

Mission Report

NOAA/NOS/NCCOS/CCMA/Biogeography Branch

July 15 – July 28, 2007

A strategy to inventory, characterize, and monitor the marine region within and around the National Park and Monument boundaries of St. John, USVI

A cooperative investigation between NOAA, National Park Service, US Geological Survey, Virgin Islands Department of Planning and Natural Resources, University of Hawaii, and the Oceanic Institute

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

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Mission Report: A strategy to inventory, characterize, and monitor the marine region within and around the National Park and Monument boundaries of St. John, USVI

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Mission Purpose:

The intent of this field mission was to continue ongoing efforts: (1) to spatially characterize and monitor the distribution, abundance and size of both reef fishes and conch within and around the waters of the Virgin Islands National Park (VIIS) and newly established Virgin Islands Coral Reef National Monument (VICR), (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, University of the Virgin Islands (UVI) and others. Examples include UVI's use of NOAA-produced habitat maps for site selection to evaluate coral bleaching effects on coral communities, NOAA/University of Hawaii's use of habitat maps and fish data for analysis on the "wedge" between VICR boundaries, NOAA's use of data collection methodology for the design of NPS protocols, and NOAA's use of habitat characterizations from sites in the mid-shelf reef (MSR) for ground truthed multi-beam habitat classification.

In April 2002, a local inter-island ferry (the Voyager Eagle) ran aground and was removed from Johnson's reef in the Virgin Islands National Park resulting in three areas National Park Service staff identified as being injured by the grounding and subsequent removal of the vessel. NOAA's Biogeography Branch (BB) is collaborating with NPS staff to develop estimates of coral cover within the areas damaged by the Voyager Eagle. These estimates will be used in litigating and negotiating compensation for damages caused by the impact of this grounding.

This year, marine debris information was collected for the first time for the Caribbean Coral Reef Ecosystem Monitoring (CREM) project, which will tie directly to the management needs of the Park. Additionally, a week prior to the commencement of this field mission, the Biogeography Branch, in partnership with NPS in St. John, continued to work on another project of acoustically tracking fish movements in the coral reef systems of the VIIS and VICR (Appendix A).

Operational Accomplishments:

- ◆ 169 sites were surveyed (Figure 1), and information on benthic habitat composition (Tables 1 & 2), fish distribution, abundance and size (Tables 3, 4 & 5), and conch abundance and distribution was collected. The project team consisted of 3 NPS, 1 Oceanic Institute and 8 NOAA scientific divers. NPS and NOAA dive logs were maintained.
- ◆ Three NPS boats were used each day of the mission. Approximately 3-4 divers per boat.
- ◆ Divers were able to conduct surveys on all days required.
- ◆ Both air and Nitrox (32 – 34% O₂) tanks were used.



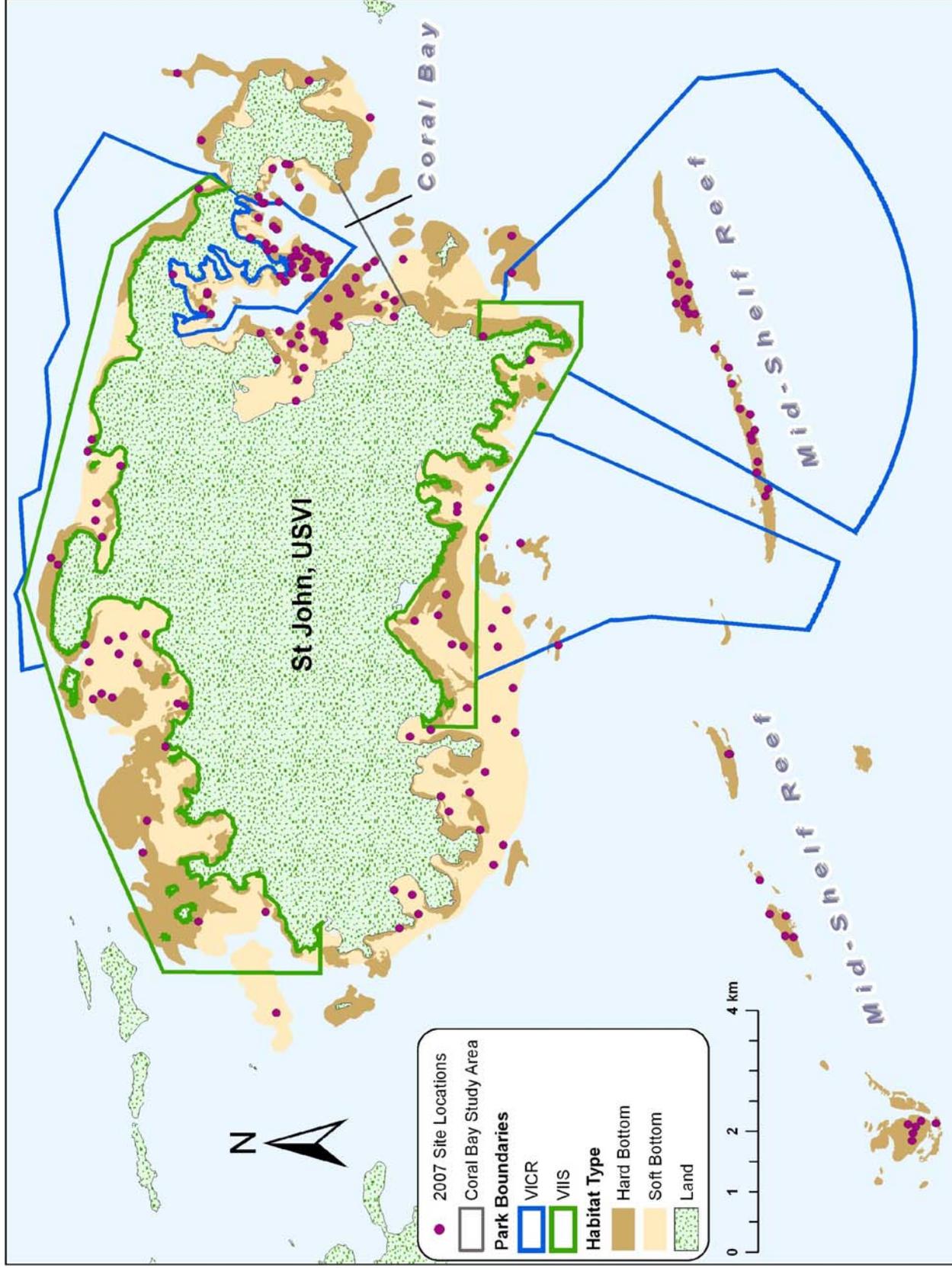


Figure 1. Map of Virgin Islands Coral Reef National Monument and Virgin Islands National Park detailing benthic composition characteristics, park boundaries and selected survey points for the July 2007 mission

Summary of Survey Results:

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 169 sites. The fish data are separated and weighted according to habitat strata and location (Tables 1 and 2). See Appendix B for weighted data calculations. **NOTE: Due to a high number of *Coryphopterus personatus* at two MSR OUTSIDE sites (n=1000 each) and one hard OTHER site (n=1700) and *Jenkinsia* sp. (n=20,000) at another hard OTHER site, these values were removed from the abundance and biomass values reported below.**

Table 1. Fish abundance, richness, biomass and diversity (all per 100m²) from MSR and Coral Bay around St. John using the belt transect method. Data are from the July 2007 St. John mission.

Habitat Location	Habitat Strata	# of Surveys	# indiv / 100m ²		biomass (g) /100m ²		# species / 100m ²		Diversity*	
			Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Mid Shelf Reef	Inside	20	174.9	24.6	7135.10	1312.15	21.8	0.7	2.32	0.09
	Outside	15	389.3	65.4	9887.17	3220.40	25.5	1.1	1.74	0.14
	OVERALL	35	300.4	26.6	8746.03	1329.03	23.9	0.5	1.98	0.06
Coral Bay	Inside	30	179.3	19.9	5051.22	757.50	21.3	0.9	2.24	0.07
	Outside	25	255.5	35.8	4405.51	681.44	20.7	0.9	1.80	0.12
	OVERALL	55	230.0	18.1	4621.44	386.60	20.9	0.5	1.94	0.06
Both	Inside	50	176.9	11.5	6204.79	553.06	21.5	0.4	2.28	0.04
	Outside	45	318.1	24.5	6970.55	898.05	22.9	0.5	1.77	0.06
	OVERALL	90	265.2	11.2	6683.75	428.91	22.4	0.3	1.96	0.03

*Shannon Diversity Index

Table 2. Fish abundance, richness, biomass and diversity (all per 100m²) from hard and soft bottom sites around the Virgin Islands National Park using the belt transect method. Data are from the July 2007 St. John mission.

Habitat Location	Habitat Strata	# of Surveys	# indiv / 100m ²		biomass (g) /100m ²		# species / 100m ²		Diversity*	
			Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Other	Hard	30	189.5	30.3	3539.37	874.73	21.7	1.8	2.05	0.13
	Soft	49	46.1	7.0	1499.95	889.60	7.6	0.6	1.47	0.08
	OVERALL	79	107.2	7.8	2369.75	451.71	13.6	0.5	1.71	0.05

*Shannon Diversity Index



A Juvenile schoolmaster (*Lutjanus apodus*) and *Jenkinsia* spp. in a patch of *Padina jamaicensis*

- ◆ The Bohnsack-Bannerot point-count method (see protocol link above) for characterizing fish species abundance, size and distribution was used to collect data at 90 RHA sites (Table 3). Due to poor visibility, 6 CB point-count surveys were not conducted. **NOTE: Due to a high number of *Coryphopterus personatus* at two MSR (2 outside, 1 inside) sites and one CB Inside (n=1000 each) and *Atherinomorus* sp. (n=20,000) a CB Outside site, these values were removed from the abundance and biomass values reported below.**

Table 3. Fish abundance, richness, biomass and diversity (all per 100m²) from MSR and CB sites using the point-count method. Data are from the July 2007 St. John mission.

Habitat Location	Habitat Type	# of Surveys	# indiv / 100m ²		biomass(g) / 100m ²		# species / 100m ²		Diversity*	
			Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Mid Shelf Reef	Inside	20	110.4	8.1	1929.09	315.42	16.6	0.6	2.18	0.08
	Outside	15	229.3	38.9	3978.47	933.33	16.8	1.0	1.62	0.14
	OVERALL	35	180.0	14.7	3128.70	374.03	16.7	0.4	1.85	0.06
Coral Bay	Inside	27	110.4	8.1	1929.09	315.42	16.6	0.6	2.18	0.08
	Outside	22	229.3	38.9	3978.47	933.33	16.8	1.0	1.62	0.14
	OVERALL	49	189.5	18.1	3293.15	448.75	16.8	0.5	1.80	0.07
Both	Inside	47	110.4	4.1	1929.09	159.52	16.6	0.3	2.18	0.04
	Outside	37	229.3	19.5	3978.47	468.59	16.8	0.5	1.62	0.07
	OVERALL	84	184.8	8.2	3210.92	205.69	16.7	0.2	1.83	0.03

* Shannon Diversity Index



A juvenile flying gurnard (*Dactylopterus volitans*) less than 5 cm long.



A cherubfish (*Centropyge argi*).

Habitat

- ◆ Data were collected at 169 sites for benthic composition characterization. Surveys at 90 sites were conducted within and around the waters of Coral Bay (CB) and the Virgin Islands Coral Reef National Monument Mid-Shelf Reef (MSR) locations using the Rapid Habitat Assessment (RHA) method. Below is a summary of RHA data weighted based on area sampled (Table 4). Methodology of RHA collection can be found at http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html. See Appendix B for weighted data calculations.

Table 4. Average percent cover for 90 hard bottom sites in and around MSR and CB for the July 2007 St. John mission.

Habitat Location	Strata Type	# of Surveys	% Coral		% Macroalgae		% Turf-Uncol		% Gorgonian		% Sponge	
			Mean	(\pm SE)	Mean	(\pm SE)	Mean	(\pm SE)	Mean	(\pm SE)	Mean	(\pm SE)
Mid Shelf Reef	Inside	20	1.6	0.3	51.3	4.7	14.4	2.8	22.2	2.9	10.6	1.3
	Outside	15	3.9	0.7	52.7	3.5	19.5	3.8	12.3	2.0	11.7	1.7
	OVERALL	35	2.9	0.29	52.1	2.00	17.4	1.77	16.4	1.17	11.2	0.80
Coral Bay	Inside	30	1.7	0.2	42.1	4.2	44.0	3.9	9.8	1.7	2.5	0.4
	Outside	25	6.3	1.2	26.6	2.8	57.6	3.5	7.6	1.5	1.9	0.2
	OVERALL	55	4.8	0.55	31.8	1.71	53.0	1.98	8.3	0.86	2.1	0.15
Both	Inside	50	1.6	0.1	47.2	2.3	27.6	1.6	16.7	1.2	7.0	0.5
	Outside	40	5.2	0.5	38.8	1.6	39.8	1.8	9.8	0.9	6.5	0.4
	OVERALL	90	3.8	0.2	42.0	0.9	35.2	0.9	12.4	0.5	6.7	0.2

- ◆ Full-scale surveys at 79 sites were conducted on hard and soft bottom sites within and around the waters of the Virgin Islands National Park. The weighted hard and soft bottom data are summarized in Table 5. Methodology on full-scale benthic composition data collection can be found using the methodology link (mentioned above).

Table 5. Average percent cover for habitat types for 79 full-scale sites for the July 2007 St. John mission.

Habitat Location	Strata Type	# of Surveys	% Coral*		% Macroalgae		% Turf-crustose		% Gorgonian		% Sponge	
			Mean	(\pm SE)	Mean	(\pm SE)	Mean	(\pm SE)	Mean	(\pm SE)	Mean	(\pm SE)
Other	Hard	30	5.1	1.0	23.8	3.7	22.7	2.4	3.7	0.7	2.8	0.3
	Soft	49	0.03	0.02	38.2	4.2	3.6	1.0	0.0	0.0	0.3	0.1
	OVERALL	79	2.2	0.19	32.1	2.04	11.8	0.77	1.6	0.13	1.4	0.10

* Values include hydrocorals (i.e. fire corals)



Barrel sponges

Conch



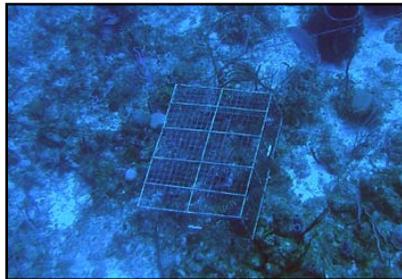
- ◆ A total of 27 conch, *Strombus gigas*, (19 immature, 8 mature) were observed along transects on soft (17 immature, 7 mature) and hard bottom (2 immature, 1 mature) sites.
- ◆ During one of the dives, a queen conch (*Strombus gigas*) was spotted wearing a visor (*Image to the left*)

Marine Debris:

- ◆ Marine debris data were recorded to meet the management needs of NPS. This was the first mission debris data were recorded for the Caribbean Coral Reef Ecosystem Monitoring (CREM) project. The marine debris observed within transects are summarized in Table 6.

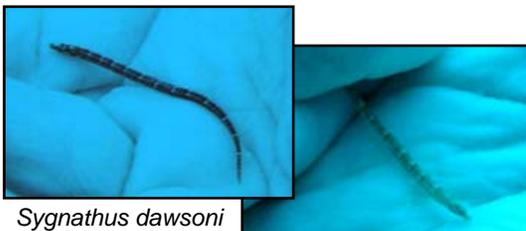
Table 6. The type and area of debris, area affected by the debris, and what the debris was colonized by during the July 2007 mission.

Debris Type	Debris Area (cm ²)	Colonized By	Area Affected (cm ²)
fishing line	10	algae	10
visor	60	conch	60
large piece of wood//rope from boat	8400	reef and algae	8400
plastic cup	40	nothing	40



Events of Note:

- ◆ There were several fish recorded on transects for the first time in St. John during this mission:
 - Bridle cardinalfish (*Apogon aurolineatus*)
 - Longsnout seahorse (*Hippocampus reidi*)
 - Sheepshead porgy (*Calamus penna*)
 - Common remora (*Remora remora*)
 - Pipehorse (*Sygnathus dawsoni*)
 - Pearly razorfish (*Xyrichthys novacula*)



Sygnathus dawsoni



Pearly razorfish, *Xyrichthys novacula*

Logistics of Note:

- ◆ Two new habitat divers were trained: Andy Davis (NPS) and Thomas Kelley (NPS)
- ◆ Point-counts were unable to be conducted at several sites (n=6) in Coral Bay due to poor visibility.
- ◆ Nitrox tanks were filled on St. Thomas resulting in one boat stopping dive operations/data collection early each day.

**Mission Participants:**

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Appendix A – Acoustic Fish Tracking Abstract

Acoustic Tracking of Reef Fishes to Elucidate Habitat Utilization Patterns and Residence Times Inside and Outside Marine Protected Areas around the Island of St. John, USVI

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With contributions from Jim Beets, Rafe Boulon, Russell Callender, John Christensen, Randy Clark, Sarah Hile, Matt Kendall, Jeff Miller, Caroline Rogers, Lisa Wedding, KimWoody

Abstract

This technical memorandum describes a developing project under the direction of NOAA's Biogeography Branch in consultation with the National Park Service and US Geological Survey to understand and quantify spatial patterns and habitat affinities of reef fishes in the US Virgin Islands. The purpose of this report is to describe and disseminate the initial results from the project and to share information on the location of acoustic receivers and species electronic tag ID codes. The Virgin Islands Coral Reef National Monument (VICRNM), adjacent to Virgin Islands National Park (VIIS), was established by Executive Order in 2000, but resources within the monument are poorly documented and the degree of connectivity to VIIS is unknown. Whereas, VICRNM was established with full protection from resource exploitation, VIIS has incurred resource harvest by fishers as allowed in its enabling legislation since 1956. Large changes in local reef communities have occurred over the past several decades, in part due to overexploitation. In order to better understand the habitat utilization patterns and movement of fishes among management regimes and areas open to fishing around St. John, we deployed an array of hydroacoustic receivers and acoustically tagged a variety of reef fish species. In July 2006, nine receivers with a detection range of ca. 350 m were deployed in Lameshur Bay on the south shore of St. John, within VIIS. Receivers were located adjacent to reefs and in seagrass beds, inshore and offshore of these reefs. Lane snappers and bluestriped grunts showed diel movement from reef habitats during daytime hours to offshore seagrass bed at night. Timing of migrations was highly predictable and coincided with changes in sunrise and sunset over the course of the year. Fish associated with reefs that did not have adjacent seagrass beds made more extensive movements than those fishes associated with reefs that had adjacent seagrass habitats. In April 2007, 21 additional receivers were deployed along much of the south shore of St. John (ca. 20 km of shoreline). This current array will address broader-scale movement among management units and examine the potential benefits of the VICRNM to provide adult "spillover" into VIIS and adjacent harvested areas. The results from this work will aid in defining fine to moderate spatial scales of reef fish habitat affinities and in designing and evaluating marine protected areas.



Appendix B - 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,

$$\bar{y}_{st} = \sum_{h=1}^L W_h \bar{y}_h \quad (4.6)$$

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

$$W_h = \frac{N_h}{\sum_{h=1}^L N_h} = \frac{N_h}{N} \quad (4.7)$$

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. MSR strata),

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

- All strata types combined (e.g. MSR, Coral Bay and Other),

$$\begin{aligned} & \left(\text{Mean \# indiv inside MSR} \times \frac{\text{area inside MSR}}{\text{Total area}} \right) + \left(\text{mean \# indiv outside MSR} \times \frac{\text{area outside MSR}}{\text{total area}} \right) + \left(\text{mean \# indiv inside CB} \times \frac{\text{area inside CB}}{\text{total area}} \right) + \left(\text{mean \# indiv outside CB} \times \frac{\text{area outside CB}}{\text{total area}} \right) \\ & + \left(\text{mean \# indiv OTHER hard} \times \frac{\text{Area OTHER hard}}{\text{total area}} \right) + \left(\text{mean \# indiv OTHER soft} \times \frac{\text{area OTHER soft}}{\text{total area}} \right) \end{aligned}$$

- ◆ 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

$$\text{var}[\bar{y}_{st}] = \sum_{h=1}^L W_h^2 \text{var}[\bar{y}_h] \quad (4.8)$$

References

Menza, C., J. Ault, J. Beets, J. Bohnsack, C. Caldwell, 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.