Status of Coral Reef Ecosystems in a Marine Managed Area in St. Croix, USVI

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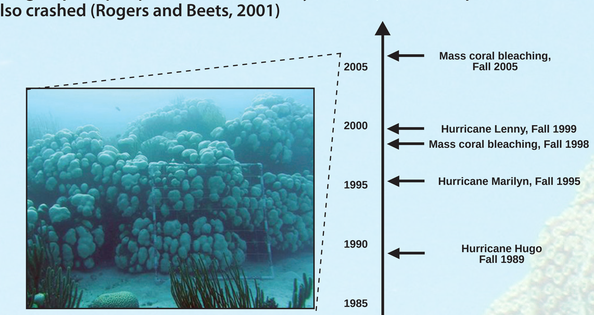
Introduction

This poster presents information on the status and trends of coral reef ecosystems in St. Croix, US Virgin Islands (USVI). Data were collected by NOAA's Center for Coastal Monitoring and Assessment Biogeography Branch (CCMA-BB) from 2001-2006 at 1,275 random locations in and around Buck Island Reef National Monument (BIRNM). The main objective was to quantify changes in fish species and assemblage diversity, abundance, biomass and size structure; to provide spatially explicit information on the distribution of key species or groups of species; and to compare community structure inside versus outside of BIRNM.

Monitoring History and Ecosystem Stress

Long-term monitoring studies since the 1980s indicated that coral reef ecosystems in the region have deteriorated due to fishing, anchor drops, excessive nutrient inputs, *Diadema* die-off, mass coral bleaching and diseases, and hurricane damage. Previous findings include:

- Average coral cover declined by 8-33%; reefs became dominated by macroalgae
- *Acropora palmata* percent cover fell by as much as 85%
- Fisheries species composition shifted to more herbivorous species
- The average size of fishes decreased *in situ* and in fisheries
- The Nassau grouper (*Epinephelus striatus*) fishery crashed, and the replacement red hind (*E. guttatus*) fishery also crashed (Rogers and Beets, 2001)

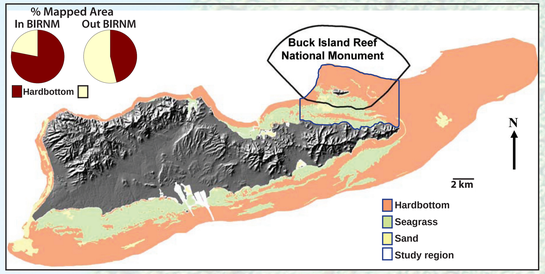


Approach

CCMA-BB St. Croix Long-term Monitoring

Study Area

- BIRNM is located on the northeastern (NE) shelf of St. Croix; includes an uninhabited island ~712,000 m^2.
- Under US National Park Service (NPS) jurisdiction; designated by the US Department of Interior in 1961.
- BIRNM is a "no-take" and "restricted anchoring" zone.



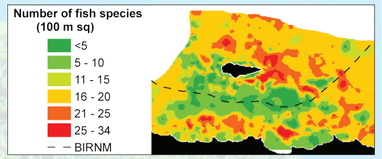
Methodology

- Data Collection - fish surveys, benthic composition and selected macroinvertebrates
  - Sampling Design: biannually, sample sites selected via stratified random design (2001-2006) using hard and soft bottom habitat types delineated in NOAA's benthic habitat map (Menza et al., 2006). From 2003-3006, sampling was also stratified by inside or outside BIRNM.
  - Fish Surveys: abundance and size at each location were obtained via visual belt transect surveys (25x4m).
  - Benthic Composition: five 1m^2 quadrats were placed on the transect to examine fine-scale biotic and abiotic components of the seascape (e.g., coral cover, macroalgal cover, etc.).
  - Macroinvertebrates: a count of the total number of *Diadema*, queen conch and spiny lobster were counted within the 25x4m belt transect. Queen conch counts were separated by mature/immature.
- Analyses -
  - Spatial and temporal patterns in several fish metrics and abundance of selected macroinvertebrates
  - Spatial and temporal patterns in benthic composition to help identify patterns in fish metrics

Results

Fish

- 201 fish species/species groups from 56 families were observed
  - 9 of the 10 most frequently encountered species belonged to families: Labridae, Acanthuridae and Scaridae.
- Largest continuous area of high species richness is inside BIRNM.



- Body lengths of the largest common groupers, snappers and grunts were less than the maximum size recorded for the species across the study region.

Species	% of max. size
yellowtail snapper (*Ocyurus chrysurus*)	70
schoolmaster snapper (*Lutjanus apodus*)	66
bluestriped grunt (*Haemulon sciurus*)	65-77
white grunt (*Haemulon plumierii*)	56-66
red hind (*Epinephelus guttatus*)	60

- When fish metrics inside BIRNM were compared with those outside, more of the metrics inside BIRNM were significantly higher ($P<0.05$) than metrics outside BIRNM.

Selected Summary Metrics	Inside BIRNM	Outside BIRNM
fish biomass (all spp. combined)	X	
herbivore biomass	X	
piscivore biomass (incl. sharks and rays)		X
shark and ray biomass	X	X
snapper (Lutjanidae) density		X
snapper (Lutjanidae) biomass	X	
grunt (Haemulidae) density		X
grunt (Haemulidae) biomass		X
parrotfish (Scaridae) biomass	X	
coney (*Cephalopholis fulva*) density	X	
coney (*Cephalopholis fulva*) biomass	X	
blue tang (*Acanthurus coeruleus*) density	X	
blue tang (*Acanthurus coeruleus*) biomass	X	
striped parrotfish (*Scarus iseri*) biomass	X	
french grunt (*Haemulon flavolineatum*) biomass		X
bluestriped grunt (*H. sciurus*) density		X

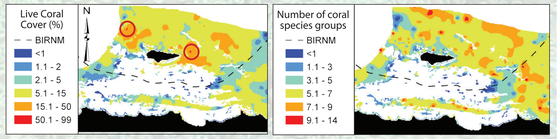
- Some of the inter-annual differences observed inside and outside BIRNM (2003-2006) were:
  - Inside BIRNM - Mean fish density (all spp. combined) increased over 3 consecutive years, with 2005 and 2006 density significantly higher than 2003.
  - Outside BIRNM - Consecutive inter-annual decline for grunt biomass. Many fish metrics showed a declining trend between 2003-2005, then showed a substantial increase in 2006.

Benthic Composition (2003-2006)

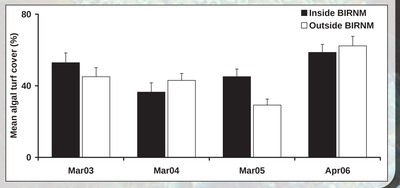
- The benthic composition of hardbottom habitat type inside BIRNM was different from those outside. Asterisks (*) indicate significant differences ($p<0.05$).

Benthic Taxa	Mean % cover (± SE)	
* significant differences ($p<0.05$)	Inside	Outside
Colonized hardbottom	***n = 310***	***n = 292***
Live coral*	4.9 (0.3)	2.4 (0.2)
Macroalgae*	14.5 (0.9)	15.7 (0.8)
Gorgonians*	2.1 (0.2)	0.7 (0.08)
Sponge*	1.4 (0.2)	1.7 (0.1)
Seagrass*	0.3 (0.2)	1.4 (0.5)

- Two areas inside BIRNM had live coral cover exceeding 50% (left). The number of hard coral species groups were relatively evenly distributed inside and outside BIRNM, with areas in both domains having 9-14 coral species (right).



- Peaks in mean algal turf cover (50-60%) were detected in the spring of 2006 following the 2005 bleaching event. Mean live coral cover approximately one year after the event was the lowest since this study commenced.



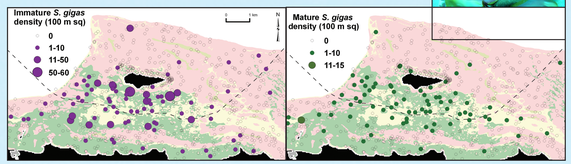
Macroinvertebrates

Long spined sea urchin (*Diadema antillarum*)

- *Diadema* densities around Buck Island have not recovered since the mass mortality in 1983. However, this study and the scientific literature indicate that some minor recovery may be occurring in lagoonal and back reef areas along the sheltered coastline of NE St. Croix.

Queen conch (*Strombus gigas*)

- The maximum number of *S. gigas* individuals (59/100m^2) was recorded at a seagrass site inside BIRNM.
- Juvenile and adult distributions were similar, indicating adult and juvenile *S. gigas* were not spatially segregated.



Caribbean spiny lobster (*Panulirus argus*)

- Anecdotal data suggests that the highest densities of spiny lobster occurred in patch reef and colonized pavement habitat types. No lobsters were observed on softbottom sites.

Diversity and Hot Spots

- Areas with high coral species richness, high live coral cover for *Montastraea cavernosa* and *M. annularis*, high fish species richness and high abundance for several fish species including coney (*C. fulva*), rock beauty (*Holacanthus tricolor*) and queen triggerfish (*Balistes vetula*) occurred along the northernmost edge of the benthic habitat map.

Recommendations

Continue coral ecosystem monitoring and assessment

- Assess changes in indicators of reef health
- Continue biodiversity assessments

Improve coral reef management

- Increase local public education and outreach
- Enforce existing marine protected areas and laws governing resource extraction
- Reduce local threats to coral reefs
- Reduce fishing pressure
- Promote stronger coordination and collaboration among Federal, Territorial, and non-governmental agencies

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Center for Coastal Monitoring and Assessment's Biogeography Branch web site:
http://biogeo.nos.noaa.gov
or
Caribbean Coral Reef Ecosystem Monitoring project web site:
http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish.html

Acknowledgements

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Citations:

- Menza, C, J Ault, J Beets, J Bohnsack, C Caldow, J Christensen, A Friedlander, C Jeffrey, M Kendall, J Luo, M Monaco, S Smith, and K Woody. 2006. A Guide to Monitoring Reef Fish in the National Park Service's South Florida/Caribbean Network. NOAA Tech Memo NOS NCCOS 39. Silver Spring, MD. 166 pp.
- Pittman, SJ, SD Hile, CFG Jeffrey, C Caldow, MS Kendall, ME Monaco, and Z Hillis-Starr. 2008. Fish assemblages and benthic habitats of Buck Island Reef National Monument (St. Croix, US Virgin Islands) and the surrounding seascape: A characterization of spatial and temporal patterns. NOAA Tech Memo NOS NCCOS 71. Silver Spring, MD. 96 pp.
- Rogers, CS and J Beets. 2001. Degradation of marine ecosystems and decline of fishery resources in marine protected areas in the US Virgin Islands. Environ Conserv 84: 312-322.