Assessing diurnal foraging patterns in green sea turtles (*Chelonia mydas)*

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Background

Since the 1700s, sea turtle populations in the Caribbean have declined by 95-97%. In 2009, The Bahamian Department of Marine Resources placed a ban on the possession and harvesting of sea turtles and sea turtle products (Bjorndal and Bolten, 2010). Green sea turtles (*Chelonia mydas*) (Fig. 1) are one of the largest marine herbivore and therefore play an important role in tropical marine ecosystems by consuming vast quantities of seagrass. In the Caribbean, they feed primarily on turtle grass *(Thalassia testudinum*). Green turtles consume the bottom half of the blade which contains higher nutrients and lower lignin levels (Bjorndal and Moran, 2007). Grazing helps to improve the health of seagrass beds by allowing the blades to grow back with a higher nutritional value (Moran and Bjorndal, 2007).

There are three methods of obtaining information about an animal's diet including stable isotope analysis, fecal sample collection, and esophageal lavage. An esophageal lavage is the only species specific and non-lethal way of collecting a diet sample. Previous studies have assessed foraging habits of green turtles using esophageal lavage; however, this method has not been successful in The Bahamas. Sampling may be more effective if there is an greater understanding of turtle feeding times. Green turtle feeding patterns may vary due to factors such as tidal state and time of day possibly affecting the size of diet samples (Taquet *et al*, 2006).

By assessing lavage samples from different tidal states (high and low) and times of day (morning, midday, afternoon), we hope to determine if these factors affect when juvenile green turtles forage in order maximize our diet sample mass. This information will allow for a better understanding of this important life stage. Our purpose is to inform the scientific community of the ideal time of day and tidal state to collect green turtle diet samples. To achieve this, we:

- **Determined if tide and time of day affect when juvenile green sea turtles forage**
- **Assessed if tide levels and time of collection affect diet sample mass**

Figure 1: Green sea turtle swimming

Study Site

- Winding Bay, located on the Atlantic side of southern Eleuthera (Fig. 2).
- Depths differing between tidal cycle (24 - 142 cm).
- Turtle grass *(Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*) are all present within our study site.

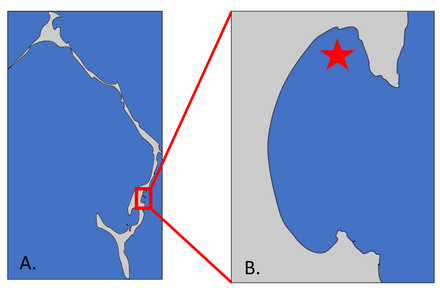

Figure 2: A. Location of Winding Bay in Eleuthera; B. Location of this study within Winding Bay indicated by the red star.

Methods

Diet Sample Collection and Analysis

1. Encircle turtles at their grazing patch with a human scare line and direct turtles into seine net for capture (Fig. 3).
2. Collect diet sample using esophageal lavage. To do this, a lubricated veterinary grade tube is placed into the esophagus while sea water is pumped. The diet sample is collected in a sieve (Fig. 4).
3. Each diet sample was weighed and separated, based on species, into the three species of seagrass and other diet components (Fig. 5).

Figure 3: Seine net capture method

Figure 4: Esophageal lavage on green turtle

Figure 5: Diet sample separation over a sieve

Green Sea Turtle Foraging Times

1. Deploy GoPro cameras around perimeter of established grazing patches. Video segments record at set tidal state and time of day (Fig. 6).
2. Review video footage and recording duration of foraging and maximum of turtles present, recording individual species and feeding (Fig. 7).

Figure 6: UBRUV (Unbaited remote underwater video)

Figure 7: Juvenile green sea turtle foraging

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Results

Capture and Diet Sample Results

- 29 diet samples were collected
- Straight carapace length (SCL) ranged from 22.5 - 41.4 cm (mean = 32.5 ± 4.9 cm).
- Diet sample mass ranged from 0.002-0.703 g (mean = 0.106 ± 0.154 g) with the largest samples collected midday (Fig. 8).
- The primary component of the diet samples was turtle grass (*Thalassia testudinum*).

Table 1: The 29 turtles we caught split up based on the tide and time of day during which they were caught

	Morning 6:00 - 9:00	Midday 10:00 - 13:00	Afternoon 14:00 - 18:00
High Tide	0	1	2
Low Tide	5	15	6

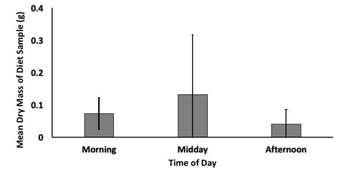

Figure 8: The mean dry mass of our diet samples compared to the time of day during which it was collected

Green Sea Turtle Foraging Times

- Seven green sea turtles observed on GoPro footage.
- 10 hours and 39 minutes of footage was collected.
- More turtles were observed in the afternoon and during low tide (Fig. 9, Fig. 10).
- The high variability may be due to the small sample size.

Table 2: The 7 turtles split up based upon the time of day and tidal state during which they were observed

	Morning 6:00 - 9:00	Midday 10:00 - 13:00	Afternoon 14:00 - 18:00
High Tide	2	3	0
Low Tide	0	1	1

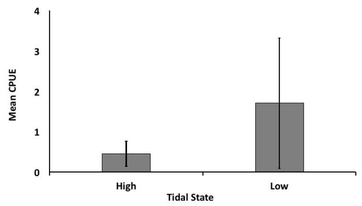

Figure 9: The number of turtles seen per hour of video footage in each tidal state

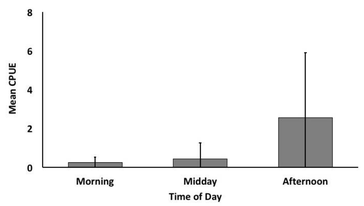

Figure 10: The number of turtles seen per hour of video footage in each time period

Discussion

The diet samples collected were relatively small with a mean weight of 0.106 ± 0.154 g. There were no statistically significant trends between diet sample size and time of day or tidal state. Even though video footage showed that more turtles were observed per hour in the afternoon (Fig. 9) and low tide (Fig. 10), due to the high variability of the data this trend was not statistically significant. Green turtles may be grazing equally at all hours of the day and tidal state. Variables such as, small sample size and the presence of a residential tiger shark, may have influenced sea turtle feeding behavior. Turtles were observed moving shallower when the tiger shark was present and expending energy evading the shark instead of feeding. It may be equally effective to collect diet samples at any tidal state or time of day, this will be more conclusive as the sample size increases.