CHANGES IN ONSHORE-OFFSHORE BENTHIC STRUCTURE WITH HERBIVORY AND NUTRIENTS

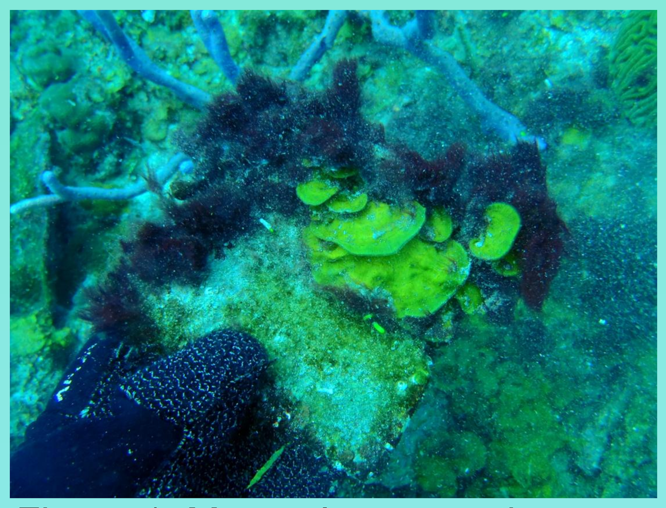

Figure 1: Macroalgae growth on a settlement tile

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Figure 2: SCUBA diver taking digital photos underwater

INTRODUCTION AND OBJECTIVES

What makes a reef healthy and desirable?

- High grazing activity
- Low nutrient levels
- Optimum temperatures, salinities, hydrology
- Few toxins and/or pollution
- Minimal turbidity

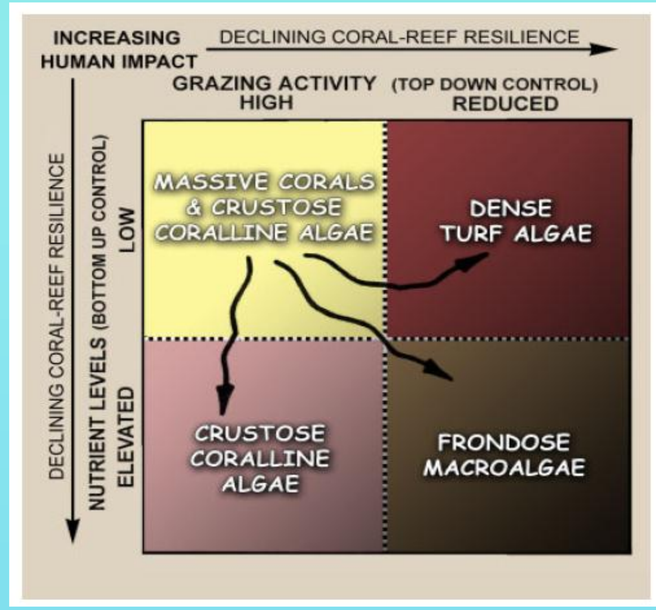

Figure 3: The Relative Dominance Model (Littler and Littler 2006)*

Top-down vs. bottom-up controls

Top-down: Herbivores control algal cover, biomass, and assemblage by continuous, selective grazing.

Bottom-up: Availability of nutrients controls algal cover, biomass and assemblage in characteristic coral reef oligotrophic waters.

Objectives and hypotheses

1. To demonstrate the relative importance of bottom-up and top-down controls in benthic community structure on nearshore and offshore coral reefs.
   - H_0: Combined treatment > Caging only > Nutrients only > Control
2. To determine if offshore reefs differ from nearshore coral reefs in their responses to nutrient enrichment and herbivore exclusion.
   - H_0: Offshore reef treatments will not have as strong of a response as the nearshore reef treatments.

EXPERIMENTAL APPROACH

Caging and nutrients

Figure 4: Cages were made of galvanized wire mesh. Osmocote™ slow release fertilizer (19:6:12) inside homemade pouches provided sustained nutrient enrichment. 2 offshore reefs and 2 nearshore reefs were used. 3 replicates of each combination were placed at each reef, totalling 6 replicates per treatment per location.

Detecting change between treatments

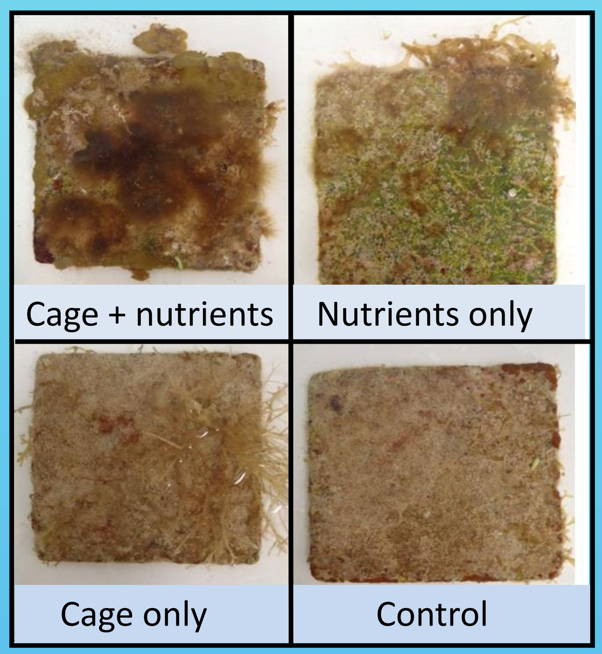

Figure 5: Settlement tiles were collected monthly and analysed to derive algal growth rates

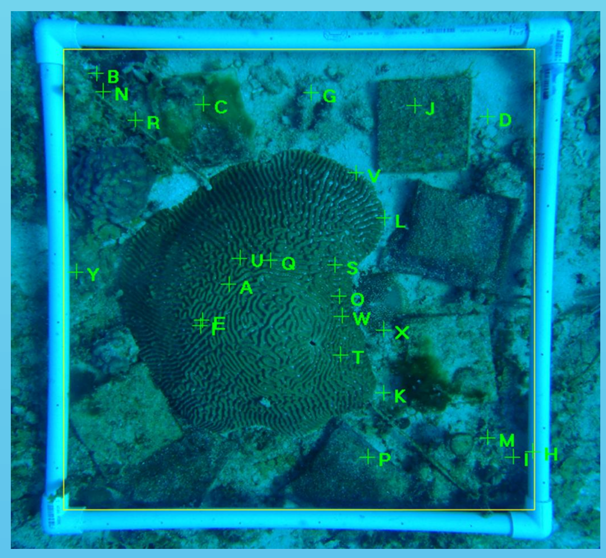

Figure 6: Digital photo quadrats were taken monthly and analysed using CPCe for percent benthic cover. Treatments were in the field for 6 months total.

Environmental characteristics

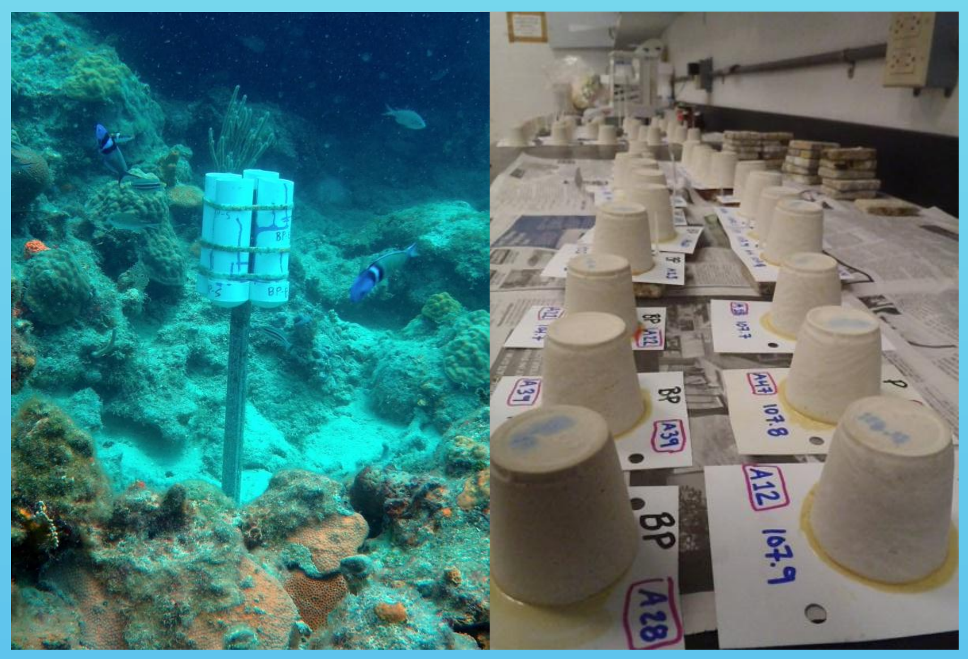

Figure 7: To account for environmental differences, sedimentation and water motion were measured between nearshore and offshore sites using sediment traps (left) and clod cards (right)

ANALYSIS AND CONCLUSIONS

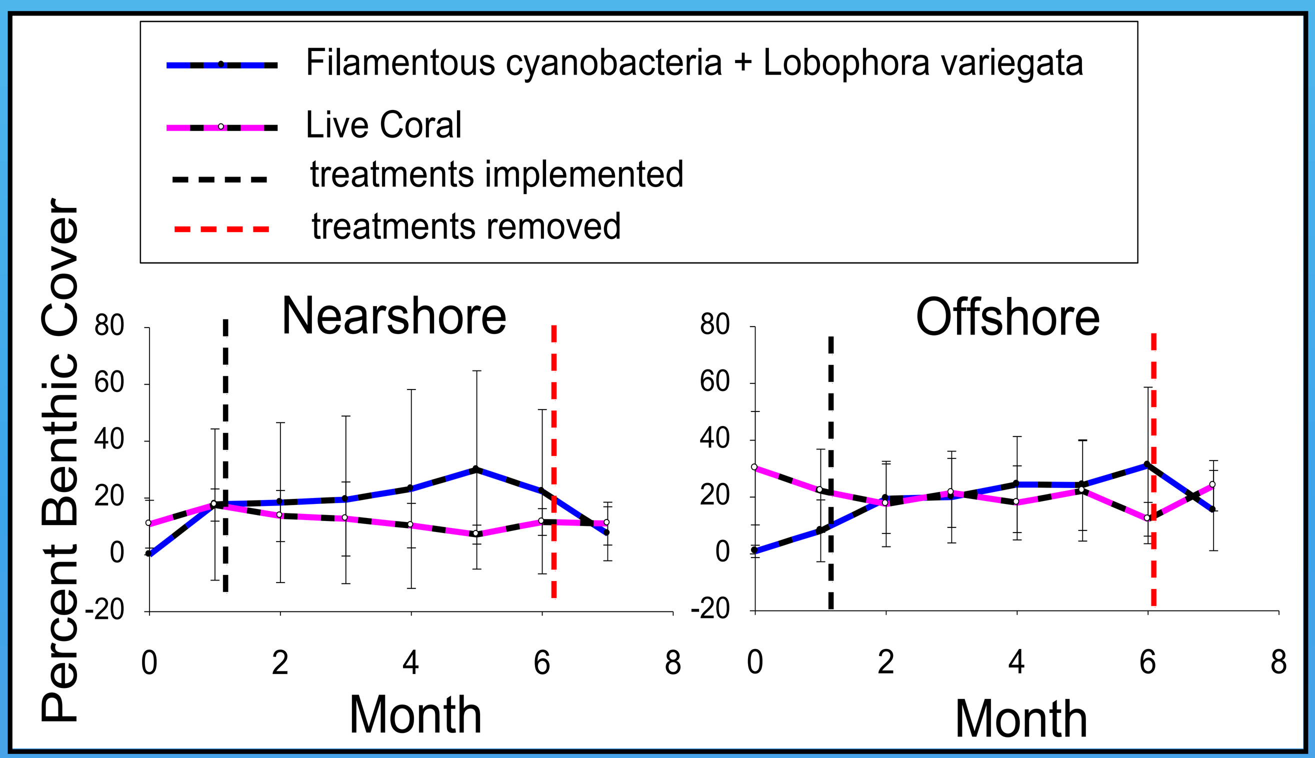

Figure 8: Temporal variation of filamentous cyanobacteria and *L. variegata* % benthic cover vs. live coral % benthic cover.

Table 1: Analysis of Similarities (ANOSIM) pairwise comparisons between treatment groups of average % cover of major benthic community factors for months 4, 5 and 6. (significant when R > 0.5)

Treatment Groups	R Statistic	Significance Level (%)
Cage + Nutrients & Nutrients Only	0.558*	0.1
Cage + Nutrients & Cage Only	0.331	0.1
Cage + Nutrients & Control	0.808*	0.1
Nutrients Only & Cage Only	0.264	0.3
Nutrients Only & Control	0.265	0.5
Cage Only & Control	0.457	0.1

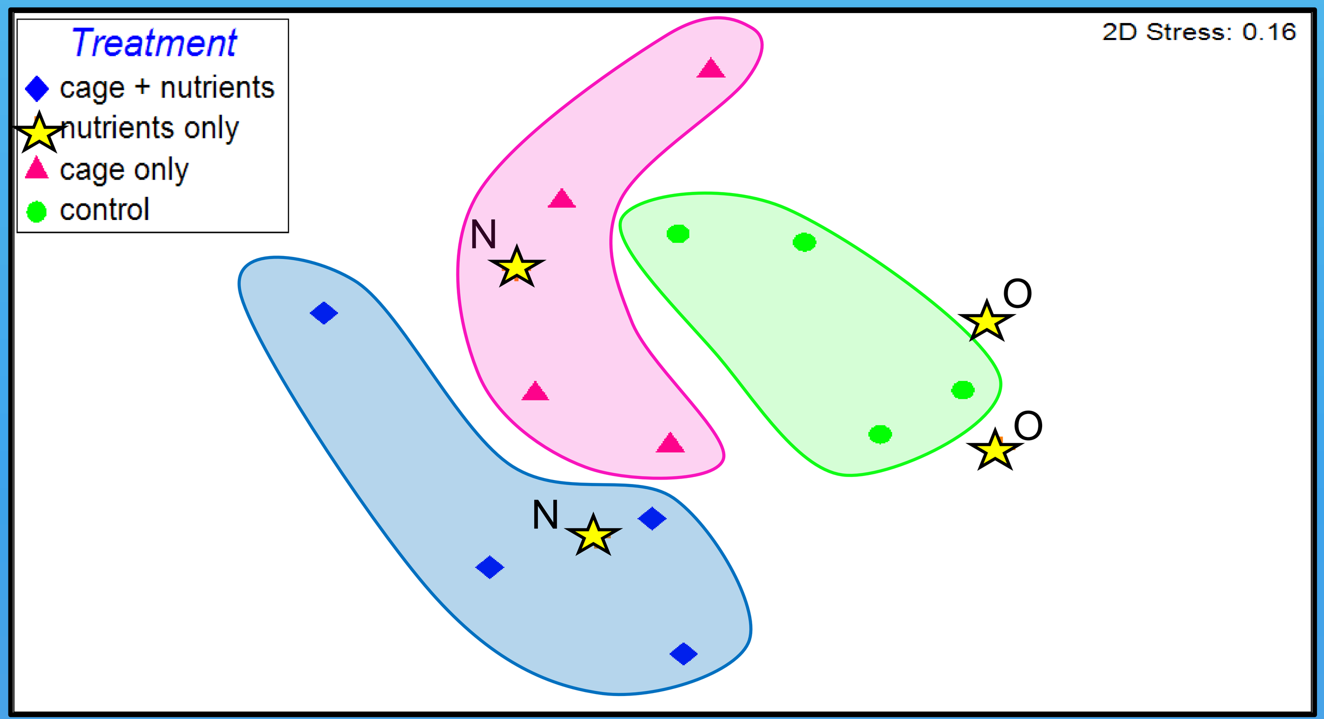

Figure 9: Multidimensional scaling (MDS) ordination of average % change in % cover of major benthic community factors. N = Nearshore site. O = Offshore site

CONCLUSIONS: Treatments combining caging and nutrient enrichment experienced the most dramatic changes. This was largely represented by increases and shifts in macroalgae species and abundance.

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CONCLUSIONS: Nearshore and offshore sites responded differently to the nutrient enrichment treatment. This may have been due to significant increases in water motion at offshore reefs (p<0.01) and/or differences in fish communities.

*Littler, M.M., Littler, D.S., 2006. Assessment of coral reefs using herbivory/nutrient assays and indicator groups of benthic primary producers: a critical synthesis, proposed protocols, and critique of management strategies. Aquatic Conservation: Marine and Freshwater Ecosystems 17: 195-215.