# Detrimental Effects of Fishing on Parrotfish Populations

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## ABSTRACT

We tested the hypothesis that Marine Protected Areas (MPAs) established in 2015 along the coast of San Salvador Island, The Bahamas have benefitted populations of reef parrotfish that are important herbivores in coral reefs. We predict that conservation practices have increased the abundance of large parrotfishes, whereas size selective fishing in unprotected sites has resulted in the loss of the largest individuals. Our results showed that there were no differences in the relative abundance of larger parrotfishes in MPAs compared to non protected sites or compared to conditions prior to 2015 when the MPAs were established. We believe that the lack of detectable increases in populations may be due to historically low fishing intensity by the small Bahamian population on the island.

## INTRODUCTION

Parrotfish are important herbivores that help maintain the competitive balance between corals and algae in tropical reef systems. Most parrotfish species are female-first sequential hermaphrodites in which the largest dominant males and large females in the population contribute disproportionately to reproduction. Fishing pressure on Caribbean parrotfishes has increased considerably over the last two decades, as more preferred fish species, like grouper, have been overexploited. Because fishermen prefer the largest parrotfishes (called terminal phase males) and target species with larger individuals, parrotfish reproduction and their functional role as major herbivores on the reefs may be compromised.

Many of the coral reef sites around San Salvador Island, The Bahamas were declared Marine Protected Areas in 2015 and fishing at these sites was restricted. The goal of this study was to determine whether protection has benefitted parrotfish compared to pre-2015 populations and compared to unprotected sites.


**Figure 1: A Map of San Salvador Island.** Colored stars indicate reef locations. Red = Rocky Point, Yellow = Snapshot Reef, Black = Telephone Pole, Green = Lindsay Reef

## METHODS

Since we could not collect our own data for this research project as we were supposed to, we compiled previous data taken from different sites around San Salvador Island dating from 2005 to 2019. We used data from four different sites: Rocky Point, Telephone Pole, Lindsay Reef, and Snapshot Reef (Figure 1). Telephone Pole, Lindsay Reef, and Snapshot Reef were all established as MPAs in 2015, but Rocky Point is still an unprotected area where fishing is allowed. We used the data collected on the following parrotfish species: stoplight, queen, yellowtail, redband, striped, and princess. Stoplight, queen, and yellowtail are all considered large species, while redband, striped, and princess parrotfish are small species (Figure 2).


**Figure 2: Photos of 4 different parrotfish species.** (A) and (B) show a princess parrotfish, and a redband parrotfish, respectively, which are both small species with lengths of typically 8-10 inches. (C) and (D) depict a queen and a stoplight parrotfish, respectively, which are considered large species and usually attain sizes of 12-18 inches.

## RESULTS

Stoplight parrotfish seemed to be the most abundant species at each reef site that was sampled for abundance (Figure 3). The percentages of various species located at each site remained similar before 2015 and after, when the Marine Protected Areas were put into place (Figure 3). *S. viride* (stoplight), *S. vetula* (queen), *and S. hypselopterus* (yellowtail) were categorized as large fish species, meaning that they would most likely be more heavily fished than smaller species. Although terminal phase fish are typically larger than initial phase, the small fish species were left out of our data analysis, to avoid skewing data (Table 1, Figure 4).

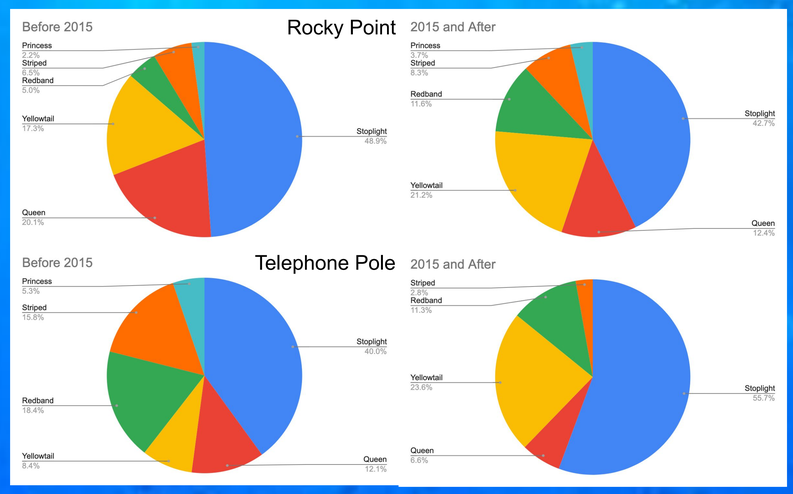


**Figure 3: Percent composition of parrotfish species at Rocky Point and Telephone Pole before and after 2015.** Representation of the large parrotfish species seemed to generally decrease at Rocky Point over time, which is not currently an MPA, whereas large species seemed to have increased at the protected Telephone Pole Reef. There are exceptions depending on the species. We ran statistical tests to determine if any of these differences were significant.

| | Year | | | |
|---|---|---|---|---|
| | 2012 | | 2016 | |
| **Reef Sites** | % Terminal Phase Fish | % Large Fish Species | % Terminal Phase Fish | % Large Fish Species |
| Rocky Point | 49.2 | 91.8 | 47.0 | 64.0 |
| Telephone Pole | 35.0 | 77.5 | 52.7 | 92.7 |
| Lindsay Reef | 37.3 | 80.6 | 42.0 | 56.5 |
| Snapshot Reef | 33.3 | 73.3 | 37.3 | 80.0 |

**Table 1: Percent terminal phase and percent large species fish of total parrotfish populations at each site in 2012 and 2016.** Establishment of Marine Protected Areas in 2015 seemed to have no effect on the percentage of terminal phase and large species fish. These percentages increased at some sites and decreased at others.

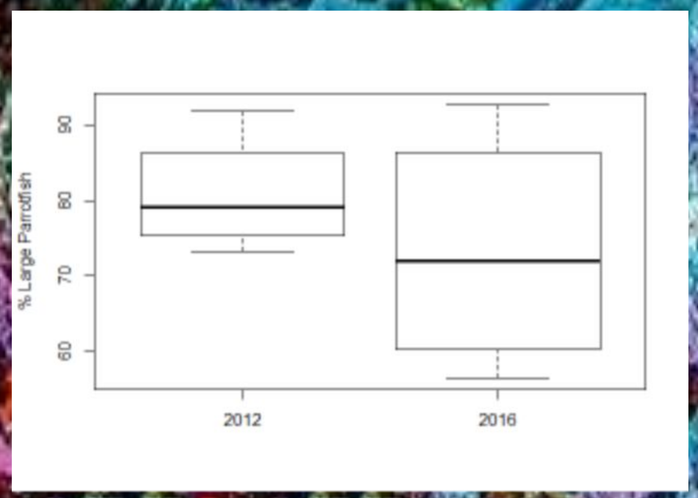


**Figure 4: Box plots comparing the representation (%) of individuals of large fish species for 2012 (before establishment of MPAs) and 2016 (after establishment of the MPAs). Paired T-tests found no significant difference between the percentages for the two years (t = 0.69, df = 3, *p* = *0.54*).**

## DISCUSSION

Our results showed that there was no significant change in the percent terminal phase fish or percent large species fish before and after 2015 when the Marine Protected Sites were established (Figure 4). This indicates that, contrary to our hypothesis, the establishment of MPAs around San Salvador did not seem to have an effect on the conservation of parrotfish populations. After comparing fishing intensity around San Salvador to other coral reefs around the Caribbean, however, we found that the sites around this island were less intensely fished than any other Caribbean site (Figure 5) based on an analysis by Hawkins and Roberts (2003). This analysis indicates that fishing intensity around San Salvador Island is so low that overfishing does not have much of an impact on populations of parrotfishes to begin with. We infer that protection of certain reef sites has not resulted in a significant change in parrotfish population composition on patch reefs of San Salvador Island.

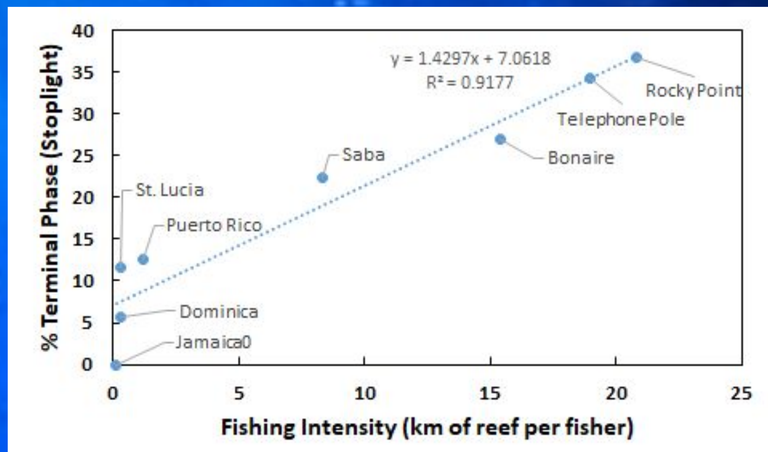


**Figure 5: The relationship between fishing intensity (km of reef per fisher) from work by Hawkins and Roberts (2003).** We fitted data our data on % terminal phase of stoplight parrotfishes from Rocky Point (unprotected) and Telephone Pole (MPA) to the regression. This analysis indicates that the estimated fishing pressure for San Salvador populations are among the lowest in the Caribbean province.

## WORKS CITED

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