

Mission Report

NOAA/NOS/NCCOS/CCMA/Biogeography Branch

January 29 – February 8, 2008

Characterization and monitoring of reef fish populations off the coast of La Parguera, Puerto Rico:

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

April 2008



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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.

Operational Accomplishments:

- ◆ 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; and macroinvertebrate (conch, lobster, *Diadema*) abundance and distribution was collected. The project team consisted of four NOAA scientific divers and one UPR diver.



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.

Table 1. Average fish abundance, biomass, richness and diversity. Data are from the January/February 2008 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	43	71.1	6.8	2136.1	252.1	17.3	0.9	2.31	0.06
Soft	37	31.2	4.6	474.2	233.9	5.1	0.5	1.04	0.09
Mangrove	10	164.2	70.1	675.9	91.7	9.6	0.8	1.45	0.18
OVERALL	90	248.0	79.5	3190.93	440.40	30.0	2.1	4.17	0.27

*Shannon Diversity Index



Habitat

- ◆ Benthic composition data were collected at all sites during the January/February 2008 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.

Table 2. Average percent cover of habitat types for 49 hardbottom sites for January/February 2008 mission.

Number of Surveys	% Coral*		% Algae-Seagrass		% Turf- Crustose		% Gorgonians		% Sponges	
	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
43	2.18	0.40	13.21	1.86	25.11	3.93	5.25	0.85	1.54	0.21

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



Macroinvertebrates

Conch

- ◆ A total of 20 conch, *Strombus gigas*, were observed during transects (n= 90) on this mission. Four conch were enumerated at four hardbottom sites (3 immature, 1 mature) and 16 conch at nine softbottom sites (14 immature, 2 mature).

Lobster

- ◆ A total of 5 Caribbean spiny lobsters, *Panulirus argus*, were observed during transects (n= 90) on this mission. Four lobster were enumerated at one mangrove site and one lobster at one hardbottom site.

Sea urchins

- ◆ A total of 54 long-spined urchins, *Diadema antillarum*, were observed during transects (n= 90) on this mission. Fifty-three *Diadema* were enumerated at one hardbottom site and one *Diadema* recorded at another hardbottom 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 3.

Table 3. The type and area of debris, area affected by the debris, and what the debris was colonized by during the January/February 2008 mission.

Debris Type	Debris Area (cm ²)	Colonized By	Area Affected (cm ²)
plastic bag	539	nothing	539
beer can	60		60
beer bottle	102	turf algae, crustose algae, cyanobacteria	102
soda can	60	algae	60
wood boat part	27000	algae	27000
plastic bag	300		600
piece of rope	1000	tunicates, hydroids, algae	1000
plastic drum	6000	algae	6000
coors light beer can	60		240
plastic bag	160	algae	160
tea cup	100	algae, crustose and filamentous algae	100
piece of fiberglass	90	algae	90
beer bottle	250	sea cucumber and algae	250
pipe	450	algae	450



Events of Note:

- ◆ The following two species were recorded on a transect for the first time since sampling began in 2000.
 - Seaweed blenny (*Parablennius marmoratus*)
 - Bluestriped lizardfish (*Synodus saurus*)
- ◆ This was the first Puerto Rico mission since collection began in 2000, where no red hinds (*Epinephelus guttatus*) were recorded in a transect.

Logistics of Note:

- ◆ This mission had the coldest water temperatures experienced to date, around 75° F.
- ◆ Water clarity at the mangrove sites was noticeable higher than observed in the past.

Mission Participants in Data Collection:

Ivonne Bejarano (UPR)
 Chris Caldwell (NCCOS/CCMA BB)
 Randy Clark (NCCOS/CCMA BB)

Kim Foley (NCCOS/CCMA BB)
 Kimberly Woody (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 .

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.