The effects of habitat degradation and overfishing on patch reef fish communities

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Background & Experimental Methods

Coral reef systems are well known for their high productivity and biodiversity that support a suite of ecosystem services. However, these systems are highly sensitive to change and are undergoing declines throughout their range (1,2). Globally, coral reefs suffer from increasing water temperatures and ocean acidification (3). Locally, habitat degradation and overfishing are the most significant threats to coral reefs (4,5). Often, local impacts disproportionally affect species at the bottom (i.e., foundation species) and top (i.e., predator species) of coral reef food webs (5,3). Despite the losses of these important functional groups, few studies investigate them simultaneously.

Here we tested the effects of these two local human impacts that are throughout the Caribbean using patch reef fish communities on artificial reefs.

Habitat Degradation x Overfishing

High Structure
- Elkhorn and Staghorn Coral
- Acropora spp.

Low Structure
- Nassau grouper
- Epinephelus striatus

Hypotheses

- Structural complexity will be positively correlated with fish biomass and diversity
- Predator presence will be negatively correlated with fish biomass

Species of Interest and Conservation

Elkhorn and Staghorn Coral
- Acropora spp.

Nassau grouper
- Epinephelus striatus

Visual Results. Photos above were taken in August 2014 at the end of the experiment. Here you can see the large abundance of fish on the high structure reefs, with the most fish present when Nassau grouper were also present.

Results

From May to August 2014, all 16 artificial reefs were surveyed weekly via snorkel and fish identity and total number of fish surrounding the reef was recorded for 10 minutes.

Using final data (reef age 60 days), structure complexity and predator presence has a significantly positive, synergistic effect on total fish abundance (two-way factor ANOVA, post hoc student t-tests with a cumulative of 45 species and 2461 individuals of fish represented above).

Future Directions

POSITIVE FEEDBACK MODEL

(A) Coral structure creates resources and refugia for fishes, (B) fishes graze coral competitors (e.g., algae) and provide nutrients (fish excretion), which (C) feedback to facilitate coral growth.

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