

# Survey of Species Richness, Abundance and Habitat Complexity on Patch Reefs in South Eleuthera, The Bahamas

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## Introduction

Patch reefs are near shore, highly structured ecosystems consisting of isolated coral outcrops in shallow areas (Figure 1). Patch reefs are ecologically important because they provide nursery habitats for many juvenile fish species (Mateo and Tobias, 2007). Nurseries supply food and shelter for young fish, allowing them to mature before they move on to deeper reefs (Mumby et al. 2004).

Fishermen on Cape Eleuthera rely on reef fish as the sole source of income, which has caused significant decreases in species populations (Danylchuk, 2003).

In 2000 the Bahamian government proposed a network of Marine Protected Areas (MPAs) to be set up throughout the country in effort to conserve heavily targeted marine species. One of the proposed MPAs was meant to be created across Cape Eleuthera.

A goal of an MPA – specifically a no-take zone – is to create a spillover effect, so that as fish populations increase within the reserve boundaries, they will relocate to other fishing areas nearby. No-take reserves also allow fish to increase in size, meaning they will have a higher fecundity and produce more larvae which migrates towards areas adjacent to the reserve.

Since 2003 The Island School has collected data on economically important species found on patch reefs within the proposed MPA area off Cape Eleuthera.

As well as maintaining this long-term data set and looking for temporal changes in fish abundance, the objective of this study is to collect data on the physical characteristics and total fish community of each patch reef. This information will be provided to the Department of Marine Resources (DMR) to help them find the most ecologically productive area to legally declare an MPA in South Eleuthera.



Figure 1 Image of a patch reef located off of Cape Eleuthera

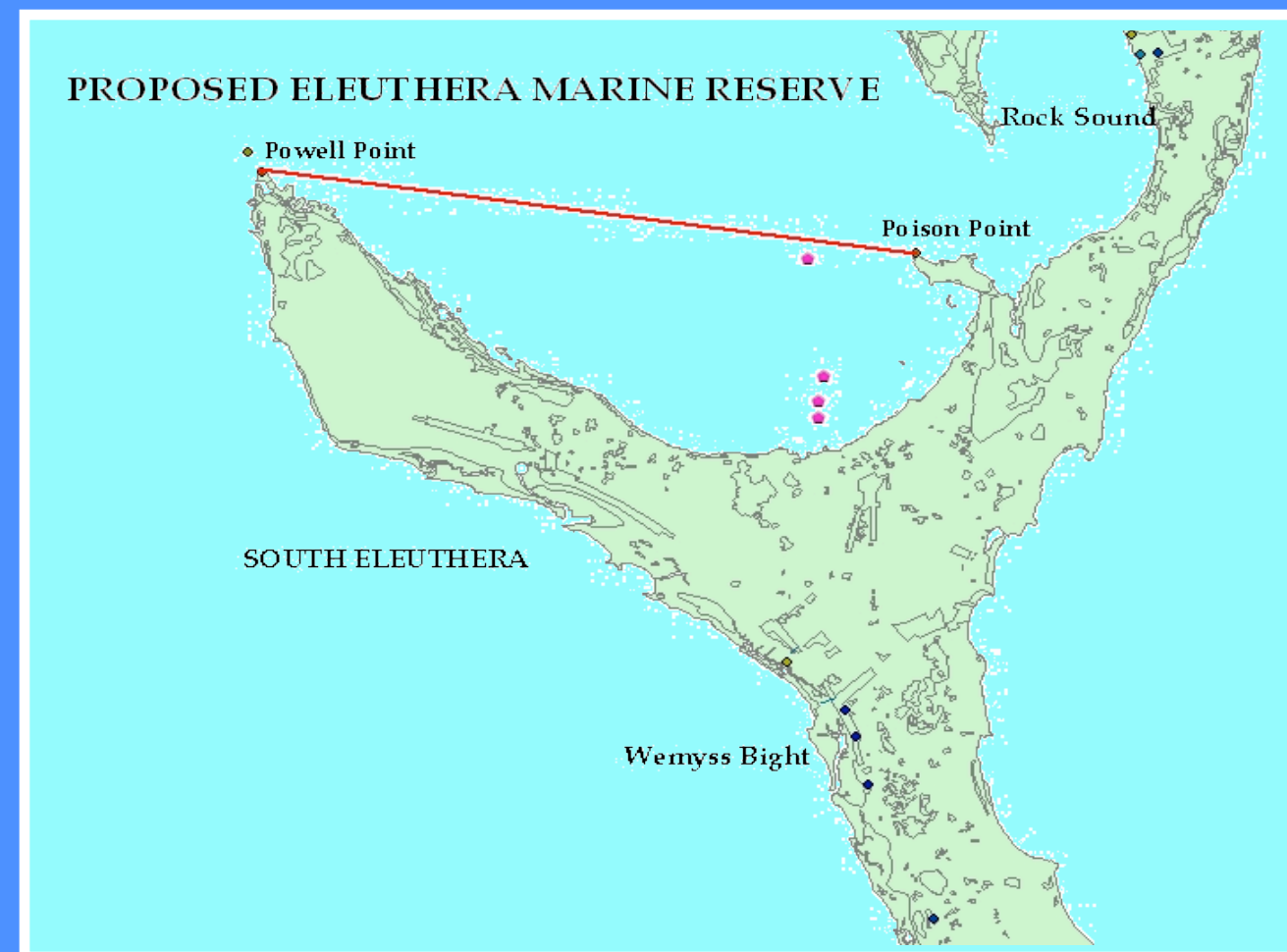


Figure 2 Area for MPA off of Cape Eleuthera proposed by Bahamian Government in 2000

## Methods

Surveys were conducted on patch reefs offshore from The Island School on the northeastern coast of Cape Eleuthera (figure 2). All of these habitats were located in boat-accessible water, approximately three meters deep.

Snorkelers took physical measurements of each reef that included patch reef length, perpendicular width, height, and depth. Rugosity was determined using a 1m length of chain which, when placed onto the reef's surface, fills into holes and crannies in the limestone to give an indication of the reef's complexity (Figure 3 and 4). The straight-line distance between the start and end point of the chain was measured with a meter ruler. The shorter the length, the greater the rugosity. Up to 12 rugosity replicates were collected.

Fish surveys were conducted on SCUBA. Aspects recorded included species, phase and size.



Figure 3 and 4 Recording rugosity measurements on Patch Reefs



Figure 4

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## Family Abundance

14 patch reefs were surveyed and a total of 52 fish species were counted with an abundance of 4886 fish. The most abundant families were grunts (69%), parrotfish (10%), and wrasse (8%). A majority of the fish recorded on the patch reefs were juveniles. (Figure 5)

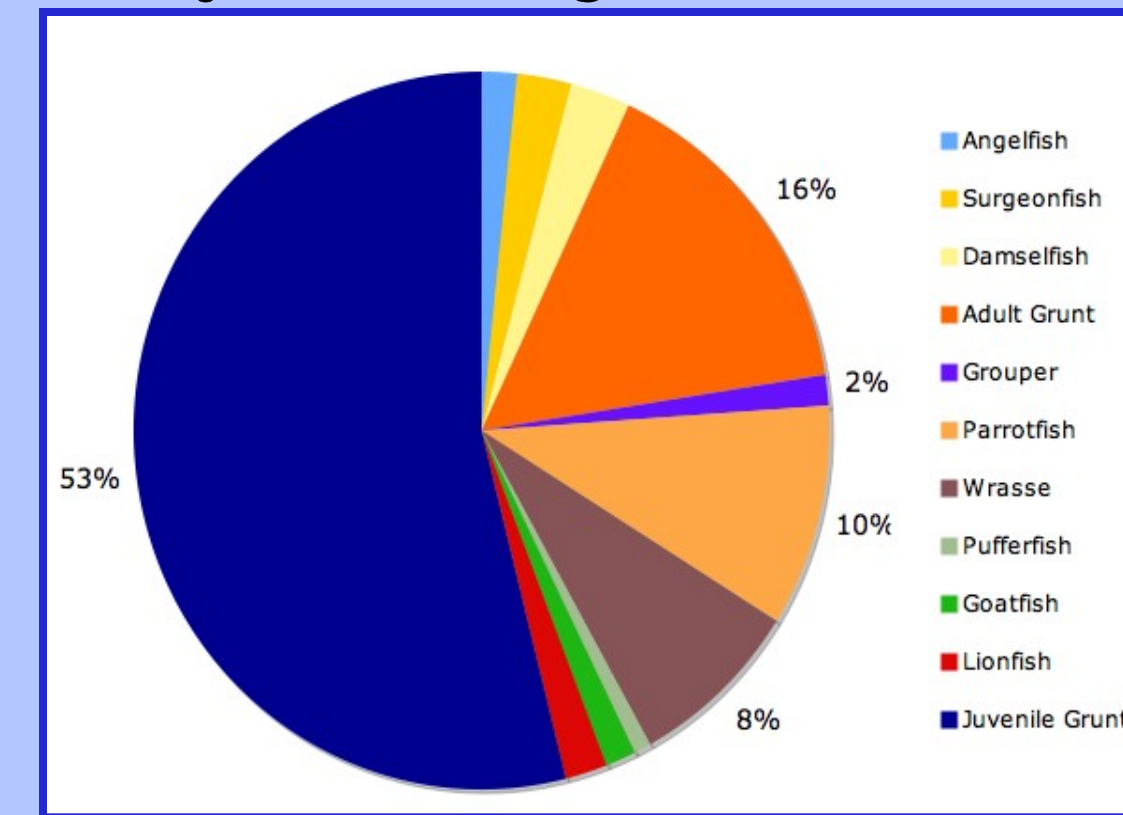


Figure 5 Total fish species abundance recorded

## Physical Data

Data showed that patch reefs with larger areas had more species ( $R^2=0.786$ ) with greater abundances ( $R^2=0.788$ ). There was no correlation between rugosity and the abundance or number of species (figures 6 and 7).

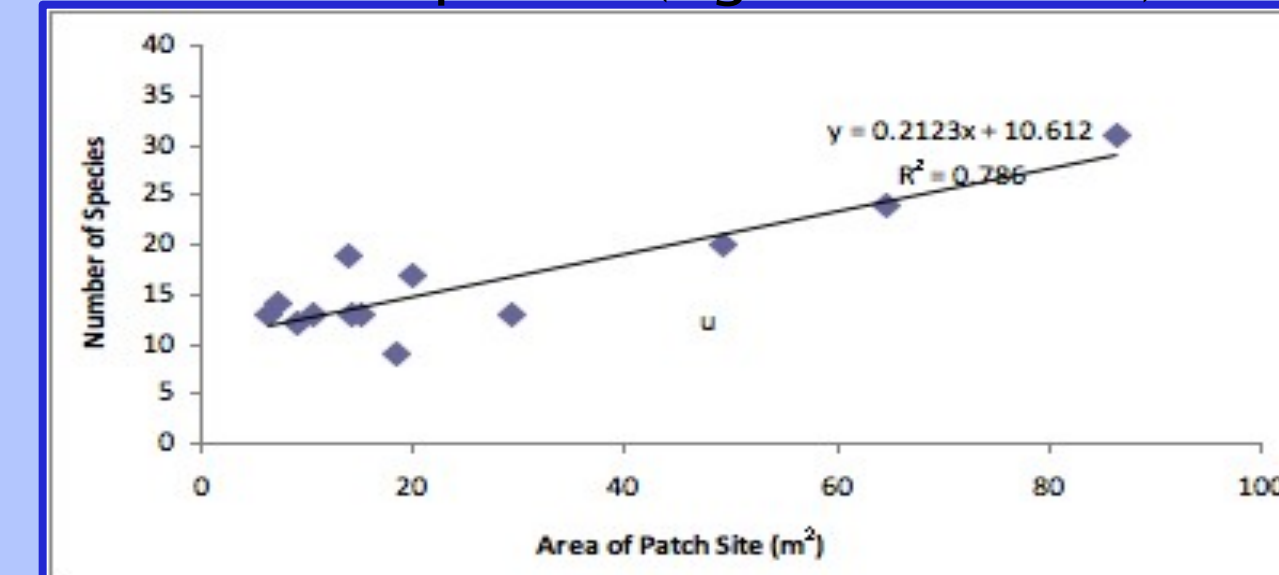


Figure 6 Area of patch in correlation to number of fish species

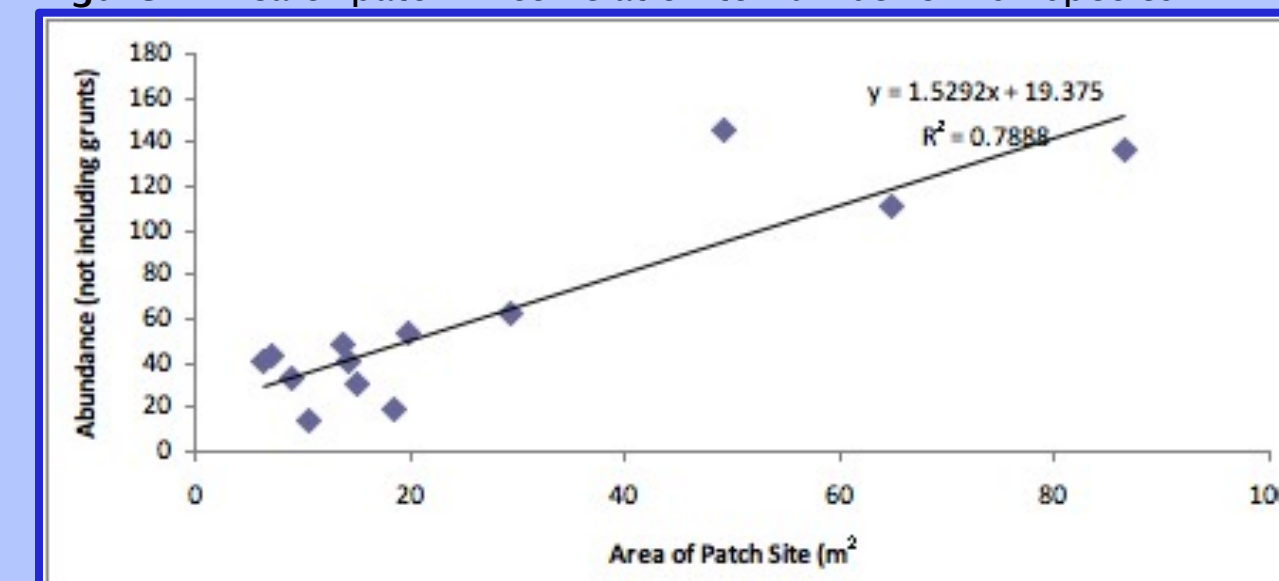


Figure 7 Area of patch in correlation to fish species abundance

## Spiny Lobster

A total of 11 spiny lobster were recorded with an average of 0.9 per patch site (figure 8). There has been no significant change in abundance.

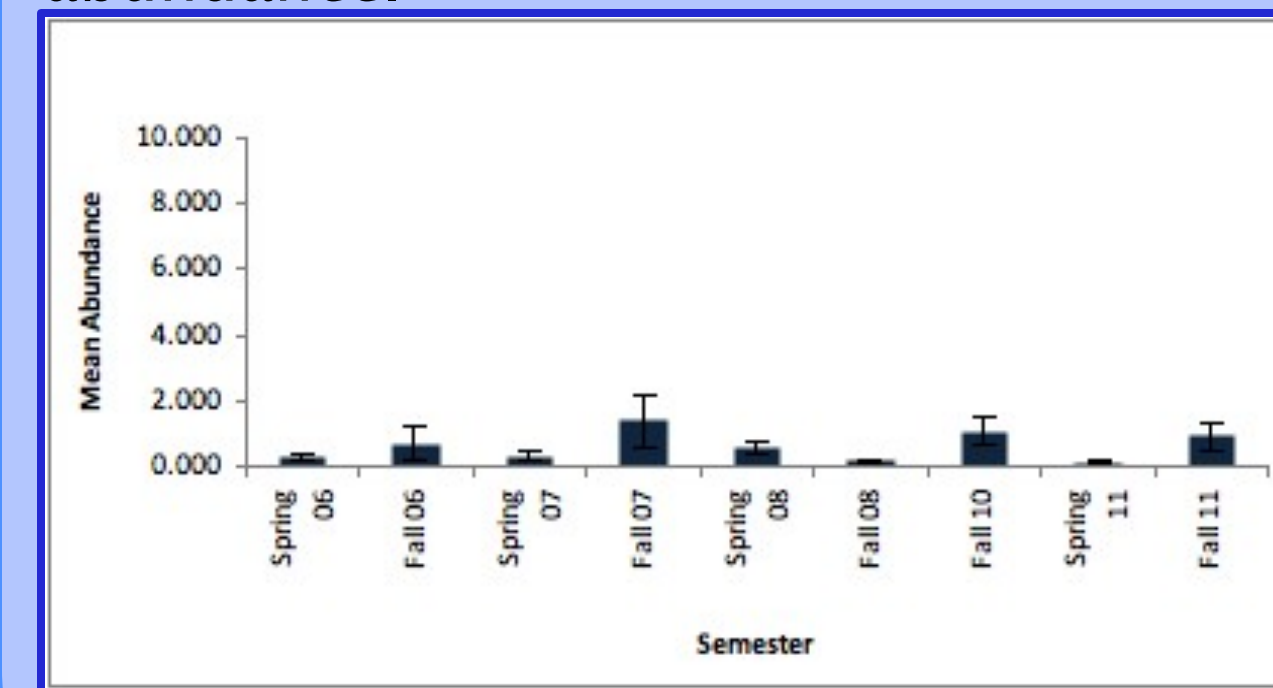


Figure 8 The mean abundance of spiny lobster recorded on patch sites from spring 2006 – fall 2011.



## Lionfish

55 lionfish were counted with a size range of 7-33 cm FL, 44% of the population were sexually mature (>19cm FL). There was an average of 4 lionfish per patch site which is a statistically significant increase ( $p=0.003$ ) from the spring 2011 abundance of 1.12 lionfish recorded per site (figure 9).

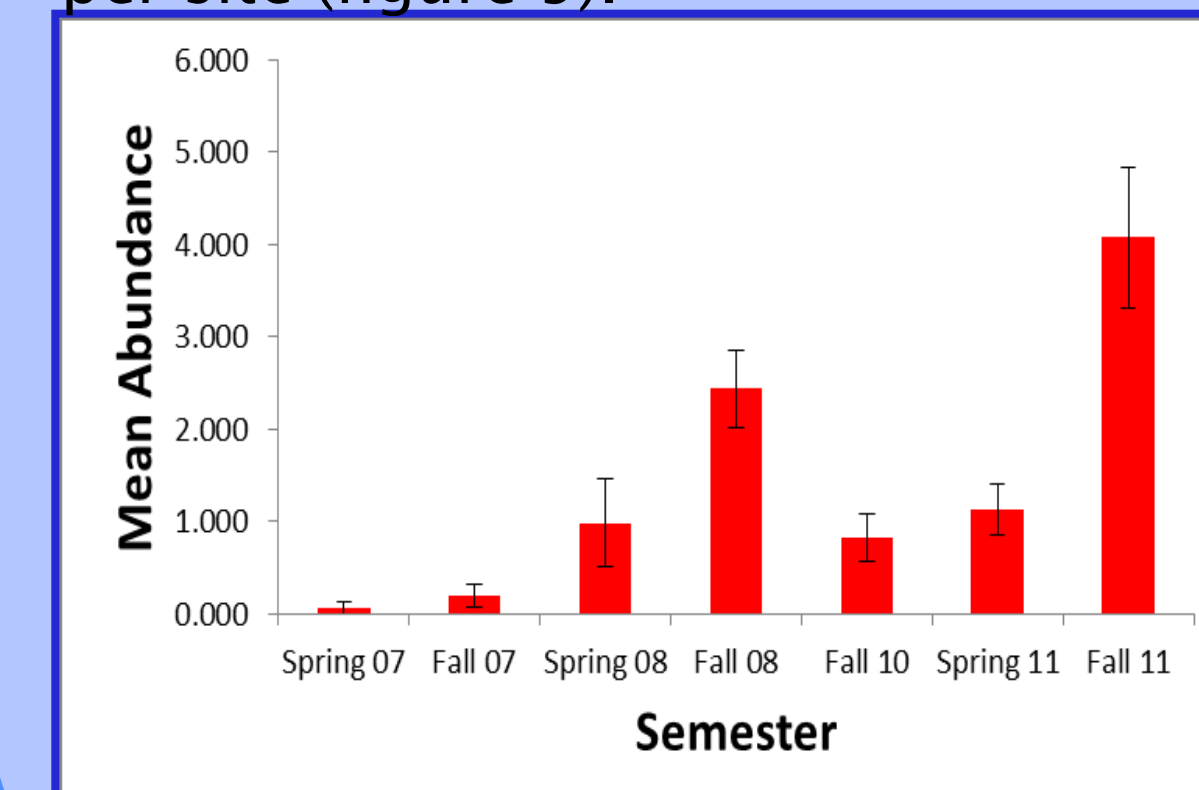


Figure 9 The mean abundance of lionfish recorded on patch sites from spring 2007 – fall 2011.



## Results

### Grouper

A total of 28 Nassau were recorded with a size range of 19-27 cm fork length (FL). None were sexually mature (>42cm FL (Bolden, 2000)) There was a decrease from spring 2011 to fall 2011, where the mean abundance in spring 2011 was 3.7. The mean abundance showed a statistically significant increase from spring 2006 to Spring 2011 ( $P=0.001$ ), and the decrease this semester was not statistically significant.

4 black grouper were spotted on the 14 reef sites (figure 10). They had a size range from 21-35 cm FL, and none were sexually mature (>95 cm FL). No significant differences were seen between the black grouper abundances through the semesters.

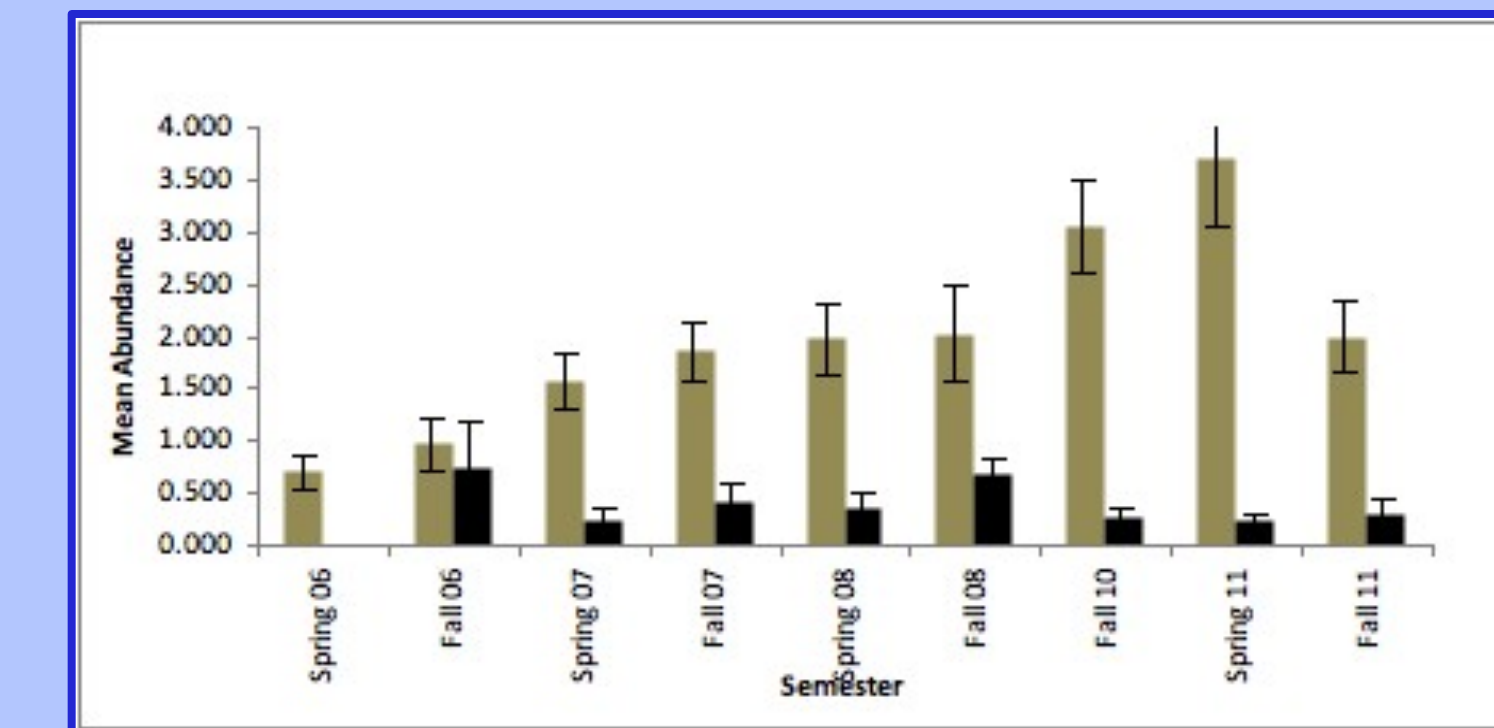


Figure 10 The mean abundance of Nassau and black grouper recorded on patch sites from spring 2006 – fall 2011.



black grouper



Nassau grouper

## Discussion

The increase in Nassau grouper from spring 2006 to spring 2011 could be because regulations were created in 2004 that restrict fishing during the winter months when grouper are spawning. The decrease observed this semester could be because fewer patch sites were surveyed than in previous semesters due to weather constraints.

There is no black grouper closed fishing season, which could explain why there has been no significant increase in the black grouper numbers and why the overall abundance is lower. These findings suggest that black grouper would also benefit from a closed fishing season.

There has been an increase in lionfish since spring 2011. This is the first year that the patch reefs have been surveyed using SCUBA which may have allowed more to be observed, for often lionfish are located deep within the reef, meaning they are not easily spotted by snorkelers. It is also important to note that there is currently no one actively removing the lionfish from the patch reefs which could also explain their high abundance.

As the area of patch reefs increased so did fish abundance and species richness. The larger reefs provide more areas for fish species to inhabit.

Our results suggest that an MPA could be more successful around larger patch reefs because these reefs have a higher abundance and species diversity. However, it may not be ideal to protect just patch reef habitat because only a very small number of adult fish were observed, meaning there would be not be an adult spillover effect which is a key reason why fishermen approve of MPAs (Bohnsack, 1999).

Future research could include going to the same patch sites to replicate the data and continue the long-term fish study. The survey area could be expanded to look at other areas such as mangroves and deeper reefs. It is also important to work further with the local Cape Eleuthera community and inform them of the importance of MPAs, for the most successful MPAs are those that involve the local community in their construction and development (Harris, 2007)

## Acknowledgements

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