Characterization of seagrass beds used by green sea turtles (*Chelonia mydas*) in South Eleuthera, The Bahamas

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Introduction

Seagrass evolved 100 million years ago from land plants that returned to the sea. Despite its misleading name, seagrass is not a grass, but instead a marine flowering plant more closely related to lilies. Seagrasses are different than seaweeds (or algae), because they have veins, real roots, and they produce flowers (Fig. 1). Most importantly, seagrass serves as a vital habitat, feeding and nursery ground for a multitude of marine organisms (McKenzie 2008). Topping the list of organisms dependent on seagrass are sea turtles. There are six species of sea turtles in the Caribbean, all recognized as threatened by the International Union for Conservation of Nature Red List (IUCN 2015). Green Turtles *Chelonia mydas* (Fig. 2) are not only the sea turtle most dependent on seagrass—seeing as it's their only food source after the juvenile stage— but they are also the most valuable reptile in the world and the most commonly found turtle in Eleuthera, the Bahamas (Pritchard 2015)

Several studies have been done regarding the relationship between green sea turtles and seagrass in other parts of the world. For instance, Lal *et al.* (2010) concluded that turtles in the Indian Ocean significantly impact seagrass meadow structure and species composition. In the interests of conserving the turtles and the seagrass in Eleuthera, both of which are on the decline due to anthropogenic causes, this project is aimed to collect baseline data and study the relation between the seagrass beds and the abundance of green sea turtles.

Figure 1. A seagrass meadow dominated by Manatee grass (*Syringodium filiformre*).

Figure 2. A Green Turtle . Photo by CEI.

Methods

Study sites

Figure 3. Study Sites in South Eleuthera, The Bahamas. (1) Starved Creek, (2) Poison Creek., (3) Broad Creek, (4) Kemps Creek, (5) Rollins Creek, (6) Deep Creek, (7) Plum Creek and (8) Winding Bay. Source: Google Earth ®

Data collection

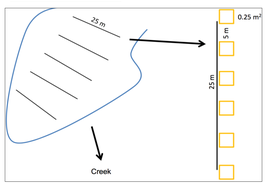

Figure 4. At each study site five transects are randomly distributed perpendicular to the shore line. Then, six quadrats are placed along the transect.

Figure 5. A transect is set out in the creek to place the quadrats.

Figure 6. Taking a core sample while numbering a quadrat.

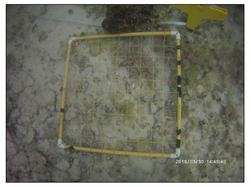

Figure 7. A quadrat set out on the transect to measure the density of the seagrass.

Figure 8. Core sample with seagrass material to take back to the lab.

Figure 9. Seagrass samples sorted into species type and above and below ground material.

Results

Seagrass monitoring

The seagrass beds were monitored at 8 study sites (Starved Creek, Poison Creek, Broad Creek, Kemps Creek, Rollins Creek, Deep Creek, Plum Creek and Winding Bay) in South Eleuthera. There, three species of seagrass were observed: Turtle grass (*Thalassia testudinum*), Manatee grass (*Syringodium filiforme*) and Shoal grass (*Halodule wrightii*).

In order to better explain the observations made at the each study site (Canopy Height, Percent Coverage, Shoot Density, Biomass, Leaf Density, Water Depth, Seagrass: Algae ratio, Biomass above/below ground, Number of shoots, Number of leaves, Leaf length), a statistical test was chosen called Principal Component Analysis (PCA) which reveals the variables that elucidate the variance in the data collected, Fig. 13 shows the variables with the highest eigenvalues and an accumulative variance of 62,17%. Axis 1 represented by the canopy height (34, 39%) and Axis 2 represented by shoot density (27, 78 %).

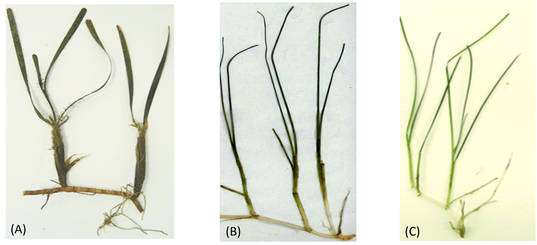

Figure 12. Seagrass species found in South Eleuthera, The Bahamas. (A) Turtle grass (*Thalassia testudinum*); (B) Manatee grass (*Syringodium filiforme*); (C) Shoal grass (*Halodule wrightii*).

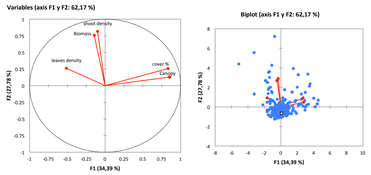

Figure 13. Principal Component Analysis (PCA) for observations from seagrass samples in eight study sites at South Eleuthera. Numbers within parentheses show the variance explained by each component.

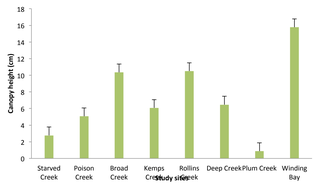

Figure 14. Average of the nopy height measure at each study site (Kruskal-Wallis F=29.78; p <0.01).

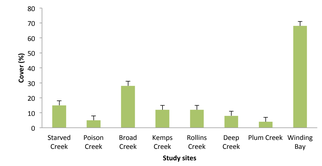

Figure 15. the percentage of cover recorded at each study site (Kruskal-Wallis F = 43.36; p < 0.01).

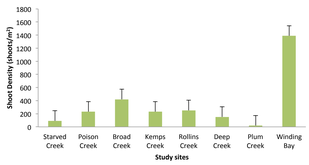

Figure 16. Average of the shoot density (shoot/m^2) estimated at each study site (Kruskal- F = 9.509; p < 0.01).

Seagrass species between study sites

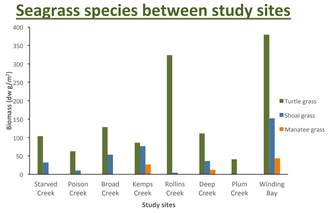

Figure 17. Average of the biomass (dw g/ m^2) of the three different species of seagrass observed at each study site.

Relative abundance of green sea turtles

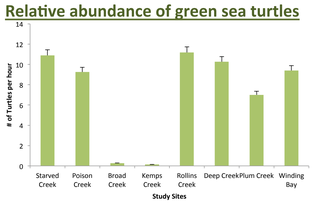

Figure 18. Histograms of the relative abundance of sea turtles (CPUE) observed at each study site.

Discussion

Seagrass structure

Seagrass communities act as 'ecological engineers' providing shelter and nutrients for many marine organisms (McKenzie 2008). Collecting data on the structure and composition of seagrass is a process to distinguish if these ecosystems are healthy, which is a valuable tool for improving management practices (McKenzie 2008).

According to Prathep *et al.* (2010) most seagrass shows seasonal variation in percent of cover, however, in this study there is only data collected for the spring season. Previous studies show a similarity regarding the dominance of one specie (*E. acoroides*) with the highest percentage of cover, in this instance the dominant species was turtle grass (*Thalassia testudinum)* (Fig. 17). Additionally, Lal *et al.* (2010) found that percent seagrass coverage was higher with a sandy substrate rather than those with dead coral and rocky bottom. In this study, although there was no analysis of the substrate, direct observations were taken which indicate that those sites with rocky substrate (e.g. Starved Creek) had one of the lowest percentage of seagrass cover, and study sites with sand or silt substrate had the highest percentage of seagrass cover (e.g. Winding Bay) (Fig. 15).

Seagrass and Green turtles

It is well known that seagrass is the dominant food source of green sea turtles (Bjorndal 1997) and that there is a world documented relationship between the two. However, results of this study indicate not correlation between seagrass characteristics and the relative abundance of sea turtles, thus further research is pertinent.

Figure 19. Green sea turtle grazing on a seagrass bed.

Caribbean green sea turtles represent an integral component of the marine meadows that they inhabit, by continuing to enhance local productivity, detritus cycling and avoiding their overgrowth (Witherintong and Witherington 2015). Lal *et al.* (2010) showed a clear decreasing trend on seagrass when assessing the general herbivory impact, including biomass and shoot density, in areas of low turtle densities to high turtle densities. The same decrease in shoot density correlating with increase in turtle density was evident in studies by Kelkar *et al.* (2013).

In conclusion, it is therefore imperative that further seagrass studies are conducted to expand on the baseline data that has been collected and to improve the accuracy of results. By establishing a detailed understanding of the seagrass meadow ecosystem, this will contribute to the success of future management and conservation strategies here in the Bahamas.

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