Evaluating the abundance and distribution of juvenile green sea turtles *(Chelonia mydas)* in South Eleuthera

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Introduction

Sea turtles live in temperate and tropical regions world wide. All seven species of sea turtles are listed as endangered under the International Union for Conservation of Nature Red List due to anthropogenic factors (Figure 1), slow growth rates and late maturity (Hamann *et al.* 2011). Green sea turtles play an important role in their ecosystems through a positive impact on seagrass health and productivity. Seagrass is a main food source and habitat for many different marine species. Green sea turtles eat seagrass causing it to grow faster and more dense. This creates a higher quality seagrass, thus increasing a major food source and habitat for other marine species (Moran & Bjorndal 2005).

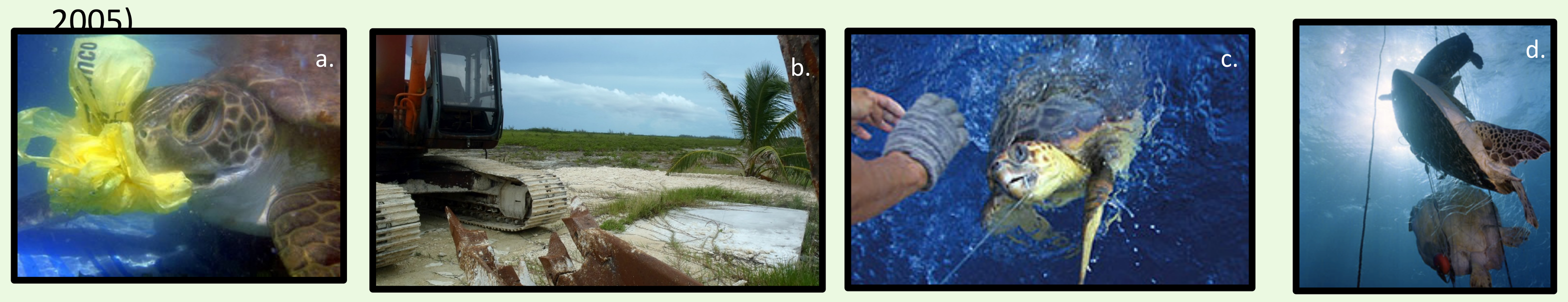

Fig. 1 Anthropogenic factors including a. pollution, b. coastal development, c. direct harvest, d. direct bycatch

This study focuses specifically on the juvenile life stage, which is spent mostly within foraging grounds. By monitoring the juvenile life stage researchers are able to make predictions about changes in populations (Bjorndal *et al.* 2005). Foraging grounds in the Bahamas are tidal mangrove creeks. There is a wide variation in abundance of sea turtles across foraging grounds. There is also variation in species of algae across foraging grounds. Juvenile and adult turtles occupy these creeks. During this part of their life cycle the turtles forage for seagrass and find protection from predators.

Little is known about the distribution of juvenile green sea turtles. Factors such as predators and seagrass may influence juvenile green turtle distribution. Examining predator distribution is important to top down control, which describes how the predators influence turtles population. Predators can lethally and non-lethally influence their prey population. Lethally is when predators physically eat their prey, sea turtles, and non-lethally affecting the turtle distribution (Heithaus *et al.* 2007). Bottom up control describe how the seagrass abundance, or food source, influences the turtles abundance.

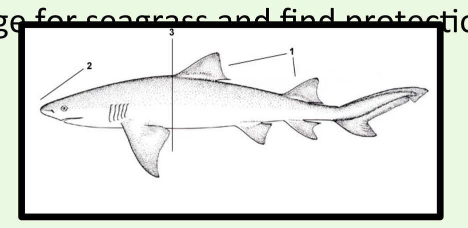
Fig. 2.1 Sharks are predators of sea turtles


Fig. 2.2 Green Sea Turtles

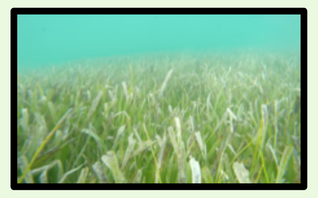
Fig. 2.3 Seagrass is a main food source and habitat for Green sea turtles and other juvenile fish

Methods

Fig. 3. Map of study sites throughout Southern Eleuthera. Study sites were separated based on their proximity to open ocean with the Bahamas Banks in light blue, Exuma Sound in dark blue, and Atlantic Ocean in black.

Abundance Surveys


Fig. 4. Visually scanned the water, taking a GPS point whenever a green sea turtle was seen.

Predator Surveys


Fig. 5. BRUVS (Baited Remote Underwater Video Surveys) are PVC pipes with a bait bag attached that is filled with Bonita tuna (Brooks *et al.* 2011).

Habitat Mapping

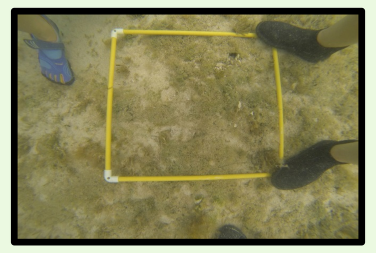
Fig. 6. Quadrats were placed throughout creeks. The substrate type, density, and species of algae and seagrass were examined.

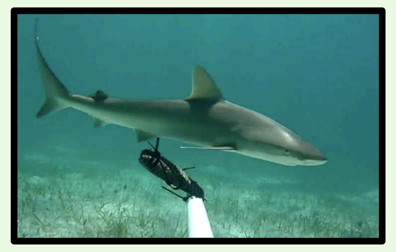
Fig. 7. The bait attracted sharks in the area to the BRUVS site and a Go-Pro recorded for 90 minutes. The footage was then analyzed to understand which predators were in each creek.

Purpose

The purpose of this study is to examine factors such as predator effects and substrate type that influence the abundance and distribution of juvenile green sea turtles within their foraging grounds in Southern Eleuthera.

Results

The study consisted of 311 habitat mapping points, 13 abundance surveys, and 43 BRUVS during the spring of 2014 throughout foraging grounds in Southern Eleuthera. The creeks were categorized by proximity to open ocean, with creeks adjacent to the Bahamas Banks in light blue, the Exuma Sound in dark blue, and the Atlantic Ocean in black.

Habitat Mapping:

Figure 8 shows the habitat mapping results and demonstrates that each creek had about the same amount of seagrass and algae.

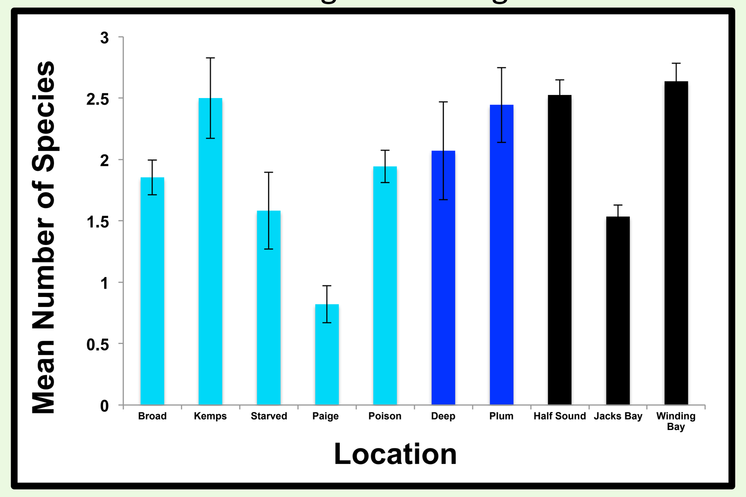

Fig. 8: The mean number of algae and seagrass species is shown throughout creeks in Southern Eleuthera.

Abundance Surveys:

Figure 9 represents the abundance survey results and demonstrates that Half Sound had the highest relative abundance of turtles with a mean of 61 sightings of turtles per survey. Deep Creek and Starved Creek also had a high relative abundance of turtles, while Broad Creek and Kemps Creek had a mean of zero turtles.

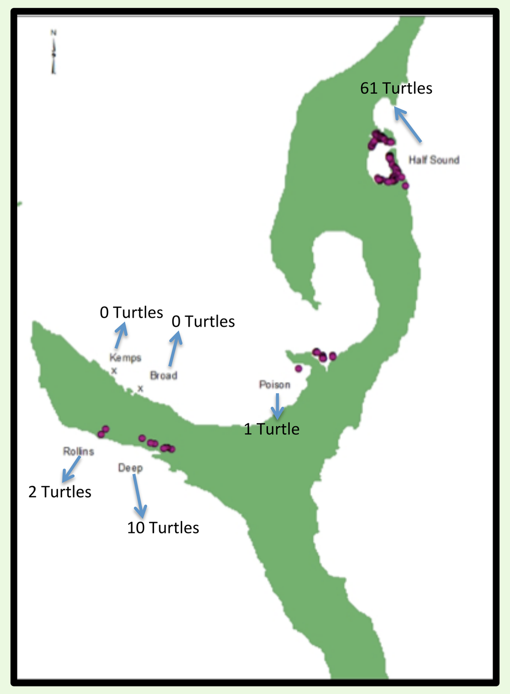

Fig. 9. The map of Southern Eleuthera shows where turtles were present with red dots and where turtles were absent with an 'x.'

Predator Surveys:

To standardize this information, the CPUE or catch per unit effort was used. The CPUE calculates how many sharks were spotted per hour. Figure 9 shows the BRUVS results, representing the relative abundance of sharks in each creek. The creek with the highest relative abundance of sharks was Starved Creek, with a mean of over 1.5 sharks per hour.

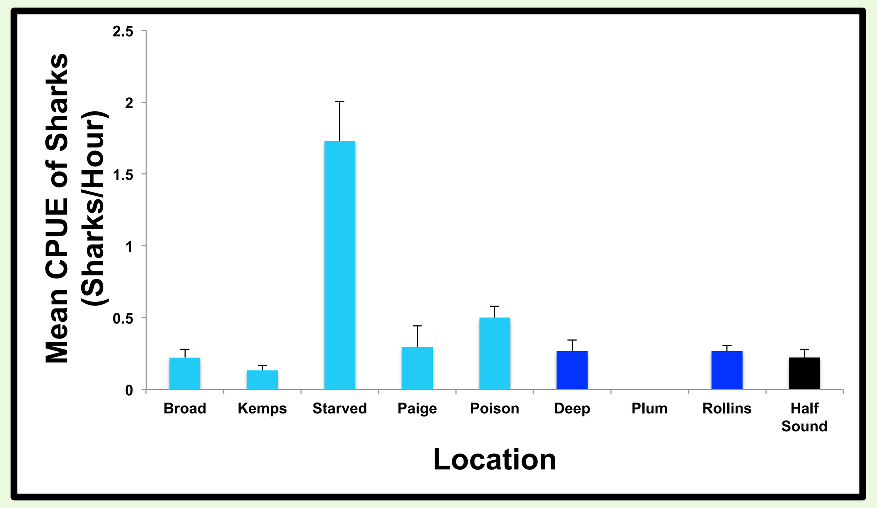

Fig. 10: The mean number of sharks in the creeks throughout Southern Eleuthera, using catch per unit effort to show the sharks seen per hour.

Figure 11 shows the mean number of sharks using CPUE and the types of species in each creek. The most abundant shark species throughout the creeks were lemon sharks and nurse sharks. Starved Creek had the highest abundance of both species. Tiger sharks, which are the main predator of green sea turtles, were only spotted in Rollins Creek.

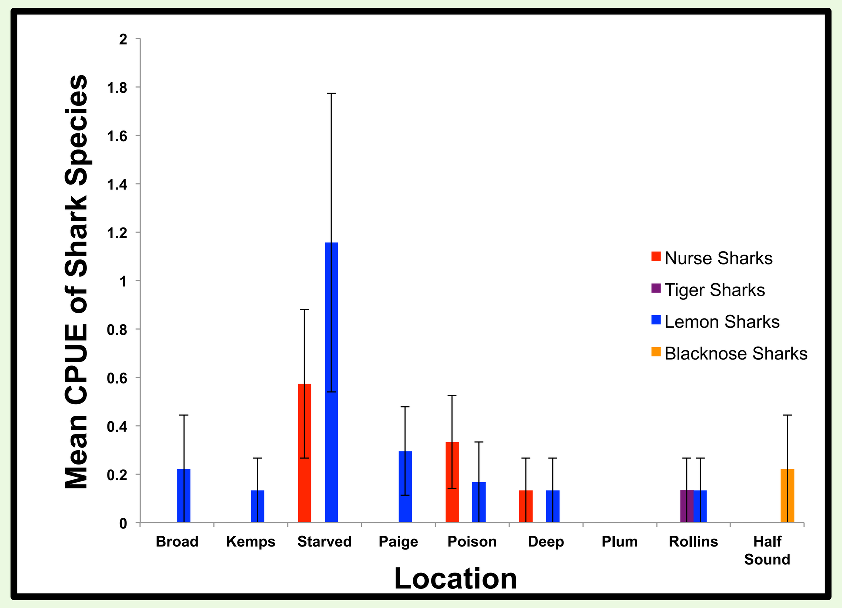

Fig 11: The mean number of shark species in creeks throughout Southern Eleuthera, using catch per unit effort to show the sharks seen per hour.

Discussion

This study begins to assess the potential influence of seagrass and shark populations on the abundance and distribution of green sea turtles. After putting the results together, the study showed that there were often a high abundance of green sea turtles in areas with a high abundance of sharks. This did not support the initial hypothesis, which stated that the turtles would avoid areas of high predator abundance, an idea demonstrated in previous studies (Heithaus *et al.* 2007). The results of our data suggest that seagrass may play a larger role in determining the distribution of green sea turtles more so than the influence of predators. This could be because the turtles risk predation in order to find better quality sea grass. Sharks also may be following green sea turtles into their foraging grounds, this is unlikely because the most abundant shark species sighted were nurse and lemon sharks. Both nurse and lemon sharks not commonly known as predators of green sea turtles use these creeks as nursery habitat. The high abundance and quality of the seagrass in the creeks allows the area to serve as a nursery habitat for juvenile fish. The characteristics of these creeks seem to be favorable to both the sharks and sea turtles.

Future Directions

Further research needs to be conducted to investigate why the green turtles are foraging in creeks that have a high abundance of predators, instead of staying in creeks with a low population of predators. This would help support the conclusive predictions about the results that were collected from the study. In the future, more data can be collected to increase the sample size of the relative abundance of predators, species of algae, and the juvenile green sea turtles. Data will be used to create maps that depict where the predators, turtles, and seagrass/algae species are most abundant. The data from this study goes towards identifying critical habitats and foraging grounds for the juvenile green sea turtles. These maps can help inform the primary areas that need to be marine protected from coastal development and other anthropogenic effects.


Fig. 12. Data collected and satellite imagery will be used to create a habitat map of the substrate type within foraging grounds throughout Southern Eleuthera.

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