

Mission Report

NOAA/NOS/NCCOS/CCMA/Biogeography Branch

August 7 – August 17, 2007

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
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Silver Spring, MD 20910

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

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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). BB data are being used also by NMFS' Southeast Fisheries Science Center as part of the SouthEast Data, Assessment, and Review (SEDAR), a review process 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); bleaching; and conch abundance and distribution was collected. The project team consisted of four NOAA scientific divers and two UPR divers. NOAA and UPR dive logs were maintained.
- ◆ One boat was used each day of the mission, except for one day where 2 boats were used to conduct mangrove surveys. During each dive one diver collected data on the fish community while a second diver characterized the habitat and invertebrate community. The third/fourth diver remained on the surface. Rotations were made each dive such that each diver made two consecutive dives then sat out one dive, allowing ample surface intervals for each diver.
- ◆ Nitrox (36 %) was the gas mixture used during the dives. Air tanks were used on a few shallow sites, and snorkel was used for the shallow mangrove sites.



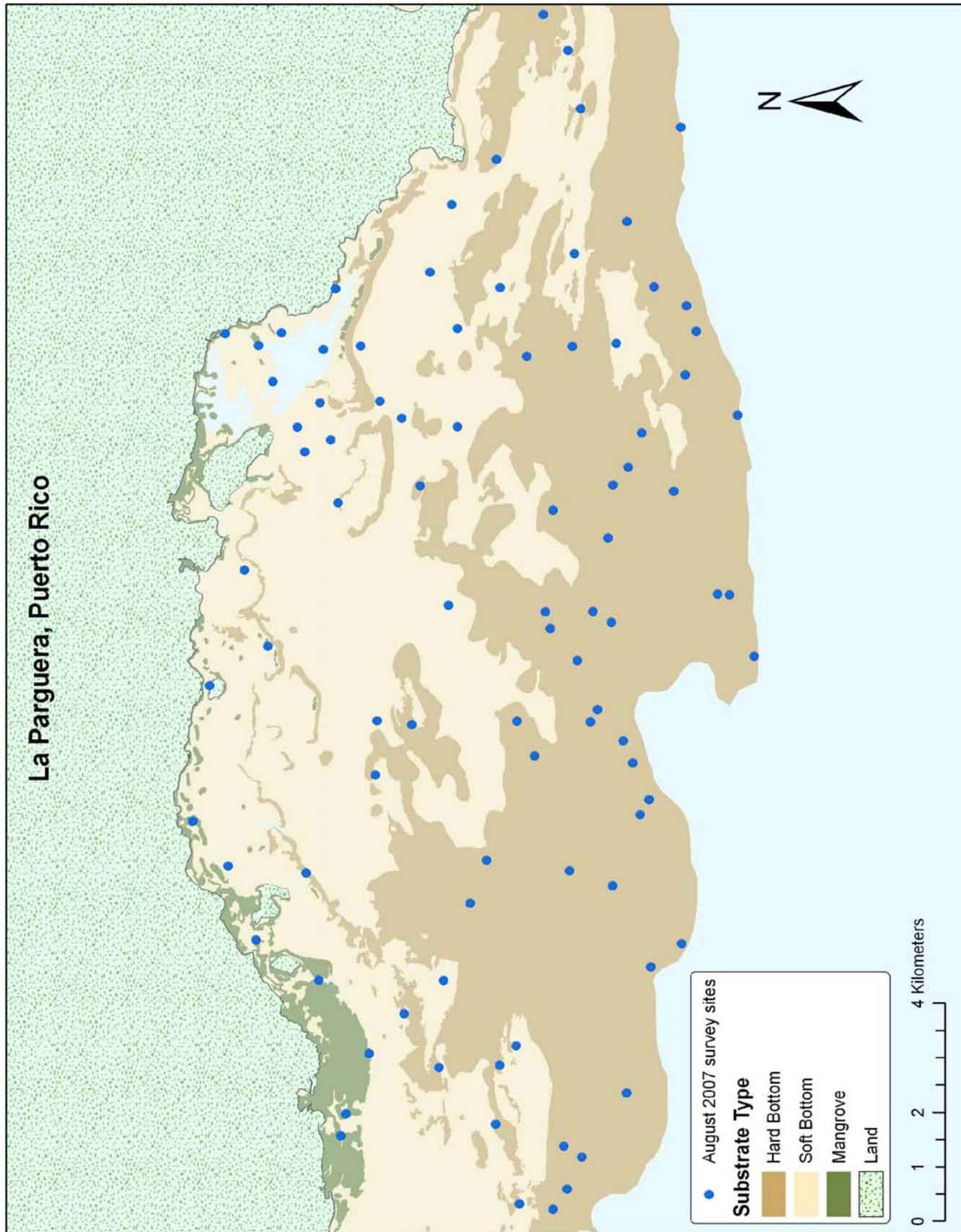


Figure 1. Map of La Parguera, Puerto Rico detailing benthic composition characteristics and selected survey points for August 2007 mission.

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 all sites. The data weighted based on area sampled are summarized in Table 1. See Appendix A for data calculations.

Table 1. Fish abundance, richness and biomass (all per 100m²). Data are from the August 2007 mission.

Habitat Type	Number of Surveys	# indiv / 100m ²		Biomass (g) /100m ²		# species / 100m ²		Mean Diversity*	
		Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
Hard	49	110.1	9.4	3135.2	361.4	20.0	0.8	2.37	0.06
Soft	31	42.0	8.4	83.7	18.6	5.4	0.5	1.07	0.11
Mangrove	10	164.5**	108.8**	1872.2	640.3	9.8	1.3	1.66	0.14
OVERALL	90	294.2	121.8	5560.32	1140.27	33.3	2.4	4.45	0.22

*Shannon Diversity Index

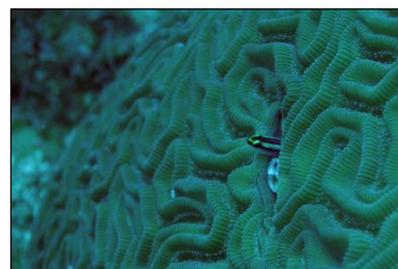
**Values reflect 1070 indiv. of Jenkinsia and Clupeidae species at one site.



Orangespotted goby
(*Nes longus*)



Juvenile banded butterflyfish
(*Chaetodon striatus*)



Sharknose goby (*Elacatinus evelynae*)
in *Diploria labyrinthiformis*

Habitat

- ◆ Benthic composition data were collected at all sites during the August 2007 mission. Detailed methodology can be found at http://ccma.nos.noaa.gov/ecosystems/coralreef/reef_fish/protocols.html. Hard bottom benthic composition data are summarized in Table 2.

Table 2. Average percent cover of habitat types for 49 hardbottom sites for August 2007 mission.

Number of Surveys	% Coral*		% Algae-Seagrass		% Turf- Crustose		% Gorgonians		% Sponges	
	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)	Mean	(± SE)
49	3.43	0.55	26.51	2.63	10.94	1.92	6.33	1.15	2.39	0.27

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



Close up of pillar coral polyps
(*Dendrogyra cylindrus*)



Elkhorn coral
(*Acropora palmata*)



Arrow crab on
(*Montastraea annularis* complex spp.)

Conch

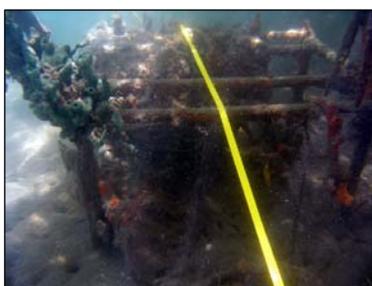
- ◆ A total of three conch, *Strombus gigas*, were observed during transects (n= 90) on this mission, two on hardbottom sites (1 immature, 1 mature) and one on a softbottom site (1 mature).

Marine Debris

- ◆ Marine debris data were recorded for the first time in Puerto Rico during this mission. The marine debris observed within transects 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 August 2007 mission.

Debris Type	Debris Area (cm ²)	Colonized By	Area Affected (cm ²)
champagne bottle	224	turf	224
plastic cylinder	120	sponges, macroalgae	160
PVC rectangular frame	420	sponges, crabs	420
glass bottle	150	macroalgae	150



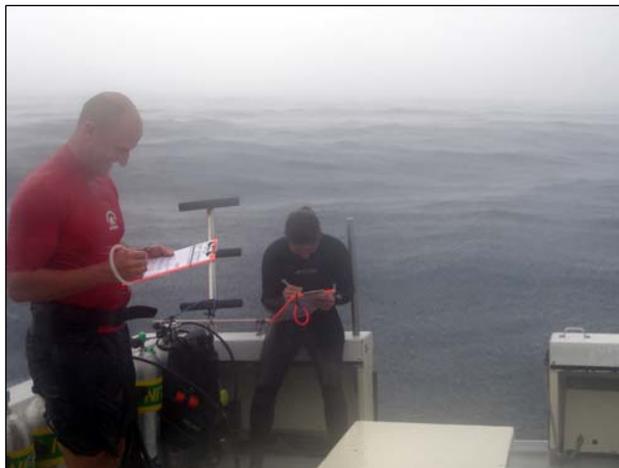
Events of Note:

- ◆ The following four species were recorded on a transect for the first time for the first time since sampling began in 2000.
 - Marked goby (*Ctenogobius stigmaticus*)
 - Peppermint basslet (*Liopropoma rubre*)
 - *Microgobius signatus*
 - Sheepshead pogy (*Calamus penna*)
- ◆ We observed some moderate bleaching at a few sites, with no apparent depth or spatial patterns. Species affected were primarily limited to *Montastraea* (photos below) and *Siderastrea* spp.



Logistics of Note:

- ◆ Hurricane Dean made an appearance towards the end of the mission, making traveling home difficult.

**Mission Participants in Data Collection:**

Ivonne Bejarano (UPR)

Chris Caldwell (NCCOS/CCMA BB)

Randy Clark (NCCOS/CCMA BB)

Kim Foley (NCCOS/CCMA BB)

Stephanie Williams (UPR)

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.