Assessing the current status of grouper, snapper, and parrotfish in South Eleuthera

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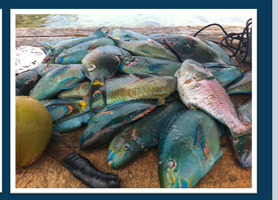
Introduction

Overfishing is a problem worldwide, globally 61% of fish stocks are fished at capacity and 29% are fished above capacity (WAITT Institute Fact Sheet). Unsustainable fishing is a threat because if fish stocks become too far depleted, it could result in loss of jobs, loss of a major protein source for subsistence fishers, and irreversible ecological damage, such as extinction of certain species. As The Bahamas is an island nation, fishing is both an economically and culturally important industry, and concern about overfishing is incredibly pertinent.





Three important families of fish in The Bahamas are grouper, snapper, and parrotfish. Grouper and snapper are key predatory fish on reef systems and their presence helps to maintain balance in the food chain (Dahlgren et al 2014). In addition, grouper and snapper are traditionally fished, both by subsistence fishermen, who rely on them for food, and by commercial fishermen. Nassau Grouper are particularly important to The Bahamas, both culturally and economically, as they are one of the Bahamas' three biggest commercial marine exports and part of the "Holy Trinity" along with Queen Conch and Spiny Lobster. Nassau Grouper are currently on the IUCN Red List of endangered species (www.iucnredlist.org). Parrotfish populations are important to monitor because they are grazers on the reef, eating algae so that it does not overgrow and kill coral. When parrotfish are being fished, it suggests that commercial fishing populations are at a level where fishermen are having trouble catching enough of them, so they have to supplement with parrotfish (Vallés & Oxenford, 2014).

In order to manage the issue of overfishing and preserve marine habitats, the Center for Biological Diversity Aichi Target 11 calls for at least 10% of coastal and marine areas to be effectively conserved by 2020, mostly through the use of marine protected areas (MPAs) (Hastings et al 2012). MPAs are areas where human activities have been limited in some way, such as restrictions on gear, limitations on fishing, or even complete bans on fishing. There has been a proposal for an MPA off of Cape Eleuthera to try and preserve the "Holy Trinity." The purpose of this study was to assess the current status of grouper, snapper, and parrotfish in order to establish a baseline for fish populations in South Eleuthera. This baseline data can be used in further studies surrounding the proposed MPA.

Methods

Google Earth image showing the two survey sites.

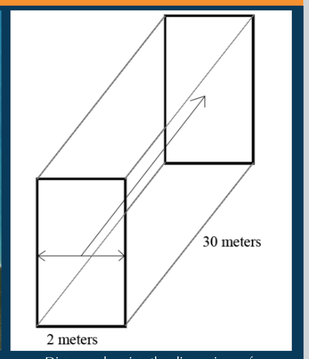
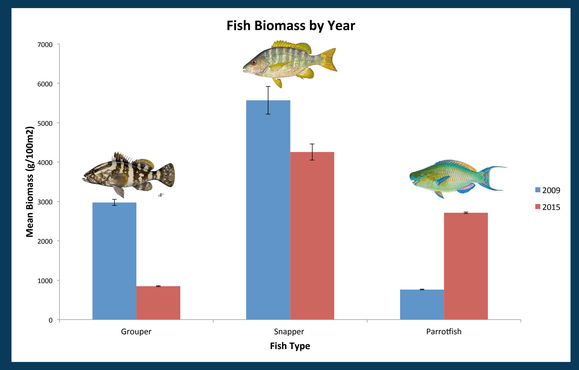


Diagram showing the dimensions of a belt transect.

The two sites (Site 1 363847.00 East, 2744415.00 North, Site 2 364872.00 East, 2742694.00 North) assessed off of Cape Eleuthera have been identified by local fishermen as Nassau grouper fishing sites (Kate Kincaid, 2014 unpublished data). These sites were also assessed in 2009, so the data is comparable between years. At these sites, the surveyors used Atlantic and Gulf Rapid Reef Assessment (AGRRA) protocol (www.agrra.org) to perform transects. Each transect was performed by two team members and took approximately six minutes to complete. One member held a 1 meter wide T-bar , swam for 30 meters, and counted the number of parrotfish, grouper, and snapper that entered the 30m x 2m area. This member also estimated the length of each fish, so that an estimate of fish biomass could be calculated. The other member of the team swam behind the first member, measured out 30 meters and directed the team to swim in a straight line.

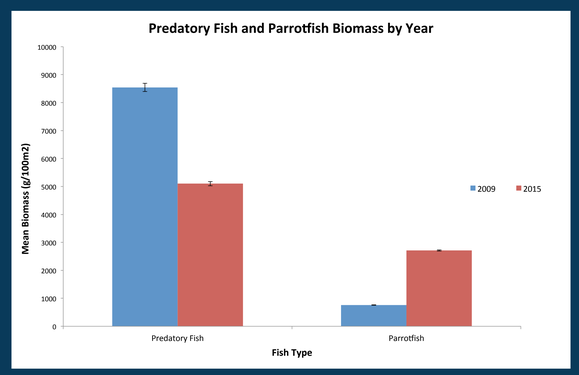
Results

Data was collected during the March 2015 study and compared to data collected in the November 2009 study. Fish biomass and density was standardized to 100m^2 for comparison. Data was tested for normality using Shapiro-Wilk Normality Test, due to the data being non-parametric data was tested using a Mann-Whitney test.



(Figure 1) The mean biomass of the grouper and snapper have decreased since 2009 while the parrotfish biomass has increased.

The biomass of grouper g/100m2, showed a decrease from 2009 to 2015, however this decline was not significant, p-value of 0.41794. Parrotfish biomass grams per 100m^2 for 2009 and 2015 did not show a significant difference with a p-value of 0.1074. Snapper biomass grams per 100m^2 for 2009 and 2015 did not show a significant difference with a p-value of 0.96012. The data indicated a trend towards decrease in biomass for groupers and snappers. The data collected for parrotfish indicated a trend towards increase (Figure 1). The data for density indicated a trend across all three families, with each showing an increase in density. Conclusions cannot be drawn from the density data because the raw data from the 2009 study was unavailable. Without the exact size estimates from 2009 accurate comparisons could not be made. The trends suggest that the fish sizes have declined, but are being seen in larger numbers (Figure 1).



(Figure 2)The biomass of predatory fish (grouper and snapper) have decreased while the grazer biomass has increased since 2009.

Predatory fish (grouper, snapper) biomass grams per 100m^2 for 2009 and 2015 did not show a significant difference with a p-value of 0.81034. Parrotfish biomass grams per 100m^2 for 2009 and 2015 did not show a significant difference with a p-value of 0.1074. The data showed a decrease in predatory fish biomass, and an increase of parrotfish biomass (Figure 2). The Density of predatory fish and parrotfish have both increased from 2009 to 2015. The density data still had the same limitations as the previous calculations from fish biomass by year. The data suggests that parrotfish population have increased along with the size of individuals. The data also suggests that predatory fish have experienced an increase of number of individuals, but a decrease in the sizes of individuals (Figure 2).

Discussion

The data collected was not significant but shows a trend that the biomass of commercially important fish, specifically grouper and snapper, has decreased, potentially meaning that fishing pressures have increased in South Eleuthera. Parrotfish biomass showed an increase that was not significant at the sites between 2009 and 2015, which could suggest an increases in fishing pressure because abundance of herbivorous fish may increase under fishing pressure (Ashworth & Ormond, 2004). All three fish families showed an increase in density per 100 meters squared that was not significant. None of the data collected was statistically significant, raw data from 2009 was not available and not a large enough sample size was collected for 2015. No definitive claim about fishing pressures can be validated. A likely explanation for the trends shown by the data is that more individuals are on the reef, but that the bigger predatory fish have been fished. As bigger predatory fish prey on juveniles of other reef fish, such as parrotfish, a lack of these predators allows for parrotfish to grow to a bigger, sexually mature size, and reproduce. Without significant data, however, this explanation is just one of many. It could be that lionfish populations have increased, and as lionfish are gape-limited predators, they could be feeding on juvenile grouper and snapper.
Limitations included the fact that the data set collected was relatively small, which meant that the study did not have much statistical power, as the data was not significant, and that there was no raw data available from 2009; there were only standardized means, limiting types of statistical tests conducted. Since there is no fish size data it is difficult to draw conclusions surrounding fish density. This is because without raw data from 2009, there is virtually no method of discerning the sizes of fish seen. Suggested next steps include increasing sample size to gather more statistically significant data, and considering monitoring lionfish populations to measure their detrimental affects which otherwise might be attributed to fishermen. Finally, it is important to conduct interviews with local fishermen for qualitative data and opinions.
Overall, while this study did not lead to a definitive claim surrounding fishing pressures in South Eleuthera, it revealed important trends in fish populations and could serve as the basis for future studies.

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