Mission Report

NOAA/NOS/NCCOS/CCMA/Biogeography Branch

March 2 – 13, 2009

Characterization and monitoring of reef fish populations within and around Buck Island Reef National Monument, USVI:
A cooperative investigation between NOAA, the National Park Service, and the Virgin Islands Department of Planning and Natural Resources

NOAA
National Ocean Service
National Centers for Coastal Ocean Science
Center for Coastal Monitoring and Assessment
Biogeography Branch
Silver Spring, MD 20910

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Mission Purpose:

The intent of this field mission was to continue ongoing efforts: (1) to spatially characterize the distribution, abundance and size of both reef fishes and conch within and around the waters of Buck Island Reef National Monument (BUIS) and the East End Marine Park (EEMP) of St. Croix, (2) to correlate this information to *in-situ* data collected on associated habitat parameters, (3) to use this information to establish the knowledge base necessary for enacting management decisions in a spatial setting and to establish the efficacy of those management decisions.

Information collected thus far is being extensively utilized by NOAA, NPS, DPNR and others. Examples include NPS' use of NOAA-produced habitat maps in monitoring efforts; The Ocean Conservancy's use of maps and fish data in efforts to assist EEMP with zonation designations within the Park; USGS/University of Miami's and NOVA Southeastern University's use of habitat maps for cryptic fish inventories. Information is also used to develop protocols for NPS, detailing how, where, and when to monitor nearshore fish assemblages, and by NOAA Coral Reef Watch to characterize and monitor the spatial extent of coral bleaching and recovery within U.S. Caribbean coral reef ecosystems. The data collected will aid NPS managers in understanding and making informed decisions regarding the resources of the South Florida / Caribbean Network.

In addition to collecting characterization and monitoring data, we spent time during this mission looking for the presence of lionfish throughout the study area. The Indo-Pacific invasive lionfish have been confirmed around St. Croix outside of the study area; however, no lionfish sightings were confirmed during this mission. These results suggest the geographic distribution of this invasive fish has not yet expanded into the Buck Island Reef National Monument or adjacent coral reefs.

Operational Accomplishments:

- A total of 100 sites were surveyed within the study area (Figure 1), and information on fish distribution, abundance and size (Table 1), benthic habitat composition (Table 2), bleaching, conch abundance and distribution (Table 3), and marine debris (Table 4) was collected. The project team consisted of 1 NPS and 8 NOAA scientific divers. NPS and NOAA dive logs were maintained.

- Two NPS boats were used for the duration of the mission. The NPS policy of live-boating was implemented to avoid any potential damage to resources from anchor drops and allowed divers to work more efficiently.

- NPS and Dive Experience air and Nitrox (32%) tanks were used during this mission. All tanks were filled at Dive Experience.

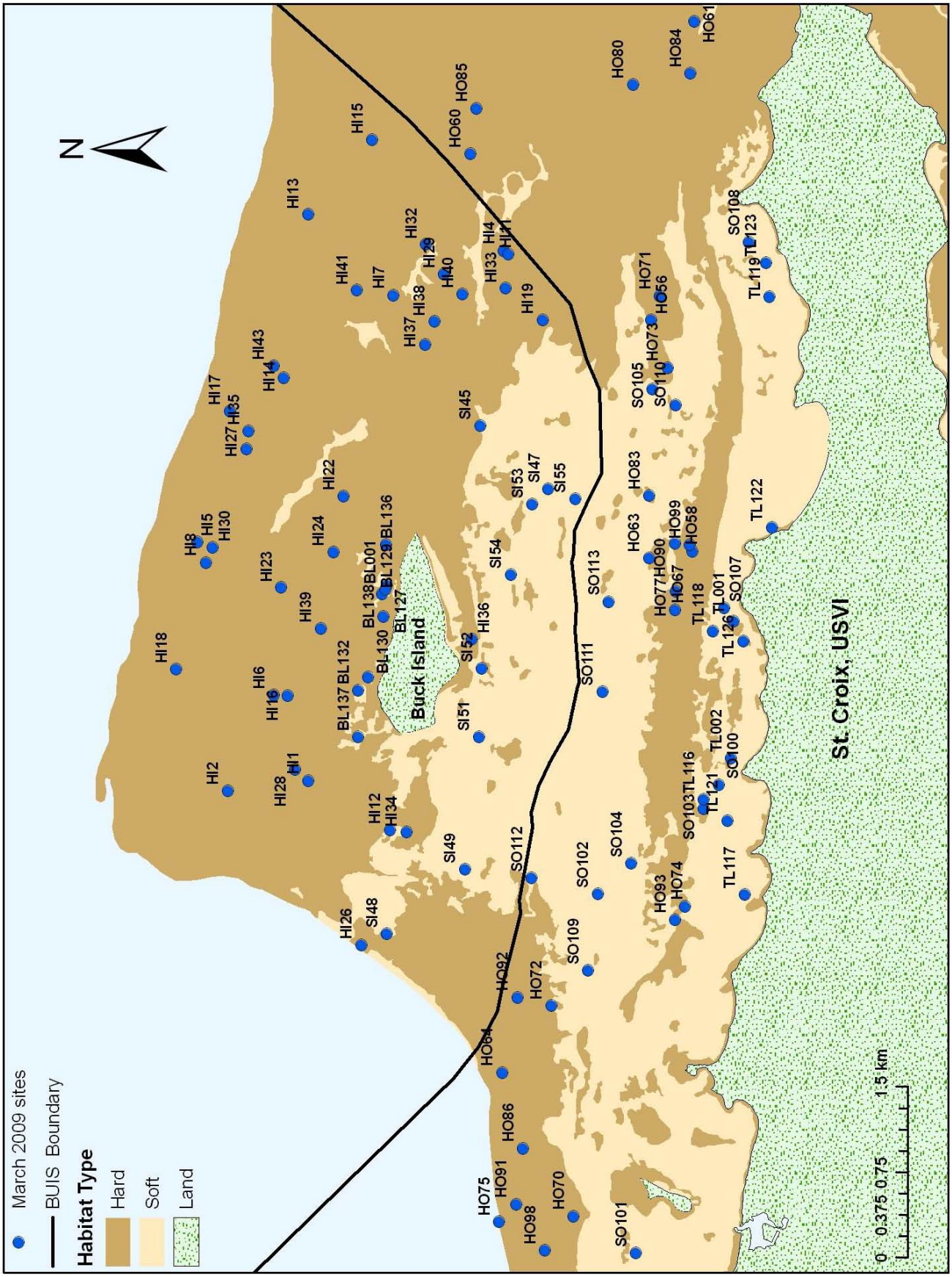


Figure 1. Map of Buck Island Reef National Monument detailing the benthic composition and selected survey points sampled during the March 2009 mission.

Summary of Surveys:

Fish

- Fish species abundance, size and distribution were characterized using the belt transect survey method (http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html) at all sites. The data are weighted based on area sampled and are summarized in Table 1. See Appendix A for data calculations.

Table 1. Fish abundance, richness and biomass (all per 100m^2). Data are from the March 2009 St. Croix mission.

Location	Habitat Type	# of Surveys	# indiv / 100m^2		Biomass (g) / 100m^2		# species /100m^2		Mean Diversity*	
			Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Inside	Hard	43	106.6	8.1	3380.81	550.41	16.8	0.9	2.17	0.07
	Soft	9	45.0	34.3	751.04	528.68	2.6	0.6	0.60	0.18
	OVERALL	**52**	**92.4**	**6.6**	**2774.68**	**354.01**	**13.5**	**0.54**	**1.81**	**0.05**
Outside	Hard	26	87.9	8.1	2570.52	428.01	17.0	1.2	2.21	0.09
	Soft	22	16.4	3.6	3130.46	2693.98	3.8	0.6	0.81	0.13
	OVERALL	**48**	**54.3**	**5.0**	**2833.98**	**396.56**	**10.8**	**0.75**	**1.55**	**0.06**
Both	Hard	69	98.5	4.1	3029.54	257.07	16.9	0.51	2.19	0.08
	Soft	31	25.2	4.9	2402.90	1347.80	3.4	0.35	0.74	0.14
	OVERALL	**100**	**72.3**	**2.0**	**2805.91**	**430.93**	**12.1**	**0.24**	**1.68**	**0.03**

*Shannon Diversity Index

Chain moray
(*Echidna catenata*)

Nurse shark
(*Ginglymostoma cirratum*)

Bridled goby
(*Coryphopterus glaucofraenum*)

Shortfin pipefish
(*Cosmocampus elucens*)

Juvenile nurse shark
(*Ginglymostoma cirratum*)

Fairy basslet
(*Gramma loreto*)

Habitat

- Benthic composition data were collected at all sites during the March 2009 mission. Hardbottom data are weighted based on area sampled and are summarized in Table 2. Detailed methodology can be found at http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html. See Appendix A for data calculations.

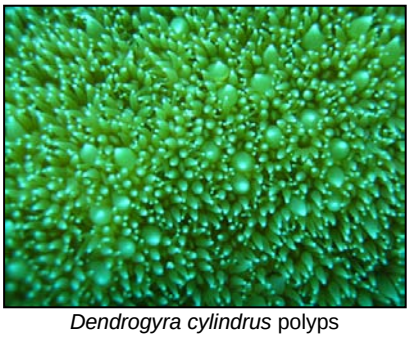
Table 2. Average percent cover of habitat types for 69 hardbottom sites for March 2009 St. Croix mission.

Location	# of Surveys	% Coral*		% Algae- seagrass		% Turf- crustose		% Gorgonian		% Sponge	
		Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Inside	43	3.18	0.55	11.32	1.27	31.48	4.36	2.33	0.39	1.27	0.22
Outside	26	3.07	0.47	12.47	2.58	42.16	5.61	1.92	0.38	2.80	0.47
Both	**69**	**3.13**	**0.27**	**11.82**	**0.89**	**36.11**	**2.45**	**2.15**	**0.20**	**1.93**	**0.16**

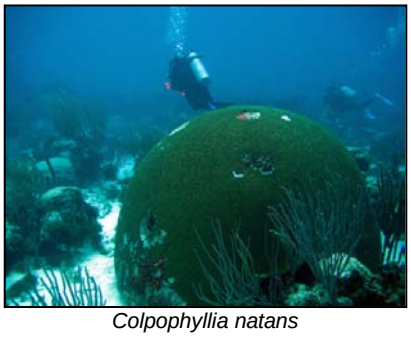
* Hydroids (fire coral, etc.) are included in this value

Acropora cervicornis

Broken *Acropora palmata* branch

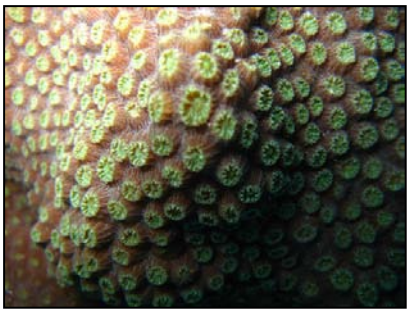


Dendrogyra cylindrus polyps



Colpophyllia natans

Agaricia species



Montastraea annularis complex

Macroinvertebrates

Conch

- The number of queen conch (*Strombas gigas*) observed within 21 of the 100 transects surveyed is summarized by location and benthic composition type in Table 3.

Table 3. The abundance of conch surveyed during the March 2009 mission.

Location	Habitat	# surveys	Immature	Mature	Total
Inside	Hard	4	1	3	4
	Soft	8	20	30	50
	Both	**12**	**21**	**33**	54
Outside	Hard	0	0	0	0
	Soft	9	57	22	79
	Both	**9**	**57**	**22**	79
Both	Hard	4	1	3	4
	Soft	17	77	52	129
	Both	**21**	**78**	**55**	**133**

Lobster

- A total of 3 Caribbean spiny lobsters, *Panulirus argus*, were recorded at three of the 100 transects.

Sea urchins

- A total of 196 long-spined sea urchins, *Diadema antillarum*, were recorded at eight of the 100 transects.

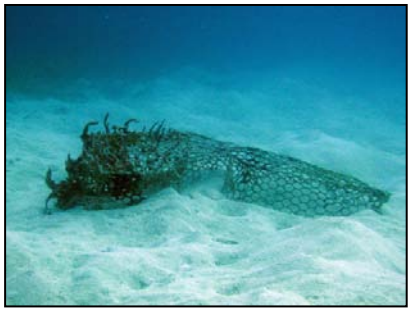
Marine Debris

- Marine debris data have been recorded during missions in St. Croix since 2007. The marine debris observed within transects during this mission are summarized in Table 4.

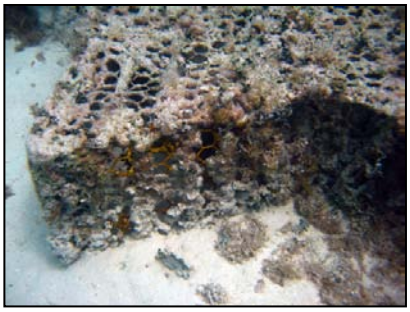
Table 4. Summary of debris information collected during the March 2009 mission.

Debris Type	Debris Area (cm^2)	Colonized By	Area Affected (cm^2)
Cable/pipe	80	Algae, gorgonians, encrusting and macro algae	80
Glass bottle	115	Calcium deposits	115
Line	1524	Hydroids	1524
Trap	82944	Fire coral, coral, algae, hydroids	82944
Trap	45454	Macroalgae, fire coral, *Porites astreoides*, gorgonians	34091
Trap (fish)	600	Algae	650

Glass bottle with encrusting algae



Abandoned fish pot



Abandoned fish pot covered with encrusting organisms

Events of Note:

- There was only one fish recorded for the first time in St. Croix during this mission:
  - Inshore lizardfish (*Synodus foetens*)

- No lionfish were observed – even though searches were conducted by designated divers.

Logistics of Note:

- Only 100 of the 120 sites were surveyed due to three days of high winds, big swells and surf.
- Erinn Muller began her data collection/ video transects on coral diseases for her Nancy Foster Scholarship work. Her methodology coincided well with the methodology used for this study to collect benthic data.
- Divers noted colder water temperatures with readings from 76-79°F
- We continued to implement the NPS policy of live-boating during our dive operations, and we were fortunate to have captains Benjamin Williams (YCC Supervisor), Andy Estep (NPS/SFCN), Rick Starr, Rich Berey and Richard Gideon (TNC) who graciously volunteered their time.
- While the volunteer boat captain solution was creative and while we sincerely appreciate the time and energy of these captains, it will be more beneficial to have set captains for the duration of the work.

Mission Divers:

Laurie Bauer (NCCOS/CCMA BB)
Randy Clark (NCCOS/CCMA BB)
Kim Foley (NCCOS/CCMA BB)
Matt Kendall (NCCOS/CCMA BB)
Ian Lundgren (NPS/BUIS)
Mark Monaco (NCCOS/CCMA BB)
Erinn Muller (NCCOS/CCMA BB)
Simon Pittman (NCCOS/CCMA BB)
Jenny Waddell (NCCOS/CRCP)
Kimberly Woody-UDS (NCCOS/CCMA BB)

Appendix A – Equations

- Overall habitat and fish mean values for each stratum (locations and substrate type) and combined strata were calculated using the following equations (Menza et al., 2006):

Mean density for the stratified survey domain is obtained by summing the weighted averages of sample strata means,

$$\bar{y}_{st} = \sum_{h=1}^{L} W_h \bar{y}_h$$

where *L* is the number of strata, and strata weighting factors (W_h) are given by

$$W_h = \frac{N_h}{\sum_{h=1}^{L} N_h} = \frac{N_h}{N}$$

where N is the total number of possible sample units in all strata. The weighting factor W_h represents the proportion of the overall survey domain (or sampling frame) contained within stratum *h*.

Two examples of calculations are provided below:

- For one stratum type (e.g. BIRNM strata),

$$y_{BIRNM} = \left(\text{mean \# indiv inside BIRNM} \times \frac{\text{area inside BIRNM}}{\text{total area strata}}\right) + \left(\text{mean \# indiv outside BIRNM} \times \frac{\text{area outside BIRNM}}{\text{total strata area}}\right)$$

- The overall and combined standard error values for fish and habitat data were calculated using the estimated variance of the mean (Menza et al., 2006). The variance of $\bar{y}_{st}$ is estimated as

$$\text{var}\left[\bar{y}_{st}\right] = \sum_{h=1}^{L} W_h^2 \, \text{var}\left[\bar{y}_h\right]$$

For benthic composition calculations, W_h = 1 because only mean estimates were derived for the hardbottom area stratum.

References:

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 Technical Memorandum NOS NCCOS 39. 166 pp.