St. Croix, USVI Mission Report

NOAA/NOS/NCCOS/CCMA/Biogeography Branch

October 18 – October 29, 2010

A cooperative investigation between NOAA's National Ocean Service and National Marine Fisheries Service-Southeast Fisheries Science Center (NMFS SEFSC), the National Park Service, the Virgin Islands Department of Planning and Natural Resources and East End Marine Park, and The Nature Conservancy

NOAA
National Ocean Service
National Centers for Coastal Ocean Science
Center for Coastal Monitoring and Assessment
Biogeography Branch
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During this mission data were collected for both the Caribbean Coral Reef Ecosystem Monitoring (CREM) project and a land-sea characterization of the East End Marine Park (EEMP) to determine Marine Protected Area (MPA) efficacy.

Mission Purpose:
The intent of this field mission was twofold. First, efforts on the CREM project continued: (1) to spatially characterize the distribution, abundance and size of both reef fishes and conch, benthic habitat composition, and abundance of *Diadema* and Caribbean spiny lobster within and around the waters of Buck Island Reef National Monument (BUIS) and the EEMP of St. Croix; (2) to correlate this information to *in-situ* data collected on associated habitat parameters; and (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.

Second, the regular St. Croix survey area was extended eastward and southward to encompass a more extensive area of the EEMP. The surveys were conducted in partnership with EEMP (VIDPNR), The Nature Conservancy (TNC), and NOAA's National Marine Fisheries Service (NMFS), Southeast Fisheries Science Center (SEFSC). The purpose of this modification was to collect information on the distribution and diversity of marine communities across the zones in the southern half of EEMP where presently very little information is available. The survey techniques used are compatible with those used for the northern portion of EEMP and neighboring BUIS to facilitate comparative analyses. In water surveys collected data on federally listed *Acropora* species, Nassau grouper (*Epinephelus striatus*) and other fauna of special concern (i.e., conch, sea urchins, lobster and the invasive lionfish).

Information collected thus far for the on-going CREM project 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; and 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. The data are also available to the public online and have been used by academia, other institutions and various individuals.

The data in this report are separated into two groups within each section. They are labeled "BUIS" for the annual on-going St. Croix mission (Figure 1) and "South" for the additional data collected on the southward and eastward area of the EEMP (Figure 2).

Operational Accomplishments:

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

BUIS:

- A total of 122 sites were surveyed within the study area (Figure 1), and information on fish distribution, abundance and size (Table 1); benthic habitat composition (Table 3); bleaching; conch, lobster and *Diadema* abundance and distribution (Table 5); and marine debris (Table 7) was collected. The project team consisted of one NPS and six NOAA (four CCMA, two SEFSC) 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.

- The boat captains for BUIS sampling were Eric Cotto (NPS/BUIS), Karen Maloof (NPS/BUIS) and Hank Tonnemacher (NPS Contractor)

South:

- A total of 74 sites were surveyed within the study area (Figure 2), and information on fish distribution, abundance and size (Table 2); benthic habitat composition (Table 4); bleaching; conch, lobster and *Diadema* abundance and distribution (Table 6); and marine debris (Table 8) was collected. The project team consisted of six NOAA (three CCMA, three SEFSC), two University of Miami-RSMAS and two TNC scientific divers. NPS and NOAA dive logs were maintained.

- One TNC and one VIDPNR boat 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.

- The boat captains for the EEMP south side sampling were Jose Sanchez (VIDPNR) and Kemit-Amon Lewis (TNC),

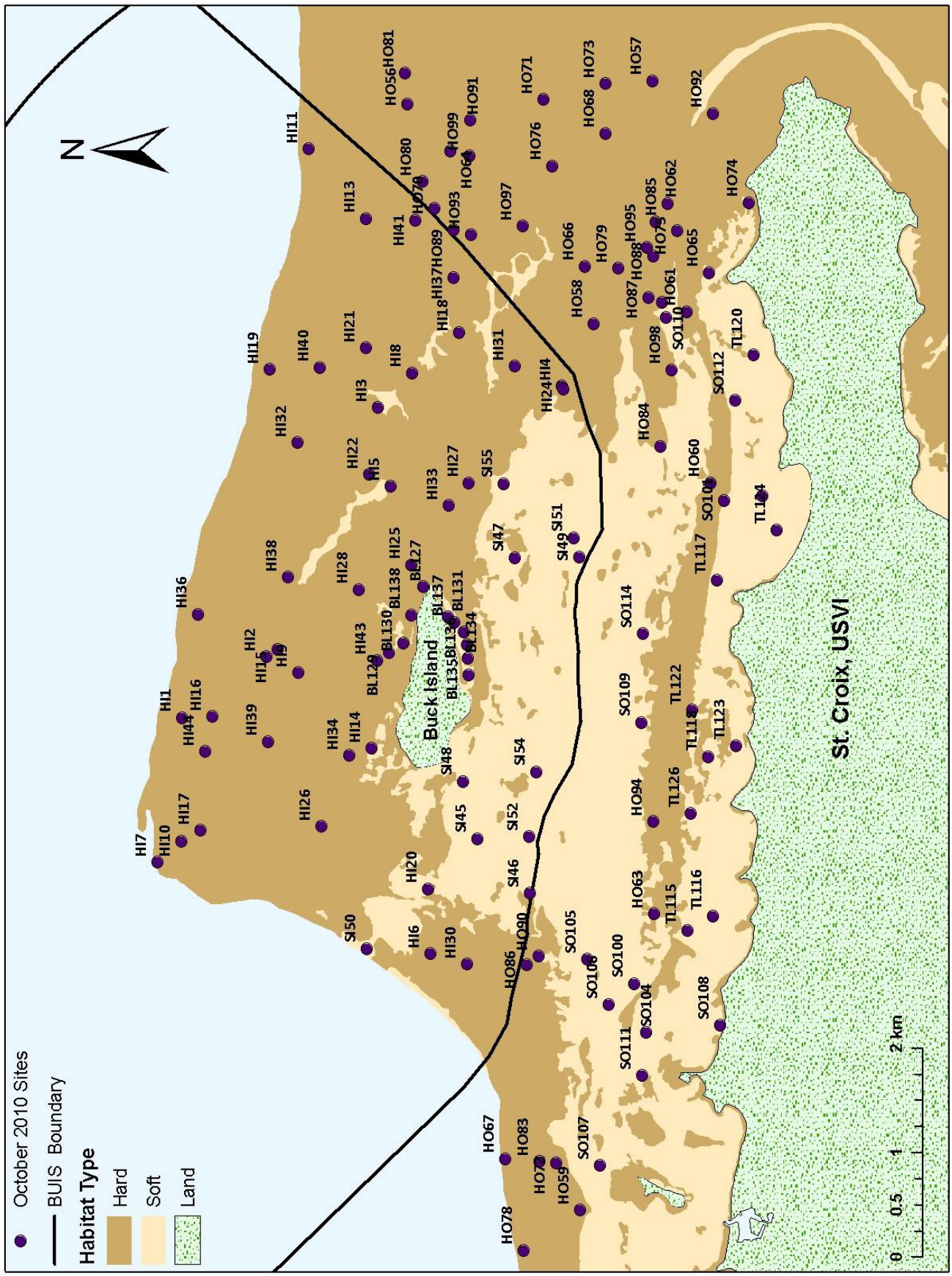


Figure 1. Map of Buck Island Reef National Monument detailing the benthic composition and selected survey points sampled during the October 2010 mission.

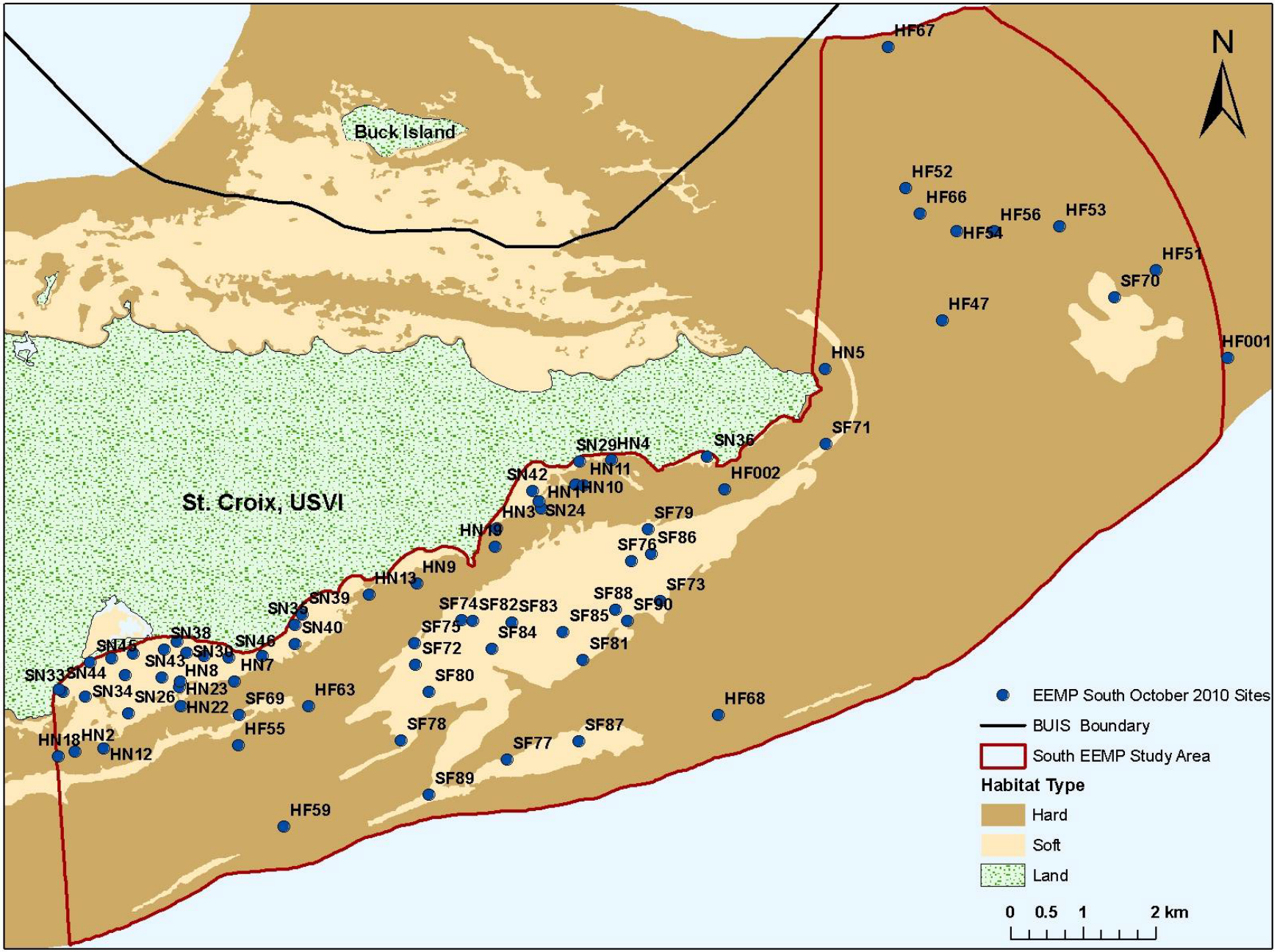


Figure 2. Map of the South side of the East End Marine Park detailing the benthic composition and selected survey points sampled during the October 2010 mission.

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 Tables 1 and 2. See Appendix A for data calculations.

Table 1. Fish abundance, richness and biomass (all per 100m^2). Data are from the October 2010 St.Croix-BUIS 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	42	222.4	20.4	7564.52	1831.48	18.6	0.7	2.09	0.06
	Soft	17	35.1	10.2	11007.43	6468.02	5.6	1.2	1.11	0.16
	OVERALL	**59**	**179.2**	**12.6**	**8358.06**	**1428.12**	**15.6**	**0.49**	**1.86**	**0.04**
Outside	Hard	39	221.5	15.8	5114.57	2310.89	18.8	0.7	2.04	0.06
	Soft	24	42.2	10.9	5424.00	3416.41	6.6	1.0	1.18	0.12
	OVERALL	**63**	**137.1**	**9.9**	**5260.16**	**1549.89**	**13.1**	**0.47**	**1.64**	**0.04**
Both	Hard	81	222.0	9.5	6502.44	1022.03	18.7	0.37	2.07	0.06
	Soft	41	40.0	6.2	7131.25	2251.28	6.3	0.59	1.16	0.13
	OVERALL	**122**	**157.1**	**4.0**	**6726.85**	**822.53**	**14.3**	**0.25**	**1.74**	**0.03**

*Shannon Diversity Index

Table 2. Fish abundance, richness and biomass (all per 100m^2). Data are from the October 2010 St. Croix-South 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)
Nearshore	Hard	16	189.5	20.9	2919.05	736.17	15.9	0.8	2.18	0.07
	Soft	22	31.5	7.1	130.46	34.41	4.4	0.5	1.02	0.11
	OVERALL	**38**	**112.2**	**7.1**	**1555.26**	**200.41**	**10.3**	**0.34**	**1.61**	**0.04**
Offshore	Hard	16	215.7	32.6	4963.53	1000.77	18.5	1.6	2.02	0.14
	Soft	20	25.6	4.3	2293.52	643.88	4.9	0.6	1.09	0.13
	OVERALL	**36**	**187.6**	**9.5**	**4568.64**	**415.26**	**16.5**	**0.55**	**1.88**	**0.07**
Both	Hard	32	214.3	29.2	4851.73	896.52	18.4	1.39	2.02	0.14
	Soft	42	27.0	2.9	1770.39	372.11	4.8	0.37	1.07	0.12
	OVERALL	**74**	**180.9**	**20.1**	**4303.52**	**619.16**	**15.9**	**0.96**	**1.86**	**0.09**

*Shannon Diversity Index

L-R: Group of black bar soldierfish (*Myripristis jacobus*), yellow goatfish (*Mulloidichthys marinticus*) and juvenile snapper (*Lutjanus* spp.); highhat (*Pareques acuminatus*); pikeblenny (*Chenopsis* sp.); and a group of princess parrotfish (*Scarus taeniopterus*), squirrelfish (*Holocentrus adscensionis*), white grunts (*Haemulon plumierii*), and a rock beauty (*Holocanthus tricolor*)

Habitat

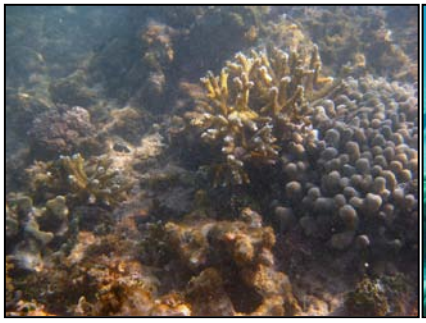
- Benthic composition data were collected at all sites during the October 2010 mission. Hardbottom data are weighted based on area sampled and are summarized in Tables 3 and 4. Detailed methodology can be found at http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html. See Appendix A for data calculations.

Table 3. Average percent cover of habitat types for 81 hardbottom sites for October 2010 St. Croix-BUIS mission.

Strata Type	# of Surveys	% Coral		% Hydrocorals		% Algae/ Seagrass		% Turf/ Crustose		% Gorgonian		% Sponge	
		Mean	(±SE)	Mean	(±SE)	Mean	(±SE)	Mean	(±SE)	Mean	(±SE)	Mean	(±SE)
Inside	42	4.84	0.70	0.50	0.18	30.26	4.59	39.96	5.02	3.41	0.55	1.91	0.36
Outside	39	3.14	0.62	0.25	0.04	48.86	5.02	17.78	4.29	2.12	0.33	2.22	0.35
Both	**81**	**4.10**	**0.34**	**0.39**	**0.06**	**38.32**	**2.42**	**30.35**	**2.42**	**2.85**	**0.24**	**2.04**	**0.18**

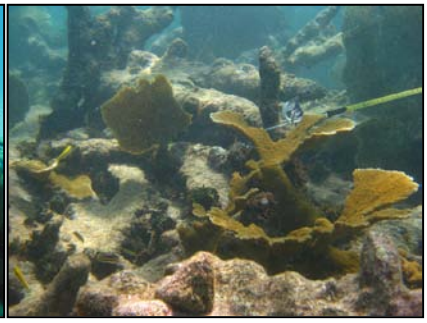
Table 4. Average percent cover of habitat types for 32 hardbottom sites for October 2010 St. Croix-South mission.

Strata Type	# of Surveys	% Coral		% Hydrocorals		% Algae/ Seagrass		% Turf/ Crustose		% Gorgonian		% Sponge	
		Mean	(±SE)	Mean	(±SE)	Mean	(±SE)	Mean	(±SE)	Mean	(±SE)	Mean	(±SE)
Nearshore	16	1.82	0.83	0.23	0.17	23.28	6.01	60.81	6.62	0.24	0.15	0.18	0.09
Offshore	16	3.07	0.92	0.18	0.06	36.42	7.75	21.09	6.31	0.81	0.27	2.15	0.36
Both	**32**	**3.01**	**0.83**	**0.18**	**0.06**	**35.70**	**6.95**	**23.26**	**5.66**	**0.78**	**0.24**	**2.04**	**0.32**

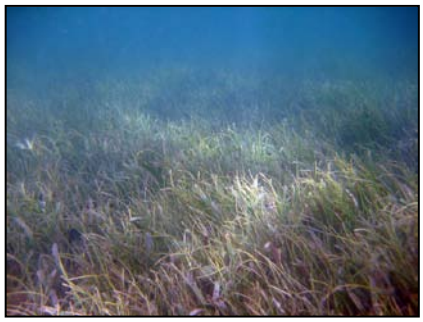


Acropora cervicornis and *Porites porites* in BUIS.

Outcrop of *Montastraea annularis* mounds in BUIS.



Live *Acropora palmata* in *Acropora* rubble in BUIS.



Field of manatee grass, *Syringodium filiforme,* on the south side of the EEMP.

Macroinvertebrates

Conch

BUIS

- The number of queen conch (*Strombas gigas*) observed within 36 of the 122 transects surveyed is summarized by location and benthic composition type in Table 5.

Table 5. Conch abundance surveyed during the St. Croix - BUIS October 2010 mission.

Location	Habitat	# surveys	Immature	Mature	Total
Inside	Hard	6	13	15	28
	Soft	13	58	50	108
	Both	**19**	**71**	**65**	**136**
Outside	Hard	2	1	9	10
	Soft	15	99	29	128
	Both	**17**	**100**	**38**	**138**
Both	Hard	8	14	24	38
	Soft	28	157	79	236
	Both	**36**	**171**	**103**	**274**

South

- The number of queen conch (*Strombas gigas*) observed within 14 of the 74 transects surveyed is summarized by location and benthic composition type in Table 6.

Table 6. Conch abundance surveyed during the St. Croix - South October 2010 mission.

Location	Habitat	# surveys	Immature	Mature	Total
Inshore	Hard	1	1	0	1
	Soft	6	14	0	14
	Both	**7**	**15**	**0**	**15**
Offshore	Hard	1	0	1	1
	Soft	6	2	17	19
	Both	**7**	**2**	**18**	**20**
Both	Hard	2	1	1	2
	Soft	12	16	17	33
	Both	**14**	**17**	**18**	**35**

Lobster

BUIS

- Three Caribbean spiny lobster, *Panulirus argus*, were recorded on three of the 122 transects surveyed. The lobsters were observed on hardbottom sites, one site within BUIS and two within the EEMP.

South

- There were no Caribbean spiny lobster, *Panulirus argus*, recorded on the 74 transects surveyed.

Sea urchins

BUIS

- A total of 38 long-spined sea urchins, *Diadema antillarum*, were recorded at 5 of the 122 transects. The urchins were recorded on hardbottom sites, one within BUIS and 37 within the EEMP.

South

- Only four long-spined sea urchins, *Diadema antillarum*, were recorded at two of the 74 transects. The urchins were recorded on nearshore hardbottom sites.

Marine Debris

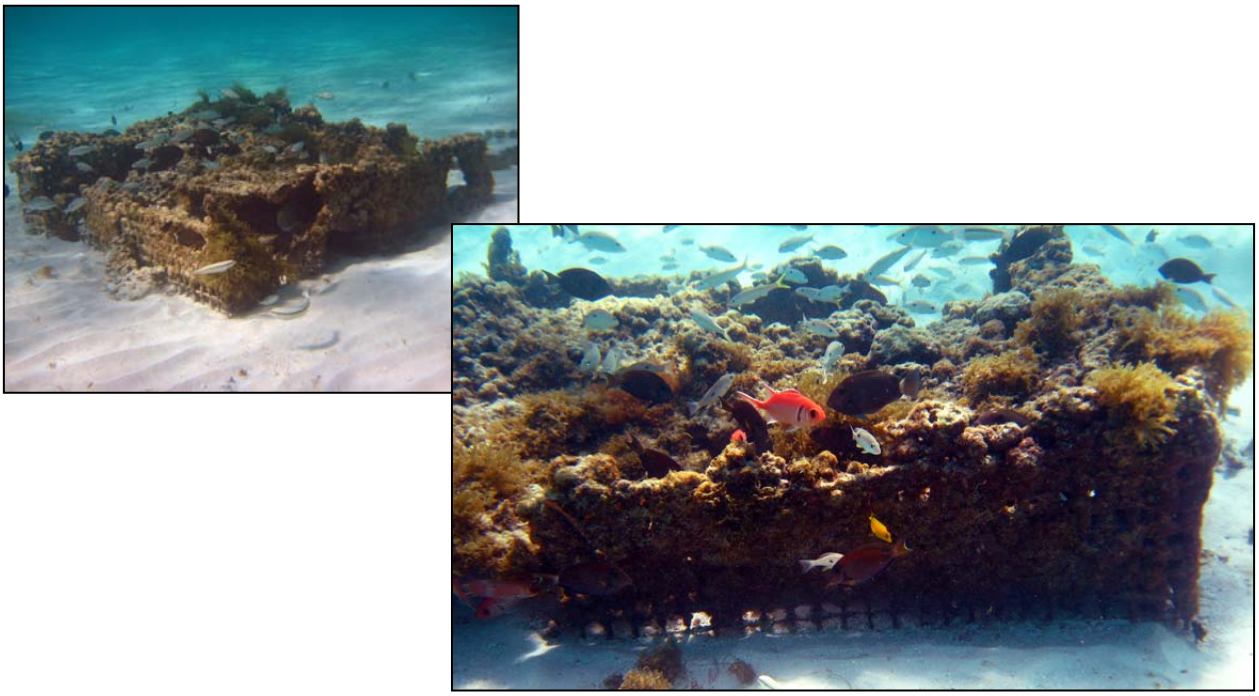
- Marine debris data have been recorded during missions in St. Croix since 2007. The marine debris observed within transects during this mission are summarized in Tables 7 and 8.

Table 7. The type and size of debris, area affected, and what colonized the debris during this St. Croix-BUIS mission.

Station	Habitat Type	Debris Type	Debris Area (cm^3)	Area Affected (cm^3)	Colonized By
HI17	Hard	rope	3	100	nothing
SI47	Soft	glass bottle	15	15	nothing
HO71	Hard	derelict fish pot	75	750	MILLSPP, sponge, cyano,
BL135	Soft	plastic	10	10	crustose coralline algae

Table 8. The type and size of debris, area affected, and what colonized the debris during this St. Croix-South mission.

Station	Habitat Type	Debris Type	Debris Area (cm^3)	Area Affected (cm^3)	Colonized By
SN34	Soft	metal rebar	32	32	turf algae, crustose coralline algae, macro algae, snails



Derelict fish pot, turned artificial habitat, located on the south side of St. Croix in the EEMP.

Events of Note:

- There were three fish recorded for the first time in St. Croix region, all St. Croix-South, during this mission:
    - Sargassum triggerfish (*Xanthichthys ringens*)
    - Bridal cardinalfish (*Apogon aurolineatus*)
    - Cherubfish (*Centropyge argi*)

- Bleaching was observed but not nearly as severe or widespread as October 2005.

Top row L-R: *Diploria strigosa*, *Agaracia* species, *Porites porites*, *Montastraea annularis* complex;
Bottom row L-R: *Colpophyllia natans*, *Diploria labrynthiformis*, *Dichocoenia stokesii*, *Montastraea annularis* complex

- A few weeks before the mission, St. Croix received unprecedented rainfall amounts. The effects were evident at some sites in the northern study area in terms of cyanobacteria/filamentous algae carpets.

Sediment in Teague Bay reef (Photo: Zandy Hillis-Starr)

- A long-spined sea biscuit (*Plagiobrissus grandis*) was observed for the first time during the more than 10 years of monitoring in this area. It was seen and recorded on the South side (EEMP) by Marc Nadon and Nathan Vaughn on 22 Oct 2010. They said it was "bounding" across the sand and then stopped and buried itself.

- A dolphin and her calf were observed during two dives on different days; other divers saw dolphins during other surveys as well.

Logistics of Note:

- Divers surveying the BUIS study region collected video on each of the transects for use in CCMA-BB's re-mapping efforts.
- Divers noted colder water temperatures with readings from 83-85°F.
- We continued to implement the NPS policy of live-boating during our dive operations.
- Commute times for the EEMP South side teams on the EEMP and TNC boats ranged from 45 minutes (calm days) to one and quarter hour (rough days).
- Weather (wind and 4-6+ ft seas) prevented surveys on three days for the southern EEMP sites and one day for the BUIS/Northern EEMP sties.
- SEFSC divers were an integral part of the success of this mission. Few dives were needed for methodology training.
- TNC divers Sarah Bergeron and Jacob Metzger participated in habitat training the first week and then collected data during the second week.
- We coordinated with Todd Gedamke (SEFSC) to place two fish traps on sites in the northern study area as a pilot to see if traps could be placed in highly rugose areas without damage to reefs. Todd also plans to look at trap data versus visual census data.
- During the first week, divers on TNC boat assisted with *Acropora palmata* nursery maintenance.

Mission Participants:

Laurie Bauer (NOAA/CCMA BB)
Sara Bergeron (TNC)
Jeremiah Blondeau (NOAA/NMFS SEFSC)
Eric Cotto (NPS/BUIS – Boat Captain)
Bryan Costa (NOAA/CCMA BB)
Kimberly Edwards (NOAA/CCMA BB)
Dave Grenda (NOAA/NMFS SEFSC)
Matt Kendall (NOAA/CCMA BB)
Kemit-Amon Lewis (TNC – Boat Captain)
Ian Lundgren – Park Dive Officer (NPS/BUIS)
Karen Maloof (NPS/BUIS – Boat Captain)
Dave McClellan (NOAA/ NMFSC SEFSC)
Jacob Metzger (TNC)
Mark Monaco (NCCOS/CCMA)
Marc Nadon (UM-RSMAS)
Simon Pittman (NOAA/CCMA BB)
Kimberly Roberson - UDS (NOAA/CCMA BB)
Ben Ruttenburg (NOAA/NMFS SEFSC)
Jose Sanchez (VIDPNR/EEMP –Boat Captain)
Hank Tonnemacher (NPS Contractor – Boat Captain)
Nathan Vaughan (UM-RSMAS)

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. BUIS strata),

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

- 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.