

La Parguera, Puerto Rico Mission Report

NOAA/NOS/NCCOS/CCMA/Biogeography Branch

January 29 – February 8, 2009

A cooperative investigation between NOAA and the
University of Puerto Rico

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

October 2009



La Parguera, Puerto Rico Mission Report

A cooperative investigation between NOAA and the University of Puerto Rico

January 29 – February 8, 2009

Mission Purpose:

This field mission was carried out as part of the Caribbean Coral Reef Ecosystem Monitoring Project led by CCMA's Biogeography Branch (BB). The goals and objectives of this project are: (1) to spatially characterize and monitor the distribution, abundance, and size of both reef fishes and macro-invertebrates (conch, lobsters, and sea urchins); (2) to relate this information to in-situ data collected on associated benthic composition parameters; (3) to use this information to establish the knowledge base necessary for enacting management decisions in a spatial setting; (4) to establish the efficacy of those management decisions; and (5) to work with the National Coral Reef Monitoring Program to develop data collection standards and easily implemented methodologies for transference to other agencies and to work toward standardizing data collection throughout the US and territories.

In addition to serving the goals and objectives above, the data collected thus far have also been utilized by partner agencies for a number of additional projects including stock assessments (U of Miami; NMFS); examination of ornamental fish populations (PRDNR); delineation of Essential Fish Habitat (Caribbean Fishery Management Council); EcoPath modeling (NMFS); and survey design (UPR). Most recently, BB data are being incorporated as part of the Southeast Data, Assessment, and Review (SEDAR) conducted by NMFS' Southeast Fisheries Science Center. The purpose of this effort is to develop stock assessments and population estimates for yellowfin grouper (*Mycteroperca interstitialis*), mutton snapper (*Lutjanus analis*) and queen conch (*Strombus gigas*) in Puerto Rico at the request of the Caribbean Fishery Management Council.

Erinn Muller, a Nancy Foster Fellowship recipient, collaborated with Biogeo to examine the spatial distribution of coral diseases, to provide baseline information on disease prevalence over varying spatial scales and to establish spatial distributions of coral diseases in La Parguera.

Logistics:

- ◆ Ninety sites were surveyed within the study area (Figure 1), and information on fish distribution, abundance and size (Table 1), benthic habitat composition (Table 2), coral bleaching, macroinvertebrate (conch, *Diadema*, lobster) abundance and distribution (Table 3), and marine debris (Table 4) was collected. The project team consisted of four NOAA scientific divers.
- ◆ Air and Nitrox (32%) tanks were used during this mission. All tanks were filled at Parguera Divers.
- ◆ The *Aquanauta* was used and captained by Angel Nazario and assisted by Joeito.



Fish diver at survey site



Benthic composition diver at survey site

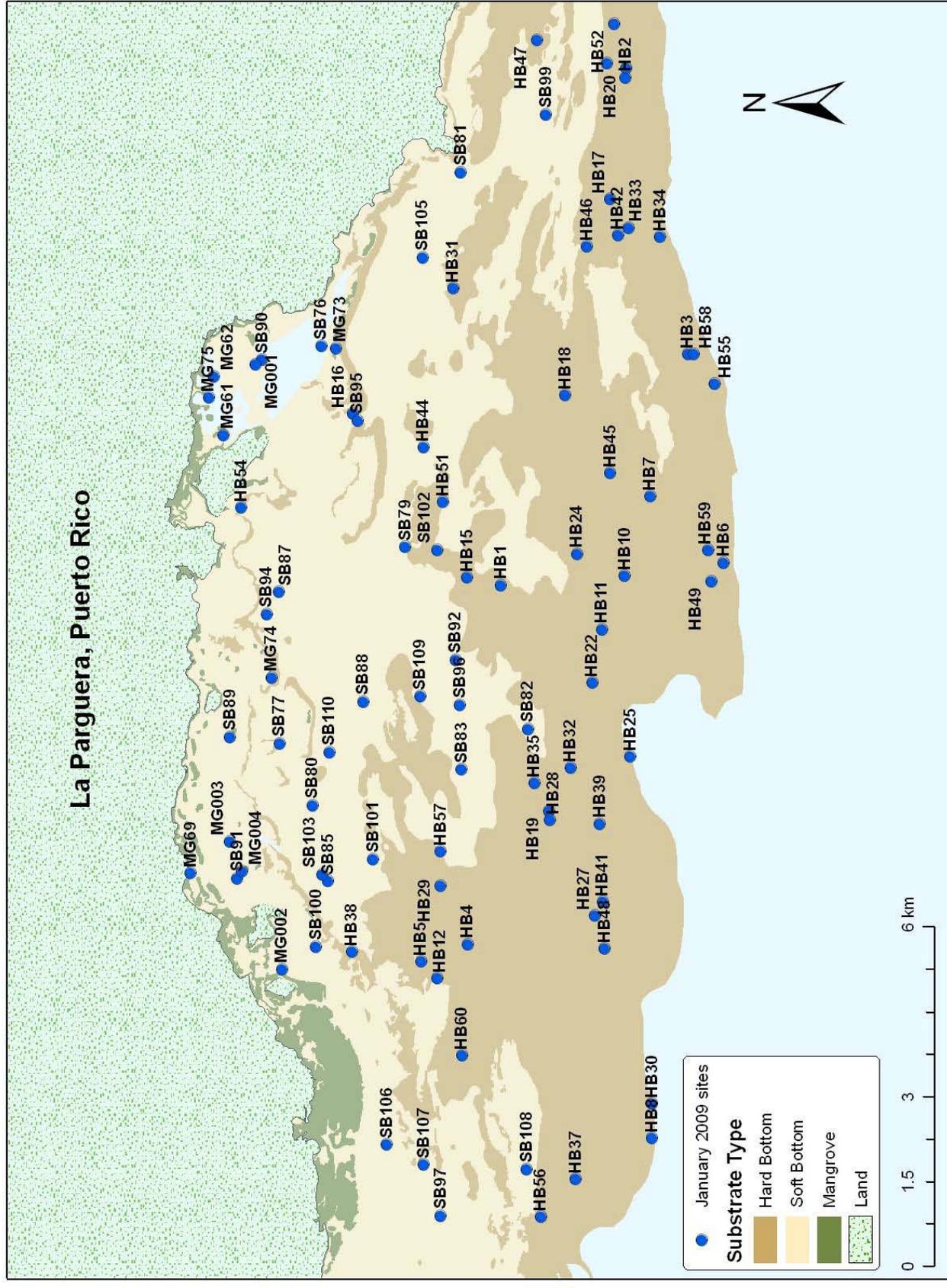


Figure 1. Map of La Parguera, Puerto Rico detailing benthic composition characteristics and selected survey points for January 2009 mission.

Summary of Survey Results:

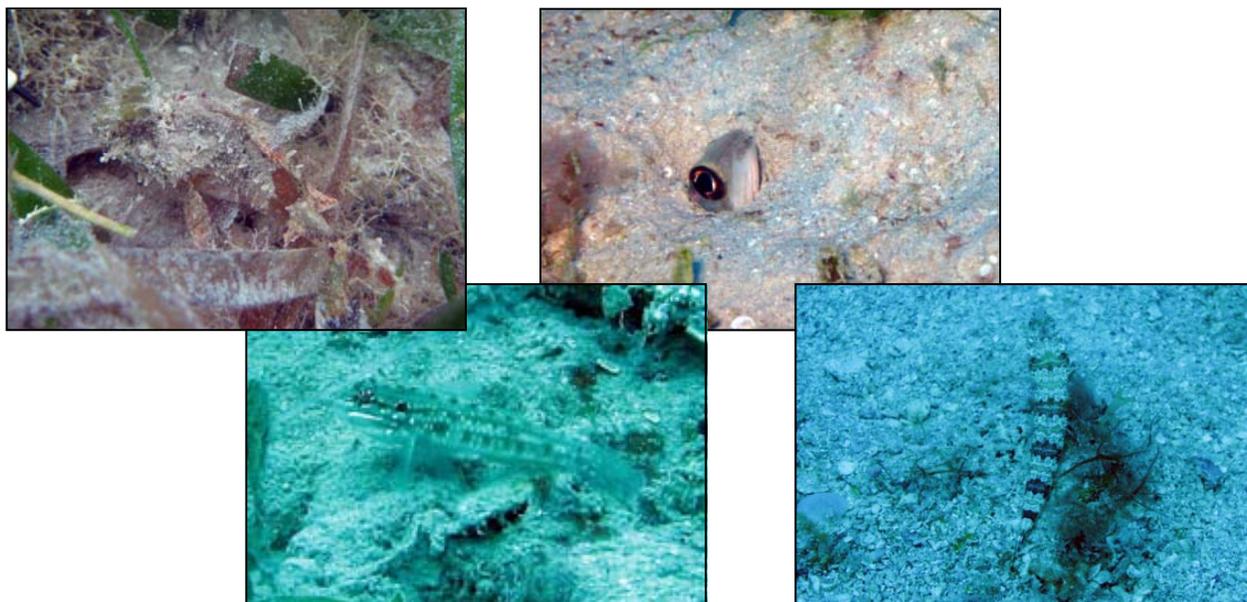
Fish

- ◆ 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 all sites. The data are weighted based on area sampled and are summarized in Table 1. See Appendix A for data calculations.
- ◆ Four of the ten mangrove sites had >1000 baitfish (*Jenkinsia* and *Atherinomorus* species) recorded.

Table 1. Average fish abundance, biomass, richness and diversity. Data are from the January 2009 mission.

Habitat Type	Number of Surveys	# indiv / 100m ²		Biomass (g) /100m ²		# species / 100m ²		Diversity*	
		Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Hard	46	76.4	6.2	2158.8	275.7	17.4	0.9	2.33	0.06
Soft	34	24.8	5.4	1113.3	907.3	4.4	0.7	0.91	0.10
Mangrove	10	921.0	335.2	5379.1	3124.3	11.0	1.0	0.99	0.23
OVERALL	90	1011.0	343.7	7924.30	3505.75	31.5	2.2	3.74	0.32

*Shannon Diversity Index



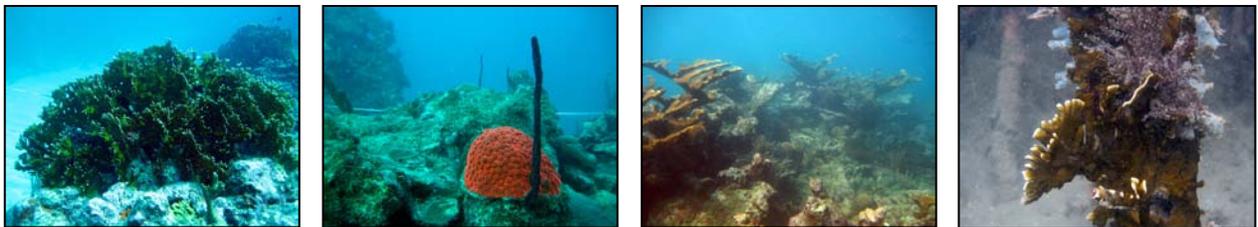
Cryptic fish seen in La Parguera (left to right): Juvenile scorpionfish (*Scorpaena plumieri*), colon goby (*Coryphopterus dicrus*), unknown conger eel species (suggested margintail conger [*Paraconger caudilimbatus*]), and sand diver (*Synodus intermedius*).

Habitat

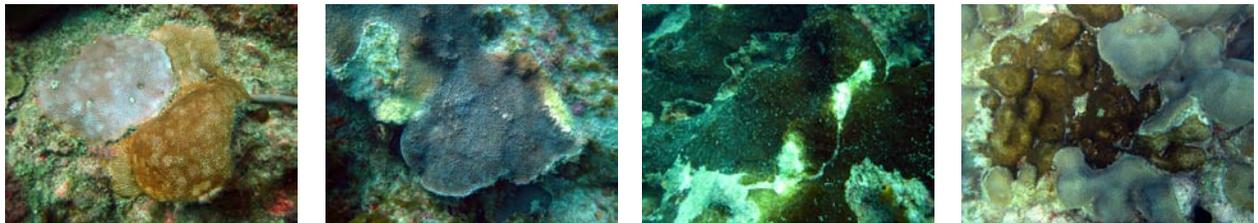
- ◆ Benthic composition data were collected at all 90 sites during the January 2009 mission. Data are weighted based on area sampled and are summarized in Table 2. Detailed methodology can be found at http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html.

Table 2. Average percent cover of habitat types for 90 sites for January 2009 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)
Hard	46	3.14	0.53	0.04	0.01	14.79	2.10	42.81	3.88	5.43	0.88	1.98	0.33
Soft	34	0.03	0.01	0.00	0.00	21.85	4.84	0.19	0.10	0.01	0.01	0.49	0.14
Mangrove	10	0.01	0.01	0.00	0.00	35.90	9.38	3.23	3.04	0.40	0.40	0.17	0.11



Habitat species (from left to right): cluster of fire coral, bright red-orange *Montastraea cavernosa*, haystack of elkhorn coral (*Acropora palmata*) and fire coral algae growing on a prop root.



Images of diseased coral (left two photos) and dead coral with cyanobacteria/filamentous algal overgrowth (right two photos).

Macroinvertebrates

Macroinvertebrates data were collected at all 90 sites within the study area.

Conch

- ◆ The number of Queen conch (*Strombus gigas*) observed within transects during full-scale surveys at 90 sites is summarized by benthic composition type in Table 3.

Table 3. The abundance of conch collected during the January 2009 mission.

Habitat	# surveys	Immature	Mature	Total
Hard	3	1	3	4
Soft	2	2	0	2
Mangrove	0	0	0	0
Overall	5	3	3	6



Lobster

- ◆ Five Caribbean spiny lobster, *Panulirus argus*, were observed. Four individuals were recorded at two mangrove sites and one individual was recorded on a hardbottom site.

Sea urchins

- ◆ A total of 81 long-spined sea urchins, *Diadema antillarum*, were observed. Eighty individuals were recorded on six hardbottom sites and one urchin was recorded at one mangrove site.

Marine Debris:

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

Table 4. The type and size of debris, area affected, and what the debris was colonized by during this mission.

Station	Habitat Type	Debris Type	Debris Area (cm ³)	Area Affected (cm ³)	Colonized By
1	Soft	Tire	7850	1963	turf algae
2	Soft	Glass bottle	30	24	Macroalgae, encrusting sponge
3	Soft	Plastic bottle	80	80	Turf algae
4	Soft	Sheet of plastic	120	120	Macroalgae
5	Mangrove	Rope	120	120	Crustose algae
		Plastic bag	150	150	-
		Plastic bottle	150	150	Filamentous/crustose algae
6	Mangrove	Bottle	105	105	Tunicates
		Fishing line	450	450	Macroalgae, crustose algae
7	Mangrove	Rope	200	200	Crustose algae
		Mesh net	100	100	Crustose algae
		Plastic sheet	160	160	Crustose algae
		12 beer cans	240	240	Filamentous algae
		10 plastic cups	200	200	Filamentous algae
		Soda bottle	75	75	Filamentous algae
		Play pot	70	70	Filamentous algae
8	Mangrove	Beer bottle	105	105	Sea cucumber, turf and crust. algae
9	Mangrove	Tire	2500	750	Zooanthids, tunicates
		Trap	67500	67500	Mussel, tunicate, sponge, algae



Debris found in mangroves (left to right): abandoned trap, fishing line and a tire.

Events of Note:

- ◆ The twinspace bass (*Serranus flaviventris*) was recorded on a transect for the first time since surveys began in 2000 in Puerto Rico.



- ◆ Four of the ten mangrove sites had 1000+ bait fish recorded.



- ◆ A nurse shark was seen in the mangroves resting underneath the prop roots.



Logistics of Note:

- ◆ Mission was accomplished with two dive teams.
- ◆ Erinn Muller began data recording for coral health this mission. She was able to test her methodology and make adjustments were needed. Upon completion of the mission, her methods were solidified.

Mission Participants in Data Collection:

Kimberly Edwards (NCCOS/CCMA BB)
Chris Jeffrey (NCCOS/CCMA BB)

Simon Pittman (NCCOS/CCMA BB)
Kimberly Woody (NCCOS/CCMA BB)



Left to right: Sea anemone with shrimp, cero mackerel, rippled sand habitat, and mussels attached to mangrove prop roots.

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 .

An example of calculations is provided below:

- All strata types combined (e.g. Hardbottom, Softbottom, Mangrove),

$$\left(\begin{array}{c} \text{Mean \#} \\ \text{indiv} \\ \text{Hard} \end{array} \times \frac{\text{area Hard}}{\text{Total area}} \right) + \left(\begin{array}{c} \text{mean \#} \\ \text{indiv Soft} \end{array} \times \frac{\text{areaSoft}}{\text{total area}} \right) + \left(\begin{array}{c} \text{mean \#} \\ \text{indiv} \\ \text{Mangrove} \end{array} \times \frac{\text{area Mangrove}}{\text{total area}} \right)$$

- ◆ 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

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

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. 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.