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Abstract

Previous research shows, within Special Protection Areas (SPA), an ever increasing number of predatory species has had dramatic effects on herbivorous species populations causing dominance shifts on the reef community. Herbivorous fish are an important mechanism in controlling macroalgae growth after coral reef disturbances. This research is being conducted in order to predict and better understand the future impact of an expanding goliath grouper (*Epinephelus itajara*) population on an already fragile ecosystem. Eight spur-and-grove reef site locations, within SPA’s, in the Florida Keys National Marine Sanctuary were selected for the purpose of this study. Transect surveys were erected in order to evaluate biodiversity and density of the different species of fish per site. Site selection was based on the presence or absence of the goliath grouper. The expectation is that the presence of the goliath grouper has a dramatic impact on the population density and biodiversity of herbivorous fish within the SPA’s.

Introduction

The goliath grouper is the largest of the grouper species in the western north Atlantic. Easily distinguished by its broad head, round tail, small eyes, and short dorsal spines, this brownish-yellow species of grouper has the ability to achieve length over 2 meters and attain weight in excess of 455 kg (Stevely, 2009). Goliath grouper feed largely on crustaceans (in particular spiny lobsters, shrimps and crabs), fishes (including stingrays and parrotfish), octopus, and young sea turtles (Koening & Coleman, 2009). Prey is ambushed, caught with a quick rush and snap of the jaws. The sharp teeth are adapted for seizing prey and preventing escape although most prey is simply engulfed and swallowed whole.

A regulation passed in the 1990’s prohibited the harvesting of goliath grouper. Once on the verge of eradication due to overfishing, populations seem to be recovering, especially along Florida’s southwest coast (Staugler, 2009). Research on goliath groupers’ life behaviors show that the first five to six years of the specie’s life is lived within the confines of the mangroves, after which time they move offshore (Koening & Coleman, 2009). Once establishment of territory offshore occurs, the goliath grouper tends to reside <100 meters from the structured area. Structured habitable areas usually consist of high relief coral, natural ledges, or artificial reefs (Koening & Coleman, 2009).

With closure of this fishery occurring less than a decade ago, and juvenile interval taking up to six years, timelines suggest that we will see a dramatic increase in the adult goliath grouper population density on offshore coral reefs and structures.

Previous research shows, within special protection areas (SPA), an ever increasing number of predatory species has dramatic effects on herbivorous species populations causing dominance shifts on the reef community (Kramer & Kenneth, 2007). Prior transect surveys indicate that biomass and mean body lengths for several common predatory fish species were significantly greater in SPA’s. Size class of herbivorous fish also varied with protection; adult herbivorous fish were significantly more abundant, while juveniles were significantly less abundant. Herbivorous fish are an important mechanism in controlling macroalgae growth after coral reef disturbance. This reduction in juvenile herbivorous fish within SPA’s could possibly be the mechanism for the initiation of cascading effects in the reef community. The richness of herbivorous fish, especially juvenile herbivorous fish, is essential to the health of the entire ecosystem (Kramer & Kenneth, 2007).

Question to be tested: (1) will an unrestricted increase in the goliath grouper population negatively affect coral reef restoration by reducing herbivorous fish abundance and grazing intensity?

Research Objective

The purpose of my research is to evaluate the future affects of an unobstructed increase in the goliath grouper population on coral reef biodiversity within the Florida Keys. Recent studies show that the goliath grouper primarily feeds on crustaceans (85%) as well as other slow moving fish (Stevely, 2009). However, from personal experiences and conversations with lifelong residences of the Florida Keys, the goliath grouper consumes anything that passes by. If my theory cannot be falsified, than the goliath grouper could have drastic effects on coral reef restoration by limiting the density of herbivorous fish, as well as, limiting biodiversity altogether. With a limited number of herbivorous fish, macroalgae has a greater chance of dominating the coral reef community.

Methods

This study will be conducted within a three month period at durations of one dive per week per site within the Florida Keys National Marine Sanctuary. A total of eight sites will be chosen, four sites will include goliath grouper while four sites will exclude the goliath grouper. Spur-and-grove reefs were selected on the basis that most of these are protected by Special Protected Areas (SPA’s) throughout the Florida Keys. Protection from recreational or commercial fishing allows research to theoretically disregard regulatory by-catch.

* **Experimental Protocol**

The experiment will utilize the belt transect method in order to quantify the abundance and biomass of targeted herbivorous fish, including surgeonfishes (*Acanthuridae*), damselfishes (*Pomacentridae*), and parrotfishes (*Scaridae*). With this method, three 25 x 5 transects will be laid out across the areas to be surveyed and quadrants put into place. All transects will be placed at the edge of the reef, heading towards its center along the top, contoured slightly with the reef topography. Each reef therefore will receive the same amount of edge and top sampling (Kramer & Heck, 2007). Prior to any observations, each transect will be put into place and secured to the ocean floor. They will remain for the duration of the study. Preceding observation dives dissolved oxygen, salinity, and temperature measurements will be taken on site.

Each diver(s) will learn to recognize 10 different lengths of PVC (5 cm increments) underwater at varies distances within a one week period, allowing the diver(s) to properly identify the correct length of fish while on site. Training in herbivorous fish identification will be given in addition to length recognition.

Goliath grouper size sampling will occur using an underwater video camera mounted with a double laser system. The laser system produces two beams that are parallel and projected onto the side of a fish. Later, at the lab, the goliath grouper can be measured by the distance between the two beams. This method has already been utilized by the laboratory at Florida State University (Koening & Coleman, 2009). Experimental design will closely follow those methods utilized within the Kramer & Heck Jr. experiment: Top-down trophic shifts in Florida Keys patch reef marine protected areas (Kremer & Heck Jr., 2007).

* **Data Analysis**

At the laboratory herbivory species type and abundance along with size class that was observed at each site will be compiled and statistical analysis. The size class categories between juvenile fish and adult fish are presented in figure 1.1 below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Herbivorous Fish** | **Juvenile** | **Initial Phase Adult** | **Terminal Adult** |
| Parrotfish | <10 cm | 10-18 cm | >18 cm |
| Surgeonfish | <6-8 cm | N/A | >8 cm |
| Damselfish | <6-8 cm | N/A | >8 cm |

*(Figure 1.1)Size Class Chart for all Herbivorous Fish Observed*

Analyses of four priorities (number of different herbivory species, their abundance, size class, and the absence or presence of the goliath grouper), over a three month period (April 2012 thru June 2012) will determine whether the goliath grouper could be negatively affecting the herbivory biodiversity of a coral reef. Any presence of or increase in the goliath grouper attendance of the coral reefs being observed, with a decline in herbivory biodiversity would suggest further research.

* **Greater Implications**

If my theory cannot be falsified then greater implications may arise from this study. Such implications as to how we can prevent the Goliath grouper from decimating the herbivorous fish populations on the coral reefs within the Florida Keys? Do we need to be concerned with the survival of crustaceans? How can we manage these species so that they may live in harmony within the confines of the reef without the possibility of extinction?

Time Table for Completion of Study

|  |  |  |  |
| --- | --- | --- | --- |
| **PHASE** | **DATE BEGIN** | **DATE END** | **TASK TO BE ACCOMPLISHED** |
| 1 | 02/27/2012 | 03/09/2012 | Compiled equipment to be utilized during experiment |
| 2 | 03/12/2012 | 03/16/2012 | Train drivers (transect const. & length/species ID) |
| 3 | 03/19/2012 | 03/30/2012 | Dive sites to construct transect & confirm Goliath Grouper’s presence. |
| 4 | 04/02/2012 | 06/29/2012 | All dives (observations) to begin & completed and field data complied |
| 5 | 07/02/2012 | 07/12/2012 | Compile field data & statistical analysis (Laboratory) |
| 6 | 07/16/2012 | 08/03/2012 | Finding documented and study results complied into research paper. |

* During phase 2 divers will be taught to properly identify the different species of fish and crustaceans that they will be encountering on test sites. The divers will also go through rigorous training on how to properly identify the length of fish utilizing PVC pipes cut to different lengths in an underwater controlled environment. Ten different exact lengths will be utilized during this training (10 cm increments).

* Phase 3 will consist of constructing 3 (25 x 5 m) belt transects per test site in different location around the site. All belt transects will be properly anchored and left in place during the full length of the study. This will ensure that observations at each site are done in the exact same location every time. Goliath grouper’s presence will be confirmed at each study site as necessary.

* Phase 5 will analyze whether the goliath groupers presence is having any impact on the biodiversity of coral reefs in the Florida Keys and whether the density of herbivory fish has increased or decreased with their presence.
* Dates chosen based on spawning rituals of the goliath grouper and herbivory fish in the Florida Keys.

Significance of Expected Results

Will an unrestricted increase in the Goliath Grouper population negatively affect coral reef restoration by reducing herbivorous fish abundance and grazing intensity? According to the expected results of this three month observation (April 2012 thru June 2012) as the Goliath grouper population rebounds within the Florida Keys National Marine Sanctuary we will begin to see a decline in herbivory fish biodiversity and density upon those reefs. With the loss of herbivory fish, due to predation by the Goliath grouper, shifts from coral dominated reefs to reefs with abundant macroalgae populations may occur. To maintain reef resilience, management activities should focus on protecting herbivore populations at all costs.

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**EDUCATION**

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* Criminal Justice Major - withdrew Nov. 2005

Aug. 1990 – Jun. 1994 **Bishop Verot High School**

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**SKILLS & INTERESTS**

* Certified Open Water Diver
* Boating, Fishing, Spear fishing, and Hunting
* Lobster Diving
* Camping
* Finishing my Degree in Environmental Studies
* Spending time with my Family
* Identifying native and exotic species within the wild with my daughters

**TRAINING**

* Domestic Violence
* Juvenile Sexual Offender
* Handcuffing & Use of Force
* Night Firearms
* Weapons of Mass Destruction
* Incident Command Systems
* Serving Search Warrants
* CPR & Blood borne Pathogens
* SOG Ground Fighting
* CMS FTO Transition Course
* Captive Wildlife
* Homeland Security
* National Marine Fisheries
* Boating Firearms
* South Region Special Operations Group
* Personal Protection Equipment
* BUI & Standardized Field Sobriety Testing
* Domestic Security Waterborne Tactics
* Airboat Handling
* Survival Spanish
* Migratory Bird Enforcement
* Expandable Baton
* GPS & Navigation
* Evidence & Forfeiture
* Interview & Interrogations
* Night Driving



**Proposal Cover Sheet**

**Term:** Fall

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Have you identified a research mentor for a senior thesis: No?

**Title of Proposal:** Will an unrestricted increase in the Goliath Grouper population negatively affect coral reef restoration by reducing herbivorous fish abundance and grazing intensity?

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Key Words: *Epinephelus itajara*, Life Behavior, Herbivorous Fish

**Checklist:**

All required portions of the first submission are included: Yes

I had external reviewer read the proposal: Yes - Megan York and Prof. N. Demers

I authorize the use of this proposal as an example in future courses.