



Assessing Juvenile Green Turtle (*Chelonia mydas*) Relative Abundance and Growth Rates in South Eleuthera, Bahamas



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Abstract

Juvenile green turtles are the most abundant species of turtles in the Bahamas. Studying juvenile population health can predict the resilience of green turtle populations in the future, and assess the effectiveness of conservation efforts. This study addresses the relative growth rates and the relative abundance of green turtles in South Eleuthera. Drone surveys and the mark-recapture method were used to monitor population size and measure growth rates as a proxy for turtle health. The research findings showed a significant difference between turtle weight and carapace size in the two study sites; Rollins Creek and Deep Creek. Results from growth rates, however, showed an insignificant difference between the two sites. Drone surveys showed that turtle abundance was highly similar in the two sites. Overall, our results indicate that the two creeks support similar populations of turtles and that there is no significant difference in population health between the two study sites. Photo identification efforts could be used in future studies to replace tagging as a less invasive method to assess turtle population health and easily recognize individuals by comparing facial features. Habitat use by green turtles can provide insights on the spatial ecology of the population, which could aid in future conservation efforts.

Introduction

The Bahamas has a high abundance of shallow seagrass and nursery habitats that hosts a great diversity of ecologically and economically valuable invertebrates, juvenile fishes, elasmobranchs, and sea turtles. Dense seagrass beds attract many juvenile green turtles, the focus of our study. Green turtles are herbivores and graze on seagrass. Their foraging behaviors have significant impacts on seagrass bed structure, productivity, and nutrient cycling (Heithaus et al. 2014; Whitman et al. 2019). Green turtles are ecologically important to seagrass meadows, but their populations are decreasing worldwide due to a variety of threats including habitat destruction, climate change, and an increase of coastal development. For these reasons, green turtles populations have become threatened and are currently listed as “Endangered” by the IUCN Red List (Butt et al., 2016). In The Bahamas, green turtles were commonly harvested and sold until 2009 when a national ban was passed by the Bahamian government, protecting all sea turtle species. The recovery rate of green turtle populations in The Bahamas is currently unknown.

Our goal is to assess the health of the green turtle populations in South Eleuthera. This area hosts juvenile turtle populations that aren’t sexually mature and therefore can’t reproduce. It’s important to understand the status of juvenile populations locally to understand the health of the population as a whole in The Bahamas (Bjorndal & Bolten 1988; Bjorndal et al. 2005). To determine the status of green turtle populations, the amount of turtles and individual health must be measured. Growth rates can be used as a proxy for measuring sea turtle health. At the Cape Eleuthera Institute, there is an ongoing long-term mark-recapture project that has been running for nine years which will provide previous data on turtle captures to calculate growth rates. Drones are an effective tool to measure the relative abundance of turtle populations without human interference. These data are critical to assessing the conservation status and health of green turtles in The Bahamas.

Research Questions

What are the relative growth rates of green turtles in South Eleuthera?

What is the relative abundance of green turtles in South Eleuthera?

Methods

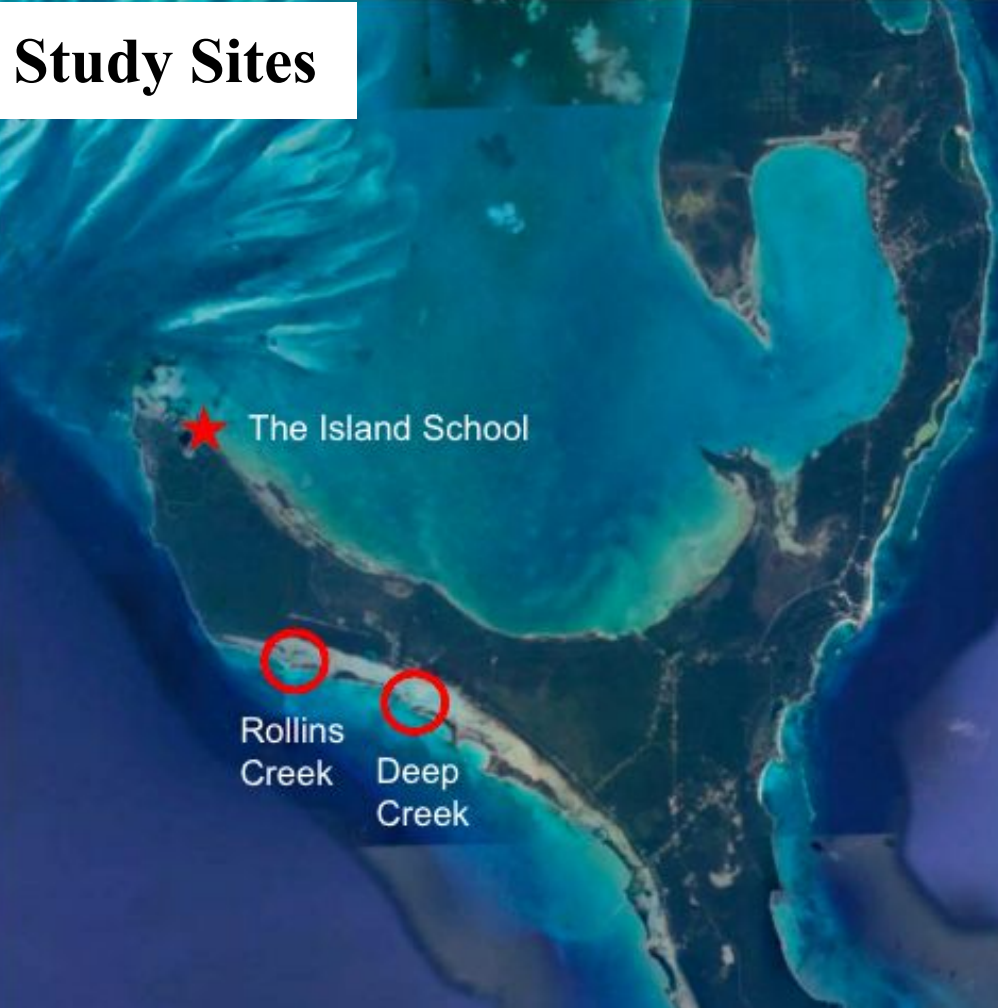


Figure 1. Image of South Eleuthera highlighting The Island School, Rollins Creek, & Deep Creek.



Figure 2. Turtle flipper showing the tag ID.

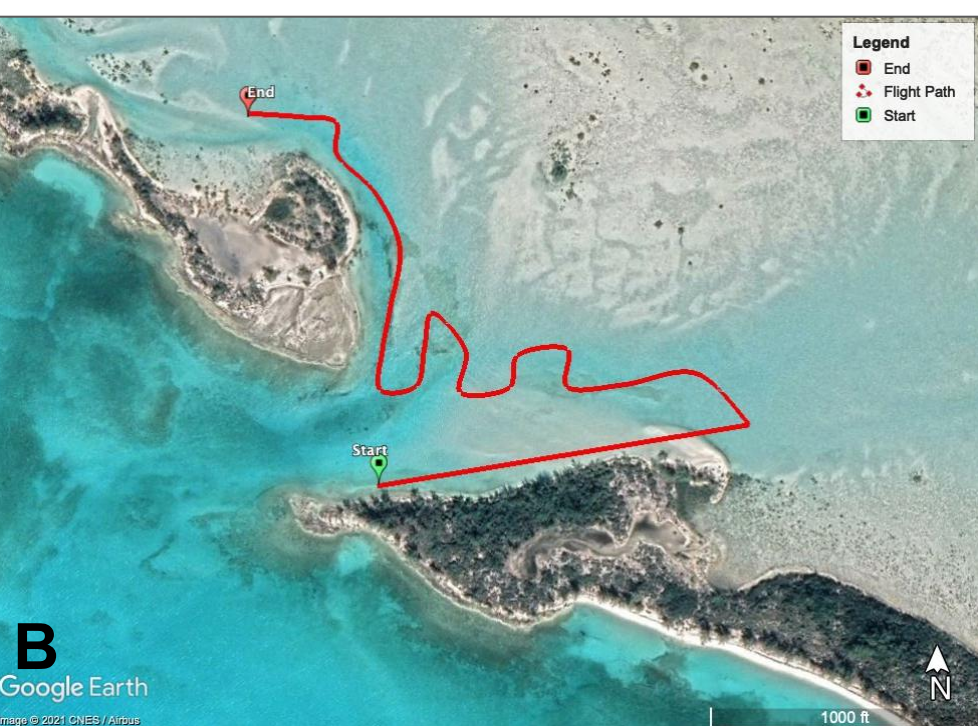
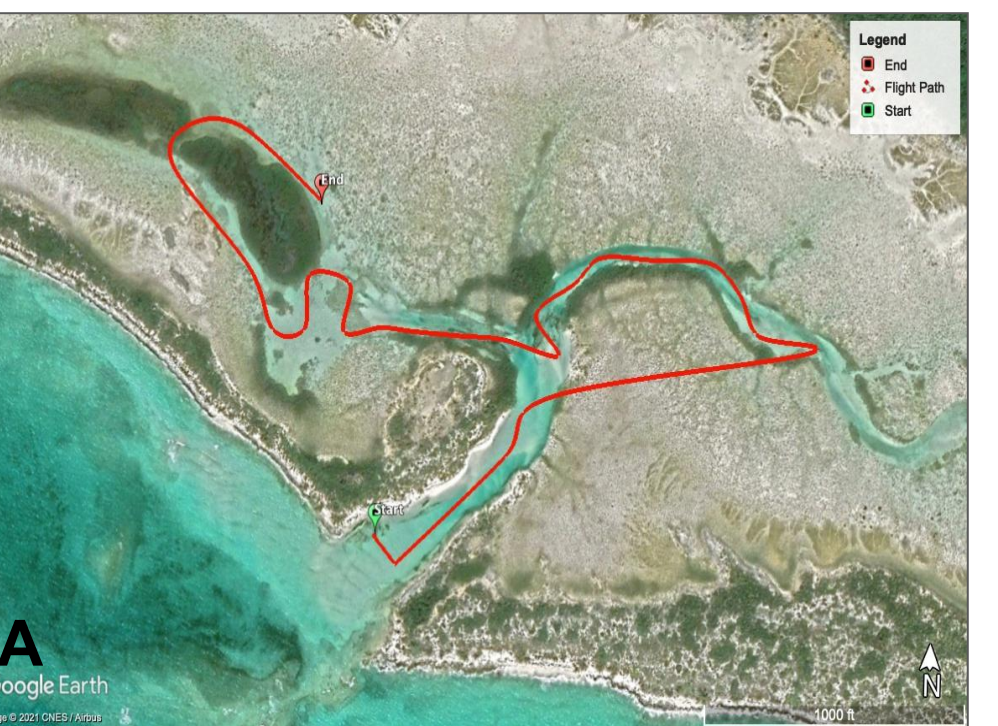


Figure 3. Satellite images of our two study sites, Rollins Creek (A) and Deep Creek (B). The drone flight paths are indicated in red.

Growth Rates:
Mark-Recapture Method

- Captured, tagged, & released individual turtles
- Collected morphometric data: straight and curved carapace length (SCL, CCL) min and max, carapace width (SCW, CCW), turtle weight (Kg), abnormalities, and photo ID.
- Recaptured green turtles were identified by tag number, and growth rates were calculated from the most recent capture.
- T-tests ($\alpha=0.05$) were performed to compare growth rates between sites.

Relative Abundance:
Drone surveys

- Predetermined drone flight paths along ten randomized points; ~ 14 minutes
- 15 meters flight altitude
- Survey footage was watched twice by two separate people to count number of turtles observed per video.

Results

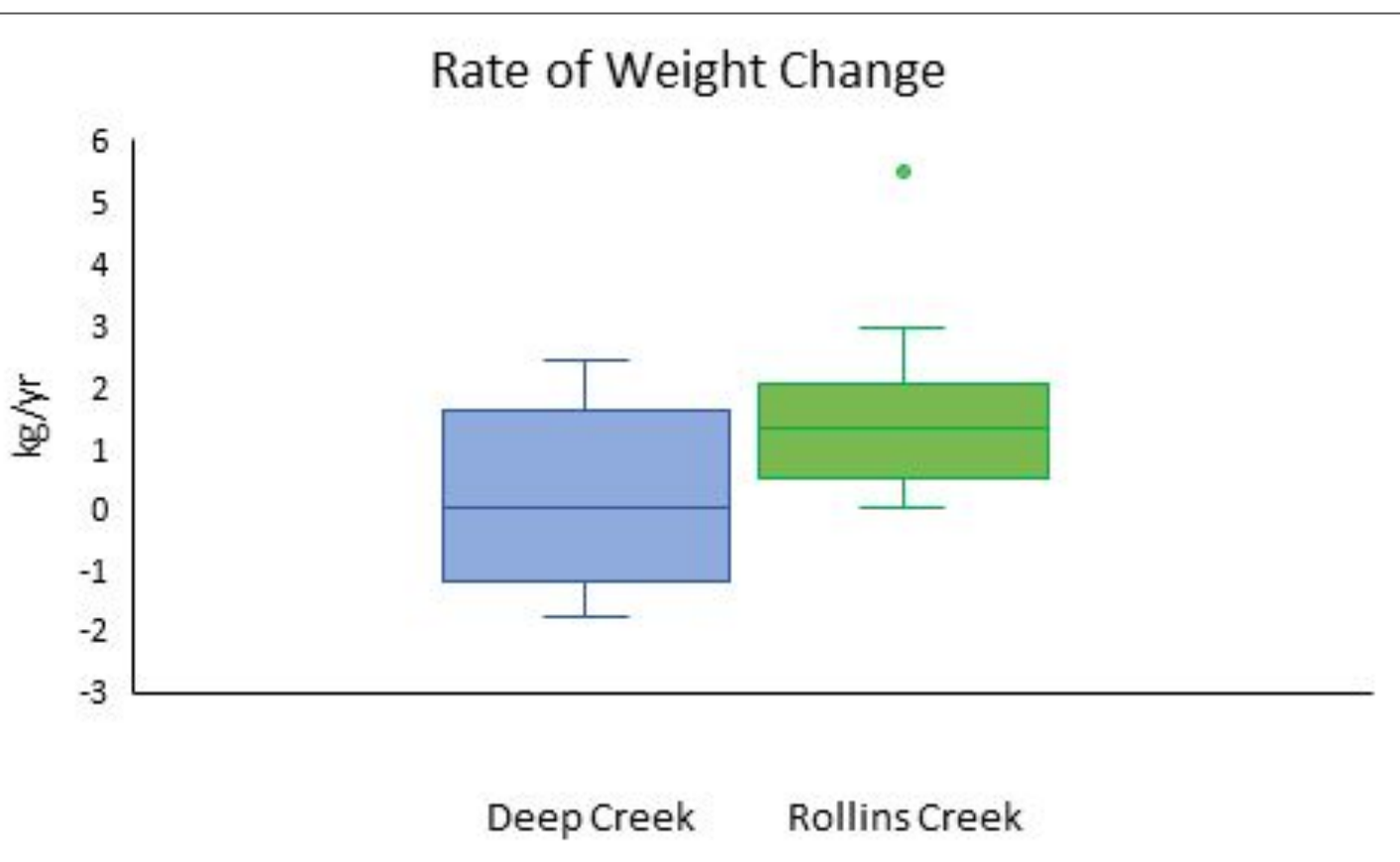


Figure 4. Growth rates measured in kilograms per year of turtle weight for Deep Creek (N = 12) and Rollins Creek (N = 22).

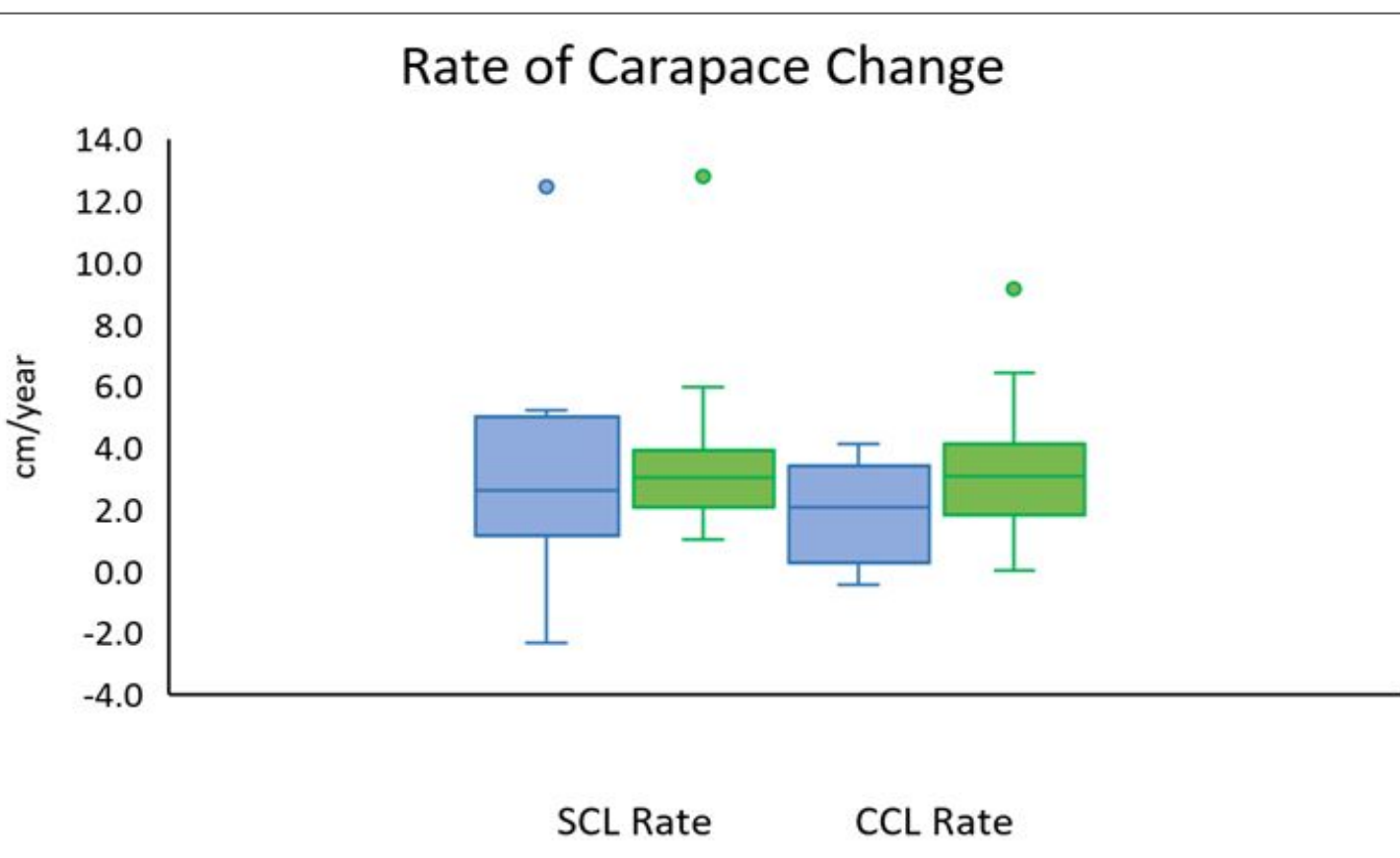


Figure 5. Growth rates of recaptured turtles measured in centimeters per year of turtle straight carapace length (SCL) and curved carapace length (CCL) for Deep Creek (N = 12) and Rollins Creek (N = 23).

Turtle Measurements	P-Value
Size (SCL min)	0.0005
Weight (Kg)	0.0059
Growth Rate (SCL/yr)	0.85
Growth Rate (Kg/yr)	0.12

Figure 6. Results of T-test comparing differences of turtle size and weight between Deep Creek and Rollins Creek, and difference of growth rates between Deep Creek & Rollins Creek.

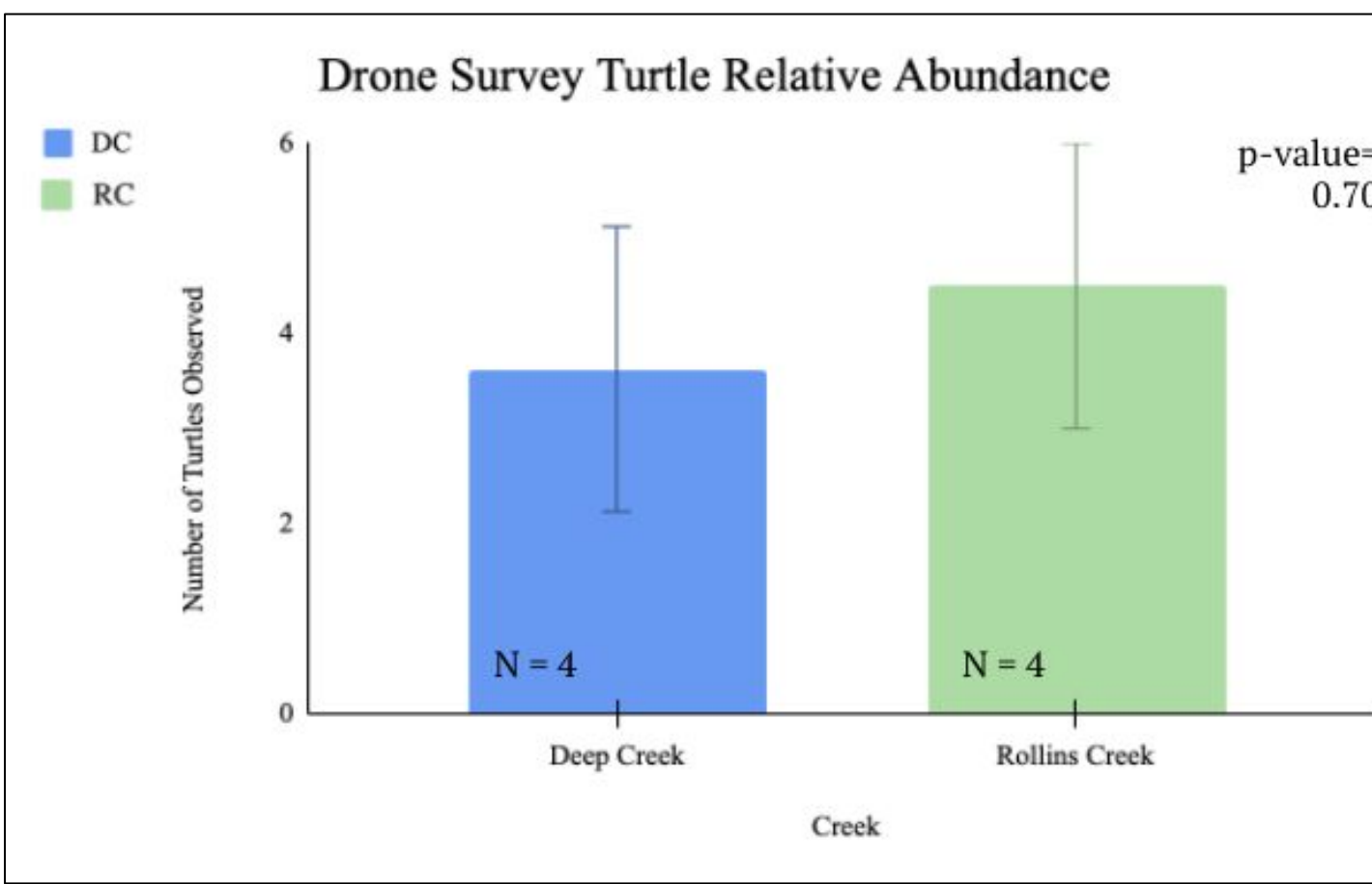


Figure 7. Green turtle relative abundance measured by drone surveys for Deep Creek (N = 4) and Rollins Creek (N = 4).

Discussion

Growth Rates

- There is no significant difference in growth rates of turtles between Deep Creek and Rollins Creek.
- These data indicate that the health of the two turtle populations are similar.
- Method Benefits: tracks individuals at a relatively low cost and is effective for long term tracking.
- Because turtles are slow growing, long term data sets such as this are important in turtle conservation to accurately assess trends in the population.
- Our research is relevant and important to monitoring the health and abundance of green turtle populations in Southern Eleuthera.

Future Directions

- Photo Identification: an alternative to tagging which is less invasive and even more effective for long term tracking.

Relative Abundance

- There is a greater amount of turtles in Rollins Creek than in Deep Creek.
- The T-Test suggests that the averages are not different enough to claim a significant population relative abundance difference between the two sites.
- Drone surveys are quicker and more effective (Varela & Rees 2020).
- Video surveys can be replayed and looked over multiple times.
- There is less pressure on a human spotter because of the ability to recheck surveys.
- Drones do not present any human disturbance factors.

Future Directions

- Measure spatial distribution of green turtles in both Rollins and Deep Creek
- Calculate population density (# of turtles / drone field of view area)

Conservation Impact

- Report findings to Bahamian governing agencies to improve green turtle conservation efforts.
- Green turtles significantly impact seagrass nutrient contents which supports greater ecosystem health.
- Measuring effectiveness of conservation efforts and health of sea turtle populations in The Bahamas.

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