements

Thanks to Jessica Rudd and Christian Daniell for their work as research advisors, as well as to the rest of the turtle research team, The Island School, the Cape Eleuthera Institute, the University of Exeter, and to Earthwatch for the funding they provided.

Literature Cited

1] Wallace, B. P., Lewison, R. L., McDonald, S. L., McDonald, R. K., Kot, C. Y., Kelez, S., ... & Crowder, L. B. (2010). Global patterns of marine turtle bycatch. Conservation letters, 3(3), 131-142 [2] Mitchelmore, C. L., Bishop, C. A., & Collier, T. K. (2017). Toxicological estimation of mortality of oceanic sea turtles oiled during the Deepwater Horizon oil spill. Endangered Species Research, 33, 39-50.
[3] Luschi, P., Hughes, G. R., Mencacci, R., De Bernardi, E., Sale, A., Broker, R., ... & Papi, F. (2003). Satellite tracking of migrating loggerhead sea turtles (Caretta caretta) displaced in the open sea. Marine Biology, 143(4), 793-801.
[4] Shimada, T., Limpus, C., Jones, R., Hazel, J., Groom, R., & Hamann, M. (2016b). Sea turtles return home after intentional displacement from coastal foraging areas. Marine biology, 163(1), 8.
[5] Benhamou, S., Sudre, J., Bourjea, J., Ciccione, S., De Santis, A., & Luschi, P. (2011). The role of geomagnetic cues in green turtle open sea navigation. PLoS One, 6(10), e26672.
[6] Shimada, T., Jones, R., Limpus, C., & Hamann, M. (2016a). Time-restricted orientation of green turtles. Journal of Experimental Marine Biology and Ecology, 484, 31-38