

Determining the Population Density and Preferred Substrates of Queen Conch (*Strombus gigas*) In Cape Eleuthera, The Bahamas

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Queen conch juveniles with no flared lip.

Introduction

Queen Conch (*Strombus gigas*) are herbivorous gastropod mollusks; they live in shallow waters, and are commonly found in sand and sea grass substrates. They are significant to the Bahamas for a multitude of reasons. Economically, conch are important because they are the second largest fishery in the Bahamas (Danylchuck, 2003). Queen conch are ecologically important because they keep the balance in the food chain by eating algae, and are a prey source for a variety of predators. Socially, conch are a symbol of Bahamian culture and a major food source. Despite their significance, conch populations have declined in recent years due to overfishing, degradation of sea grass beds, water pollution, and a lack of regulatory fishing mechanisms (Turnquest, 2012).

Past studies comparing the population density of a marine protected area (MPA) and an unprotected area have shown that the density in the MPA is higher than the unprotected area (Stoner and Ray 1996). Previous Island School semesters have shown that there is good nursery habitat right off the cape in South Eleuthera, and the area is currently part of the proposed MPA. While conch juveniles settle in South Eleuthera, we are less aware of the abundance of adults. Queen conch are a density-dependent species, because of their internal fertilization, slow movement, and sex ratio of 1:1 (Stoner et al.², 2012). In other words, they can only reproduce at a certain density. Therefore, if less than 47 individuals are present in a hectare (ha) there is little chance of reproduction occurring (Stoner et al.¹, 2012). In addition, conch reach sexual maturity after four years; this elongated process of sexual maturity adds to their decline because they cannot reproduce quickly.

Purpose: To determine the population density and preferred substrate of queen conch

Hypothesis 1: The density of adult conch will not be high enough for mating to occur because there are not enough adult conch/ha. as a result of overfishing.

Hypothesis 2: Most adult conch will be found in sand substrates, as this has been identified in previous studies as their preferred habitat.

Methods

Our research was conducted in and around the proposed MPA boundaries in Cape Eleuthera, Bahamas. Our methods were consistent with those of Stoner and Ray (1996). We conducted transects (1000m x 6m) based off of systematically randomized coordinates on a GPS (Fig. 1). Two snorkelers were towed behind a boat (Fig. 2), and signaled the presence and age of conch with hand signals, which were recorded by students on the boat (Fig. 3). Depth, time, and bottom type were also recorded. Some collected conch were brought back to the lab and measured (Fig. 4).



Fig.1

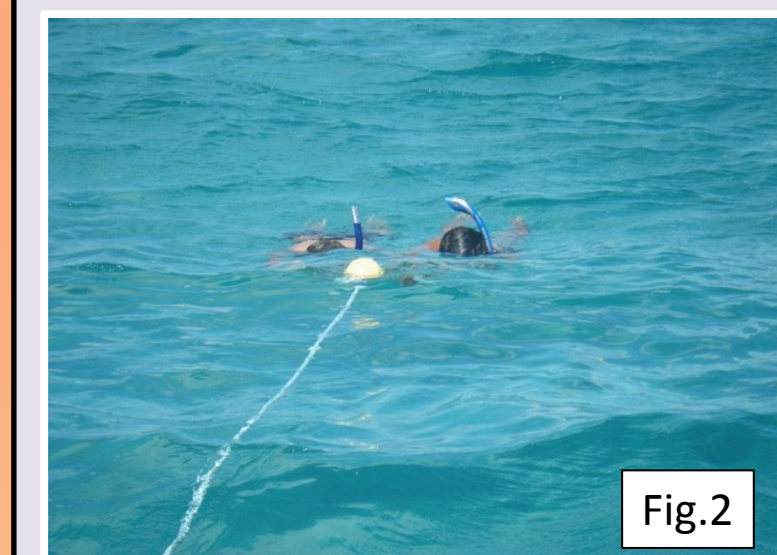


Fig.2

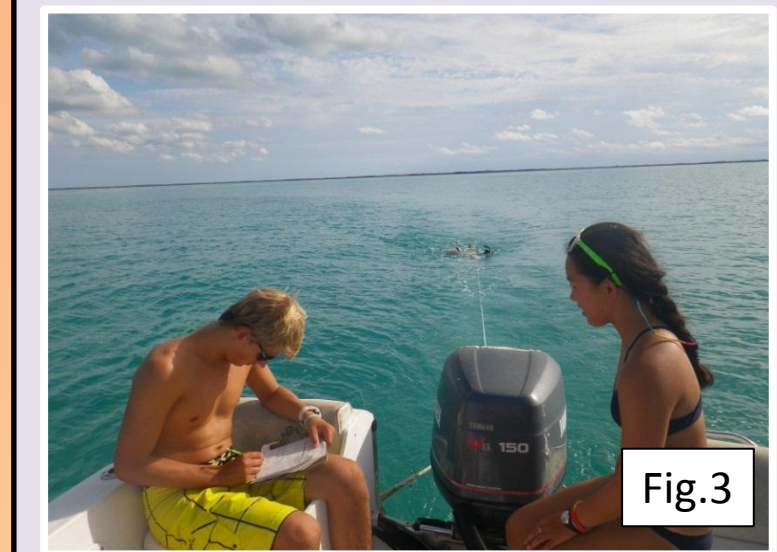


Fig.3



Fig.4

Fig. 1 Global Positioning System (GPS) used to locate the transects.
Fig. 2 Students being towed behind a boat during a transect.
Fig.3 Student researchers recording data during a transect.
Fig.4 Student researcher measuring the siphonal length of a collected conch shell.

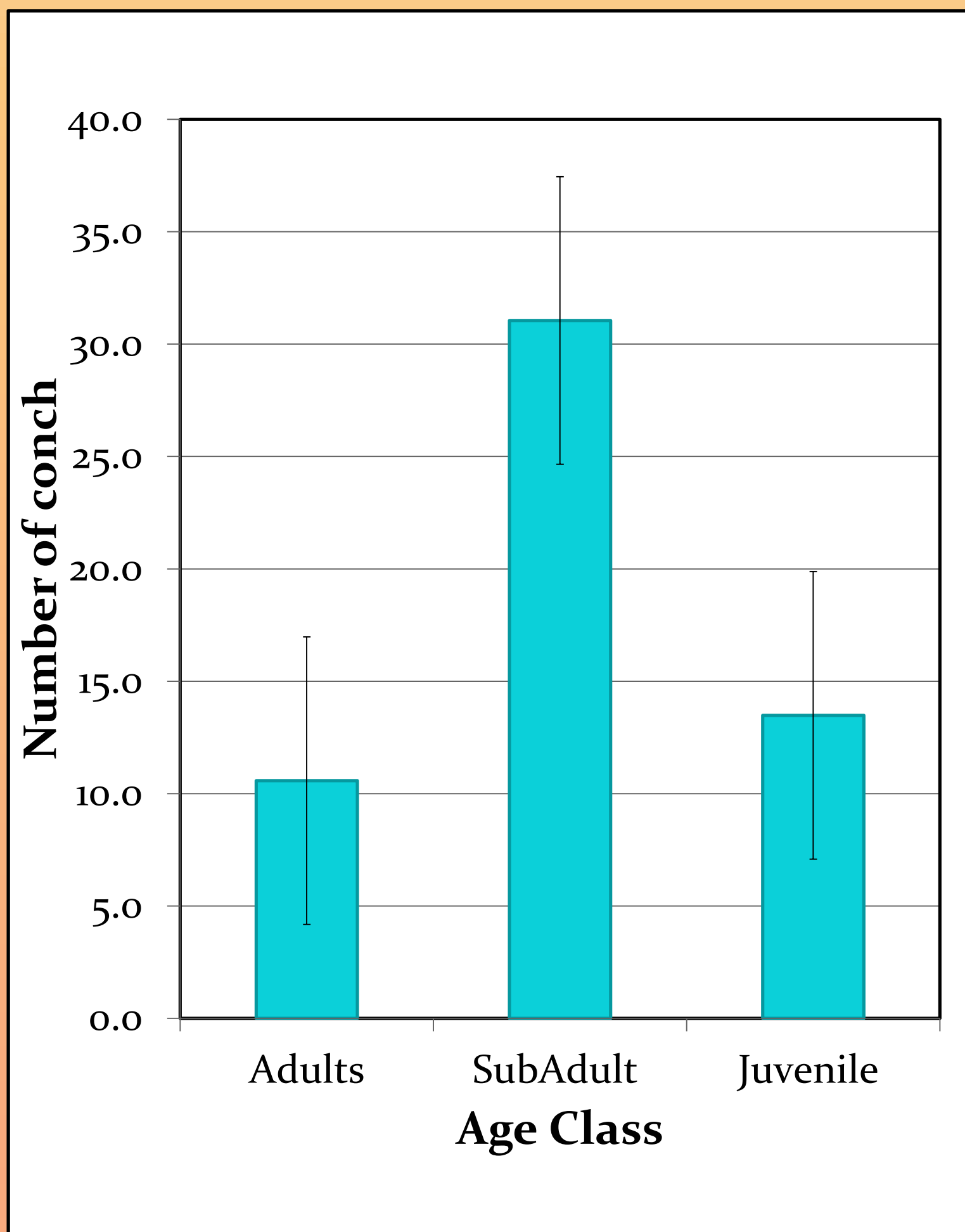


Figure 5- Graph comparing the mean number of conch ha⁻¹ seen per age class. As you can see, the amount of subadults is notably higher.

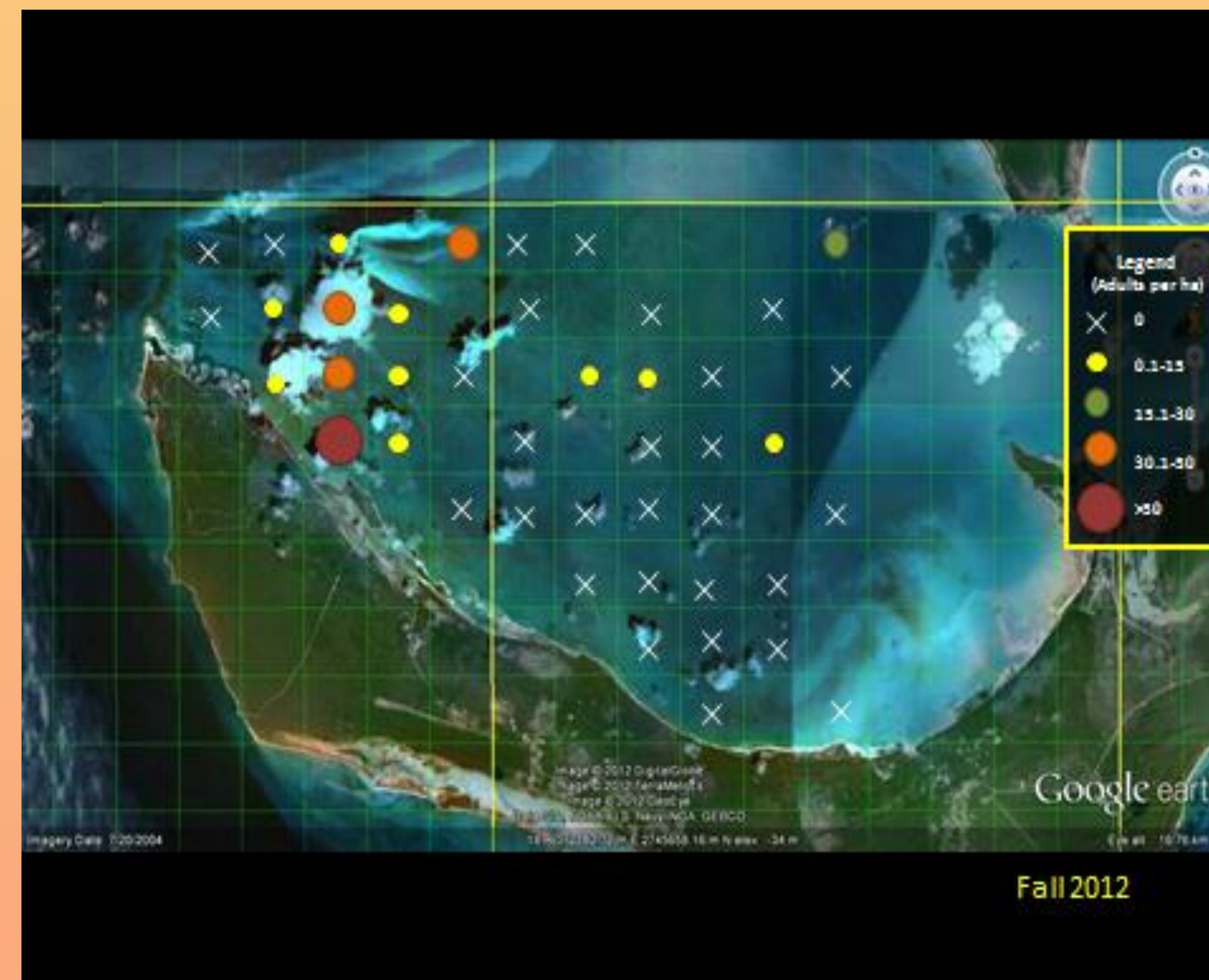


Figure 6. Map showing population densities of adult queen conch in South Eleuthera. With increasing circle size, there was increased adult population densities.

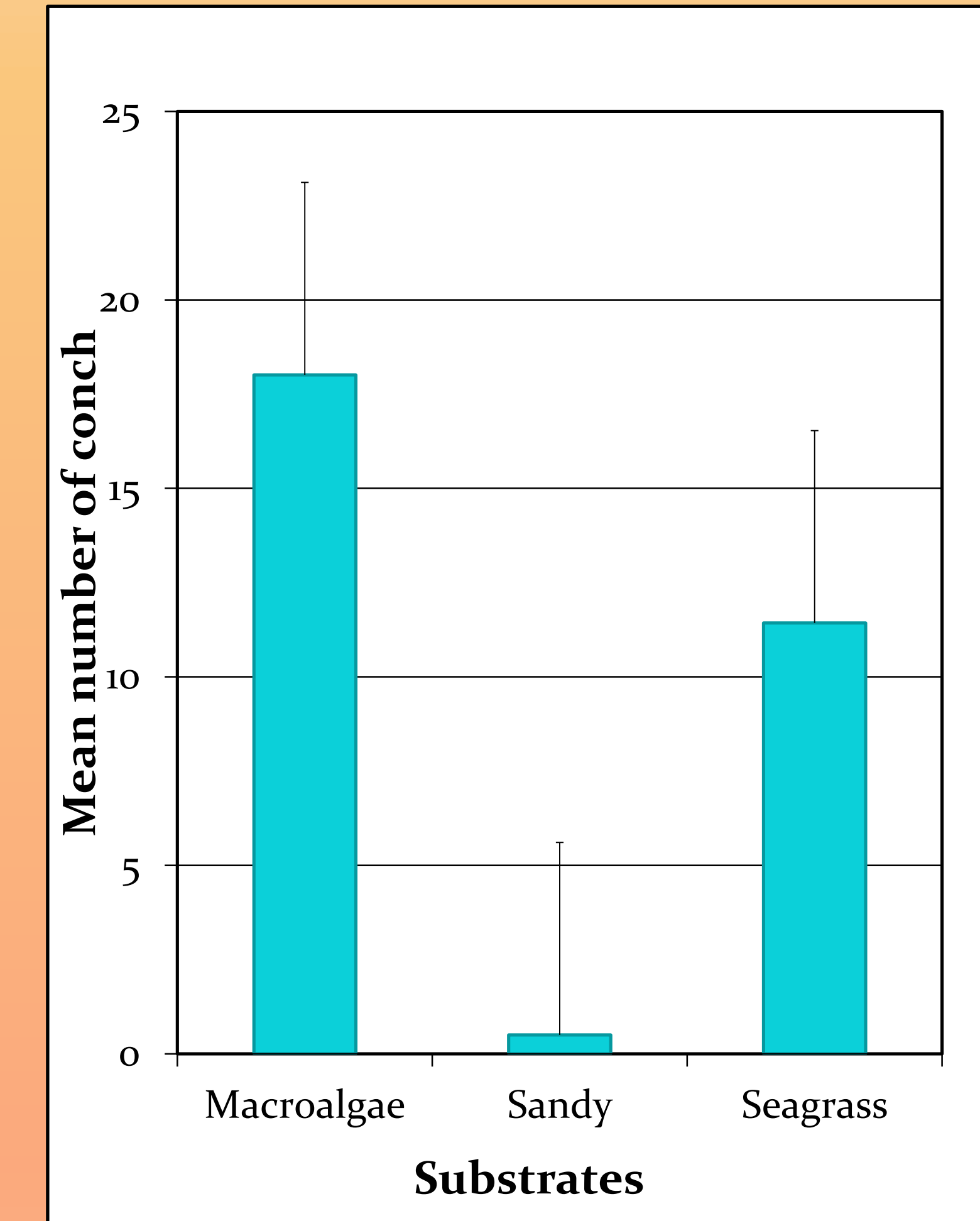


Figure 7. Graph showing the mean amount of adult conch ha⁻¹ seen in the sand, macroalgae and seagrass substrate. From this graph, conch prefer macroalgae and seagrass substrates.

Results

A total of 114 queen conch were seen in 25 transects run in Cape Eleuthera, the Bahamas. The mean number of sub adults/ha were higher than the means of both the adults and juveniles/ha (Fig. 5). The highest densities of queen conch were observed in the western half of the proposed MPA grounds, reaching a maximum of 400 individual conch/ha (Fig. 6). However, despite this high number of conch, there were 12 transects where no conch were seen at all. 91% of the hectares observed did not have enough adult conch for reproduction. In addition, the highest densities of conch observed were in macroalgae substrates, not in sand and seagrass substrates. There was a mean of <1 adult conch/ha in sand substrates and there was a mean of 18 adult conch/ha in macroalgae substrates (Fig. 7).



Fig.8

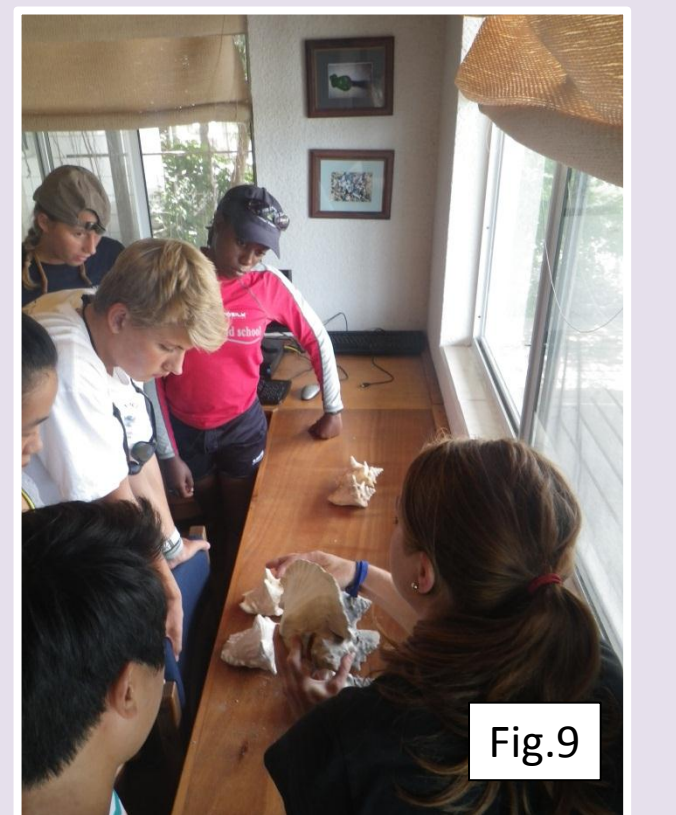


Fig.9



Fig.10

Fig.8 Juvenile queen conch.
Fig.9 Student researchers learning about how to measure siphonal length and lip thickness of a conch.
Fig.10 Different size conch, all in the juvenile age class. Collected off of Boy's Dorm Beach.

Discussion

Our first hypothesis was that in the proposed MPA there would not be enough adult conch/ha. for reproduction to occur. We formulated this hypothesis because it takes more than 47 conch/ha. for reproduction (Stoner et al.¹, 2012), and we think that density will be too low due to overfishing. 91% of the transects run (SP 12 and FA 12 data) did not have enough adults for reproduction, supporting our first hypothesis. Our second hypothesis was that we would find most adult conch in sandy substrates near reefs, because previous studies in the Caribbean found that adult conch use reefs in sand substrates for protection (Glazer and Kidney, 2004). We determined that most of the adult conch in South Eleuthera were found in macroalgae and seagrass substrates, rejecting our second hypothesis.

We would like to suggest revising the boundaries of the proposed MPA here in South Eleuthera, Bahamas. By focusing on including an area with more macroalgae substrates, the MPA would be more effective in protecting conch populations. On a global scale, conch is worthy of attention because it is an example of the effects of overfishing. Conch is only one of the many species being overfished in the world, and overfishing is creating an imbalance in the food chain and marine ecosystems. Our research team hopes to encourage further fishing regulations that will be strictly enforced and followed. By adhering to these regulations, we will be able to protect many different species, not just the queen conch.

Acknowledgments

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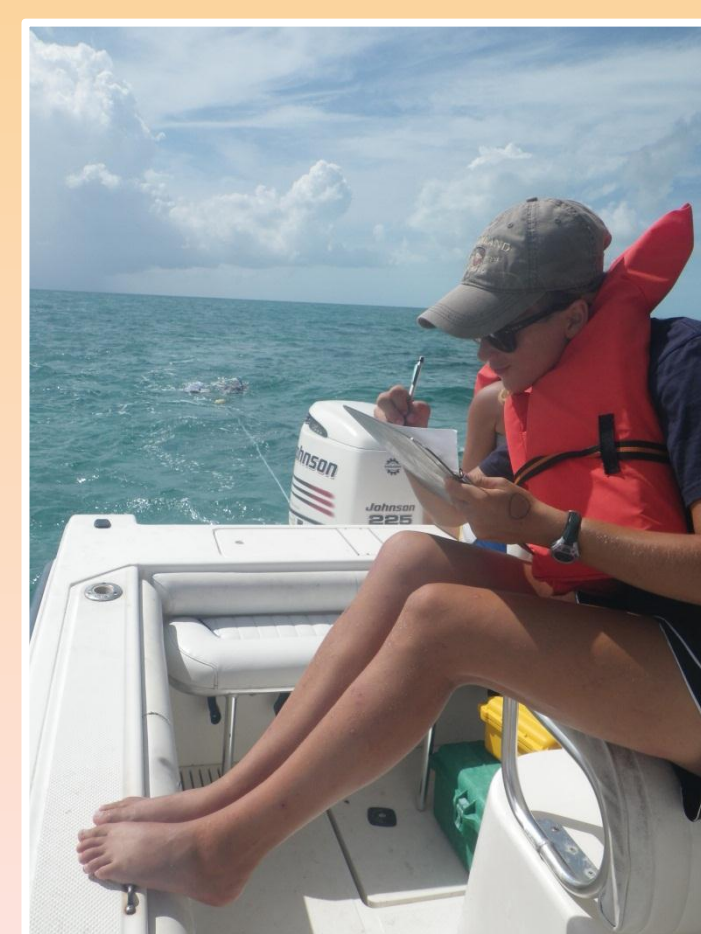
- Our advisors Claire and Becky
- The Island School
- Cape Eleuthera Institute (CEI)
- The boathouse crew
- Avian at Coco Plum's



Conch research team at Coco Plum's.



Conch research team out in the field.



Student researcher collecting data on a transect.



An adult conch found in the field.



Researcher collecting depth at the end of a transect.

Citations

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²Stoner, A.W. Davis, M.H. Booker, C.J. 2012. Negative consequences of allee effect are compounded by fishing pressure: Comparison of queen conch reproduction in fishing grounds and a marine protected area. Bulletin of Marine Science 88(1): 89-104.
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Student researchers holding collected conch in the field.