BASELINE CHARACTERIZATION OF CORAL REEF AND SEAGRASS COMMUNITIES FROM ISLA DE VIEQUES, PUERTO RICO

by :

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September, 2001

Acknowledgements

The authors want to express their gratitude to Captain Denny Johnson, owner of Blue Caribe Dive Shop for his support with boat and diving logistics during our field work at Isla de Vieques. Graduate stude nts Yira Rodriguez and Rocio García performed most of the work related with digital video analyses. This study was performed under contract with the Department of Natural and Environmental Resources of the Government of Puerto Rico. Funding was provided by the Center for Coastal Monitoring and Assessment of NOAA, Grant Award # NAO70AO493 to Dr. Jorge R. García Sais.

Table of Contents

Introduction

Isla de Vieques has been the focus of an intense debate regarding the potential impact of U. S. Navy military activities upon its marine resources. Coral reefs and seagrass habitats are of particular concern because of their economic relevance as ecotourism attraction sites of extraordinary marine biodiversity, and also because they function as essential habitats for commercially important fish and shellfish (mostly Queen Conch and Spiny Lobster) populations that are locally exploited. Due to the up-current location of the Vieques Island, its coral reefs and other coastal habitats are potentially important sources of fish and marine invertebrate larvae (including lobster) that can replenish mainland populations down-current from Vieques and Culebra Islands (Roberts, 1997).

Previous reports on Vieques coral reefs include the work by Antonius and Weiner (1982) based on the Florida Reef Foundation study prepared in relation to a suit against the Navy back in 1978. In this study, a number of shallow coral reef sections from within the eastern military bombing range in Vieques were compared to other reefs from the U. S. Virgin Islands. Antonius and Weiner (1982) concluded that the reefs within the bombing range in Vieques exhibited a slightly superior health condition in terms of diseased and/or dead corals than the control reefs from the Virgin Islands. Their theory is that man utilization of coral reefs for tourism and fishing activities is perhaps more detrimental than the bombing practices by the U. S. Navy at Isla de Vieques. They also commented on the difficulties of assessment of bomb versus storm induced breakage of coral colonies.

Reefs outside the U. S. Navy shooting range or deep reef sections within the shooting range had not been previously characterized. In the other available study of the coral reefs from Isla de Vieques, Dodge (1982) did not find any significant differences in coral growth between colonies within and external to the bombing range in Vieques. Despite much controversy, the coral reef communities of the Isla de Vieques have not been properly characterized in terms of the variations of percent cover by sessile-benthic components at different depths. Also, important fish and megabenthic invertebrate populations were not included in the Antonius and Weiner (1982) survey and characterization of these important components of the coral reef community has been lacking.

This work represents a quantitative and qualitative baseline survey of the sessile-benthic and pelagic (fish) communities associated with coral reefs and seagrass habitats located in areas outside the U. S. shooting range in Isla de Vieques. The work includes characterization of marine habitats within the Isla de Vieques Natural Reserve and as such, forms part of a series of quantitative baseline assessments prepared for other natural reserve sites with coral reefs systems in Puerto Rico (García et al. 2000; García et al. 2001).

Methods

This work includes characterization of the coral reef and seagrass communities within the Isla de Vieques Natural Reserve and at three additional zones around Isla de Vieques (Figure 1). The four sampling zones include the shelf sections off La Esperanza (within the Isla de Vieques Natural Reserve) and off Puerto Ferro, on the south coast, the Punta Arenas shelf on the southwest and the reefs and seagrass beds off Isabel Segunda on the north coast. Geo-references and depths for all reef and seagrass sites studied are presented in Table 1.

Table 1. Geographic coordinates and depths of coral reef and seagrass habitats surveyed, February - May, 2001.

Reef Sites	Date	Depth (m)	Latitude	Longitude
Canjilones Reef	Feb. 6, 2001	15.2	18° 05.380' N	065° 35.413' W
Puerto Ferro Reef	Feb. 7, 2001	12	18° 04.845' N	065° 25.057' W
Pirata Reef	Feb. 8, 2001	15.2	18° 05.512' N	065° 35.011, W
Boya Esperanza Reef	Feb. 9, 2001	9.1	18° 04.832' N	065° 29.277' W
West Caballo Blanco	May 17, 2001	4.5	18° 10.297' N	065° 28.126' W
Arrecife Mosquito	May 18, 2001	10.6	18° 09.804' N	065° 29.632' W
Arrecife Comandante	May 19, 2001	5.5	18° 09.465' N	065° 28.227' W
Boya 6	May 19, 2001	10.6	18° 10.711 N	065° 31.148' W
Arrecife Coronas	May 20, 2001	10.6	18° 09.896' N	065° 09.454' W
North Caballo Blanco	May 21,2001	3.0	18° 10.563' N	065° 28.029' W
Black Jack	May 22,2001	30.3	18° 03.319' N	065° 27.794' W
Bajo Holiday	May 21,2001	18.2	18° 13.500' N	065° 23.500' W
Seagrass Sites				
Punta Arenas 1	Feb. 6, 2001	2.7	18° 07.068' N	065° 34.718' W
Punta Arenas 2	Feb. 6, 2001	4.5	18° 07.276' N	065° 34.884' W
Punta Arenas 3	Feb. 8, 2001	7.6	18° 06.753' N	065° 35.117' W
Puerto Esperanza 1	Feb. 7, 2001	2.1	18° 05.474' N	065° 28.166' W
Puerto Esperanza 2	Feb. 9, 2001	4.5	18° 05.379' N	065° 28.462' W
Puerto Esperanza 3	May 17, 2001	8.5	18° 05.331' N	065° 28.610' W
South Arrecife Coronas				
West Caballo Blanco	May 17, 2001	12.7	18° 09.647' N	065° 29.237' W
West Rompeolas 1	May 20, 2001	3.6	18° 07.051' N	065° 31.442' W
West Rompeolas 2	May 17, 2001	6.7	18° 08.296' N	065° 31.606' W
North of Martineau 1				
North of Martineau 2	May 17, 2001	7.0	18° 08.685' N	065° 28.329' W

Field Procedures

Sessile-Benthic Reef Communities

Initial exploratory scans of the area by echosounding runs and towed divers preceded quantitative survey work at reef habitats. This exercise provided a general perspective of reef

morphometry and aided in the selection of reef zones to be surveyed. Reef sections of optimal coral growth were selected. Five replicate transects were permanently established at each reef

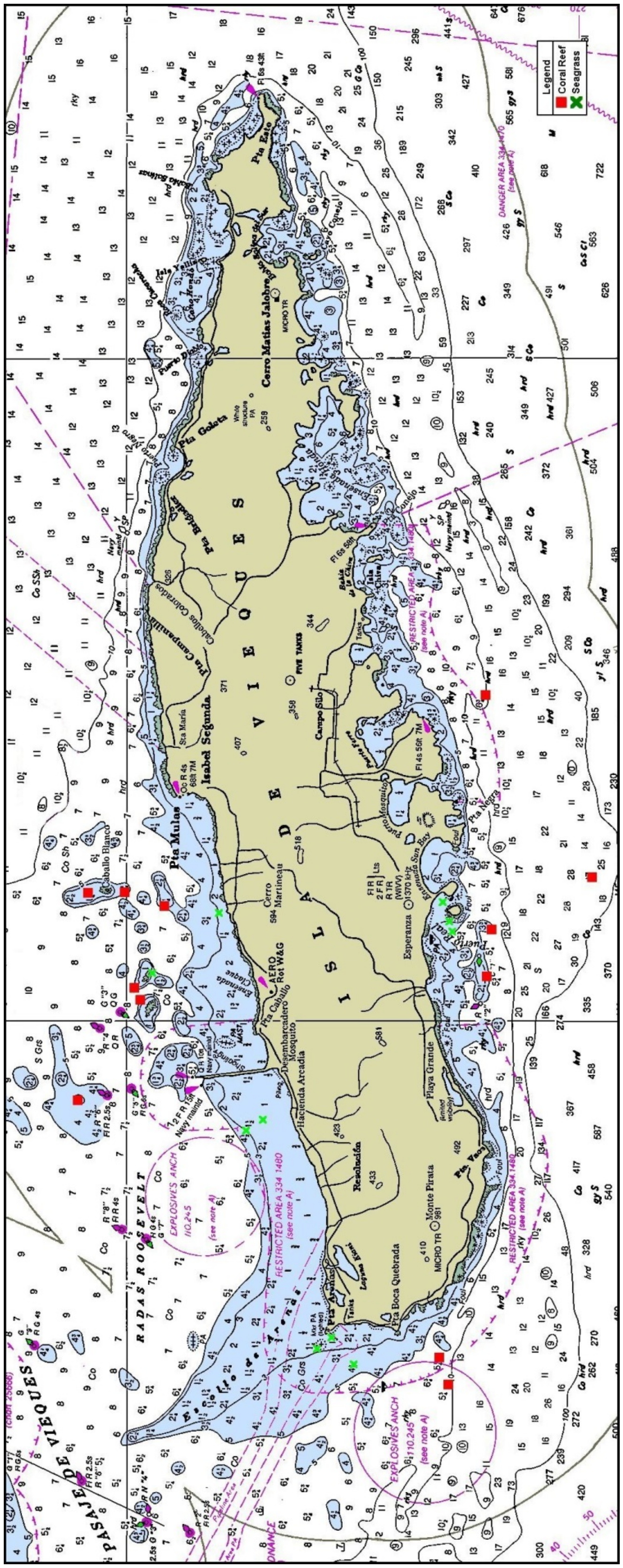


Figure 1. Location of reef and seagrass community surveys.

using steel rods as markers. Specific positioning of transects aimed to follow consistency in depth range and structural formation of the reef. A total of 12 reefs around Vieques (outside the

shooting range) were surveyed. A line with a surface buoy was tied from one end of the third transect as a location marker and the position of the buoy was recorded with a DGPS unit.

Quantitative assessments of sessile-benthic reef communities were obtained using a modification of the Chain Transect Method (Porter, 1972) and also applying a video-transect technique for comparisson and archival reference. The Chain Transect Method (Porter, 1972) is a continuous intercept transect technique that provides information of the percent linear cover by sessile biota and other substrate categories, and also allows construction of community profiles by assignment of metric units to each substrate transition. Marsh et al. (1984) discussed the range of biologically significant parameters that can be extracted from chain transect data on coral reef communities. For a review on reef survey methods see UNESCO, 1978; Bouchon, 1981; Ohlhorst et al. 1988; UNEP 1993). Transects were established over the substrate using a 10 meter long fiberglass tape measure tensioned between two rods. Rods provided permanent markings that allow repeated observations of benthic community structure over time. A short linked chain was loosely draped over the reef and the linear area (number of chain links) of the different substrate types (or biota) occurring beneath the chain recorded. Chain links were 1.42 cm long. Individual measurements of substrate categories, as recorded from the number of chain links were sorted, added and divided by the total distance (in chain links) on each transect to calculate cumulative percentages of linear cover by each category.Steel nails were hammered into available hard substrate (dead coral sections) approximately 0.5 – 1.0 meter apart to provide fixed reference points along the linear transect. All transect data was recorded on plastic paper (polypaper) and kept on file. Records of depth, transect number, date, and station identification will appear on all transect data forms.

Quantitative video data were collected along each 10-m (33-ft) transect using a Sony digital- 8 video camera (Model DCR-TRV 520) within an Ikelite underwater housing. A stainless steel rod that extended approximately 45 cm (18 inches) beyond the camera housing lens plate was attached to the housing to maintain a constant camera-subject distance during filming. Prior to filming, a fiberglass measuring tape was stretched between each transect end marker to serve as a reference scale and transect line. During the filming of each video transect, the camera was held perpendicular to the seafloor and moved slowly along the transect line. Ten randomly selected, non-overlapping video frames were selected from each video transect. Video frames were reviewed using a Sony digital camera interfaced with a 27-inch color video monitor. Individual video frames were “captured” and saved as picture files in a computer. Two sets of 25 electronic point overlays were constructed from x, y plots of random numbers generated with Excel software and saved as templates. These templates were overlaid on each captured video frame, resulting in 50 random points within each frame. The number of points that covered each of the substrate-biotic groups was recorded as its percent cover within each frame. The individual percent cover values of the 10 selected frames were combined from each transect.

Substrate categories represented by sessile-benthic organisms were recorded as growth forms using abbreviations, or codes (e.g. ENCCOR - encrusting coral), and identified to the lowest possible taxon (e.g. *Diploria strigosa*). This form of data reporting is compatible with CARICOMP (1994) and UNEP (1993) formats. Coral taxonomy followed the most recent revision by Veron (2000). Definitions to the codes used in reporting the different substrate categories are presented as Appendix 1. Soft corals, with the exception of encrusting forms (e.g. *Erythropodium caribaeorum*), were counted as number of colonies present whenever any of their branches intersected the transect line. Soft corals have a small basal area relative to their colony size and therefore, are not well represented by their linear cover on the bottom.

The vertical relief of the reef, or rugosity, was calculated by subtracting 10 meters from the total length (links) recorded with the chain at the 10 meter marker of the reference tape. Underwater videos of each transect at each reef site were taken using a SONY TR 700 on HI-8 format and a Amphibico-Buddy System housing. Each video transect was identified by a counter readout on each tape. All original transect data was recorded on plastic paper (polypaper) and kept on file. Records of depth, transect number, date, and station identification appear on all transect data forms.
Species diversity (H') and evenness (J') indices were calculated for each of the coral reef sites surveyed.

Diversity (H'), also known as Shannon's Index (Pielou, 1966) was calculated as:

$$H' = \sum_{i=1}^{S} p_i \bullet \ln(p_i)$$

where S is the number of coral taxa in the sample, and pi is the number of individuals of the i^{th} coral taxon divided by (N), the total number of coral colonies in the sample.
Evenness (J') was calculated with Pielou's (1966) index of evenness:

$$J' = H' / \ln(S)$$

where H' is Shannon's index and S is the total number of coral taxa in a sample.

(B) Motile Megabenthic Invertebrates and Fishes

Motile megabenthic (larger than 1 cm) invertebrates (lobsters, crabs, echinoids, molluscs, etc.) and diurnal, non-criptic fishes associated with reefs and seagrass habitats were surveyed using the belt-transect technique. Transects were 10 meters long by 3 meters wide (surface area = 30 m^2). We identified and enumerated fishes and megabenthic invertebrates present within 1.5 meters along each side of the linear transects used for the reef benthic community surveys. This method provides the basis for analysis of relationships between substrate variables, such as sessile biological components (e.g. live coral cover) and ichthyofaunal/megabenthic invertebrates taxonomic composition, diversity, and abundance (Fowler, 1987). A total of five (5) belt-transects were surveyed at each reef/seagrass station (total area = 150 m^2). Abundance data on motile megabenthic invertebrates and fishes was reported as number of individuals per 30 m^2 (belt-transect area). Fishes and megabenthic invertebrates observed outside belt-transect survey areas were recorded and included as supplemental taxonomic information from each station. Common names of motile mega-benthic invertebrates and fishes follow those in Humann (1999) and Randall (1993). Panoramic videos from all stations were filmed to provide a qualitative assessment of the reef biota.

Results

Characterization of Coral Reef Communities

1. Canjilones Reef

Canjilones Reef is a diffuse “spur-and-groove” formation located at the base of the southern edge of a rather long and narrow rocky ridge that runs along an east-west axis off Punta Arenas, on the southwest coast of Vieques (Figure 2). The ridge presents an almost flat, hard-ground terrace with sparse gorgonians and coral heads at depths of 9-11 meters and slopes down to a depth of 15 meters where the spur-and-groove coral reef formation has developed. The spurs rise only about 2-3 meters from the narrow sandy channels that separate them at the base. Our permanent transects were established along five consecutive spurs at a depth of 15.2 meters. Panoramic pictures of Canjilones Reef are included as Photo Album 1.

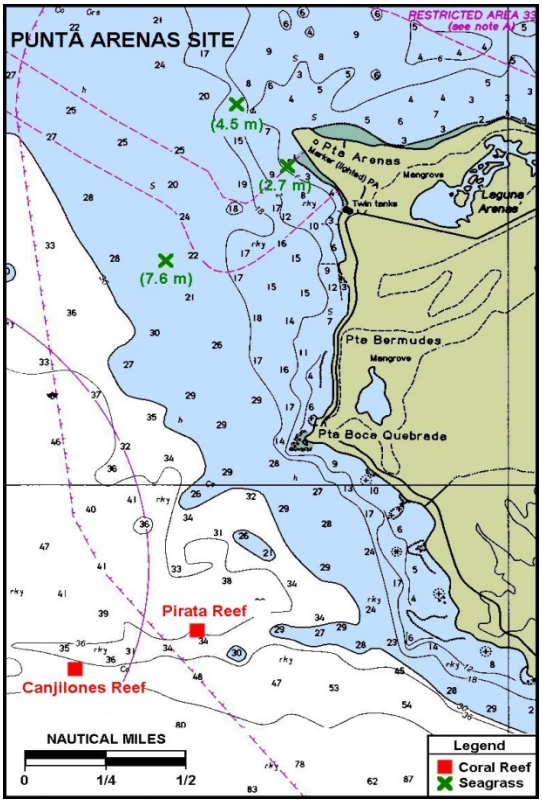


Figure 2. Location of reefs and seagrass survey stations along the western coast of Vieques.

The sessile-benthic community is characterized by a moderate surface cover of stony corals (mean : 24.5 %) and density of gorgonians (mean : 19 colonies per transect). A total of 25 species of stony corals were identified from Canjilones Reef. The Boulder Brain Coral, *Montastrea annularis* was the main reef building coral species, representing approximately 70% of the total surface cover by corals (Table 2). Great Star Coral (*Montastrea cavernosa*) and Lettuce Coral (*Agaricia agaricites*) were also common. Boulder Star Coral contributed substantially to the relatively high substrate rugosity of this reef (mean: 6.05 m) with large, massive (vertically projected) colonies. Turf algae, consisting of a mixed assemblage of

articulate coralline red and brown macroalgae (mostly *Lobophora* sp.) was found covering most of the hard substrates not colonized by stony corals. Its mean cover along transects was 47.4 %. Abiotic substrate categories presented a relatively high cover (mean: 19.2 %), mostly associated with reef overhangs (or ledges) created by the laminar growth of Boulder Star Coral.

Density of stony coral colonies in video-transects averaged 18.9 col/m^2 (Table 3). Colonies of Boulder Star Coral represented approximately 65 % of the total colonies present in video-transects at Canjilones Reef. The three morphotypes of *Montastrea annularis* were present. The mean cover of each morphotype in video-transects is included as Appendix 1. The index of coral species diversity (H') for each of the five video-transects ranged between 1.36 at Tr-3 to 2.08 at Tr-1 (Table 4). The total number of coral species per video-transect ranged between 7 – 11 and the total number of colonies varied between 25 – 40.

A total of 55 species of reef fishes were identified during our snapshot survey at Canjilones Reef (Table 5). The mean abundance of fishes within belt-transects was 36.8 Ind/30m^2, and the mean number of species present per transect was 16. This is a rather low abundance, compared to other reefs surveyed around Puerto Rico (García et al, 2000, García et al, 2001). It is possible that the strong wave action and associated surge and relatively low visibility prevailing during our survey masked somewhat the abundance of reef fishes at this reef. The most abundant species were the Bicolor Damselfish (*Stegastes partitus*), Striped Parrotfish (*Scarus iserti*) and the Blue Tang (*Acanthurus coeruleus*). Species of commercial value included the red Hind (*Epinephelus guttatus*) and the Coney (*Cephalopholis fulva*). Large predators, such as the Great Barracuda and several Nurse Sharks were present. No motile megabenthic invertebrates were recorded within belt-transects. Two juvenile Spiny Lobsters, *Panulirus a*rgus were observed outside transect survey areas.

Table 2. Canjilones Reef. Percent cover by reef sessile-benthic substrate categories. Chain-link method, February, 2001.

	TRANSECTS					
Survey Date: Feb. 6, 2001	**1**	**2**	**3**	**4**	**5**	**MEAN**
Depth : 15.2 m						
Rugosity	3.45	6.34	7.82	6.41	6.25	**6.05**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	13.09	21.79	16.83	12.42	21.96	**17.22**
Montastrea cavernosa	4.08	3.62		3.52	0.52	**2.35**
Agaricia agaricites		0.52	2.08	5.17		**1.55**
Siderastrea siderea	4.31				0.80	**1.02**
Porites porites	1.71		1.35			**0.61**
Porites astreoides			1.19		1.22	**0.48**
Colpophyllia natans				1.37		**0.27**
Agaricia fragilis		0.52		0.43		**0.19**
Diploria labyrinthiformis			0.95			**0.19**
Meandrina meandrites			0.87			**0.17**
Millepora alcicornis			0.71			**0.14**
Agaricia grahamae			0.56			**0.11**
Agaricia sp.	0.52					**0.10**
Mycetophyllia lamarckiana					0.43	**0.09**

Madracis decactis					0.17	**0.03**
Total Stony Corals	23.71	26.45	24.54	22.91	25.10	**24.54**

Table 2. Continued

Encrusting Gorgonians	0	0	4.2	0	1.23	**1.09**
Sponges	0.82	0.49	0.84	5.85	3.38	**2.28**
Turf Algae	64.68	42.35	47.8	42.47	39.45	**47.35**
Fleshy Algae	2.53	3.18	8.08	4.81	6.77	**5.07**
Calcareous Algae	0	0	1.12	0	0	**0.22**
Abiotic Cover						
Reef Overhangs	8.25	18.30	13.12	22.06	17.91	**15.93**
Rubble	0	7.38	0	1.89	4.00	**2.65**
Sand	0	1.41	0.34	0	1.23	**0.60**
Total Abiotic	8.25	27.09	13.46	23.95	23.14	**19.18**
Gorgonians (# colonies)	15	28	24	10	20	**19**

Stony Corals Outside Transects:

Acropora cervicornis
Dendrogyra cilindrus
Dichocoenia stokesii
Diploria strigosa
Eusmilia fastigiata
Isophyllastrea rigida
Isophyllia sinuosa
Mycetophyllia ferox
Scolymia cubensis
Stephanocoenia michilini

Table 3. Canjilones Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. February, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
Forma: annularis	6.11	8.33	10.56	1.67	2.22	5.78
Forma: faveolata	1.67	5.00	1.67	5.00	5.00	3.67
Forma: franksi	3.89	3.33	1.67	3.33	2.22	2.89
M. cavernosa	2.22	1.67	0.56	3.33	0	1.56
Porites astreoides	0	1.11	2.78	1.11	0.56	1.11
P. porites	0.56	0	0.56	0.56	0.56	0.44
P. furcata	0	0.56	0.56	0	0	0.22
Dendrogyra cylindrus	1.67	0	0	0	0	0.33
Agaricia sp	0.56	0.56	0	2.78	0.56	0.89
Siderastrea sp.	1.11	0	0	0	0	0.22
Madracis sp	1.67	0.56	0	0.56	0.56	0.67
Mycethophyllia sp	0	1.11	0	0.56	0	0.33
Eusmilia fastigiata	0	0	0	0.56	0	0.11
Diploria labyrinthiformis	0.56	0	0	0	0.56	0.22

D. strigosa	0.56	0	0	0	0.56	0.22
D. clivosa	0	0	0	0	1.11	0.22
TOTAL	**20.56**	**22.22**	**18.33**	**19.44**	**13.89**	**18.89**

Table 4. Canjilones Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. February, 2001

Video Transect	No. of Species	Total Number of Colonies	Species Diversity (H')	Species Evenness (J)
1	11	37	2.08	0.87
2	9	40	1.76	0.80
3	7	33	1.36	0.70
4	10	35	2.01	0.87
5	10	25	1.93	0.84
		Mean	**1.83**	**0.82**

TABLE 5. Canjilones Reef. Taxonomic composition and abundance of reef fishes within belt-transects. February, 2001

Survey Date: Feb. 6, 2001
Depth : 15.2 m

		TRANSECTS					
		1	**2**	**3**	**4**	**5**	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Stegastes partitus	Bicolor damselfish	6	4	4	6	5	**5.0**
Scarus iserti	Stripped parrotfish	4	4	4		5	**3.4**
Acanthurus coeruleus	Blue tang			2	12	1	**3.0**
Coryphopterus personatus	Masked goby			8	3	3	**2.8**
Thalassoma bifasciatum	Bluehead wrasse	3		3	2	5	**2.6**
Acanthurus bahianus	Ocean surgeon	1	1		7	3	**2.4**
Chromis cyanea	Blue chromis		3	4	2	3	**2.4**
Stegastes leucostictus	Beaugregory		2	2	1	1	**1.2**
Sparisoma aurofrenatum	Redband parrotfish	2	2		1		**1.0**
Chaetodon capistratus	Foureye butterflyfish	2				2	**0.8**
Scarus vetula	Queen parrotfish	1	1	1	1		**0.8**
Sparisoma radians	Bucktooth parrotfish	2	2				**0.8**
Acanthurus chirurgus	Doctorfish			1	1	1	**0.6**
Coryphopterus lipernes	Peppermint goby		1		2		**0.6**
Gobiosoma evelynae	Sharknose goby	3					**0.6**
Holacanthus tricolor	Rock beauty	1		1		1	**0.6**
Microspathodon chrysurus	Yellowtail damselfish		1	1	1		**0.6**
Myripristis jacobus	Blackbar soldierfish		1	2			**0.6**
Pseudupeneus maculatus	Spotted goatfish				3		**0.6**
Serranus tigrinus	Harlequin bass	2	1				**0.6**
Canthigaster rostrata	Caribbean puffer	1				1	**0.4**
Cephalopolis fulva	Coney	1				1	**0.4**
Chaetodon striatus	Banded butterflyfish				2		**0.4**
Haemulon aurolineatum	Tomtate			2			**0.4**
Holocentrus rufus	Squirrelfish	1	1				**0.4**

Scarus taeniopterus	Princess parrotfish					2	**0.4**
Stegastes dorsopunicans	Dusky damselfish				2		**0.4**
Aulostomus maculates	Trumpetfish			1			**0.2**

Table 5. Continued

Bodianus rufus	Spanish hogfish				1		**0.2**
Cantherhines pullus	Tail-light filefish				1		**0.2**
Carangoides ruber	Bar jack			1			**0.2**
Chaetodon aculeatus	Longsnout butterflyfish					1	**0.2**
Coryphopterus sp.	Goby					1	**0.2**
Epinephelus guttatus	Red hind		1				**0.2**
Halichoeres bivitatus	Slippery dick					1	**0.2**
Halichoeres garnoti	Yellow-head wrasse			1			**0.2**
Hypoplectrus chlorurus	Yellowtail hamlet			1			**0.2**
Lutjanus mahogani	Mahogani snapper			1			**0.2**
Malacoctenus triangulatus	Saddled blenny		1				**0.2**
Pomacanthus arcuatus	Gray angelfish					1	**0.2**
Priacanthus cruentatus	Bigeye					1	**0.2**
Sparisoma sp.	Parrotfish	1					**0.2**
Sphyraena barracuda	Great barracuda					1	**0.2**
	TOTAL INDIVIDUALS	**31**	**26**	**40**	**48**	**39**	**36.8**
	TOTAL SPECIES	**15**	**15**	**18**	**17**	**20**	**17**
Outside transects:							
Calamus pennatula	Pluma						
Flammeo marianus	Longspine squirrelfish						
Ginglymostoma cirratum	Nurse Shark						
Gramma loretto	Royal gramma						
Haemulon chrysargyreum	Smallmouth grunt						
Haemulon macrostomum	Spanish grunt						
Haemulon plumieri	White grunt						
Haemulon sciurus	Bluestripped grunt						
Hypoplectrus puella	Barred hamlet						
Lutjanus apodus	Schoolmaster						
Pomacanthus ciliaris	French angelfish						
Sparisoma viride	Stoplight parrotfish						

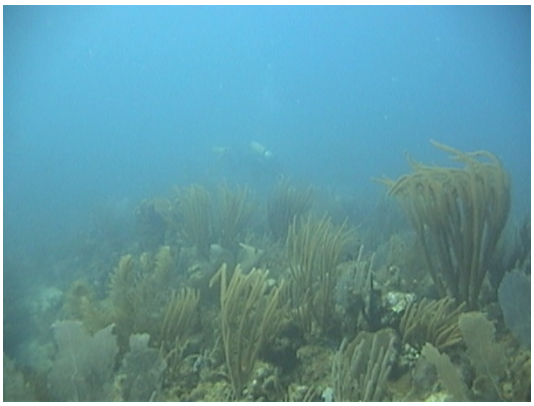
Table 6. Canjilones Reef. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects, February 2001

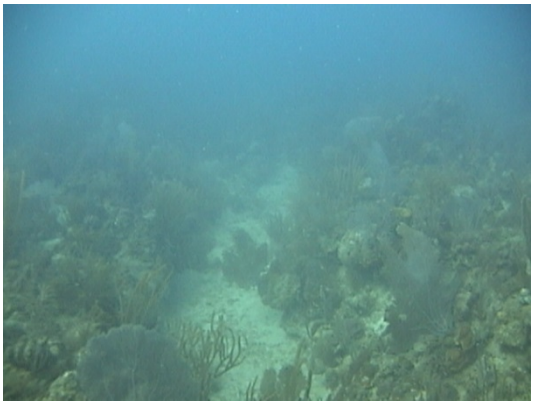
Survey Date: Feb. 6, 2001
Depth: 15.2 m

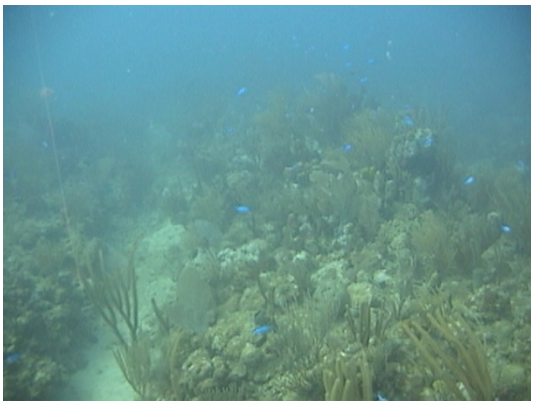
		TRANSECTS					**MEAN**
		1	**2**	**3**	**4**	**5**	**ABUNDANCE (IND/30 m2)**
SPECIES	**COMMON NAME**						
NO MACROINVERTEBRATES							**0.0**

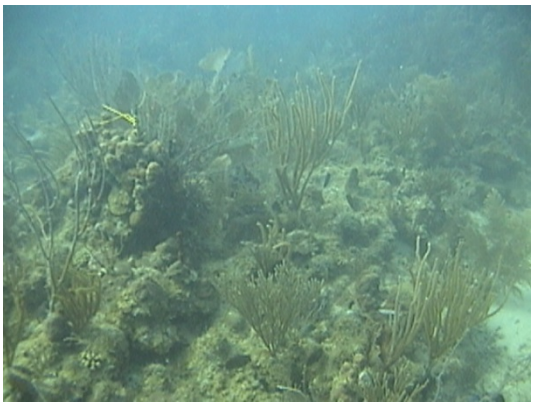
TOTALS	0	0	0	0	0	**0.0**

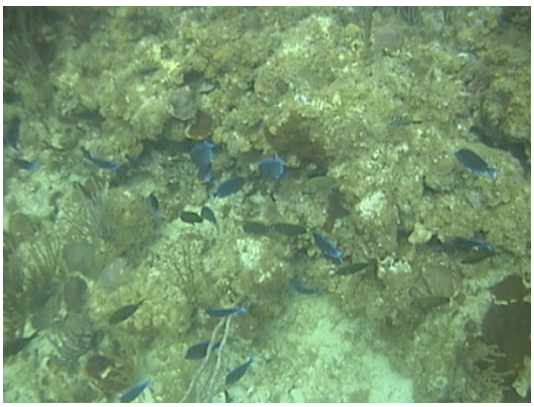
Photo Album 1. Canjilones Reef

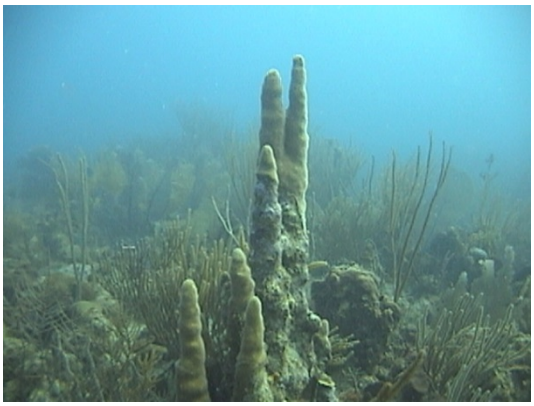


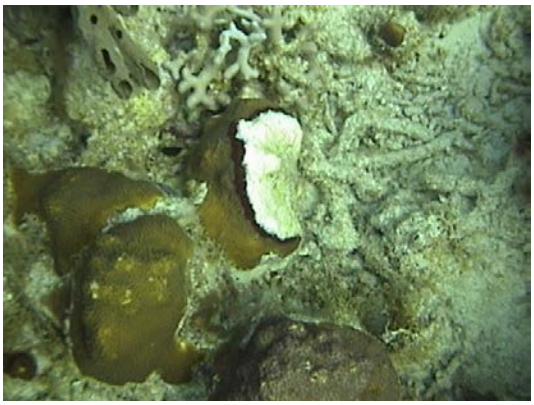












2. Puerto Ferro Reef

Puerto Ferro Reef is a mostly flat, hard-ground platform located about one nautical mile south off the Puerto Ferro Lighthouse, on the south-central coast of Vieques (Figure 3). The substrate is irregular, with many holes and small crevices resembling a submerged eolianite dune. The hard-ground reef off Puerto Ferro is an extensive system dominated by gorgonians, sponges and a dense algal turf. The base of the reef platform is a pool of white coralline sand at a depth of 16 meters. The reef interface is abrupt, with a vertical wall presenting deep crevices near the base. Our survey was performed at a depth of 12.0 meters, just at the edge of the vertical wall interface. Transects were established following the edge of the hard-ground platform. Panoramic views of the Puerto Ferro Reef are presented as Photo Album 2.

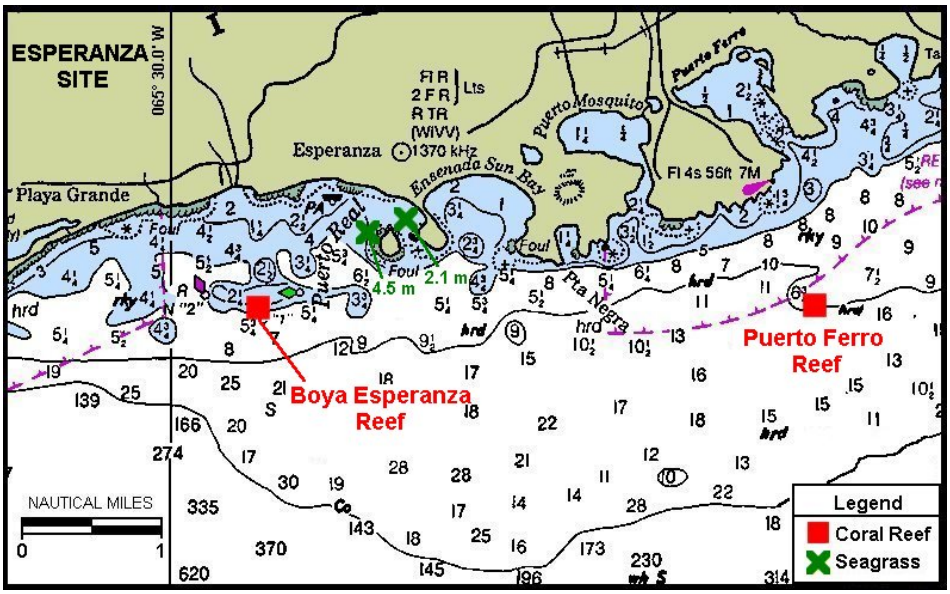


Figure 3. Location of reef and seagrass habitats surveyed along the south coast of Vieques.

The sessile-benthic community at Puerto Ferro Reef was visually dominated by soft corals, (or gorgonians). An average of 32 gorgonian colonies were intercepted per transect (range: 26-45 colonies/transect). The encrusting gorgonian, *Erythropodium caribaeorum* was present at all five transects with a mean surface cover of 2.3 %. Stony corals averaged a surface cover of 4.6%, with many colonies of small size exhibiting encrusting growth (Table 7). Twenty-four (24) coral species were identified during our survey at Puerto Ferro Reef. The Great Star Coral, *Montastrea cavernosa* was the dominant species in terms of surface cover. The Mustard Hill Coral, *Porites astreoides*, ranked second in terms of surface cover and was recorded in four out of the five transects surveyed. Most of the reef hard substrate was covered by a thick algal turf (mean cover: 72.8 %), composed of red coralline algae (*Amphiroa* sp.) and brown macroalgae, mostly *Lobophora*. The reef surface cover by fleshy algae was 12.2 % for an overall cover by benthic algae of 85%. Abiotic substrate categories presented a mean cover of 6.4 %, mostly associated with reef overhangs created by the crevices in the reef. The mean cover of substrate categories in video-transects is included as Appendix 2.

Density of stony coral colonies in video-transects was very low, consistent with their low percent substrate cover in the reef. A total of eight coral species were present in the five video-transects, with a mean density of 2.11 col/m^2 (Table 8). The index of coral species diversity (H') for each of the five video-transects ranged between 0 at Tr-5 to 1.56 at Tr-1 (Table 9). The total number of coral species per video-transect ranged between 1 – 5 and the total number of colonies varied between 1 – 7.

A total of 65 reef fishes were identified at Puerto Ferro Reef, 46 of which were observed within belt-transect areas (Table 10). The mean abundance of fishes was 49 Ind/30 m^2 and the mean number of species per transect was 19. The numerically dominant assemblage included the Bicolor Damselfish (*Stegastes partitus*), French Grunt (*Haemulon flavolineatum*), Bluehead Wrasse (*Thalassoma bifasciatum*) and Striped Parrotfish (*Scarus iserti*). Species of commercial value included the Yellowtail, Lane, Mutton and Grey Snappers (*Ocyurus chrysurus, Lutjanus synagris, L. analis, L. griseus*), Red Hind (*Epinephelus guttatus*), Coney (*Cephalopholis fulva*), Hogfish (*Lachnolaimus maximus*), and Cero Mackerel (*Scomberomorus regalis*). Large reef predators, such as the Great Barracuda (*Sphyraena barracuda*) and the Greater Amberjack (*Seriola dumerili*) were also present. Large schools of grunts (Haemulidae) and Lane Snappers (Lutjanidae) were observed at the reef-sand interface.

Motile megabenthic invertebrates within belt-transects included the Spiny Lobster (*Panulirus argus*) and the Long-spine Urchin (*Diadema antillarum*) (see Table 11). Adult Queen Conch (*Strombus gigas*) were in the sandy section of the reef, outside transect areas.

Table 7. Puerto Ferro Reef. Percent cover by reef sessile-benthic substrate categories, Chain-link method, February, 2001.

Survey Date: Feb. 7, 2001	TRANSECTS					
Depth: 12.0 m	**1**	**2**	**3**	**4**	**5**	**MEAN**
Rugosity	1.24	3.11	2.72	3.38	2.49	**2.59**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea cavernosa			3.22	2.09		**1.06**
Porites astreoides	0.50	0.32	1.89		2.00	**0.94**
Montastrea annularis	1.34		1.81			**0.63**
Millepora alcicornis		2.14		0.31	0.11	**0.51**
Madracis decactis					1.92	**0.38**
Porites porites	0.38	0.97			0.34	**0.34**
Diploria strigosa		1.40				**0.28**
Isophyllia sinuosa					0.90	**0.18**
Agaricia agaricites	0.38	0.32				**0.14**
Meandrina meandrites					0.56	**0.11**
juvenile coral	0.25					**0.05**
Siderastrea siderea			0.22			**0.04**
Total Stony Corals	2.85	5.15	6.92	2.40	5.83	**4.63**
Encrusting Gorgonians	2.22	6.03	1.18	1.35	0.64	**2.28**
Sponges	0.53	6.10	0.78	0	0	**1.48**
Zoanthids	0	0	0	0.84	0	**0.17**

Turf Algae	78.56	63.39	54.95	81.09	86.22	**72.84**
Fleshy Algae	13.79	15.56	27.44	1.72	2.56	**12.21**
Abiotic Cover						
Reef Overhangs	0	2.67	8.02	11.51	4.73	**5.39**

Table 7. Continued

Sand	2.05	1.07	0.55	0	0	**0.73**
Holes/Gaps	0	0	0	0.84	0	**0.23**
Total Abiotic	2.05	3.74	8.57	12.35	4.73	**6.35**
Gorgonians (# colonies)	33	45	28	26	26	**32**

Coral species outside transects:

Acropora cervicornis
Agaricia grahame
Colpophyllia natans
Dendrogyra cilindrus
Dichocoenia stokesii
Diploria labyrinthiformis
Eusmilia fastigiata
Isophyllastrea rigida
Leptoseris cucullata
Mycetophyllia aliciae
Siderastrea radians
Scolymia lacera

Table 8. Puerto Ferro Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. February, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis	0.56	0	0	1.67	0	0.44
M. cavernosa	1.11	0	0.56	0.56	0	0.44
Porites astreoides	0.56	0.56	0.56	0.56	0	0.44
P. porites	0.56	0	0	0	0	0.11
Colpophillia sp	0	0	0	0.56	0	0.11
Madracis decactis	0.56	0	0	0	0.56	0.22
Meandrina meandrites	0	0.56	0.56	0	0	0.22
Stephanocoenia sp	0	0	0	0.56	0	0.11
TOTAL	**3.33**	**1.11**	**1.67**	**3.89**	**0.56**	**2.11**

Table 9. Puerto Ferro Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. February, 2001

Video Transect	**No. of Species**	**Total Number of colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	5	6	1.56	0.97
2	2	2	0.69	1.00

3	3	3	1.10	1.00
4	5	7	1.48	0.92
5	1	1	N/A	N/A
		Mean	**1.21**	**0.97**

Table 10. Puerto Ferro Reef. Taxonomic composition and abundance of reef fishes within belt-transects. February, 2001

Survey Date: Feb. 7, 2001
Depth: 12.0 m

		TRANSECTS					
		1	**2**	**3**	**4**	**5**	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Stegastes partitus	Bicolor damselfish	5	5	6	7	12	**7.0**
Haemulon flavolineatum	French grunt	3	2	1	14	5	**5.0**
Thalassoma bifasciatum	Bluehead wrasse			2	10	13	**5.0**
Scarus iserti	Stripped parrotfish			5	9	7	**4.2**
Coryphopterus personatus	Masked goby		3	11			**2.8**
Myripristis jacobus	Blackbar soldierfish	1	3		8	2	**2.8**
Stegastes leucostictus	Beaugregory	2	2	3	2		**1.8**
Chromis cyanea	Blue chromis				4	3	**1.4**
Haemulon aurolineatum	Tomtate		7				**1.4**
Melichthys niger	Black durgon		2		2	2	**1.2**
Aulostomus maculatus	Trumpetfish	2			1	2	**1.0**
Bodianus rufus	Spanish hogfish	1	2	1		1	**1.0**
Holocentrus rufus	Squirrelfish	1	2	1	1		**1.0**
Priacanthus cruentatus	Glasseye	1	2		1	1	**1.0**
Acanthurus chirurgus	Doctorfish		2		1	1	**0.8**
Chaetodon striatus	Banded butterflyfish		2		2		**0.8**
Gramma loreto	Royal gramma		3		1		**0.8**
Sparisoma radians	Bucktooth parrotfish	3		1			**0.8**
Acanthurus bahianus	Ocean surgeon	1		2			**0.6**
Haemulon sciurus	Bluestripped grunt	1	1	1			**0.6**
Halichoeres garnoti	Yellow-head wrasse	1		2			**0.6**
Lutjanus apodus	Schoolmaster					3	**0.6**
Microspatodon chrysurus	Yellowtail damselfish	1				2	**0.6**
Ocyurus chrysurus	Yellowtail snapper	2	1				**0.6**
Sparisoma aurofrenatum	Redband parrotfish	1		2			**0.6**
Acanthurus coeruleus	Blue tang	1		1			**0.4**
Balistes vetula	Queen triggerfish		1	1			**0.4**
Chaetodon capistratus	Foureye butterflyfish					2	**0.4**
Lactophrys triqueter	Smooth trunkfish	1			1		**0.4**
Sparisoma viride	Stoplight parrotfish	2					**0.4**
Abudefduf sexatilis	Sargent major				1		**0.2**
Anisotremus virginicus	Porgy				1		**0.2**
Cantherhines pullus	Tail-light filefish			1			**0.2**
Equetus acuminatus	Cubbyu	1					**0.2**
Flammeo marianus	Longspine squirrelfish					1	**0.2**
Gobiosoma evelynae	Sharknose goby					1	**0.2**
Haemulon plumieri	White grunt	1					**0.2**

Halichoeres maculipina	Clown wrasse				1		**0.2**
Holacanthus tricolor	Rock beauty				1		**0.2**
Holocentrus ascensionis	Longjaw squirrelfish			1			**0.2**
Pomacanthus arcuatus	Gray angelfish					1	**0.2**

Table 10. Continued

Pomacanthus ciliaris	French angelfish					1	**0.2**
Scarus taeniopterus	Princess parrotfish	1					**0.2**
Scarus vetula	Queen parrotfish					1	**0.2**
Scorpaena plumieri	Spotted scorpionfish			1			**0.2**
Sparisoma rubripinne	Yellowtail parrotfish			1			**0.2**
	TOTAL INDIVIDUALS	**33**	**40**	**44**	**68**	**61**	**49.2**
	TOTAL SPECIES	**21**	**16**	**19**	**19**	**19**	**19**

Outside transects:	
Calamus pennatula	Pluma
Cephalopholis fulva	Coney
Chaetodon aculeatus	Longsnouth butterflyfish
Dasyatis americana	Southern stingray
Epinephelus guttatus	Red hind
Haemulon carbonarium	Caesar grunt
Kyphosus sectatrix	Bermuda chub
Lachnolaimus maximus	Hogfish
Lutjanus annalis	Mutton snapper
Lutjanus griseus	Mangrove snapper
Lutjanus synagris	Lane snapper
Mulloides martinicus	Yellowtail goatfish
Pseudupeneus maculatus	Spotted goatfish
Scarus coeruleus	Blue parrotfish
Scomberomorus regalis	Cero mackerel
Seriola dumerili	Greater amberjack
Serranus tigrinus	Harlequin bass
Sparisoma rubripinne	Yellowtail parrotfish
Sphyraena barracuda	Great barracuda

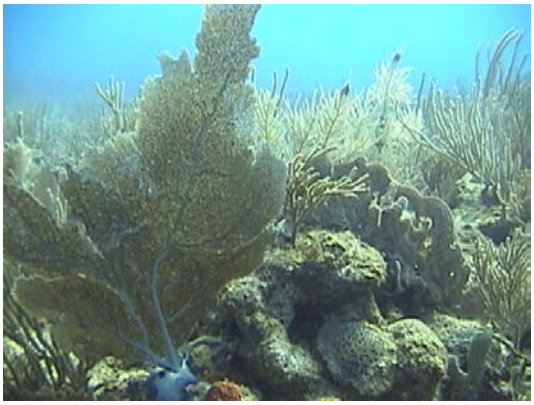
Table 11. Puerto Ferro Reef. Taxonomic composition and abundance of motile megabenthic Invertebrates within belt-transects. February, 2001.

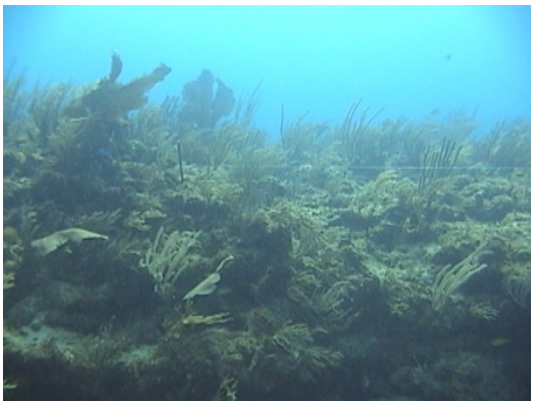
Survey Date: Feb. 7, 2001
Depth: 12.0 m

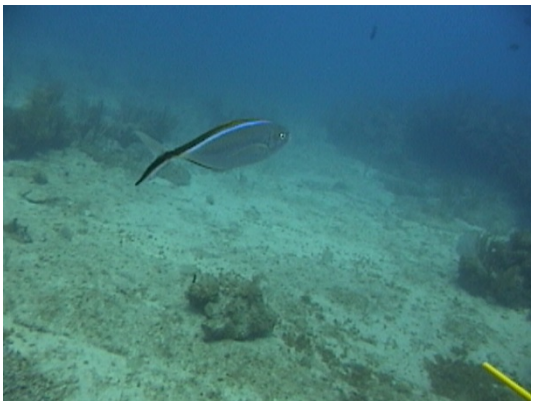
		TRANSECTS					
		1	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE (IND/30 m2)**
SPECIES	**COMMON NAME**						
Diadema antillarum	Long spine urchin	1				1	**0.4**
Panulirus argus	Spiny lobster				1		**0.2**

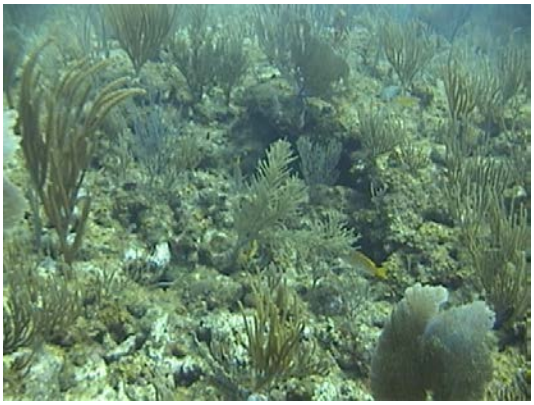
TOTALS	**1**	**0**	**0**	**1**	**1**	**0.6**

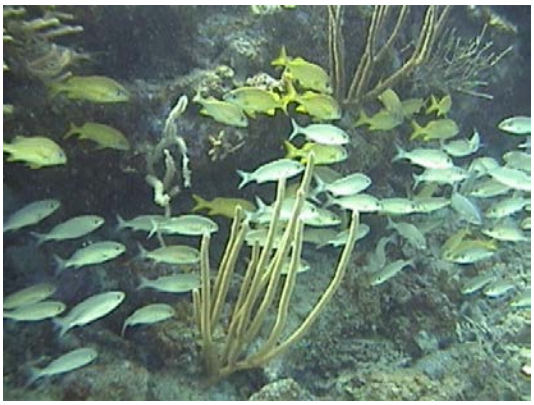
Photo Album 2. Puerto Ferro Reeef











3. Monte Pirata Reef (West Vieques)

Monte Pirata Reef sits at the northern edge of a hard-ground ridge that runs along an east-west axis off the southwest coast of Vieques. The reef is a low relief, rather diffuse spur-and-groove formation found at depths between 12-16 meters on the slope of the hard ground ridge. Transects were established along consecutive spurs at a depth of 12.1 meters. Panoramic views of the Monte Pirata Reef are shown in Photo Album 3.

The sessile-benthic reef community exhibited a varied assemblage of stony corals and gorgonians. A total of 23 species of stony corals, including 21 species intercepted by transects were identified from Monte Pirata Reef (Table 12). Massive, encrusting and branching stony coral growth types were present with a combined surface cover of 27.4% (range: 19.4 – 34.8 %). Boulder Star Coral, *Montastrea annularis* was the dominant coral species in terms of surface cover with a mean of 15.1 %. Finger Coral (*Porites porites*), Lettuce Coral (*Agaricia agaricites*), Greater Star Coral (*Siderastrea siderea*) and Great Star Coral (*Montastrea cavernosa*) were also common within transects surveyed. Sponges, zoanthids (*Palythoa* sp.) and encrusting gorgonian (*Erythropodium caribaeorum*) were recorded along transects, but represented small components of the benthic community structure. A dense algal turf was found colonizing an average of 50.9 % of the available hard substrate. A mixed assemblage of red coralline algae and brown macroalgae (mostly *Lobophora* sp. and *Dyctiota* sp.) were the main components of the algal turf. Abiotic substrate categories represented a surface cover of 17.1 %, largely associated with reef overhangs created by coral growth and sand deposited on reef substrate depressions. Surface cover by sessile-benthic substrate categories in video-transects is shown in Appendix 3.

Density of stony coral colonies in video-transects averaged 15.2 col/m^2 (Table 13). Colonies of Boulder Star Coral represented approximately 50.5 % of the total colonies present in video-transects at Pirata Reef. The three morphotypes of *Montastrea annularis* were present, being the *faveolata* morphotype the one showing highest densities of colonies/ m^2. The index of coral species diversity (H') for each of the five video-transects ranged between 1.65 at Tr-4 to 2.26 at Tr-5 (Table 14). The total number of coral species per video-transect ranged between 8 – 13 and the total number of colonies varied between 20 – 37.

A total of 60 reef fishes were identified at Monte Pirata Reef, 38 of which were observed within belt-transect areas (Table 15). The mean abundance of fishes was 38.6 Ind/30 m^2 and the mean number of species per transect was 17. The numerically dominant assemblage included the Bluehead Wrasse (*Thalassoma bifasciatum*), Bicolor Damselfish (*Stegastes partitus*), Blue Chromis (*Chromis cyanea*), Creole Wrasse (*Clepticus parrae*) and Princess Parrotfish (*Scarus taeniopterus*). Species of commercial value included the Nassau Grouper (*Epinephelus striatus*), Yellowtail and Mutton Snappers (*Ocyurus chrysurus, Lutjanus analis*), Red Hind (*Epinephelus guttatus*), Coney (*Cephalopholis fulva*), and Cero Mackerel (*Scomberomorus regalis*). Large reef predators, such as the Great Barracuda (*Sphyraena barracuda*) were observed.

No motile megabenthic invertebrates were observed within belt-transects (Table 16).

Table 12. Monte Pirata Reef. Percent cover by reef sessile-benthic substrate categories. February, 2001

Survey date: Feb. 8, 2001	TRANSECTS					
Depth: 12.1 m	**1**	**2**	**3**	**4**	**5**	**MEAN**
Rugosity (m)	6.93	4.20	4.54	2.87	3.87	**4.48**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	15.96	8.46	12.23	23.76	14.64	**15.01**
Porites porites	0.35	5.36	1.03	2.17	0.3	**1.84**
Dendrogyra cylindrus					7.43	**1.49**
Agaricia agaricites	4.26	0.5	2.06			**1.36**
Siderastrea siderea	1.65	1.69		3.03		**1.27**
Colpophyllia natans					5.41	**1.08**
Montastrea cavernosa	2.07		2.41	0.66		**1.03**
Agaricia grahamae	0.59	0.89	1.65			**0.63**
Acropora cervicornis					3.05	**0.61**
Porites astreoides	0.59		0.76		1.08	**0.49**
Diploria strigosa	1.36			0.78		**0.43**
Meandrina meandrites				2.08		**0.42**
Mycetophyllia aliciae	0.47	1.59				**0.41**
Madracis decactis					1.62	**0.32**
Stephanocoenia michilini				0.55	0.81	**0.27**
Dichocoenia stokesii		0.89		0.33		**0.24**
Diploria labyrinthiformis	1.06					**0.21**
Mussa angulosa					0.51	**0.10**
Scolymia cubensis				0.22		**0.04**
Eusmilia fastigiata			0.21			**0.04**
Millepora alcicornis			0.21			**0.04**
Total Stony Corals	28.36	19.38	20.56	33.58	34.85	**27.35**
Encrusting Gorgonians	1.89	0.21	0.19	1.55	0.30	**0.83**
Sponges	1.06	2.26	0.76	1.32	1.42	**1.36**
Zoanthids	1.00	0	0	0	1.73	**0.55**
Turf Algae	55.79	61.31	51.90	43.55	41.96	**50.90**
Fleshy Algae	3.31	1.69	2.06	1.86	0.51	**1.89**
Calcareous Algae	0	0	0	0.33	0	**0.07**
Abiotic Cover						
Reef Overhangs	7.57	13.18	17.94	11.18	16.22	**13.22**
Sand	0.42	1.97	1.94	6.68	0	**2.20**
Rubble	0	0	2.61	0	3.05	**1.13**
Hole/Gaps	0.58	0	2.03	0	0	**0.52**
Total Abiotic	8.57	15.15	24.52	17.86	19.27	**17.07**
Gorgonians (# colonies)	27	31	28	35	20	**28**

Table 13. Monte Pirata Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. February, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
forma annularis	4.44	3.33	0.56	0.56	2.22	2.22
forma faveolata	2.22	2.22	3.89	5.00	5.00	3.67
forma franksi	2.22	2.22	0	2.22	2.22	1.78
M. cavernosa	1.67	1.67	2.22	0.56	1.67	1.56
Porites astreoides	1.67	7.22	1.67	0.56	1.67	2.56
P. porites	0.56	0	0	0	0.56	0.22
P. furcata	0	0.56	0	0	0	0.11
Colpophillia natans	0	0	1.11	0	1.67	0.56
Mycetophyllya sp	0	0.56	0	0	0	0.11
Meandrina meandrites	0	0.56	0	0	0	0.11
Dendrogyra cylindrus	0	0	0.56	0	0.56	0.22
Acropora cervicornis	0	0	0	0	0.56	0.11
Agaricia sp	2.22	1.11	0.56	0	0.56	0.89
Siderastrea siderea	1.11	0.56	0.56	2.22	0	0.89
Madracis decactis	0	0	0	0	0.56	0.11
Diploria labyrinthiformis	0	0	0	0	0.56	0.11
D. clivosa	0	0.56	0	1.67	0	0.44
D. strigosa	0.56	0	0	0	0.56	0.22
TOTAL	**16.11**	**20.00**	**11.11**	**11.11**	**17.78**	**15.22**

Table 14. Monte Pirata Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. February, 2001

Video Transect	**No. of Species**	**Total Number of Colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	9	30	2.03	0.92
2	11	37	1.99	0.83
3	8	20	1.80	0.87
4	7	23	1.65	0.65
5	13	33	2.26	0.88
		Mean	**1.95**	**0.83**

Table 15. Monte Pirata Reef. Taxonomic composition and abundance of reef fishes within belt-transects. February, 2001

Survey date: Feb. 8, 2001
Depth: 12.1 m

		TRANSECTS					
		1	**2**	**3**	**4**	**5**	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Thalassoma bifasciatum	Bluehead wrasse	2	2	12	8	3	**5.4**
Stegastes partitus	Bicolor damselfish	5	6		6	4	**4.2**
Chromis cyanea	Blue chromis	6		2	5	5	**3.6**
Clepticus parrae	Creole wrasse		8			7	**3.0**
Scarus taeniopterus	Princess parrotfish	5			7		**2.4**
Scarus iserti	Stripped parrotfish	2		6	1		**1.8**
Halichoeres garnoti	Yellowhead wrasse		3	1	3	1	**1.6**
Sparisoma viride	Stoplight parrotfish	3	1	3		1	**1.6**
Chaetodon capistratus	Foureye butterflyfish	1	2		2	1	**1.2**
Haemulon flavolineatum	French grunt	2	1	1	1	1	**1.2**
Sparisoma radians	Bucktooth parrotfish	3		2	1		**1.2**
Acanthurus bahianus	Ocean surgeon	1	1	2	1		**1.0**
Gobiosoma evelynae	Sharknose goby		1			4	**1.0**
Sparisoma aurofrenatum	Redband parrotfish	1	1	1	2		**1.0**
Stegastes planifrons	Yellow-eye damselfish			3	1	1	**1.0**
Chaetodon striatus	Banded butterflyfish		1	1	2		**0.8**
Canthigaster rostrata	Caribbean puffer	1	1			1	**0.6**
Haemulon chrysargyreum	Smallmouth grunt	1				2	**0.6**
Myripristis jacobus	Blackbar soldierfish	3					**0.6**
Acanthurus chirurgus	Doctorfish	1	1				**0.4**
Acanthurus coeruleus	Blue tang		1	1			**0.4**
Aulostomus maculatus	Trumpetfish	1			1		**0.4**
Holocentrus rufus	Squirrelfish	1		1			**0.4**
Serranus tigrinus	Harlequin bass			1		1	**0.4**
Calamus pennatula	Pluma			1			**0.2**
Carangoides ruber	Bar jack	1					**0.2**
Equetus punctatus	Spotted drum					1	**0.2**
Halichoeres maculipinna	Clown wrasse				1		**0.2**
Holacanthus tricolor	Rock beauty			1			**0.2**
Hypoplectrus chlorurus	Yellowtail hamlet	1					**0.2**
Hypoplectrus nigricans	Black hamlet			1			**0.2**
Lactophrys bicaudalis	Spotted trunkfish					1	**0.2**
Lutjanus apodus	Schoolmaster			1			**0.2**
Microspathodon chrysurus	Yellowtail damselfish				1		**0.2**
Pomacanthus arcuatus	Gray angelfish					1	**0.2**
Priacanthus cruentatus	Bigeye				1		**0.2**
Pseudupeneus maculatus	Spotted goatfish				1		**0.2**
Scarus vetula	Queen parrotfish				1		**0.2**

	TOTAL INDIVIDUALS	**41**	**30**	**41**	**46**	**35**	**38.6**
	TOTAL SPECIES	**19**	**14**	**18**	**19**	**16**	**17**

Table 15. Continued

Outside transects:

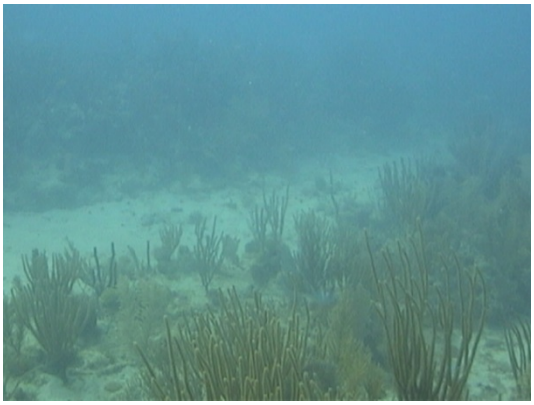
Haemulon macrostomum	Spanish grunt
Balistes vetula	Queen triggerfish
Cephalopholis fulva	Coney
Chromis multilineata	Yellowedge chromis
Clepticus parrae	Creole wrasse
Decapterus macarellus	Mackerel scad
Epinephelus guttatus	Red hind
Epinephelus striatus	Nassau grouper
Gramma loretto	Royal gramma
Haemulon macrostomum	Spanish grunt
Haemulon plumieri	White grunt
Holocentrus ascensionis	Longjaw squirrelfish
Hypoplectrus puella	Barred hamlet
Lactophrys triqueter	Smooth trunkfish
Lutjanus analis	Mutton snapper
Mulloides martinicus	Yellowtail goatfish
Ocyurus chrysurus	Yellowtain snapper
Pomacanthus ciliaris	French angelfish
Scomberomorus regalis	Cero mackerel
Sparisoma rubripinne	Yellowtail parrotfish
Sphyraena barracuda	Great barracuda
Stegastes dorsopunicans	Dusky damselfish

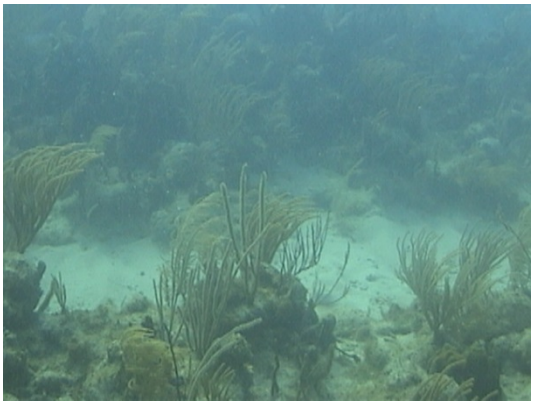
Table 16. Monte Pirata Reef. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects. February, 2001

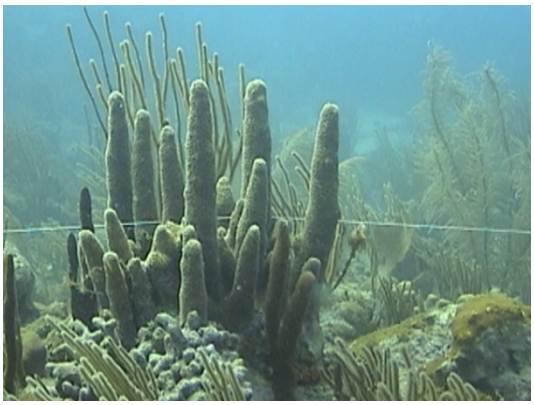
Survey Date: Feb. 8, 2001
Depth: 12.1 m

		TRANSECTS					
SPECIES	**COMMON NAME**	**1**	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE (IND/30 m2)**
No macroinvertebrates		0	0	0	0	0	0.0
	TOTALS	**0**	**0**	**0**	**0**	**0**	**0.0**

Photo Album 4. Monte Pirata Reef







4. Boya Esperanza Reef

Boya Esperanza Reef is a submerged patch reef sitting at the edge of a hard-ground platform located about 0.8 nautical miles off Puerto Esperanza, on the south coast of Vieques (Figure 3). A green navigation buoy marks the eastern boundary of the reef and the entrance channel to Puerto Esperanza. The reef has a highly irregular bathymetry, with large coral outcrops rising more than five meters from the base of the reef platform and reaching to about 2 meters from the surface. Extensive coralline sand pools (deposits) are found at the base of the reef on its northern boundary. Large crevices are found at the interface of the sandy bottom and the rock/coral outcrops. Our survey was performed on the southern section of the reef, at a depth of 9-10 meters. Transects were established in a north-south direction on top of large coral outcrops of Boulder Star Coral. Panoramic images of the reef are included in Photo Album 4.

Gigantic colonies of Boulder Star Coral, *Montastrea annularis* represent the most prominent feature of Boya Esperanza Reef. Several coral boulders reach a diameter of more than 4 meters and rise from the base up to about 5 meters. Besides the huge coral colonies, most other corals were small to medium sized encrusting colonies. This shallow reef seems to be revealing the effects of very strong wave action associated with hurricanes upon benthic community structure. A total of 21 species of stony corals were identified at Boya Esperanza Reef, 14 of which were intercepted by linear transects in our survey. Live stony corals averaged a surface cover of 36.0 % (range: 6.6 – 45.5 %) along linear transects (Table 17). Surface cover by Boulder Star Coral represented 80.0 % of the total cover by stony corals. Soft corals (gorgonians) were moderately abundant, with a mean density of 21 colonies intercepted per transect. The encrusting gorgonian, *Erythropodium caribaeorum* was present in four out of the five transects with a mean cover of 1.3 %. Zoanthids and ascideans were also present, but represented only minor components of the benthic reef community structure. Turf algae was the dominant biological component in terms of coral cover with a mean of 56.5 %. The percent cover by sessile-benthic substrate categories from video-transects is included as Appendix 4.

Density of stony coral colonies in video-transects averaged 12.6 col/m^2 (Table 18). Colonies of Boulder Star Coral represented approximately 61.9 % of the total colonies present in video-transects at Pirata Reef. The three morphotypes of *Montastrea annularis* were present, being the *annularis* morphotype the one showing highest density with a mean of 7.22 colonies/ m^2. The index of coral species diversity (H') for each of the five video-transects ranged between 0.17 at Tr-3 to 1.78 at Tr-5 (Table 19). The total number of coral species per video-transect ranged between 2 – 8 and the total number of colonies varied between 17 – 27.

A total of 51 reef fishes were identified at Monte Pirata Reef, 46 of which were observed within belt-transect areas (Table 20). The mean abundance of fishes was 63.4 Ind/30 m^2 and the mean number of species per transect was 20. The numerically dominant assemblage included the Bluehead Wrasse (*Thalassoma bifasciatum*), Bicolor Damselfish (*Stegastes partitus*), and the zooplanktivorous assemblage of Blue and Brown Chromis (*Chromis cyanea, C. multilineata*). Species of commercial value included Yellowtail, Lane and Gray Snappers (*Ocyurus chrysurus, Lutjanus synagris, L. griseus*) and the Cero Mackerel (*Scomberomorus regalis*).

Motile megabenthic invertebrates within belt-transects included the Slate-pencil Urchin (*Eucidaris tribuloides*) and the Rough Fireclam (*Lima scabra*) (Table 21). One large Spiny Lobster (*Panulirus argus*) was observed outside transect survey areas.

Table 17. Boya Esperanza Reef. Percent cover by reef sessile-benthic substrate categories. February, 2001

Survey Date: Feb. 9, 2001	TRANSECTS					
Depth: 9.1 m	**1**	**2**	**3**	**4**	**5**	**MEAN**
Rugosity	3.58	3.94	4.49	3.45	2.63	**3.62**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	31.82	26.39	45.48	33.60	6.58	**28.77**
Siderastrea siderea		0.40	2.42		3.34	**1.23**
Porites astreoides	0.63	2.00		1.47	1.91	**1.20**
Montastrea cavernosa	3.12	1.21	0.98			**1.06**
Siderastrea radians	4.06	0.80				**0.97**
Diploria strigosa		2.64	0.55			**0.64**
Porites porites				0.44	2.38	**0.56**
Millepora alcicornis	0.21			0.74	0.64	**0.32**
Colpophyllia natans					1.35	**0.27**
Diploria labyrinthiformis					1.23	**0.25**
Agaricia agaricites			0.29		0.87	**0.23**
Stephanocoenia michilini			0.97			**0.19**
Isophyllastrea rigida				0.95		**0.19**
Mycetophyllia ferox		0.70				**0.14**
Total Stony Corals	39.84	34.14	50.69	37.20	18.30	**36.03**
Encrusting Gorgonians	0	2.65	2.62	0.97	0.22	**1.29**
Zoanthids	0	1.29	0	0	0	**0.26**
Ascidians	0	0	1.17	0	0	**0.23**
Sponges	0	0	0	0	1.11	**0.22**
Turf Algae	57.14	61.31	34.96	54.94	74.33	**56.54**
Fleshy Algae	1.69	0.61	0.49	0	0	**0.56**
Calcareous Algae	1.33	0	0.49	1.86	0.67	**0.87**
Abiotic Cover						
Reef Overhangs	0	0	8.48	5.06	5.38	**3.78**
Holes/Gaps	0	0	1.46	0	0	**0.29**
Gorgonians (# colonies)	22	22	18	19	25	**21**

Table 18. Boya Esperanza Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. February, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
forma annularis	8.33	8.33	12.78	3.89	2.78	7.22
forma faveolata	0	0	0	0	0.56	0.11
forma franksi	0.56	0.56	0	0.56	0.56	0.44
M. cavernosa	1.11	0.56	0	0	0.56	0.44
Porites astreoides	0.56	0.56	0	1.67	3.89	1.33
P. porites	0	0.56	0.56	0	0	0.22
Isophyllia sinuosa	0	0	0	0.56	0.56	0.22
Siderastrea sp.	1.11	1.11	0	0.56	1.11	0.78
Agaricia sp	0	0.56	0	0	0	0.11
Diploria strigosa	0.56	2.78	0	2.22	2.78	1.67
TOTAL	**12.22**	**15.00**	**13.33**	**9.44**	**12.78**	**12.56**

Table 19. Boya Esperanza Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. February, 2001

Video Transect	**No. of Species**	**Total Number of Colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	6	22	1.12	0.62
2	8	27	1.44	0.69
3	2	24	0.17	0.25
4	6	17	1.51	0.84
5	8	23	1.78	0.86
		Mean	**1.20**	**0.65**

Table 20. Boya Esperanza Reef. Taxonomic composition and abundance of reef fishes within belt-transects. February, 2001

Survey Date: Feb. 9, 2001
Depth: 9.1 m

		TRANSECTS					
		1	**2**	**3**	**4**	**5**	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Thalassoma bifasciatum	Bluehead wrasse	15	13	4	23	2	**11.4**
Stegastes partitus	Bicolor damselfish	4	10	10	13	6	**8.6**
Chromis cyanea	Blue chromis	8	6	9	7	3	**6.6**
Chromis multilineata	Yellow-edge chromis		2	10	20		**6.4**
Scarus iserti	Stripped parrotfish	2	2	2	6		**2.4**
Sparisoma viride	Stoplight parrotfish	1	4	2	5		**2.4**
Sparisoma aurofrenatum	Redband parrotfish		2	3	3	3	**2.2**

Microspathodon chrysurus	Yellowtail damselfish	1	2	5	1	1	**2.0**

Table 20. Continued

Clepticus parrae	Creole wrasse			1	8		**1.8**
Haemulon flavolineatum	French grunt	1		8			**1.8**
Halichoeres garnoti	Yellow head wrasse	3	1		2	2	**1.6**
Stegastes dorsopunicans	Dusky damselfish		4		1	2	**1.4**
Acanthurus coeruleus	Blue tang	2		2	1	1	**1.2**
Ophioblennius atlanticus	Redlip blenny	1		1	4		**1.2**
Gobiosoma evelynae	Sharknose goby	1			4		**1.0**
Mulloides martinicus	Yellowtail goatfish		1	4			**1.0**
Scarus taeniopterus	Princess parrotfish				4	1	**1.0**
Malacoctenus triangulatus	Saddled blenny		1	1		2	**0.8**
Myripristis jacobu	Blackbar soldierfish				4		**0.8**
Abudefduf sexatilis	Sargent major	1		2			**0.6**
Haemulon macrostomum	Spanish grunt		2		1		**0.6**
Bodianus rufus	Spanish hogfish			1	1		**0.4**
Caranx chrysos	Blue runner			1	**1**		**0.4**
Haemulon aurolineatum	Tomtate			2			**0.4**
Holocentrus rufus	Squirrelfish	1		1			**0.4**
Priacanthus cruentatus	Bigeye	1				1	**0.4**
Serranus tigrinus	Harlequin bass	1			1		**0.4**
Sparisoma radians	Bucktooth parrotfish		2				**0.4**
Stegastes planifrons	Yellow-eye damselfish	1		1			**0.4**
Acanthurus bahianus	Ocean surgeon					1	**0.2**
Acanthurus chirurgus	Doctorfish					1	**0.2**
Aulostomus maculatus	Trumpetfish				1		**0.2**
Calamus pennatula	Pluma					1	**0.2**
Canthigaster rostrata	Caribbean puffer			1			**0.2**
Haemulon carbonarium	Caesar grunt			1			**0.2**
Haemulon chrysargyreum	Smallmouth grunt			1			**0.2**
Halichoeres sp.	Wrasse			1			**0.2**
Holacanthus ciliaris	Queen angelfish				1		**0.2**
Holocentrus ascensionis	Longjaw squirrelfish		1				**0.2**
Hypoplectrus puella	Barred hamlet	1					**0.2**
Lutjanus synagris	Lane snapper			1			**0.2**
Ocyurus chrysurus	Yellowtail snapper	1					**0.2**
Pomacanthus arcuatus	Gray angelfish	1					**0.2**
Pseudupeneus maculatus	Spotted goatfish	1					**0.2**
Scarus vetula	Queen parrotfish					1	**0.2**
Stegastes leucostictus	Beaugregory	1					**0.2**
	TOTAL INDIVIDUALS	**49**	**53**	**75**	**112**	**28**	**63.4**
	TOTAL SPECIES	**21**	**15**	**25**	**23**	**15**	**20**

Outside transects:

Carangoides ruber	Bar jack
Lutjanus griseus	Gray snapper
Lutjanus synagris	Lane snapper
Pomacanthus ciliaris	French angelfish

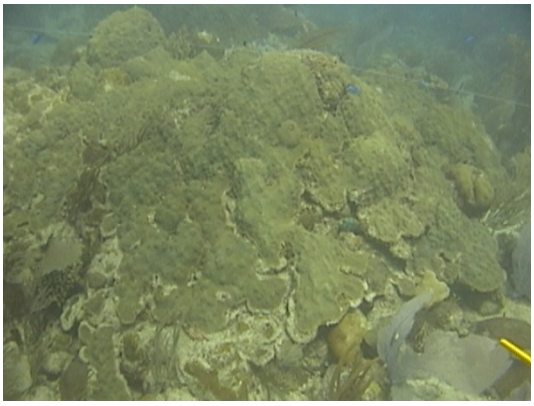
Scomberomorus regalis	Cero mackerel

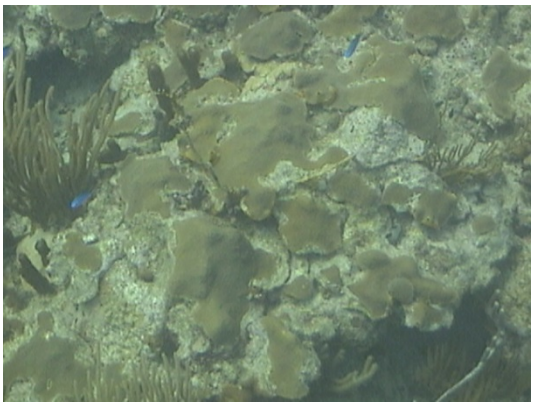
Table 21. Boya Esperanza Reef. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects. February, 2001

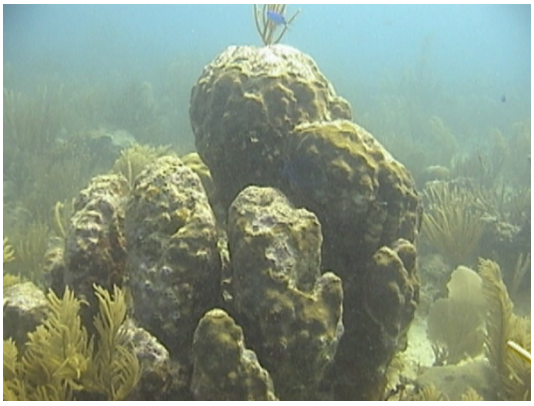
Survey Date: Feb. 9, 2001
Depth: 9.1 m

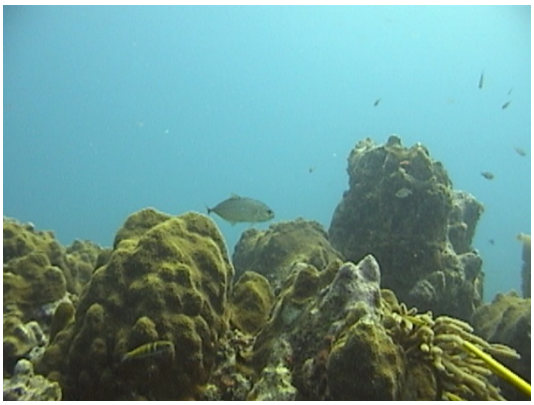
		TRANSECTS					
		1	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE (IND/30 m2)**
SPECIES	**COMMON NAME**						
Eucidaris tribuloides	Slate pencil urchin	0	0	2	0	0	0.4
Lima scabra	Rough fileclam			1			0.2
	TOTALS	**0**	**0**	**3**	**0**	**0**	**0.6**

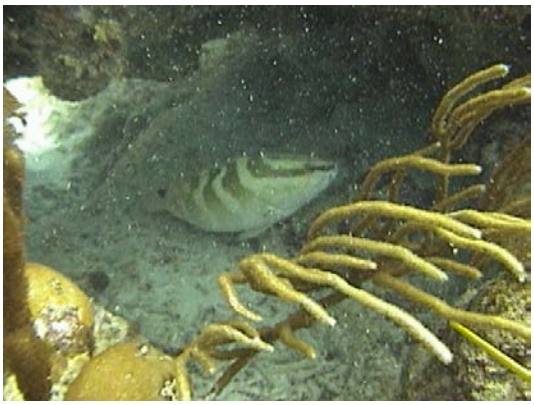
Photo Album 4. Boya Esperanza Reef

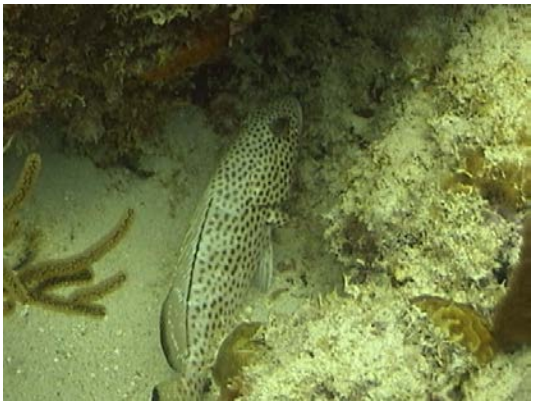












5. Caballo Blanco Reef Crest

Caballo Blanco is an emergent reef, or key, located about 1.8 nautical miles off from Cerro Martineau, on the north coast of Vieques (Figure 4). The reef crest is a shallow, low relief platform that extends almost throughout the entire length of the reef. Maximum depth at the reef crest is about 3 meters with a very gentle slope reaching the surface close to the sandy islet. An extensive, now completely destroyed Elkhorn Coral (*Acropora palmata*) biotope is found on the shallower sections of the reef crest bordering the key. Very large Elkhorn Coral arms rest broken and piled at the bottom forming a reef of coral rubble. Such magnitude of mechanical destruction appears to be attributable to extreme wave action caused by hurricanes. Fire Coral, (*Millepora* spp.), encrusting gorgonian (*Erythropodium caribaeorum*), algal turf and cyanobacterial films have overgrown many sections of the dead *A. palmata* fragments. New healthy colonies of Elkhorn Coral were common, particularly at the deeper sections of the reef crest. White coralline sands covered many sections of the reef crest. Massive coral boulders, encrusting coral colonies and gorgonians were found interspersed in the reef crest. Permanent transects were established at a depth of 3.0 meters over a hard ground substrate at the northern (most extensive) section of the reef crest. Panoramic views of Caballo Blanco Reef Crest are included as Photo Album # 5.

The hard ground substrate of the reef crest was mostly covered by a fine algal turf packed with coralline sands. The mean cover by algal turf was 77.8 %. A total of 12 species of stony corals were identified during our snapshot survey. Stony corals ranked second in terms of surface cover with a mean of 12.6 %. Blade Fire Coral (*Millepora complanata*) was the most abundant coral (hydrocoral). It was present at all transects surveyed and presented a mean cover of 6.8 % (Table 21). Encrusting colonies of Symmetrical Brain Coral (*Diploria strigosa*) and Mustard Hill Coral (*Porites astreoides*) were present in three out of five transect surveyed. Boulder Star Coral (*Montastrea annularis*) ranked second in terms of surface cover with only one (but large) massive colony intercepted by transect 5. Isolated massive coral colonies of Pillar Coral (*Dendrogyra cilindrus*) and Grooved Brain Coral (*Diploria labyrinthyformis*) were also common at Caballo Blanco reef crest. Percent cover by sessile-benthic substrate categories from video-transects is included as Appendix 5.

Density of stony coral colonies in video-transects averaged 3.3 col/m^2 (Table 22). Colonies of Mustard Hill Coral (Porites astreoides) and Symmetrical Brain Coral (*Diploria strigosa*) combined for 86.8 % of the total colonies present in video-transects at Caballo Blanco Reef Crest. The index of coral species diversity (H') for each of the five video-transects ranged between 0at Tr-4 to 1.04 at Tr-1 (Table 23). The total number of coral species per video-transect ranged between 1 – 3 and the total number of colonies varied between 2 – 10.
A total of 27 reef fishes were identified at Caballo Blanco Reef Crest, 22 of which were observed within belt-transect areas (Table 24). The mean abundance of fishes was 32.0 Ind/30 m^2 and the mean number of species per transect was 13. The numerically dominant assemblage included the Bicolor and Dusky Damselfishes (*Stegastes partitus, S. dorsopunicans*), Doctorfish (*Acanthurus chirurgus*) Spanish Grunt (*Haemulon macrostomum*), Striped parrotfish (*Scarus iserti*) and Bluehead Wrasse (*Thalassoma bifasciatum*). Large predators or fish species of commercial value were not observed.

Motile megabenthic invertebrates were highly abundant at the reef crest of Caballo Blanco. The combined mean density of six species present within belt-transects was 56.2 Ind/30m^2 (Table 25). The most abundant species was the Rock-Boring Sea Urchin (*Echinometra lucunter*). The Long-spined and Slate-pencil Sea Urchins (*Diadema antillarum, Eucidaris tribuloides*) were also part of the megabenthic invertebrate assemblage.

Table 21. Caballo Blanco Reef Crest. Percent cover of sessile-benthic substrate categories. Chain transect method. May, 2001

Survey date: May 21, 2001	TRANSECTS					
Depth: 4.5 m	**1**	**2**	**3**	**4**	**5**	**MEAN**
Rugosity (m)	3.28	3.21	4.06	2.25	2.8	**3.12**
SUBSTRATE CATEGORIES						
Stony Corals						
Millepora complanata	6.02	8.39	4.41	7.93	7.34	**6.82**
Diploria strigosa	2.56	8.18	2.70			**2.69**
Montastrea annularis					7.26	**1.45**
Porites astreoides		0.32	2.92	1.38		**0.92**
Diploria clivosa		3.41				**0.68**
Total Stony Corals	8.58	20.29	10.03	9.30	14.60	**12.56**
Gorgonian Colonies	9	10	6	3	3	**6**
Encrusting Gorgonians	0.42	1.29	0.40	0.90		**0.60**
Zoanthids	0.42		1.92			**0.47**
Turf Algae	87.42	70.55	74.25	77.90	78.84	**77.79**
Calcareous Algae			1.99			**0.40**
Abiotic Substrates						
Reef Overhangs			11.45	4.98	4.22	**4.13**
Sand	3.16	7.87		6.93	2.34	**4.06**
Total Abiotic	3.16	7.87	11.45	11.91	6.56	**8.19**

Outside transects:

Diploria strigosa
Millepora alcicornis
Porites porites
Agaricia agaricites
Acropora cervicornis
Siderastrea siderea
Dendrogyra cylindrus

Table 22. Caballo Blanco Reef Crest. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. May, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis	0	0	0	0	0.56	0.11
Porites astreoides	0.56	1.67	3.33	2.78	0.56	1.78
Diploria labyrinthiformis	0.56	0	0	0	0	0.11
D. clivosa	0	1.11	0	0	0	0.22
D. strigosa	1.11	2.78	1.67	0	0	1.11
TOTAL	**2.22**	**5.56**	**5.00**	**2.78**	**1.11**	**3.33**

Table 23. Caballo Blanco Reef Crest. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. May, 2001

Video Transect	No. of Species	Total Number of Colonies	Species Diversity (H')	Species Evenness (J)
1	3	4	1.04	0.95
2	3	10	1.03	0.94
3	2	9	0.64	0.92
4	1	5	N/A	N/A
5	2	2	0.69	1.00
Mean			**0.85**	**0.95**

Table 24. Caballo Blanco Reef Crest. Taxonomic composition and abundance of reef fishes within belt-transects. May, 2001.

Survey Date: May 21, 2001
Depth: 3.0 m

		TRANSECTS					
		1	2	3	4	5	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Stegastes partitus				11	6	9	**5.2**
Stegastes dorsopunicans		8	8				**3.2**
Acanthurus chirurgus			2		11		**2.6**
Haemulon macrostomum		1		1	3	7	**2.4**
Scarus iserti		5		2	2	3	**2.4**
Thalassoma bifasciatum		3		2	1	4	**2.0**
Microspathodon chrysurus		2		3	2	2	**1.8**
Ophioblennius atlanticus		3	1	3	1	1	**1.8**
Sparisoma aurofrenatum		1	2	3	1	2	**1.8**
Sparisoma viride		2	2	1	3		**1.6**
Acanthurus coeruleus		2	1	1	1	2	**1.4**
Halichoeres bivittatus		1	2			2	**1.0**
Abudefduf sexatilis		4					**0.8**
Halichoeres radiatus		1		1	1	1	**0.8**
Scarus taeniopterus		1	1	1		1	**0.8**
Sparisoma radians		3					**0.6**
Stegastes variabilis					1	1	**0.4**
Serranus tigrinus		1		1			**0.4**
Sparisoma rubripinne				1		1	**0.4**
Acanthurus bahianus					1		**0.2**
Holocentrus rufus		1					**0.2**
Malacoctenus triangulatus		1					**0.2**
	TOTAL INDIVIDUALS	**40**	**19**	**31**	**34**	**36**	**32.0**
	TOTAL SPECIES	**17**	**8**	**13**	**13**	**13**	**13**

Outside transects:
Cantherhines pullus
Haemulon plumieri
Haemulon flavolineatum

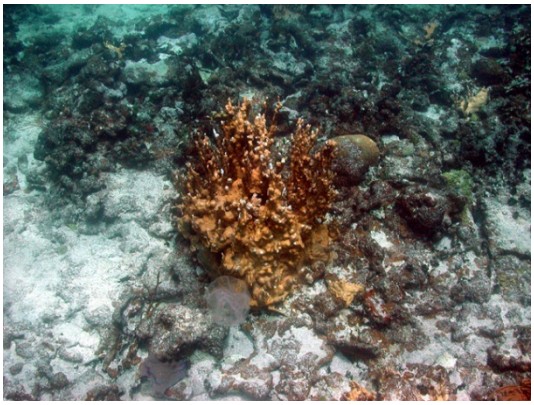
Myripristis jacobus
Carangoides ruber

Table 25. Caballo Blanco Reef Crest. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects. May, 2001

Survey date: May 17, 2001
Depth: 3.0 m

SPECIES	COMMON NAME	TRANSECTS 1	2	3	4	5	MEAN ABUNDANCE (IND/30 m2)
Echinometra lucunter	Rock-boring Urchin	31	28	48	35	16	31.6
Astraea spp.	Starsnail	20	20	9	8	16	14.6
Diadema antillarum	Long-spined Sea Urchin	5	2	6	5	5	4.6
Echinometra viridis	Reef Urchin	2	2	5	2	1	2.4
Eucidaris tribuloides	Slate-pencil Urchin	2	0	2	5	2	2.2
Mithrax sp.	Spider Crab	0	0	3	1	0	0.7
	TOTALS	**60**	**52**	**73**	**56**	**40**	**56.2**

Photo Album 5. Caballo Blanco Reef Crest



6. Caballo Blanco Reef Slope

The fore reef of Caballo Blanco features a gently sloping terrace at depths between 3-4 meters and a steeper drop to its base at a depth of 11 meters (Figure 4). Our survey was performed on the upper terrace of the reef slope at a depth of four meters. This is an area where large, massive colonies of Boulder Brain Coral (*Montastrea annularis*) produce substantial topographic relief and habitat complexity. Some of these coral heads reach 2-3 meters in height and at least two meters in diameter. The reef substrate is irregular with many holes and crevices. Our transects were aligned north-south along the reef slope, following a depth contour of 4.0 meters. Panoramic images of the reef slope at Caballo Blanco are presented as Photo Album 6.

The vertically projected growth of large, massive colonies of Boulder Brain Coral were the most conspicuous feature of the reef slope at Caballo Blanco. The mean cover by Boulder Brain Coral (*Montastrea annularis*) was 25.8 %, representative of almost 82 % of the total cover by stony corals (e.g. 31.2 %). A total of 21 species of stony corals were identified, 11 of which were intersected by line transects during our survey. The main assemblage of stony corals in terms of surface cover was composed of species that typically grow as massive colonies, such as *M. annularis*, *Diploria labyrinthiformis*, and *Siderastrea siderea*. Encrusting species included *D. strigosa* and *P. astreoides.* Soft corals (gorgonians) were present in relatively low densities (mean: 14 colonies/transect). The dominant biotic substrate component of the reef sessile-benthic community in terms of surface cover was the algal turf with a mean of 47.4 % (range: 32.1 – 62.8 %). Calcareous algae, mostly *Halimeda incrasata* was very common at the reef slope with a mean cover of 13.0 %. Encrusting gorgonians (*Erythropodium caribaeorum)* and sponges were observed in several transects, but with very low surface cover. Reef overhangs, mostly associated with massive coral growth averaged a surface cover of 13% and contributed significantly to a high reef substrate rugosity (e.g. 5.9 m). Data of percent cover by sessile-benthic substrate categories from video-transects are included as Appendix 6.

Density of stony coral colonies in video-transects averaged 11.3 col/m^2 (Table 27). Colonies of Boulder Star Coral represented approximately 61.8 % of the total colonies present in video-transects at Caballo Blanco Reef Slope. The three morphotypes of *Montastrea annularis* were present, being the *annularis* morphotype the one showing highest density with a mean of 5.78 colonies/ m^2. The index of coral species diversity (H') for each of the five video-transects ranged between 0.56 at Tr-3 to 1.82 at Tr-1 (Table 28). The total number of coral species per video-transect ranged between 2 – 8 and the total number of colonies varied between 12 – 25.

A total of 42 reef fishes were identified at Caballo Blanco Reef Slope, 26 of which were observed within belt-transect areas (Table 29). The mean abundance of fishes was 28.4 Ind/30 m^2 and the mean number of species per transect was 11. The numerically dominant assemblage included the Dusky Damselfishes (*Stegastes dorsopunicans*), Bluehead Wrasse (*Thalassoma bifasciatum*), Striped, Redband and Stoplight Parrotfishes (*Scarus iserti*, *Sparisoma aurofrenatum, S. viride*). Species of commercial value included the Yellowtail and Schoolmaster Snappers (*Ocyurus chrysurus, Lutjanus apodus*) and the Red Hind (*Epinephelus guttatus*).

Motile megabenthic invertebrates within belt-transects at the reef slope of Caballo Blanco presented a mean density of 2.4 Ind/30 m^2 (Table 30). The taxonomic assemblage included three species of sea urchins (*Echinometra viridis, E. lucunter* and *Diadema antillarum*), the gastropod *Astraea* sp. and one Rock Lobster (*Panulirus guttatus*).

Table 26. Caballo Blanco Reef Slope. Percent cover by sessile-benthic substrate categories. Chain-link method. May, 2001

Survey Date: May 17, 2001	TRANSECTS					
Depth: 4.5 m	**1**	**2**	**3**	**4**	**5**	**MEAN**
Rugosity (m)	6.07	5.99	7.01	6.14	4.2	**5.88**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	38.65	21.96	22.75	32.47	13.31	**25.83**
Siderastrea siderea	3.67	3.00			2.18	**1.77**
Diploria labyrinthiformis		5.20				**1.04**
Diploria strigosa					4.58	**0.92**
Porites astreoides	1.05	1.06			0.20	**0.46**
Dichocoenia stokesii		1.59				**0.32**
Montastrea cavernosa		0.79		0.79		**0.32**
Agaricia agaricites	0.87				0.10	**0.19**
Colpophyllia natans			0.75			**0.15**
Millepora alcicornis				0.44		**0.09**
Porites porites			0.33			**0.07**
Total Stony Corals	44.24	33.6	23.85	33.71	20.35	**31.15**
Encrusting Gorgonian			0.88	0.62	0.2	**0.34**
Sponges	1.74			0.35		**0.42**
Turf Algae	32.11	36.3	62.75	43.87	62.12	**47.43**
Calcareous Algae	13.57	3.07	8.11	0.79	0.49	**5.21**
Fleshy Algae	1.06	0.94		0.79		**0.56**
Abiotic Substrates						
Reef Overhangs	4.04	20.21	4.41	19.89	16.34	**12.98**
Sand	3.24	5.88				**1.82**
Hole					0.5	**0.10**
	7.28	26.09	4.41	19.89	16.85	**14.9**
Gorgonian Colonies	16	12	5	18	19	**14**

Coral Species Outside Transects:

Acropora cervicornis
Eusmilia fastigiata
Agaricia grahamae
Mycetophyllia lamarckiana
Siderastrea radians
Isophyllia sinuosa
Meandrina meandrites
Dendrogyra cylindrus
Mycetophyllia aliciae
Stephanocoenia michilini

Table 27. Caballo Blanco Reef Slope. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. May, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
forma annularis	4.44	7.78	5.00	7.78	3.89	5.78
forma faveolata	2.22	0	0	0	0	0.44
forma franksi	2.78	0	0	0	1.11	0.78
M. cavernosa	0.56	1.11	0	0	0	0.33
Agaricia sp	0	0	0	0	0.56	0.11
Porites astreoides	1.11	0	0	1.11	4.44	1.33
P. porites	0.56	0	1.67	0	0.56	0.56
P. furcata	0.56	0	0	0	0	0.11
Siderastrea radians	1.67	2.78	0	1.11	1.67	1.44
Madracis sp	0	0	0	0	0	0.00
Diploria labyrinthiformis	0	0.56	0	0	0	0.11
D.strigosa	0	0	0	0	0.56	0.11
D. clivosa	0.56	0	0	0.56	0	0.22
TOTAL	**14.44**	**12.22**	**6.67**	**10.56**	**12.78**	**11.33**

Table 28. Caballo Blanco Reef Slope. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. May, 2001

Video Transect	**No. of Species**	**Total Number of colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	8	25	1.82	0.88
2	4	22	0.98	0.71
3	2	12	0.56	0.81
4	4	19	0.85	0.62
5	7	23	1.62	0.83
		Mean	**1.17**	**0.77**

Table 29. Caballo Blanco Reef Slope. Taxonomic composition and abundance of reef fishes within belt-transects. May, 2001

Survey date: May 17, 2001
Depth: 4.5 m

		TRANSECTS					
		1	**2**	**3**	**4**	**5**	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Stegastes dorsopunicans		14	11	11	8	7	10.2

Thalassoma bifasciatum		3	1	6		1	2.2

Table 29. Continued

Scarus iserti			7	1	2	2.0
Sparisoma aurofrenatum	2	1	4	2	1	2.0
Sparisoma viride	1		4	3	2	2.0
Chromis multilineata			4	4		1.6
Holocentrus rufus	2	1	2		1	1.2
Scarus vetula				3	2	1.0
Gobiosoma evelynae				1	3	0.8
Hypoplectrus nigricans	1	1	1	1		0.8
Acanthurus coeruleus			2	1		0.6
Coryphopterus personatus	3					0.6
Microspathodon chrysurus	1		2			0.6
Acanthurus bahianus			1	1		0.4
Abudefduf sexatilis	1					0.2
Canthigaster rostrata	1					0.2
Chaetodon capistratus					1	0.2
Haemulon sciurus					1	0.2
Hypoplectrus chlorurus				1		0.2
Hypoplectrus puella				1		0.2
Halichoeres bivitatus					1	0.2
Lutjanus apodus			1			0.2
Priacanthus cruentatus			1			0.2
Scarus taeniopterus	1					0.2
Sparisoma rubripinne		1				0.2
Stegastes partitus					1	0.2
TOTAL INDIVIDUALS	30	16	46	27	23	**28.4**
TOTAL SPECIES	11	6	13	12	12	**11**

Outside transects:

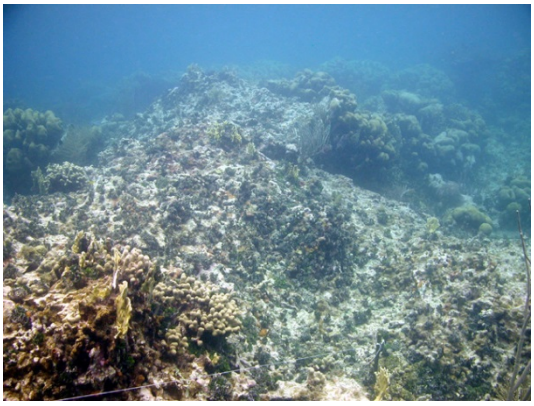
Ocyurus chrysurus
Epinephelus guttatus
Synodus intermedius
Hypoplectrus unicolor
Gerres cinereus
Chromis cyanea
Halichoeres garnoti
Haemulon plumieri
Carangoides ruber
Acanthurus chirurgus
Myripristis jacobus
Halichoeres radiatus
Stegastes leucostictus
Equetus acuminatus
Aulostomus maculatus
Haemulon macrostomum

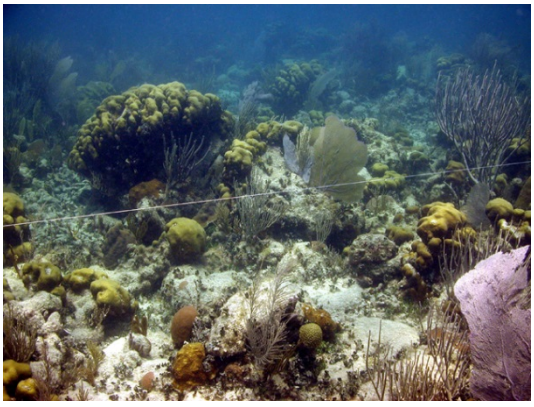
Table 30. Caballo Blanco Reef Slope. Taxonomic composition and abundance of motile megabenthic invertebrates. May, 2001

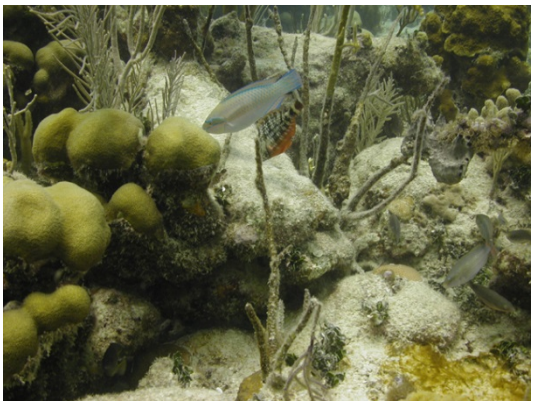
Survey date: May 17, 2001
Depth: 4.5 m

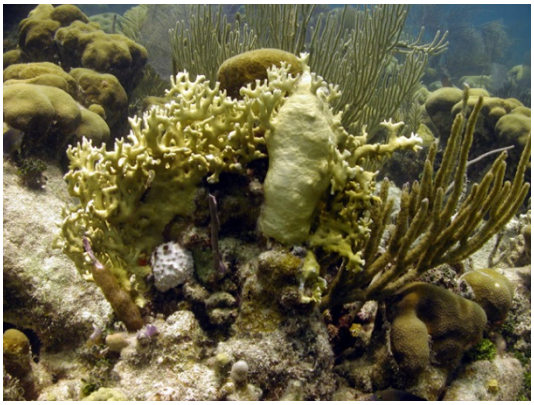
		TRANSECTS					
		1	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE (IND/30 m2)**
SPECIES	**COMMON NAME**						
Echinometra viridis	Reef Urchin	2	1		1		**0.8**
Echinometra lucunter	Rock-boring Urchin	1		2			**0.6**
Diadema antillarum	Long-spined Sea Urchin	1		2			**0.6**
Astraea sp.	Starsnail			1			**0.2**
Panulirus guttatus	Rock lobster	1					**0.2**
	TOTALS	**5**	**1**	**5**	**1**	**0**	**2.4**

Photo Album 6. Caballo Blanco Reef Slope









7. Mosquito Reef

Mosquito Reef is an emergent islet, or "key" localized at about 1.7 nautical miles off from Punta Caballo, on the north coast of Vieques (Figure 4). The coral reef system is a fringing formation with an extensive reef crest surrounding the islet and a steep slope down to its base at a depth of 14.5 meters. A seagrass bed is found at the reef interface. A vast accumulation of large broken fragments of Elkhorn Coral, *Acropora palmata* overgrown by turf algae and other encrusting biota were observed at the reef crest. Our survey was performed on the northeast section of the reef slope at a depth of 10.6 meters. The reef substrate at the slope was irregular, with many massive coral colonies providing substantial topographic relief. Panoramic views of the Mosquito coral reef community are included as Photo Album 7.

A species rich assemblage of soft and stony corals was the most prominent feature of the reef slope at Mosquito Reef. A total of 24 stony coral species were identified in the vicinity of our survey area, 12 of which were intercepted by transects (Table 31). Mean cover by stony corals along transects was 35.5 % (range: 24.3 – 44.3 %). Boulder Star Coral was the dominant species in terms of surface cover with a mean of 17.9 % (range: 10.8 – 28.1 %). In addition to the Boulder Star Coral, three other species were present at all five transects surveyed, these were the Boulder Brain Coral (*Colpophyllia natans*)**,** Finger Coral (*Porites porites*) and the Mustard Hill Coral (*Porites astreoides*). Soft corals (gorgonians) were moderately abundant in the shallow sections of the reef slope, but were less prominent near the base of the reef where large coral heads occupied most of the available space. Gorgonians averaged 12 colonies per transect. Small patches of the encrusting gorgonian, *Erythropodium caribaeorum* was present at all five transects with a mean cover of 3.1 %. Sponges were intercepted by four transects and averaged a surface cover of 2.2%. Abiotic substrates, mainly influenced by reef overhangs from large coral heads and ledges presented a mean cover of 16.3 %. Both turf and fleshy algae were found at all transects with a combined mean cover of 42.9 %. Data of percent cover by sessile-benthic substrate categories from video-transects are included as Appendix 7.

Density of stony coral colonies in video-transects averaged 19.3 col/m^2 (Table 32). Colonies of Boulder Star Coral represented approximately 44.4 % of the total colonies present in video-transects at Mosquito Reef. The three morphotypes of *Montastrea annularis* were present, being the *faveolata* morphotype the one showing highest density with a mean of 4.89 colonies/ m^2. The index of coral species diversity (H') for each of the five video-transects ranged between 1.79 at Tr-4 to 2.20 at Tr-5 (Table 33). The total number of coral species per video-transect ranged between 9 – 11 and the total number of colonies varied between 25 – 41.

A total of 46 reef fishes were identified from Mosquito Reef, 34 of which were observed within belt-transect areas (Table 34). The mean abundance of fishes was 60.8 Ind/30 m^2 and the mean number of species per transect was 17. The numerically dominant assemblage included the Masked Goby (*Coryphopterus personatus*), Yellow-eye Damselfish (*Stegastes planifrons*) and the Striped and Redband Parrotfishes (*Scarus iserti*, *Sparisoma aurofrenatum*). The Squirrelfish (*Holocentrus rufus*), Sargeant Major (*Abudefduf sexatilis*) and Blue Tang (*Acanthurus coeruleus*) were present at all transects. Species of commercial value included the Yellowtail and Lane Snappers (*Ocyurus chrysurus, Lutjanus synagris*), the Red Hind and Nassau Groupers (*Epinephelus guttatus*, *E. striatus*), and the Hogfish (*Lachnolaimus maximus*). Large reef predators, such a the Great Barracuda (*Sphyraena barracuda*) and the Southern Stingray (*Dasyatis americana*) were present at the reef.

Motile megabenthic invertebrates within belt-transects at the reef slope of Mosquito Reef included the Rock-boring and Long-spined Sea Urchins (*Echinometra lucunter* and *Diadema antillarum*).

Table 31. Mosquito Reef. Percent cover by sessile-benthic substrate categories. Chain transect method. May, 2001

Survey Date: May 18, 2001	TRANSECTS					MEAN
Depth: 10.6 m	**1**	**2**	**3**	**4**	**5**	
Rugosity (m)	4.31	4.21	3.52	5.24	4.1	**4.28**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	11.59	22.11	28.18	10.82	16.88	**17.92**
Colpophyllia natans	3.14	7.82	5.18	1.84	4.33	**4.46**
Porites porites	1.40	6.62	7.99	1.51	0.30	**3.56**
Montastrea cavernosa	1.40		0.42	10.23	2.70	**2.95**
Porites astreoides	1.75	4.08	2.37	4.00	1.49	**2.74**
Siderastrea siderea	1.67			0.28	4.96	**1.38**
Mycetophyllia aliciae		0.60		3.21		**0.76**
Siderastrea radians	2.37	0.99	0.21			**0.71**
Millepora alcicornis	0.20				2.60	**0.56**
Agaricia agaricites		0.40		0.85	0.40	**0.33**
Acropora cervicornis	0.59					**0.12**
Scolymia sp.	0.20					**0.04**
Total Stony Corals	24.30	42.62	44.30	32.74	33.66	**35.52**
Encrusting Gorgonian	2.72	0.40	2.00	2.69	7.58	**3.08**
Sponges	3.14	3.16	2.00		2.91	**2.24**
Turf Algae	47.49	31.50	35.65	45.73	46.14	**41.30**
Fleshy Algae	2.93	2.60	1.35	0.55	0.50	**1.59**
Abiotic Substrates						
Reef Overhangs	16.99	11.32	11.02	16.93		**11.25**
Coral Rubble	1.26	6.44	3.11	1.39	9.21	**4.28**
Holes	1.47		0.63			**0.42**
Dead Coral		1.97				**0.39**
Total Abiotic	19.72	19.73	14.76	18.32	9.21	**16.34**
Gorgonians (# colonies)	19	10	7	15	5	**12**

Coral Species Outside Transects
Isophyllia rigida
Diploria strigosa
Diploria labyrinthiformis
Mussa sp.
Stephanocoenia michilini
Madracis decactis
Mycetophyllia aliciae
Leptoseris cucullata
Eusmilia fastigiata

Dichocoenia stokesii
Mycetophyllia lamarckiana
Isophyllia sinuosa

Table 32. Mosquito Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. May, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
forma annularis	0.56	1.67	0.56	1.67	3.33	1.56
forma faveolata	5.56	5.56	3.33	7.22	2.78	4.89
forma franksi	2.78	3.33	1.11	0.56	2.78	2.11
M. cavernosa	1.11	0.56	1.11	7.22	2.78	2.56
Porites astreoides	6.67	5.00	3.33	2.22	2.22	3.89
P. porites	1.11	0.56	0	0	0	0.33
P. furcata	0	1.67	1.11	0.56	0.56	0.78
Colpophillia natans	0.56	0.56	1.67	0	1.67	0.89
Mycetophyllya sp.	0	0.56	0.56	1.67	0	0.56
Madracis decactis	0	0	0.56	0	0	0.11
Eusmilia fastigiata	0	0	0	0	0.56	0.11
Scolymia sp	0	0	0	0.56	0	0.11
Agaricia sp	0	0	0	0.56	0	0.11
Siderastrea siderea	0	1.11	0.56	0	3.33	1.00
S. radians	0.56	0	0	0	0	0.11
Diploria labyrinthiformis	0	0	0	0.56	0.56	0.22
D. clivosa	0.56	0	0	0	0.56	0.22
TOTAL	**18.89**	**20.56**	**13.89**	**22.78**	**20.56**	**19.33**

Table 33. Mosquito Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. May, 2001

Video Transect	**No. of Species**	**Total Number of Colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	9	36	1.80	0.82
2	10	37	1.95	0.85
3	10	25	2.06	0.89
4	10	41	1.79	0.78
5	11	38	2.20	0.92
		Mean	**1.96**	**0.85**

Table 34. Mosquito Reef. Taxonomic composition and abundance of reef fishes within belt-transects. May, 2001

Survey Date: May 18, 2001
Depth: 10.6 m

		TRANSECTS					
		1	2	3	4	5	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Coryphopterus personatus		10	10	50	21	33	**24.8**
Stegastes planifrons		10	12	9	1	10	**8.4**
Scarus iserti		3	3	7	8	2	**4.6**
Sparisoma aurofrenatum		3	1	3	2	3	**2.4**
Holocentrus rufus		1	4	2	2	2	**2.2**
Ocyurus chrysurus		1		4		5	**2**
Abudefduf sexatilis		2	2	1	2	2	**1.8**
Acanthurus coeruleus		1	1	3	2	1	**1.6**
Sparisoma viride			3	1	1	3	**1.6**
Gobiosoma evelynae			1		2	1	**0.8**
Microspathodon chrysurus		2			2		**0.8**
Acanthurus bahianus		1		1		1	**0.6**
Aulostomus maculatus			1	1		1	**0.6**
Canthigaster rostrata		1			2		**0.6**
Haemulon aurolineatum			2	1			**0.6**
Pomacanthus arcuatus		1			1	1	**0.6**
Scarus vetula			1	1	1		**0.6**
Acanthurus chirurgus		1				1	**0.4**
Coryphopterus lipernes						2	**0.4**
Hypoplectrus chlorurus		1	1				**0.4**
Hypoplectrus puella				1	1		**0.4**
Hypoplectrus unicolor		1			1		**0.4**
Scarus taeniopterus					2		**0.4**
Chaetodon capistratus					1		**0.2**
Gerres cinereus					1		**0.2**
Haemulon chrysargyreum			1				**0.2**
Haemulon flavolineatum			1				**0.2**
Halichoeres garnoti			1				**0.2**
Lutjanus apodus						1	**0.2**
Myrypristis jacobus						1	**0.2**
Priacanthus cruentatus		1					**0.2**
Sphyraena barracuda			1				**0.2**
Stegastes leucostictus				1			**0.2**
Thalassoma bifasciatum			1	8			**1.8**

	TOTAL INDIVIDUALS	**40**	**47**	**94**	**53**	**70**	**60.8**
	TOTAL SPECIES	**16**	**18**	**16**	**18**	**17**	**17**

Table 34. Continued

Outside transects:

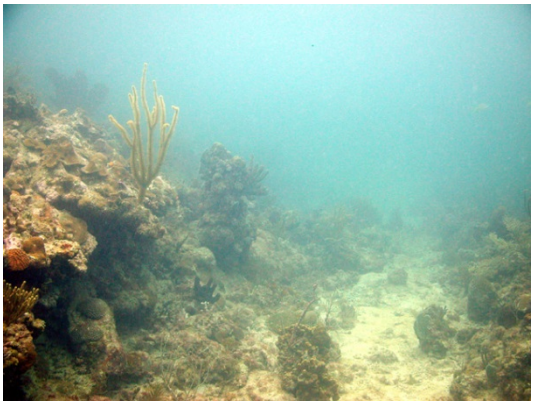
Epinephelus striatus
Epinephelus guttatus
Lutjanus synagris
Haemulon plumieri
Haemulon macrostomum
Gramma loretto
Haemulon sciurus
Carangoides ruber
Fistularia tabacaria
Pseudupeneus maculatus
Pomacanthus paru
Stegastes partitus
Lachnolaimus maximus
Synodus sp.

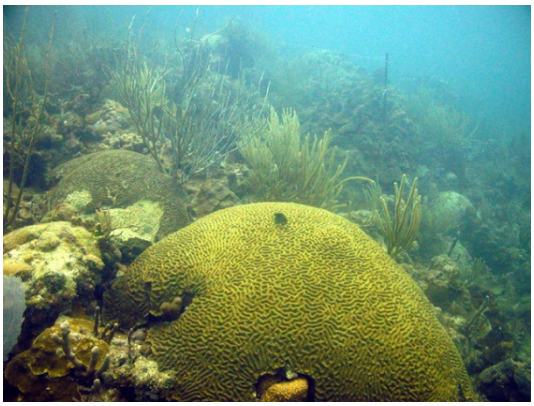
Table 35. Mosquito Reef. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects. May, 2001

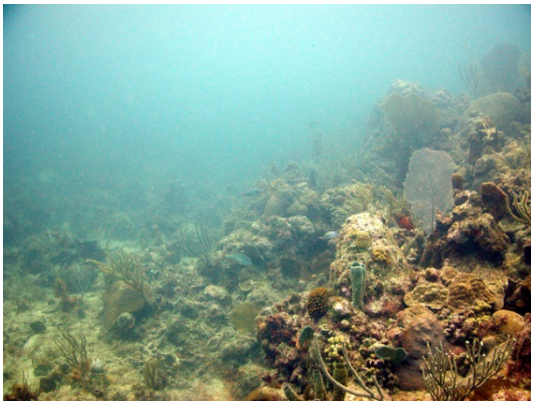
Survey Date: May 18, 2001
Depth: 10.6 m

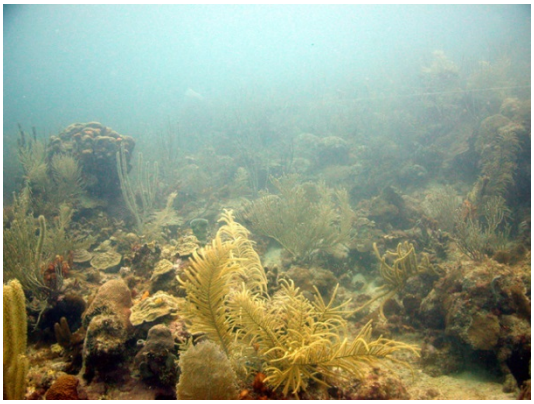
		TRANSECTS					
		1	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE (IND/30 m2)**
SPECIES	**COMMON NAME**						
Echinometra lucunter	Rock-boring Urchin	1					**0.2**
Diadema antillarum	Long-spined Sea Urchin				1		
	TOTALS	**1**	**0**	**0**	**1**	**0**	**0.4**

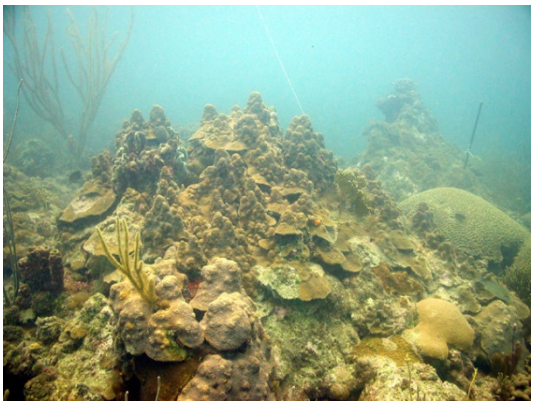
Photo Album 7. Mosquito Reef

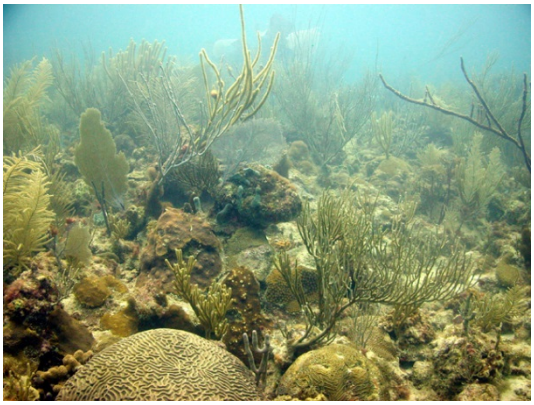


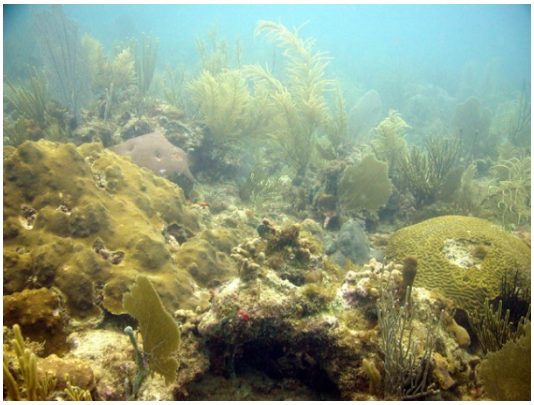


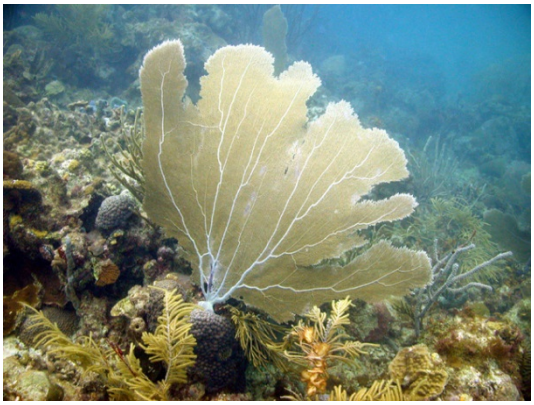












8. Corona Reef

Corona Reef is an emergent islet, or "key" located due east of Mosquito Reef. The coral reef system is a fringing formation similar to Mosquito Reef, with a wide reef crest and a narrow and steep slope dropping to its base at a depth of 14 meters. The reef substrate is irregular, but stony corals are mostly found as encrusting and branching colonies and do not contribute much topographic relief. Our survey was performed on the northwest section of the reef slope at a depth of 10.6 meters. Panoramic images of Coronas Reef are included as Photo Album 8.

The sessile-benthic reef community at Coronas Reef is characterized by small and medium sized stony corals growing mostly interspersed as encrusting and branching isolated colonies in the reef. A total of 26 stony coral species were identified in the vicinity of our survey area, 14 of which were intercepted by transects. Mean cover by stony corals along transects was 17.5 % (range: 11.0 – 28.8 %). Boulder Star and Great Star Corals (*Montastrea annularis, M. cavernosa*) were the only species present at all transects surveyed and also the dominant species in terms of surface cover with means of 6.9 % and 4.9 %, respectively (Table 36). Mustard Hill Coral (*Porites astreoides*) and Massive Starlet Coral (*Siderastrea siderea*) were present at four transects with a mean cover of 2.1 % and 1.6 %, respectively. Soft corals (gorgonians) were moderately abundant with a mean of 12 colonies intercepted per transect. The encrusting gorgonian, *Erythropodium caribaeorum* was present at all five transects with a mean cover of 2.1%. Encrusting and erect sponges (*Callyspongia vaginalis, Niphates sp., Aplysina sp.)* were common (mean surface cover: 3.9 %). Abiotic substrates, mainly influenced by reef overhangs presented a mean cover of 13.5 %. Turf algae was the dominant component of the sessile-benthic reef community in terms of surface cover with a mean of 60.8 % (range: 49.1 – 68.5 %). Fleshy (mostly brown) macroalgae were present in low amounts (mean cover: 0.2 %). Data of percent cover by sessile-benthic substrate categories from video-transects are included as Appendix 8.

Density of stony coral colonies in video-transects averaged 13.9 col/m^2 (Table 37). Colonies of Boulder Star Coral represented approximately 34.3 % of the total colonies present in video-transects at Mosquito Reef. The three morphotypes of *Montastrea annularis* were present, being the *annularis* morphotype the one showing highest density with a mean of 2.4 colonies/ m^2. The index of coral species diversity (H') for each of the five video-transects ranged between 1.64 at Tr-3 to 1.93 at Tr-1 (Table 38). The total number of coral species per video-transect ranged between 6 – 8 and the total number of colonies varied between 15 – 39.

A total of 54 reef fishes were identified at Mosquito Reef, 38 of which were observed within belt-transect areas (Table 39). The mean abundance of fishes was 63.4 Ind/30 m^2 and the mean number of species per transect was 18. The numerically dominant assemblage included the Masked Goby (*Coryphopterus personatus*), Striped Parrotfish (*Scarus iserti*), Sharknose Goby (*Gobiosoma evelinae*) and Yellow-eye Damselfish (*Stegastes planifrons*). Swarms of the Masked Goby, a zooplanktivore that lives in reef crevices and other substrate depressions represented 44 % of the total fishes within belt-transects. Species of commercial value included the Yellowtail and Schoolmaster Snappers (*Ocyurus chrysurus, Lutjanus apodus*), the Red Hind and Nassau Groupers (*Epinephelus guttatus*, *E. striatus*), and the Hogfish (*Lachnolaimus maximus*). Large reef predators, such as the Cero Mackerel (*Scomberomorus regalis*) and the Green Moray Eel (*Gymnothorax funebris*) were present at the reef. Large schools of pelagic Bar Jacks (*Carangoides ruber*) were observed foraging midwater in the reef.

The only motile megabenthic invertebrate observed within belt-transects at Corona Reef was a Spider Crab (Table 40).

Table 36. Coronas Reef. Percent cover by sessile-benthic substrate categories. Chain-link method. May, 2001

Survey date: May 20, 2001	TRANSECTS					
Depth: 10.6 m	**1**	**2**	**3**	**4**	**5**	**MEAN**
Rugosity (m)	5.73	6.52	5.07	5.31	3.72	**5.27**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	15.94	1.51	2.99	6.14	7.91	**6.90**
Montastrea cavernosa	5.40	2.66	5.51	3.79	7.29	**4.93**
Siderastrea siderea	1.71	4.18		3.53	0.95	**2.07**
Porites astreoides	2.48	1.69	2.06	1.84		**1.61**
Porites porites	1.52				1.34	**0.57**
Agaricia agaricites	1.27	0.91				**0.44**
Diploria strigosa					1.23	**0.25**
Agaricia fragilis		0.43			0.41	**0.17**
Colpophyllia natans				0.83		**0.17**
Stephanocoenia michilini		0.26	0.37			**0.13**
Oculina diffusa				0.55		**0.11**
Eusmilia fastigiata	0.36					**0.07**
Scolymia cubensis	0.18			0.18		**0.07**
Agaricia sp.				0.28		**0.06**
Total Stony Corals	28.84	11.62	10.96	17.12	19.11	**17.53**
Sponges	2.41	4.84	3.05	7.84	1.53	**3.93**
Encrusting Gorgonian	3.49	2.72	1.00	2.94	0.73	**2.18**
Turf Algae	49.06	54.65	67.99	63.86	68.49	**60.81**
Fleshy Algae		0.51			0.41	**0.18**
Abiotic Substrates						
Reef Overhangs	13.09	20.27	17.00	7.19	9.77	**13.46**
Silt		5.39				**1.08**
Sand	3.11			1.10		**0.84**
Total Abiotic Cover	16.20	25.66	17.00	8.29	9.77	**15.38**
Gorgonian Colonies	15	18	31	22	23	**22**

Coral Species Outside transects

Madracis decactis
Dendrogyra cylindrus
Isophyllia sinuosa
Acropora cervicornis
Diploria labyrinthiformis
Mycetophyllia aliciae
Isophyllia rigida
Meandrina meandrites
Leptoseris cucullata
Dichocoenia stokesii
Mycetophyllia ferox

Solenastrea sp.

Table 37. Coronas Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. May, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
forma annularis	4.44	1.11	1.67	2.78	2.22	2.44
forma faveolata	2.22	0	0.56	3.33	0.56	1.33
forma franksi	1.67	2.78	0.56	0	0	1.00
M. cavernosa	4.44	2.78	2.78	5.56	3.33	3.78
Porites astreoides	1.67	1.11	1.67	2.78	3.33	2.11
P. porites	0	0	0	0	0.56	0.11
Eusmilia fastigiata	0	0	0	1.11	0	0.22
Madracis sp	1.67	0	0	0	0	0.33
Agaricia sp		0	0	1.11	0	0.28
Siderastrea siderea	2.22	0	0	0	0.56	0.56
S. radians	0	1.11	1.11	4.44	0.56	1.44
Diploria clivosa	0.56	0	0	0	1.11	0.33
D. strigosa	0	1.11	0	0.56	0	0.33
TOTAL	**18.89**	**8.89**	**8.33**	**21.11**	**12.22**	**13.89**

Table 38. Coronas Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. May, 2001

Video Transect	**No. of Species**	**Total Number of Colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	8	34	1.93	0.93
2	6	18	1.69	0.94
3	6	15	1.64	0.92
4	8	39	1.89	0.91
5	8	22	1.80	0.86
		Mean	**1.79**	**0.91**

Table 39. Coronas Reef. Taxonomic composition and abundance of reef fishes within belt transects. May, 2001

Survey date: May 20, 2001

Depth: 10.6 m

		TRANSECTS					
		1	2	3	4	5	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Coryphopterus personatus		53	43	14	28	3	**28.2**
Scarus iserti		7	8	5	4	4	**5.6**
Gobiosoma evelynae		4	4	5	5	2	**4.0**
Stegastes planifrons		4	3	5	6	1	**3.8**
Carangoides ruber						12	**2.4**
Abudefduf sexatilis		2	3		3		**1.6**
Scarus taeniopterus		2	2	1	2		**1.4**

Table 39. Continued

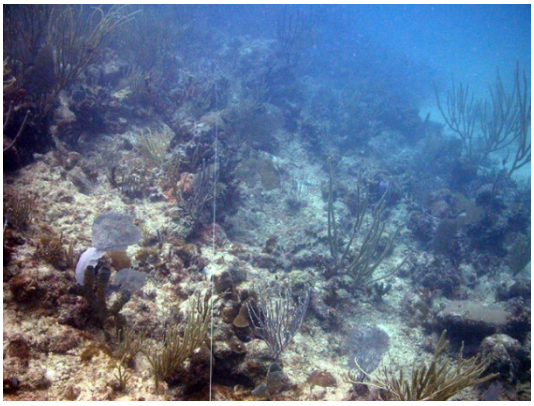
Sparisoma aurofrenatum		1	1	3		2	**1.4**
Sparisoma viride		2	1	2	2		**1.4**
Holocentrus rufus		2	1	1	2		**1.2**
Acanthurus coeruleus			1	2	1		**0.8**
Ocyurus chrysurus		1			3		**0.8**
Pomacanthus arcuatus		1		1		2	**0.8**
Acanthurus bahianus			1	2			**0.6**
Canthigaster rostrata			1	1	1		**0.6**
Coryphopterus lipernes		1	1		1		**0.6**
Hypoplectrus unicolor		1		1		1	**0.6**
Stegastes dorsopunicans					1	2	**0.6**
Stegastes leucostictus			1	1	1		**0.6**
Acanthurus chirurgus		1			1		**0.4**
Chaetodon capistratus					2		**0.4**
Epinephelus guttatus				1		1	**0.4**
Halichoeres garnoti				1		1	**0.4**
Sparisoma rubripinne			1			1	**0.4**
Aulostomus maculatus					1		**0.2**
Bothus lunatus					1		**0.2**
Gerres cinereus				1			**0.2**
Haemulon aurolineatum		1					**0.2**
Haemulon flavolineatum					1		**0.2**
Holocentrus ascensionis				1			**0.2**
Hypoplectrus puella				1			**0.2**
Microspathodon chrysurus		1					**0.2**
Pomacanthus paru					1		**0.2**
Priacanthus cruentatus					1		**0.2**
Scarus vetula			1				**0.2**
Stegastes partitus				1			**0.2**
Synodus intermedius						1	**0.2**
	TOTAL INDIVIDUALS	**88**	**75**	**50**	**69**	**35**	**63.4**
	TOTAL SPECIES	**18**	**17**	**20**	**22**	**14**	**18**
Outside transects:							
Haemulon sciurus							
Epinephelus striatus							
Holacanthus ciliaris							
Sparisoma chrysopterum							
Haemulon macrostomum							
Lachnolaimus maximus							
Cantherhines pullus							
Calamus bajonado							
Hypoplectrus nigricans							
Haemulon chrysargyreum							
Gramma loretto							
Haemulon plumieri							
Lutjanus apodus							
Gymnothorax funebris							
Acanthostracion quadricornis							
Scomberomorus regalis							

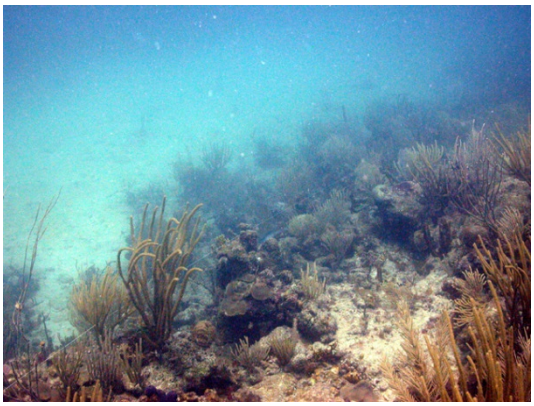
Table 40. Coronas Reef. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects. May, 2001

Survey date: May 20, 200
Depth: 10.6

		TRANSECTS					
		1	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE (IND/30 m2)**
SPECIES	**COMMON NAME**						
Mithrax sp.	Spider Crab		1			1	0.4
	TOTALS	**0**	**1**	**0**	**0**	**1**	**0.4**

Photo Album 8. Coronas Reef





9. Comandante Reef

Comandante is a submerged patch reef that rises almost to the surface at about one nautical mile off from Cerro Martineau, on the north coast of Vieques (Figure 4). The reef has two shallow sections where an Elkhorn Coral (*Acropora palmata*) biotope had reached optimum development, with many colonies of extraordinarily large size. The *Acropora* biotope was completely destroyed at the time of our survey, displaying many overturned colonies and large fragments of coral overgrown by turf algae and other encrusting biota. The cause of such mechanical devastation is unknown, but could to be related to extremely strong wave action, possibly associated with hurricanes. The reef slopes down to depths of 9-10 meters, where a stand of Turtle Grass (*Thalassia testudinum*) meets the reef base. The reef slope is a zone of high topographic relief contributed by large colonies of Boulder Star Coral (*Montastrea annularis*). Our survey was performed on the western section of the reef slope at a depth of 5.5 meters. Panoramic images of Comandante Reef are included as Photo Album 9.

The percent cover by sessile-benthic substrate categories at Comandante Reef is shown in Table 41. Stony corals were the dominant component of the sessile-benthic community in terms of surface cover with a mean of 40.7 % (range: 20.9 – 57.9 %). A total of 21 coral species were identified at Comandante Reef. Large, massive colonies of Boulder Star Coral (*Montasatrea annularis*) accounted for 74 % of the total surface cover by stony corals. Many colonies of 2-3 meters in height were present. The Branching Fire Coral (*Millepora alcicornis*) and the Boulder Brain Coral (*Colpophyllia natans*) ranked second and third in terms of surface cover by stony corals with means of 5.2 % and 2.5 %, respectively. Soft corals (gorgonians) were moderately abundant at the reef slope (mean: 17 colonies/transect), but were visibly more abundant in shallower sections of the reef. The encrusting gorgonian (*Erythropodium caribaeorum*) was found at all transects surveyed with a mean surface cover of 1.6 %. The combined mean cover by turf algae (mixed assemblage), calcareous algae (mostly *Halimeda tuna, H. opuntia*) and fleshy (mostly brown-*Dictyota* sp.) macroalgae was 42.8 % in surveyed transects. Data of percent cover by sessile-benthic substrate categories from video-transects are included as Appendix 9.

Density of stony coral colonies in video-transects averaged 13.2 col/m^2 (Table 42). Colonies of Boulder Star Coral represented approximately 74.0 % of the total colonies present in video-transects at Comandante Reef. The three morphotypes of *Montastrea annularis* were present, being the *faveolata* morphotype the one showing highest density with a mean of 3.7 colonies/ m^2. The index of coral species diversity (H') for each of the five video-transects ranged between 1.15 at Tr-1 to 1.84 at Tr-2 (Table 43). The total number of coral species per video-transect ranged between 4 – 9 and the total number of colonies varied between 17 – 29.

A total of 52 reef fishes were identified at Comandante, 41 of which were observed within belt-transect areas (Table 44). The mean abundance of fishes was 56.0 Ind/30 m^2 and the mean number of species per transect was 19. The numerically dominant assemblage included the Striped Parrotfish (*Scarus iserti*), Yellow-eye Damselfish (*Stegastes planifrons*), Masked Goby (*Coryphopterus personatus*), Stoplight and Redband Parrotfishes *(Sparisoma viride, S. aurofrenatum*) and the schooling pelagic zooplanktivores Mackerel scad (*Decapterus macarellus*). Species of commercial value included the Yellowtail and Schoolmaster Snappers (*Ocyurus chrysurus, Lutjanus apodus*), the Red Hind and Yellowfin Groupers (*Epinephelus guttatus, Mycteroperca venenosa*), and the Hogfish (*Lachnolaimus maximus*).

The only motile megabenthic invertebrate observed within belt-transects at Comandante Reef was the Long-spined Sea Urchin (Table 45).

Table 41. Comandante Reef. Percent cover by sessile-benthic substrate categories. Chain-link method. May, 2001

	TRANSECTS					
	1	**2**	**3**	**4**	**5**	**MEAN**
Rugosity (m)	5.93	6.31	6.21	7.41	3.65	**5.90**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	37.83	29.74	32.59	37.93	12.46	**30.11**
Millepora alcicornis	18.63	3.86	0.87	2.36	0.31	**5.21**
Colpophyllia natans		4.90	3.56		4.25	**2.54**
Montastrea cavernosa			1.83		2.05	**0.78**
Porites astreoides	1.44	1.64		0.57		**0.73**
Acropora cervicornis		2.33			0.52	**0.57**
Porites porites				1.62		**0.32**
Siderastrea siderea					1.34	**0.27**
Siderastrea radians			0.43			**0.09**
Agaricia agaricites			0.26			**0.05**
Total Stony Corals	57.90	42.49	39.54	42.47	20.94	**40.67**
Encrusting Gorgonian	1.44	0.86	2.41	0.86	2.20	**1.55**
Sponges		1.10	0.93	0.49	1.54	**0.81**
Zoanthids		.60				**0.12**
Turf Algae	32.62	48.19	28.70	28.10	38.38	**35.20**
Calcareous Algae	3.07	2.27	5.99	8.28	16.84	**7.29**
Fleshy algae		0.92	0.25		0.52	**0.34**
Abiotic Substrates						
Reef Overhangs	1.44	2.71	15.68	17.41	16.11	**10.67**
Sand	3.53	0.86	6.17	0.81	1.44	**2.56**
Hole	0	0	0.35	1.61	0	**0.39**
Total Abiotic Cover	4.98	3.57	22.20	19.83	17.55	**13.62**
Gorgonian Colonies	15	17	15	12	25	**17**

Coral Species Outside Transects

Diploria strigosa
Dichocoenia stokesii
Stephanocoenia michilini
Eusmilia fastigiata
Stylaster roseus
Diploria clivosa
Mycetophyllia aliciae
Isophyllia rigida
Diploria labyrinthiformis
Mycetophyllia lamarckiana
Meandrina meandrites

Table 42. Comandante Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. May, 2001

Coral and Hydrocoral	**T-1**	**T-2**	**T-3**	**T-4**	**T-5**	**Mean**
Montastrea annularis						
forma annularis	0.56	3.33	0.56	7.22	1.67	2.67
forma faveolata	5.56	3.33	3.89	4.44	1.11	3.67
forma franksi	0	0.56	5.56	3.33	7.78	3.44
M. cavernosa	0	0	1.67	0	1.11	0.56
Porites astreoides	2.22	0.56	0	0.56	1.67	1.00
P. furcata	0	0	0.56	0	0.56	0.22
Acropora cervicornis	0	1.11	0	0	0	0.22
Colpophyllia sp	0	1.67	0.56	0	1.11	0.67
Agaricia sp	0.56	0	0	0	0.56	0.22
Madracis sp	0	0.56	0	0	0	0.11
Diploria labyrinthiformis	0.56	0	0	0	0	0.11
D. strigosa	0	1.11	0	0	0.56	0.33
TOTAL	**9.44**	**12.22**	**12.78**	**15.56**	**16.11**	**13.22**

Table 43. Comandante Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. May, 2001

Video Transect	**No. of Species**	**Total Number of Colonies**	**Species Diversity (H')**	**Species Evenness (J)**
1	5	17	1.15	0.72
2	8	22	1.84	0.88
3	6	23	1.40	0.78
4	4	28	1.16	0.84
209	9	29	1.72	0.78
		Mean	**1.45**	**0.80**

Table 44. Comandante Reef. Taxonomic composition and abundance of reef fishes within belt-transects. May, 2001

Survey Date: May 19, 2001
Depth: 5.5 m

		TRANSECTS					
		1	2	3	4	5	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Scarus iserti		7	36		6	6	**11.0**
Stegastes planifrons		13	9	8	12		**8.4**
Coryphopterus personatus		1		30			**6.2**
Sparisoma viride		1	5	2	5	3	**3.2**
Decapterus macarellus		15					**3.0**
Sparisoma aurofrenatum		1	5	3	1	2	**2.4**
Acanthurus coeruleus		4	2	1	3		**2.0**
Thalassoma bifasciatum			4		5		**1.8**

Table 44. Continued

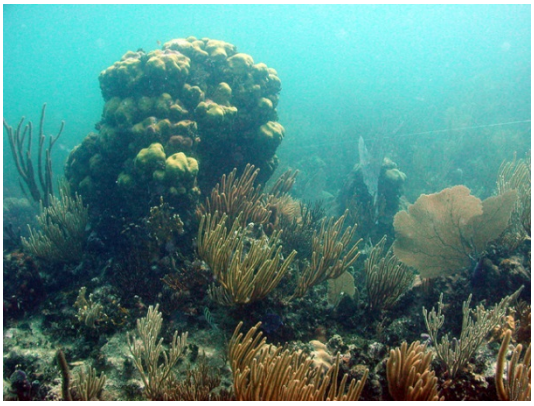
Holocentrus rufus		2	1	2		2	**1.4**
Acanthurus chirurgus		1	3			2	**1.2**
Gobiosoma evelynae		1	1		1	3	**1.2**
Microspathodon chrysurus		1	2	1	1	1	**1.2**
Carangoides ruber		3			2		**1.0**
Chaetodon capistratus		1	1		1	2	**1.0**
Stegastes dorsopunicans					1	4	**1.0**
Abudefduf sexatilis				1	3		**0.8**
Acanthurus bahianus		2			1		**0.6**
Haemulon sciurus			1		1	1	**0.6**
Hypoplectrus nigricans		1	1		1		**0.6**
Myripristis jacobus			1		2		**0.6**
Ocyurus chrysurus						3	**0.6**
Pomacanthus arcuatus				1	1	1	**0.6**
Scarus taeniopterus			2	1			**0.6**
Scarus vetula		1		1	1		**0.6**
Coryphopterus lipernes		1		1			**0.4**
Halichoeres garnoti		1	1				**0.4**
Priacanthus cruentatus			1	1			**0.4**
Sparisoma radians			1			1	**0.4**
Cantherhines pullus					1		**0.2**
Canthigaster rostrata		1					**0.2**
Coryphopterus sp.				1			**0.2**
Haemulon flavolineatum			1				**0.2**
Haemulon macrostomum					1		**0.2**
Hypoplectrus puella			1				**0.2**
Hypoplectrus sp.				1			**0.2**
Hypoplectrus unicolor					1		**0.2**
Lachnolaimus maximus						1	**0.2**
Lutjanus apodus		1					**0.2**
Malacoctenus triangulatus		1					**0.2**
Pomacanthus paru				1			**0.2**
Stegastes leucostictus					1		**0.2**
	TOTAL INDIVIDUALS	**61**	**79**	**56**	**52**	**32**	**56.0**
	TOTAL SPECIES	**21**	**20**	**16**	**22**	**14**	**19**
Outside transects:							
Mycteroperca venenosa							
Epinephelus guttatus							
Chaetodon ocellatus							
Dasyatis americana							
Sparisoma rubripinne							
Mulloides martinicus							
Pseudupeneus maculatus							
Lactophrys bicaudalis							
Aulostomus maculatus							
Gerres cinereus							
Haemulon plumieri							

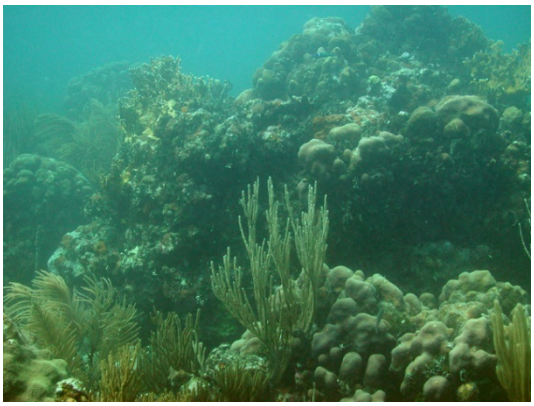
Table 45. Comandante Reef. Taxonomic composition and abundance of motile megabenthic invertebrates within belt-transects. May, 2001

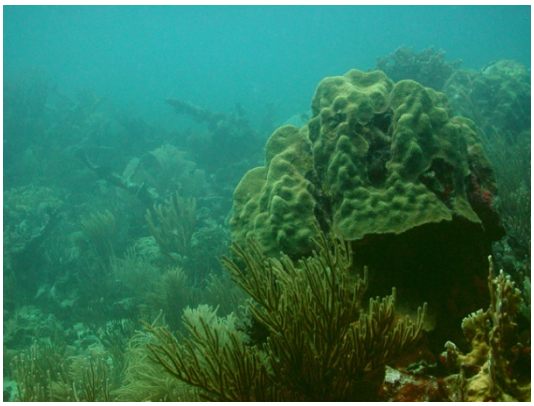
Survey Date: May 19, 2001
Depth: 5.5 m

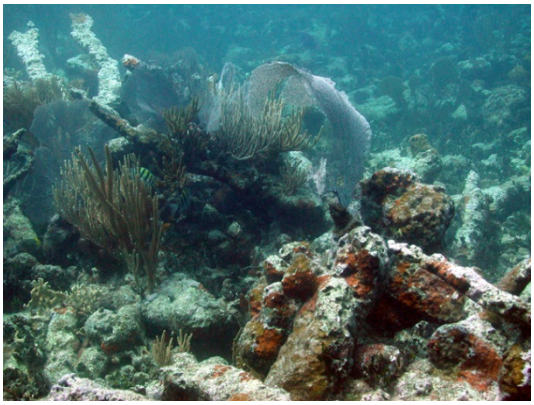
		TRANSECTS					
		1	2	3	4	5	MEAN ABUNDANCE (IND/30 m2)
SPECIES	**COMMON NAME**						
Diadema antillarum	Long-spined Sea Urchin	1		1	1		0.6
	TOTALS	**1**	**0**	**1**	**1**	**0**	**0.6**

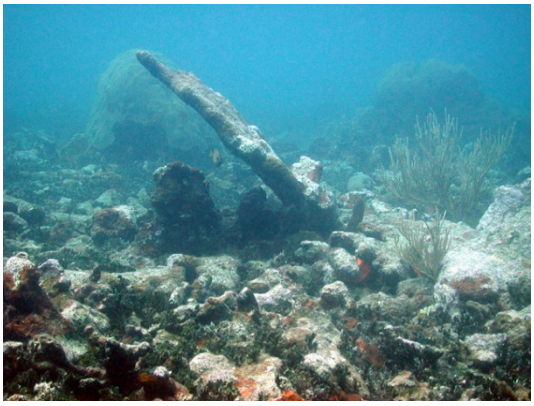
Photo Album 9. Comandante Reef

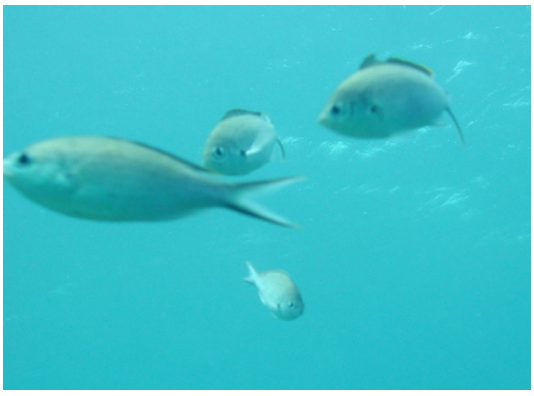












10. Boya 6 Reef

Boya 6 Reef is a hard ground system located 4.5 nautical miles off from Puerto Mosquito on the northwest coast of Vieques. This is a submerged promontory that rises from a sandy bottom at a depth of approximately 13.0 meters to a depth of 6.0 meters on its shallowmost section. Our survey was performed along the edge of the reef slope, near its base at a depth of 10.6 meters. Panoramic images of the reef are included as Photo Album 10.

Table 46 shows the percent cover by sessile-benthic substrate categories at Boya 6 Reef. A dense turf algae packed with fine sands was the dominant sessile-benthic component in terms of surface cover with a mean of 60.1 % (range: 52.3 – 64.6 %) along permanent transects. Soft corals (gorgonians) were the most prominent sessile-benthic invertebrate assemblage with a mean of 33 colonies intercepted per transect (range: 29 – 38 colonies/transect). The encrusting gorgonian (*Erythropodium caribaeorum*) was present at all transects with a mean cover of 2.9 %. Stony corals were found mostly as encrusting colonies interspersed in the reef, with few massive coral heads contributing topographic relief. A total of 20 stony coral species were identified during our snapshot survey. Boulder Star Coral (*Montastrea annularis*), Great Star Coral (*M. cavernosa*) and Mustard Hill Coral (*Porites astreoides*) were the dominant species in terms of surface cover among an assemblage of 13 species intercepted by transects. The total surface cover by stony corals was 13.4 % (range: 9.1 – 18.1 %). Sponges (*Niphates sp., Xestospongia muta, Callyspongia vaginalis, Aplysina sp.*) were found at all transects surveyed with a mean surface cover of 2.9 %. Abiotic substrates, including reef overhangs, coral rubble and sand combined for a total cover of 20.3%. Data of percent cover by sessile-benthic substrate categories from video-transects are included as Appendix 10.

Density of stony coral colonies in video-transects averaged 11.0 col/m^2 (Table 47). Colonies of Boulder Star Coral (*Montastrea annularis*) represented approximately 33.4 % of the total colonies present in video-transects at Boya 6 Reef. The three morphotypes of *M. annularis* were present, being the *annularis* morphotype the one showing highest density with a mean of 2.9 colonies/ m^2. Great Star Coral (*M. cavernosa*) and Mustard Hill Coral (*P. astreoides*) were also important species in terms of coral densities at Boya 6 Reef with means of 2.9 and 2.1 col/m^2, respectively. The index of coral species diversity (H') for each of the five video-transects ranged between 1.17 at Tr-1 to 1.83 at Tr-4 (Table 48). The total number of coral species per video-transect ranged between 4 – 8 and the total number of colonies varied between 11 – 26.

A total of 54 reef fishes were identified at Arrecife Boya 6, 40 of which were observed within belt-transect areas (Table 49). The mean abundance of fishes was 43.0 Ind/30 m^2 and the mean number of species per transect was 19. The numerically dominant assemblage included the Striped Parrotfish (*Scarus iserti*), Masked Goby (*Coryphopterus personatus*), Yellow-eye Damselfish (*Stegastes planifrons*), Squirrelfish (*Holocentrus rufus*), French grunt (*Haemulon flavolineatum*), Redband Parrotfish (*Sparisoma aurofrenatum*), Bluehead Wrasse (*Thalassoma bifasciatum*) and the Tomtate (*Haemulon aurolineatum*). Species of commercial value included the Yellowtail and Schoolmaster Snappers (*Ocyurus chrysurus, Lutjanus apodus*), the Red Hind and Yellowfin Groupers (*Epinephelus guttatus, Mycteroperca venenosa*), and the Buffalo Trunkfish (*Lactophrys trigonus*).

Motile megabenthic invertebrate observed within belt-transects at Arrecife Boya 6 included three Spiny Lobsters, one Queen Conch, the Long-spined Sea Urchin, Sea Cucumbers and a Hermit Crab (Table 50).

Table 46. Boya 6 Reef. Percent cover of sessile-benthic substrate categories. Chain-link method. May, 2001

Survey Date: May 19, 2001	TRANSECTS					MEAN
Depth: 10.6 m	**1**	**2**	**3**	**4**	**5**	
Rugosity (m)	3.31	3.8	4.85	3.59	4.17	**3.94**
SUBSTRATE CATEGORIES						
Stony Corals						
Montastrea annularis	5.26	2.54	6.60	2.28	9.67	**5.27**
Montastrea cavernosa	1.05	3.48	3.98	7.95		**3.29**
Porites astreoides	1.06	1.30	0.88	2.28	1.48	**1.40**
Porites porites	1.13			2.50	2.12	**1.15**
Madracis decactis			2.56	0.31		**0.57**
Siderastrea siderea		0.80	0.66		0.60	**0.41**
Diploria labyrinthiformis				1.24		**0.25**
Agaricia agaricites	0.83			0.31		**0.23**
Colpophyllia natans		0.41		0.73		**0.23**
Leptoseris cucullata		0.51		0.52		**0.21**
Stephanocoenia michilini			0.85			**0.17**
Diploria clivosa					0.60	**0.12**
Millepora alcicornis					0.40	**0.08**
Total Stony Corals	9.32	9.06	15.56	18.11	14.83	**13.38**
Encrusting Gorgonians	3.60	3.26	4.38	0.52	2.61	**2.87**
Sponges	1.50	2.97	0.74	2.58	6.63	**2.88**
Zoanthids				0.41		**0.08**
Ascideans	0.32					
Turf Algae	52.29	57.17	61.95	64.48	64.64	**60.11**
Fleshy Algae					1.48	**0.30**
Abiotic Substrates						
Reef Overhangs	10.37	11.67	13.20	12.44	9.53	**11.44**
Coral Rubble	15.03	10.58	2.56			**5.63**
Silt	6.46	3.70	1.04			**2.24**
Sand	1.16	1.63			0.30	**0.62**
Holes			0.57	1.47		**0.41**
Total Abiotic Cover	33.02	27.58	17.37	13.91	9.83	**20.34**
Gorgonian Colonies	31	38	33	33	29	**33**
Coral Species Outside Transects:						
Diploria strigosa						
Meandrina meandrites						
Agaricia fragilis						
Eusmilia fastigiata						
Acropora cervicornis						
Mycetophyllia aliciae						
Scolymia cubensis						

Table 47. Boya 6 Reef. Densities (colonies per m^2) of Identified Scleractinian Corals and Hydrocorals based on video surveys of permanent transects. May, 2001

Coral and Hydrocoral	T-1	T-2	T-3	T-4	T-5	Mean
Montastrea annularis						
forma annularis	3.33	2.22	4.44	1.11	3.33	2.89
forma faveolata	1.11	1.11	1.11	0	0	0.67
forma franksi	0	0	0.56	0	0	0.11
M. cavernosa	0	5.00	3.33	3.89	2.22	2.89
Porites astreoides	1.11	1.11	1.67	3.33	3.33	2.11
P. porites	0	0	0	0	0.56	0.11
P. furcata	0.56	0	0	1.11	0.56	0.44
Colpophyllia natans	0	0	0	1.11	0.56	0.33
Siderastrea sp.	0	1.11	0	0.56	0	0.33
Madracis sp	0	0	2.22	0.56	0	0.56
Diploria labyrinthiformis	0	0	0.56	1.11	0.56	0.44
D. clivosa	0	0	0.56	0	0	0.11
TOTAL	**6.11**	**10.56**	**14.44**	**12.78**	**11.11**	**11.00**

Table 48. Boya 6 Reef. Species Diversity and Evenness of Identified Scleractinian Corals and Hydrocorals Based on Video Surveys of Permanent Transects. May, 2001

Video Transect	No. of Species	Total Number of Colonies	Species Diversity (H')	Species Evenness (J)
1	4	11	1.17	0.84
2	5	19	1.39	0.87
3	8	26	1.81	0.87
4	8	23	1.83	0.88
5	7	20	1.64	0.84
		Mean	**1.57**	**0.86**

Table 49. Boya 6 Reef. Taxonomic composition and abundance of reef fishes within belt-transects. May, 2001

Survey Date: May 19, 2001
Depth: 10.6 m

		TRANSECTS					
		1	2	3	4	5	
		(individuals/30 m2)					
SPECIES	**COMMON NAME**						**MEAN**
Scarus iserti		12	4		8	5	**5.8**
Coryphopterus personatus			6	16	1	1	**4.8**
Stegastes planifrons		1	6	1	8	7	**4.6**

Table 49. Continued

Holocentrus rufus	4	3	4	5	3	**3.8**
Haemulon flavolineatum	1	3	6		3	**2.6**
Sparisoma aurofrenatum	4	1	3	1	3	**2.4**
Thalassoma bifasciatum	4		5	3		**2.4**
Haemulon aurolineatum	1	2	1	4	2	**2.0**
Sparisoma viride		1	1	3	3	**1.6**
Acanthurus bahianus	2				4	**1.2**
Aulostomus maculatus	1	1	1	1	1	**1.0**
Equetus acuminatus	1		2	1		**0.8**
Pomacanthus arcuatus	1	1		1	1	**0.8**
Scarus taeniopterus	1	1		2		**0.8**
Scarus vetula		1	2		1	**0.8**
Canthigaster rostrata	2			1		**0.6**
Chromis cyanea	1	1	1			**0.6**
Sparisoma radians		1			2	**0.6**
Stegastes leucostictus			1	2		**0.6**
Acanthurus chirurgus		1		1		**0.4**
Halichoeres garnoti				1	1	**0.4**
Hypoplectrus chlorurus			1		1	**0.4**
Hypoplectrus puella			1		1	**0.4**
Hypoplectrus unicolor	1			1		**0.4**
Acanthurus coeruleus				1		**0.2**
Anisotremus virginicus					1	**0.2**
Bodianus rufus			1			**0.2**
Clepticus parrae					1	**0.2**
Epinephelus guttatus					1	**0.2**
Haemulon sciurus				1		**0.2**
Holacanthus ciliaris	1					**0.2**
Holocentrus ascensionis			1			**0.2**
Hypoplectrus nigricans	1					**0.2**
Hypoplectrus sp.				1		**0.2**
Lactophrys triqueter	1					**0.2**
Lutjanus apodus					1	**0.2**
Mycteroperca venenosa				1		**0.2**
Priacanhus cruentatus					1	**0.2**
Pseudupeneus maculatus	1					**0.2**
Serranus tigrinus			1			**0.2**
TOTAL INDIVIDUALS	**41**	**33**	**49**	**48**	**44**	**43.0**

Outside transects:

Calamus pennatula
Haemulon macrostomum
Balistes vetula
Cantherhines macrocerus
Ocyurus chrysurus

Gobiosoma evelynae
Pomacanthus paru
Table 49. Continued

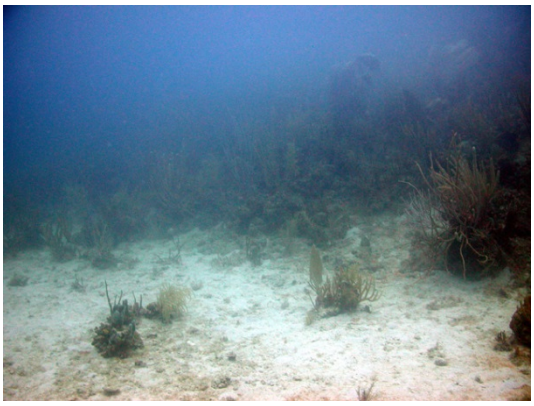
Stegastes partitus
Holacanthus ciliaris
Carangoides ruber
Gramma loretto
Haemulon plumieri
Mycteroperca venenosa
Lactophrys trigonus

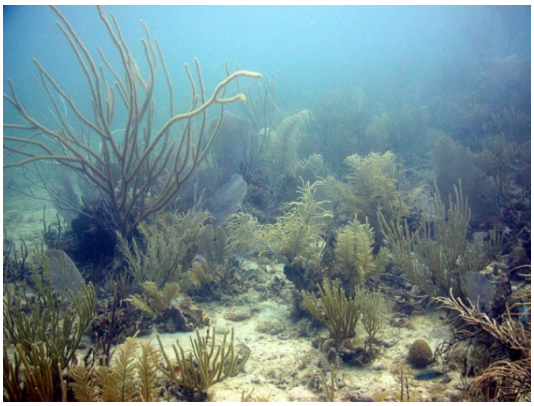
Table 50. Arrecife Boya 6. Taxonomic composition and abundance of motile-megabenthic invertebrates within belt-transects. May, 2001

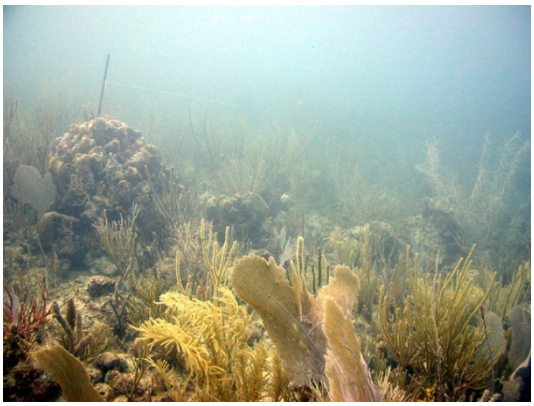
Survey Date: May 19, 2001
Depth: 10.6 m

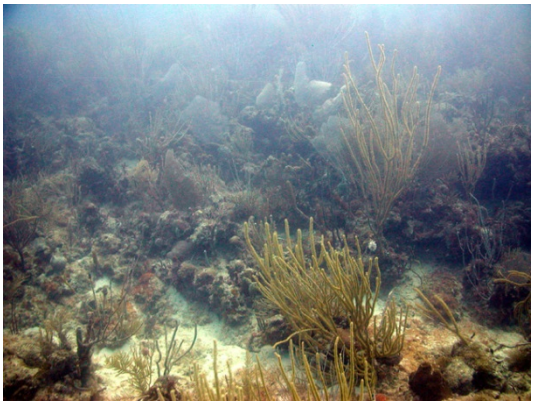
		TRANSECTS					
		1	**2**	**3**	**4**	**5**	**MEAN ABUNDANCE** (IND/30 m2)
SPECIES	**COMMON NAME**						
Panulirus argus	Spiny Lobster				3		0.6
Strombus gigas	Queen Conch			1			0.2
Diadema antillarum	Long-spined Sea Urchin			1			0.2
Holothuria thomasi	Sea cucumber			2			0.4
Anomura	Hermit crab	1					0.2
	Totals	**1**	**0**	**4**	**3**	**0**	**1.6**

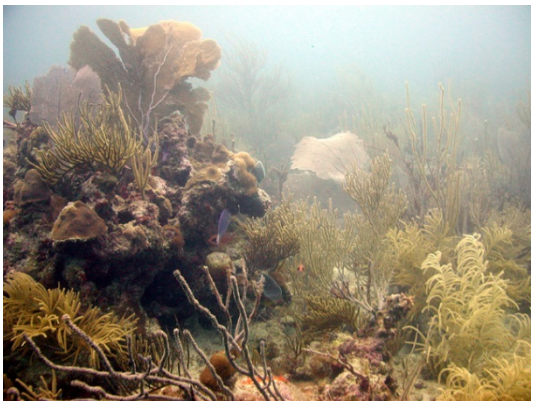
Photo Album 10. Boya 6 Reef

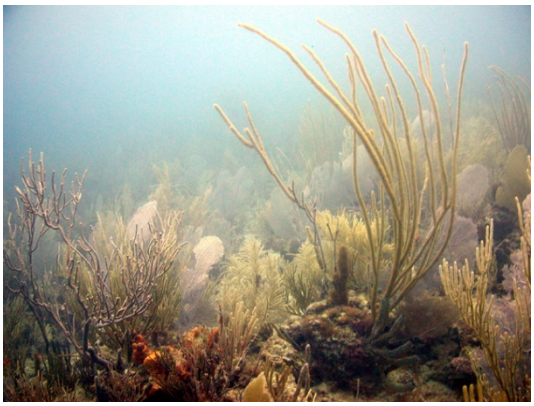


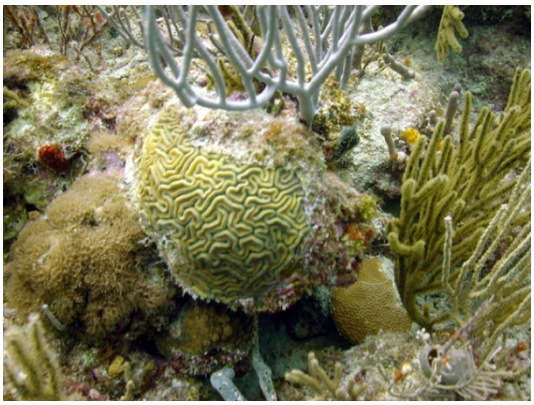












11. Bajo Holiday

Bajo Holiday is an outer reef in the Sonda de Vieques located approximately 4.2 nautical miles off from Pta. Campanilla on the north-northeast coast of Vieques. At the time of our survey there was a very strong current that did not allow quantitative work to be performed at this reef. The following is a qualitative description based on a bounce dive.

Bajo Holiday is a hard ground platform that rises from a sandy bottom at a depth of 23.5 meters to a depth of 14.5 meters in its shallowmost section. It is an almost flat terrace densely colonized by soft corals (gorgonians), many of which were unusually large colonies. The substrate was covered by a dense algal turf packed with fine sands. Stony corals were not abundant and grew interspersed as isolated, mostly encrusting colonies. The topographic relief contributed by stony corals was negligible. The Symmetrical Brain Coral, *Diploria strigosa* was visually the most common species. Encrusting colonies of Great Star Coral, Boulder Star Coral and Mustard Hill Coral (*Montastrea cavernosa, M. annularis, Porites astreoides*) were also present. Massive colonies of Pillar Coral, *Dendrogyra cilindrus* were observed.

The fish community was characterized by a relatively high density of pelagic species. Schools of small Bar Jacks (*Carangoides ruber*) were seen at midwater. These were being foraged upon by several Great Barracudas (*Sphyraena barracuda*). Schools of Black Durgons (*Melichthys niger*) and Creole Wrasses (*Clepticus parrae*) were also present in the water column. Near the bottom, schools of juvenile Yellowtail Snappers (*Ocyurus chrysurus*) were present among the soft coral forest. The Queen Triggerfish (*Balistes vetula*) and several parrotfishes (e.g. Redband, Stoplight, Queen, Striped) were observed foraging and grazing in the hard ground. In general, the benthic fish community was depauperate, possibly due to the lack of physical structures providing a reef habitat.

12. Black Jack Reef

Black Jack Reef is an outer shelf promontory located close to the shelf-edge, at about two nautical miles off from Ensenada Sun Bay, on the south coast of Vieques (Figure 2). The reef rises from a depth of 51 meters to a depth of 31 meters at the top of the pinnacle. We performed a qualitative survey of the most common fishes and stony corals at depths between 31-36 meters. The pinnacle section was characterized by moderate abundance of soft corals, including many large colonies. Stony corals were found mostly as encrusting and mound-shaped colonies interspersed among the reef without providing much topographic relief. The Great Star Coral (*Montastrea cavernosa*) was visibly the most abundant coral. Great Star Coral (*M. annularis*) and Lettuce coral (*Agaricia agaricites*) were also part of the main stony coral assemblage. The reef slopes down to a deeper terrace at depths of 36-40 meters where soft corals decline abruptly in abundance and stony coral cover increases substantially. Dense cover by laminar growth of Boulder Star Coral and Lettuce Coral was evident across sections of the deeper terrace.

The fish community at Black Jack Reef was characterized by the high abundance of pelagic species, including top predators, such as the Great Barracuda (*Sphyraena barracu*da) and the King and Cero Mackerels (*Scomberomorus cavalla, S. regalis*). Schools of Black Durgons (*Melichthys niger*) and Sargassum Triggerfish (*Xanthichthys ringens*) occupied midwater sections in the reef. An assemblage of common reef fishes

was found close to the reef substrate. Some of the most abundant taxa included the Bluehead and Yellowhead Wrasses (*Thalassoma bifasciatum, Halichoeres garnoti*), Doctorfishes (*Acanthurus* spp.), Parrotfishes (*Scarus* spp., *Sparisoma* spp.) and Blue Chromis (*Chromis cyanea*). Swarms of the Masked Goby (*Gobiosoma personatus*) were observed at crevices and ledges. Species of commercial value included several large individuals of the Mutton and Yellowtail Snappers (*Lutjanus analis, Ocyurus chrysurus*), Hogfish (*Lachnolaimus maximus*) and the groupers Red Hind and Coneys (*Epinephelus guttatus, Cephalopholis fulva*).

B. Seagrass Bed Communities
1. Punta Arenas

Seagrass bed communities were surveyed at depths of 2.7 m, 4.5 m and 7.0 m off the off Punta Arenas, on the southeast and southwest coast of Vieques (Figures 2-3). Extensive seagrass beds were found throughout the Punta Arenas region of Vieques in a depth range of 2 – 8 meters. Water (horizontal) visibility at the time of our survey was of approximately 15 meters and the water currents were strong (about 1 knot). Mixed stands of the Turtle Grass (*Thalassia testudinum*) and the Manatee Grass (*Syringodium filiforme*) were the main macrophytic components of the community. Calcareous macroalgae were found growing intermixed in the seagrass beds. At depths of 2.7 and 4.5 meters, the main macroalgal assemblage included *Valonia sp., Halimeda monile, H. discoidea, Udotea flabellum, Penicillus sp.* and *Avrainvillea sp*. At the deeper 7.0 m depth, the red coralline macroalgae, *Jania* sp. and *Amphiroa* sp. and the calcareous species *Penicillus capitatus*. and *Udotea* sp. were the main macroalgal assemblage associated with seagrasses. Panoramic images of the seagrass bed at Pta Arenas are included as Photo Album 11.

Motile megabenthic invertebrates and fishes present within belt-transects at the Punta Arenas seagrass stations surveyed are presented in Tables 51-53. The Queen Conch (*Strombus gigas*) the Sea Star (*Oreaster reticulatus*), Sea Cucumbers (*Holothuria mexicana*) and crabs (*Calappa* sp.) were the main motile megabenthic invertebrates present. The Thin Tube Coral (*Cladocora debilis*) was present outside transects at Punta Arenas 1. Rose Coral (*Manicina aereolata*) was common at Punta Arenas 3.

A total of eight fish species were present at the Punta Arenas 1 station. The main assemblage included the Black-ear Wrasse (*Halichoeres poeyi*) and the Princess and Bucktooth Parrotfishes (*Sparisoma taeniopterus, S. radians*). Large schools of pelagic Mackerel Scads (*Decapterus macarellus*) were the most abundant within belt-transects at Punta Arenas 2. The Bucktooth and Yellowtail Parrotfishes (*Sparisoma taeniopterus, S. rubripinne*) and Yellowtail Parrotfishes (*Sparisoma radians, S. rubripinne*) along with the Black-ear Wrasse (*Halichoeres poeyi*) were observed in (at least) two transects. On juvenile individual of the Yellowtail Snapper (*Ocyurus chrysurus*) was also present within belt-transects at Punta Arenas 2. The Slippery Dick (*Halichoeres bivittatus*) was the only fish observed at Punta Arenas 3.

Table 51. Seagrass bed Punta Arenas. Taxonomic composition and abundance of motile mega-benthic invertebrates and fishes identified from belt transects.

Punta Arenas 1
GPS Position: 18° 07.068' N; 065° 34.718' 'W
Depth: 2.7 m
Date: February 6, 2001

	ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
	TRANSECT						
	1	**2**	**3**	**4**	**5**	**6**	

INVERTEBRATE SPECIES	**COMMON NAME**							
Calappa sp	Box crab	1	1	1	1			0.7

Table 51. Continued

Holothuria sp.	Sea cucumber				1	1		0.3
Oreaster reticulatus	Cushion sea star							0.0
Strombus gigas	Queen conch	1						0.2
	Individuals/30m² =	**2**	**1**	**1**	**2**	**1**	**0**	**1.2**

Outside transects:

Halimeda discoidea	Watercress alga
Hydrozoans	
Syringodium filiforme	Manatee grass
Valonia sp.	Sea pearls
Avrainvillea sp.	Blade alga
Halimeda monile	Watercress alga
Cladocora debilis	
Udotea sp.	Mermaid's fans
Penicillus sp.	Brush alga

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPECIES	**COMMON NAME**							
Halichoeres bivittatus	Slippery dick	1						0.2
Halichoeres pictus	Painted wrasse			1		1	1	0.5
Ocyurus chrysurus	Yellowtail snapper						1	0.2
Pseudupeneus maculatus	Spotted goatfish						1	0.2
Scarus taeniopterus	Princess parrotfish						3	0.5
Sparisoma aurofrenatum	Redband parrotfish						1	0.2
Sparisoma radians	Bucktooth parrotfish		1	1			1	0.5
Thalassoma bifasciatum	Bluehead wrasse						2	0.3
	Ind./30 m² =	**1**	**1**	**2**	**0**	**1**	**10**	**2.5**
	Num. Species =	**1**	**1**	**2**	**0**	**1**	**7**	

Outside transects:
None

Table 52. Seagrass bed Punta Arenas. Taxonomic composition and abundance Of motile mega-Benthic invertebrates and fishes identified from belt transects.

Punta Arenas 2
GPS Position: 18° 07.276' N; 065° 34.883' 'W
Depth: 4.5 m
Date: February 6, 2001

		ABUNDANCE (Ind/30m²) TRANSECT						MEAN ABUNDANCE (Ind/30m²)
		1	2	3	4	5	6	
INVERTEBRATE SPECIES	**COMMON NAME**							
Holothuria sp.	Sea cucumber	1						0.2
Strombus gigas	Queen conch			1	1	1		0.5
	Individuals/30m² =	**1**	**0**	**1**	**1**	**1**	**0**	**0.7**

Outside transects:

Manicina areolata	Rose coral
Syringodium filiforme	Manatee grass

		ABUNDANCE (Ind/30m²) TRANSECT						MEAN ABUNDANCE (Ind/30m²)
		1	2	3	4	5	6	
FISH SPECIES	**COMMON NAME**							
Decapterus macarellus	Mackerel scad	26						4.3
Halichores pictus	Painted wrasse		1	1				0.3
Ocyurus chrysurus	Yellowtail snapper	1						0.2
Pseudupeneus maculatus	Spotted goatfish		1	1				0.3
Sparisoma radians	Bucktooth parrotfish			1				0.2
Sparisoma rubripinne	Yellowtail parrotfish		1	1				
	Ind./30 m² =	**27**	**3**	**4**	**0**	**0**	**0**	**5.7**
	Num. Species =	**2**	**3**	**4**	**0**	**0**	**0**	

Outside transects:

None

Table 53. Seagrass bed Punta Arenas. Taxonomic composition and abundance of motile mega-benthic invertebrates and fishes identified from belt- transects

Punta Arenas 3
GPS Position: 18° 06.753' N; 065° 35.117' 'W
Depth: 7.0 m
Date: February 8, 2001

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Oreaster reticulatus	Cushion sea star		1	2	2	1		1.0
Strombus costatus	Milk conch	2	2	3	1	2	3	2.2
Strombus gigas	Queen conch				1	2		0.5
	Individuals/30m² =	**2**	**3**	**5**	**4**	**5**	**3**	**3.7**

Outside transects:

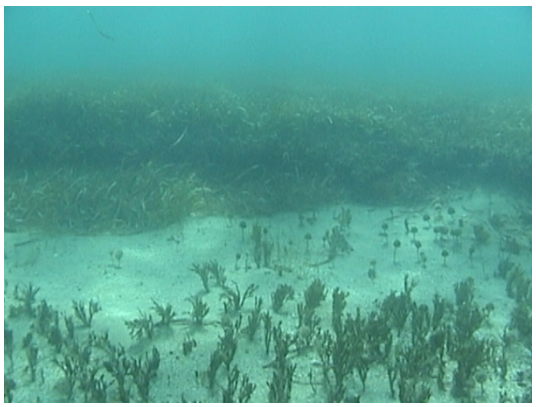
Cladocora arbuscula	Tube Coral
Manicina areolata	Rose coral
Penicillus sp.	Brush alga
Udotea flabellum	Mermaids's fans
Syringodium filiforme	Manatee grass
Jania sp.	Segmented alga
Amphiroa sp.	Twig alga

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPECIES	**COMMON NAME**							
		0	0	0	0	0	0	

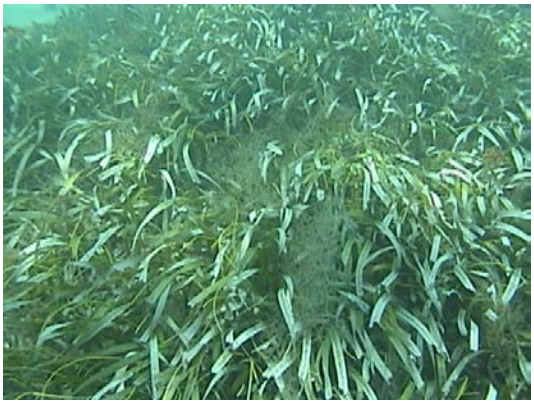
Outside transects:

None

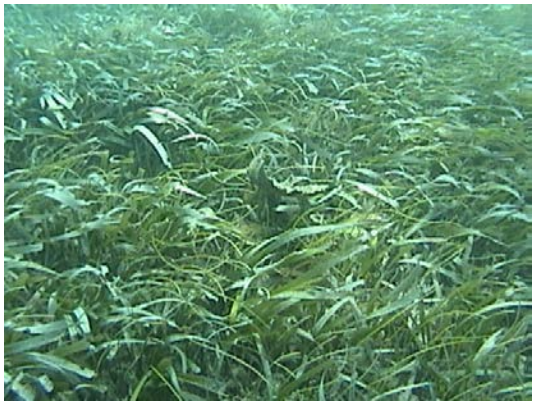
Photo Album 11. Punta Arenas Seagrass



Pta. Arenas (2.7 m)



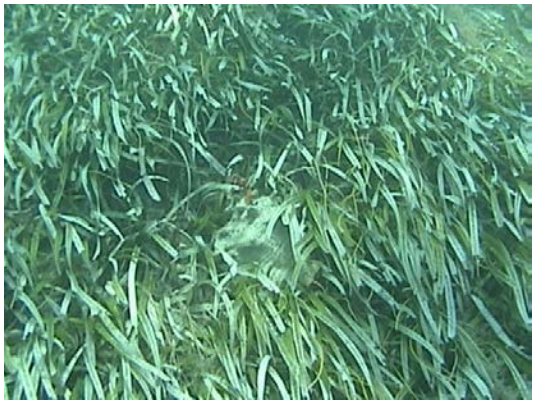
Pta. Arenas (2.7 m)



Pta. Arenas (2.7 m)

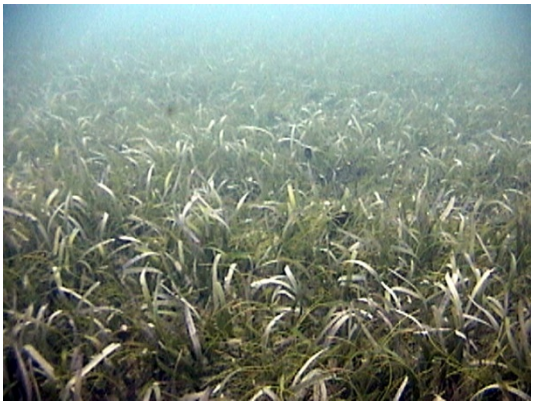
Pta. Arenas (4.5 m)

Pta. Arenas (4.5 m)

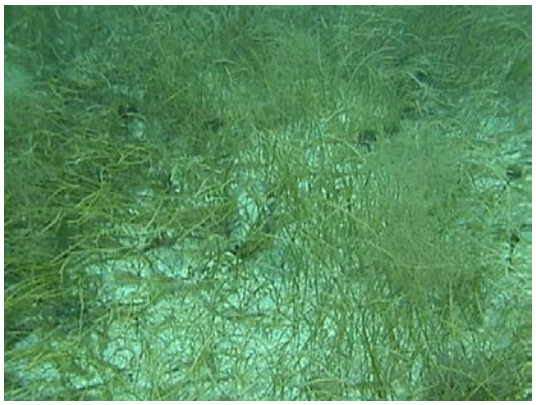


Pta. Arenas (2.7 m)

Pta. Arenas (4.5 m)

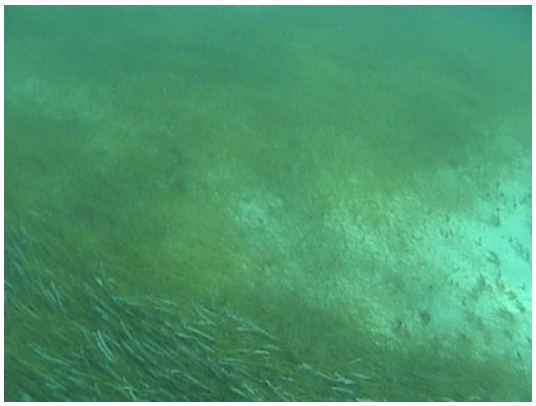


Pta. Arenas (7.0 m)



Pta. Arenas (4.5 m)

Pta. Arenas (7.0 m)



Pta. Arenas (7.0 m)

Pta. Arenas (7.0 m)

2. La Esperanza

Seagrass bed communities were surveyed at depths of 2.5 m, 4.5 m and 8.5 m off the off Ensenada La Esperanza, on the south coast of Vieques (Figure 2). Seagrass beds were found throughout the protected embayment off La Esperanza, in a depth range of 1.5 – 8.5 meters. Water (horizontal) visibility at the time of our survey was of approximately 6 meters and the water currents were mild (less than 0.25 knots). Mixed stands of the Turtle Grass (*Thalassia testudinum*) and the Manatee Grass (*Syringodium filiforme*) were the main macrophytic components of the community. Calcareous macroalgae were found growing intermixed in the seagrass beds. The main macroalgal assemblage associated with seagrasses in the La Esperanza stations included *Udotea sp, Valonia sp., Penicillus sp.* and *Halimeda incrasata.* Panoramic images of the seagrass beds at Esperanza are included as Photo Album 12.

Motile megabenthic invertebrates and fishes present within belt-transects at La Esperanza seagrass stations are presented in Tables 54-56. One sea cucumber (*Holothuria* sp.) and juveniles of the Spiny Lobster (*Panulirus argus*) and the Rock Lobster (*Panulirus guttatus*) were found inside transects, living inside Queen Conch (*Strombus gigas*) empty shells at La Esperanza 1. Live Queen Conch were observed at La Esperanza 3, along with Milk Conch (*Strombus costatus*) and The Sea Star (*Oreaster reticulatus*). No motile megabenthic invertebrates were found within belt-transects at La Esperanza 2.

Table 54. Seagrass bed Esperanza. Taxonomic composition and abundance of motile mega-Benthic invertebrates and fishes identified from belt transects

Esperanza 1
GPS Position: 18° 05.474' N; 065° 28.166' 'W
Depth: 2.5 m
Date: February 7, 2001

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Panulirus argus	Spiny lobster	1		1	3			0.8
Panulirus guttatus	Spotted spiny lobster		1					0.2
	Individuals/30m² =	**1**	**1**	**1**	**3**	**0**	**0**	**1.0**

Outside transects:

Syringodium filiforme	Manatee grass
Penicillus sp.	Brush alga
Halimeda incrassata	Watercress alga
Udotea flabellum	Mermaid's fans

Table 54. Continued

FISH SPECIES	COMMON NAME	ABUNDANCE (Ind/30m²) TRANSECT 1	2	3	4	5	6	MEAN ABUNDANCE (Ind/30m²)
Sparisoma radians	Bucktooth parrotfish		3	1			1	0.8
Sparisoma aurofrenatum	Redband parrotfish		1					0.2
Sparisoma sp.	Parrotfish			2	3	5	6	2.7
Halichoeres pictus	Painted wrasse					1		0.2
Halichoeres maculipinna	Clown wrasse				4	2	2	1.3
Ind./30 m² =		**0**	**4**	**3**	**7**	**8**	**9**	**5.2**
Num. Species =		**0**	**2**	**2**	**2**	**3**	**3**	

Outside transects:

None

Table 55. Seagrass bed Esperanza. Taxonomic composition and abundance of motile mega-Benthic invertebrates and fishes identified from belt transects

Esperanza 2
GPS Position: 18° 05.379' N; 065° 28.462' 'W
Depth: 4.5 m
Date: February 9, 2001

INVERTEBRATE SPECIES	COMMON NAME	ABUNDANCE (Ind/30m²) TRANSECT 1	2	3	4	5	6	MEAN ABUNDANCE (Ind/30m²)
None								0.0

Outside Transects:

Syringodium filiforme	Manatee grass
Penicillus sp.	Brush alga
Udotea flabellum	Mermaid's fans
Halimeda incrassata	Watercress alga
Valonia sp.	Sea pearl

FISH SPECIES	COMMON NAME	ABUNDANCE (Ind/30m²) TRANSECT 1	2	3	4	5	6	MEAN ABUNDANCE (Ind/30m²)

Halichores bivittatus	Slippery dick	1			2			0.3

Table 55. Continued

Pseudupeneus maculatus	Spotted goatfish	1				1		0.2
Halichoeres maculipinna	Clown wrasse	1	1			4	5	1.8
Sparisoma radians	Bucktooth parrotfish	1				2	1	0.7
Halichoeres poeyi	Black-ear wrasse		1					0.2
	Ind./30 m² =	**4**	**2**	**0**	**2**	**7**	**6**	**3.5**
	Num. Species =	**4**	**2**	**0**	**1**	**3**	**2**	

Outside transects:

None

Table 56. Seagrass bed Esperanza. Taxonomic composition and abundance of motile mega-benthic invertebrates and fishes identified from belt transects.

Esperanza 3
GPS Position: 18° 05.328' N; 065° 28.603' 'W
Depth: 8.5 m
Date: May 22, 2001

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Tripneustes ventricosus	WI Sea egg					1		0.2
Strombus gigas	Queen conch				1	1		0.3
	Individuals/30m² =	**0**	**0**	**0**	**1**	**2**	**0**	**0.5**

Outside transect:

Halimeda monile	Watercress alga
Penicillus capitatus	Brush alga
Udotea sp.	Mermaid's fans
Syringodium filiforme	Manatee grass

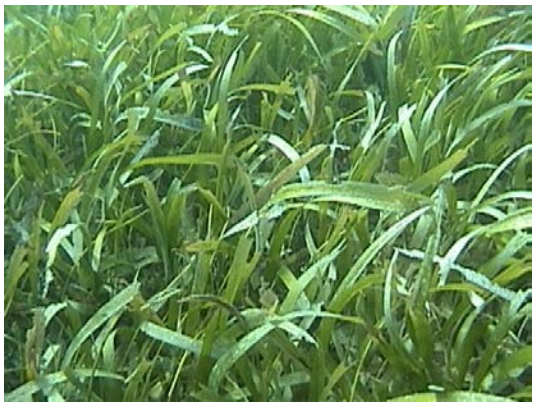
Table 56. Continued

		ABUNDANCE (Ind/30m²)						MEAN ABUNDANCE (Ind/30m²)
		TRANSECT						
		1	2	3	4	5	6	
FISH SPECIES	**COMMON NAME**							
Halichoeres bivittatus	Slippery dick	1						0.2
Sparisoma radians	Bucktooth parrotfish	3						0.5
Pseudupeneus maculatus	Spotted goatfish	2	1					0.5
Cryptotomus roseus	Slender parrotfish			1				0.2
	Ind./30 m² =	**6**	**1**	**1**	**0**	**0**	**0**	**1.3**
	Num. Species =	**3**	**1**	**1**	**0**	**0**	**0**	

Outside transects:
None

Photo Album 12. Esperanza Seagrass

Esperanza (2m)



Esperanza (2m)

Esperanza (2m)

Esperanza (2m

3. East of Rompeolas: Coronas, Comandante, Punta Martineau

Seagrass bed communities were surveyed at depths of 12.7 m south of Arrecife Coronas, at 9.1 m south of Arrecife Comandante and at 6.1 m and 7.0 m north off Punta Martineau, on the north coast of Vieques (Figure 4). Seagrass beds are distributed throughout the area surveyed from Punta Martineau in the east, to the area west of Rompeolas (Desembarcadero Mosquito) at depths ranging between 2 – 13 meters. Mixed stands of Turtle Grass (*Thalassia testudinum*) and Manatee Grass (*Syringodium filiforme*) were the main macrophytic species of the community. Calcareous macroalgae were found growing intermixed in the seagrass beds. South of Arrecife Coronas, at depths of 12.7 meters, the main macroalgal assemblage included *Halimeda sp, Udotea sp, Penicillus capitatus* and *Jania* sp. South of Arrecife Comandante, at depths of 9.1 meters, the main macroalgal assemblage included *Halimeda discoidea, Udotea sp, Penicillus capitatus, Lobophora variegata* and *Jania* sp. North of Punta Martineau, at a depth of 6.1 meters, the main macroalgal assemblage included *Halimeda opuntia, H. monile, Udotea cyanthiformis, Penicillus capitatus, Lobophora variegata* and *Padina* sp. A series of small patch reefs were present in the northwestern sections of the seagrass bed north of Punta Martineau, surveyed at a depth of 6.1 meters. Panoramic images of seagrass beds North of Punta Martineau are included as Photo Album 13.

Motile megabenthic invertebrates and fishes present within belt-transects at seagrass stations located east of the Rompeloas (Desembarcadero Mosquito) are presented in Tables 57-60. South of Arrecife Coronas, The Rose Coral (*Manicina aereolata*) and the gastropod, *Vasum muricatum*, were present within belt-transects. At this station, the Rose Coral was present in five out of the six transects surveyed with a mean density of 1.5 Individuals/30m^2. One colony of the Rose Coral (*M. aereolata*) and four adult Queen Conch (*Strombus gigas*) individuals were found within transects at the seagrass station South of Arrecife Comandante. North of Punta Martineau, the Sea Star (*Oreaster reticulatus*) and one Queen Conch were observed within belt-transects.

The fish communities at seagrasses South of Arrecife Coronas and Punta Martineau were characterized by the high abundance of post recruitment stage juvenile grunts within belt-transects (Tables 57, 59, 60). The Black-ear Wrasse (*Halichoeres poeyi*) was also common from these seagrass stations. The seagrass station North of Punta Martineau at a depth of 6.1 meters featured the highest aggregations of post-recruitment juvenile grunts with mean densities of 49.2 Individuals/30 m^2 and up to 100 individuals per transect (Table 59). Other coral reef fish juveniles, including species of commercial value (Yellowtail Snapper, Nassau Grouper) were observed within and outside transects at Punta Martineau seagrass (Tables 59-60). South of Arrecife Comandante, an assemblage consisting of resident seagrass fishes, such as the Yellowfin Mojarra (*Gerres cinereus*), Bucktooth Parrotfish (*Sparisoma radians*), and the Clown and Slippery Dick Wrasses (*Halichoeres maculipinna, H. bivittatus*) were observed. Reef fish juveniles, including one Yellowfin Snapper, one juvenile Doctorfish and the Caribbean Puffer were part of the fish assemblage. Schools of small pelagic sardines (*Harengula* sp.) and one their predators, the Bar Jack were transient across the seagrass bed South of Arrecife Comandante.

Table 57. Seagrass South of Coronas Reef. Taxonomic composition and abundance of motile Mega-benthic invertebrates and fishes identified from belt transects.

South of Arrecife Coronas
GPS Position: 18° 09.647' N; 065° 29.237' W
Depth: 12.7 m
Date: May 17, 2001

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Vasum muricatum				1				0.2
Manicina areolata	Rose coral	2	3	1	1		2	1.5
	Individuals/30m² =	**2**	**3**	**2**	**1**	**0**	**2**	**1.7**

Outside transects:

Syringodium filiforme	Manatee grass
Udotea sp.	Mermaid's fans
Halimeda spp.	Watercress alga
Penicillus capitatus	Brush alga
Manicina areolata	Rose coral
Jania sp.	Segmented alga
Vasum muricatum	

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPE CIES	**COMMON NAME**							
Haemulon sp. (juvenile)	Grunt	8	26	30				10.7
Halichoeres poeyi	Black-ear wrasse				1			0.2
	Ind./30 m² =	**8**	**26**	**30**	**1**	**0**	**0**	**10.8**
	Num. Species =	**1**	**1**	**1**	**1**	**0**	**0**	

Outside transects:
None

Table 58. Seagrass bed South Comandante Reef. Taxonomic composition and Abundance of motile mega-benthic invertebrates identified from belt transects.

South of Comandante Reef
GPS Position: 18° 09.300' N; 065° 28.176' W
Depth: 9.1 m
Date: May 18, 2001

		ABUNDANCE (Ind/30m²) TRANSECT						MEAN ABUNDANCE (Ind/30m²)
		1	2	3	4	5	6	
INVERTEBRATE SPECIES	**COMMON NAME**							
Strombus gigas	Queen conch	1	2	1				0.7
Manicina areolata	Rose coral			1				0.2
	Individuals/30m² =	**1**	**2**	**2**	**0**	**0**	**0**	**0.8**

Outside transects:

Jania sp.	Segmented alga
Lobophora variegata	Fan leaf alga
Udotea sp.	Mermaid's fans
Halimeda discoidea	Watercress alga
Penicillus capitatus	Brush alga
Syringodium filiforme	Manatee grass
Avrainvillea sp.	Blade alga

		ABUNDANCE (Ind/30m²) TRANSECT						MEAN ABUNDANCE (Ind/30m²)
		1	2	3	4	5	6	
FISH SPECIES	**COMMON NAME**							
Gerre cinereus	Yellowfin mojarra	1						0.2
Harengula sp.	Hering	15						2.5
Carangoides ruber	Bar jack		1					0.2
Ocyurus chrysurus	Yellowtail snapper			2		1		0.5
Halichoeres maculipinna	Clown wrasse			3			4	1.2
Halichoeres bivittatus	Slippery dick			1			1	0.3
Sparisoma radians	Bucktooth parrotfish						1	0.2
Acanthurus bahianus	Ocean surgeon						1	0.2
Canthigaster rostrata	Caribbean puffer						1	0.2
	Ind./30 m² =	**16**	**1**	**6**	**0**	**1**	**8**	**5.3**
	Num. Species =	**2**	**1**	**3**	**0**	**1**	**5**	

Outside transects:
None

Table 59. Seagrass bed West of Rompeolas. Taxonomic composition and abundance of motile Mega-benthic invertebrates identified from belt transects

West of Rompeolas
GPS Position: 18° 07.951' N; 065° 31.442' 'W
Depth: 3.1 m
Date: May 20, 2001

		ABUNDANCE (Ind/30m²) TRANSECT						**MEAN ABUNDANCE (Ind/30m²)**
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Oreaster reticulatus	Cushion sea star		1	1			1	0.5
Holothuria mexicana	Sea cucumber						1	0.2
	Individuals/30m² =	**0**	**1**	**1**	**0**	**0**	**2**	**0.7**

Outside Transect:

Padina sp.	Scroll alga
Penicillus dumetosus	Brush alga
Penicillus capitatus	Brush alga
Udotea cyanthiformis	Mermaid's fans
Halimeda opuntia	Watercress alga
Avrainvillea sp.	Blade alga
Dictyosphaeria cavernosa	Green bubble weed
Jania sp	Segmented alga
Dictyota sp.	Y Branched algae
Porites porites	Finger coral
Valonia ventricosa	Sea pearl
Halimeda monile	Watercress alga

		ABUNDANCE (Ind/30m²) TRANSECT						**MEAN ABUNDANCE (Ind/30m²)**
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPECIES	**COMMON NAME**							
Sparisoma radians	Bucktooth parrotfish		3	1	1			0.8
Halichoeres pictus	Painted wrasse						1	0.2
	Ind./30 m² =	**0**	**3**	**1**	**1**	**0**	**1**	**1.0**
	Num. Species =	**0**	**1**	**1**	**1**	**0**	**1**	

Table 60. Seagrass bed West of Rompeolas 1. Taxonomic composition and abundance of motile Mega-benthic invertebrates identified from belt transects

West of Rompeolas 1
GPS Position: 18° 07.951' N; 065° 31.442' 'W
Depth: 6.4 m
Date: May 20, 2001

		ABUNDANCE (Ind/30m²) TRANSECT						MEAN ABUNDANCE (Ind/30m²)
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Oreaster reticulatus	Cushion sea star	1	1	3		1		1.0
Strombus gigas	Queen conch	1						0.2
Lytechinus variegatus	Variegated urchin			1				0.2
Manicina areolata	Rose coral				2			0.3
Strombus sp.	Conch	1						0.2
Clypeaster sp.	Sand dollar			1		1	1	0.5
	Individuals/30m² =	**3**	**1**	**5**	**2**	**2**	**1**	**2.3**

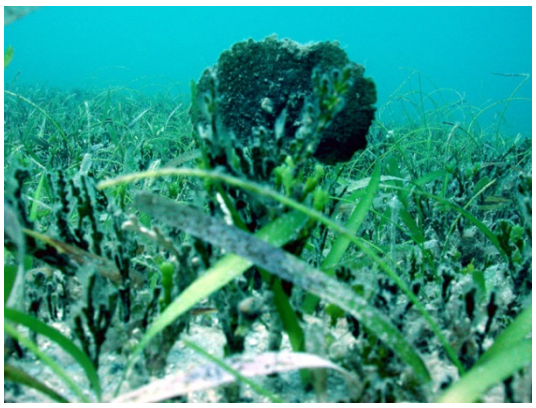
Outside transects:

Padina sp.	Scroll alga
Halimeda opuntia	Watercress alga
Halimeda monile	Watercress alga
Penicillus capitatus	Brush alga
Avrainvillea sp.	Blade alga
Udotea cyanthiformis	Mermaid's fans
Meoma ventricosa	Red heart urchin

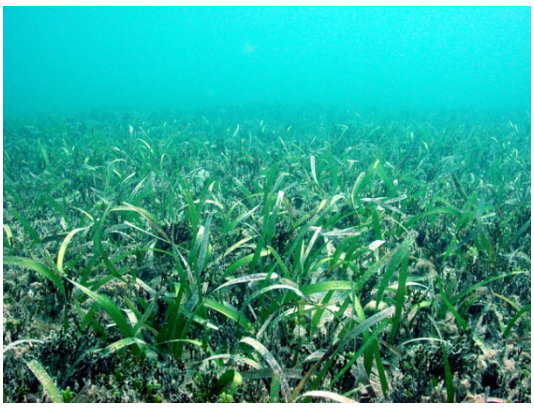
		ABUNDANCE (Ind/30m²) TRANSECT						MEAN ABUNDANCE (Ind/30m²)
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPECIES	**COMMON NAME**							
Halichoeres maculipinna	Clown wrasse		1				1	0.3
Haemulon sp.	Grunt		4	3			30	6.2
Sparisoma radians	Bucktooth parrotfish			1	2	3		1.0
Ocyurus chrysurus	Yellowtail snapper						1	0.2
Xyrichtys sp.	Razorfish		1					0.2
	Ind./30 m² =	**0**	**6**	**4**	**2**	**3**	**32**	**7.8**
	Num. Species =	**0**	**3**	**2**	**1**	**1**	**3**	

Outside transects:
None

Photo Album 13. Punta Martineau Seagrass



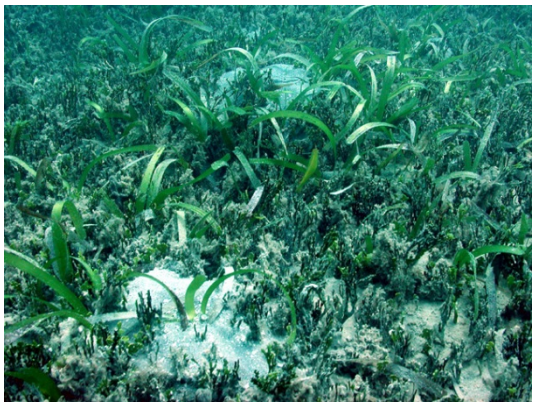
Martineau (7 m)



Martineau (7 m)

Martineau (7 m)

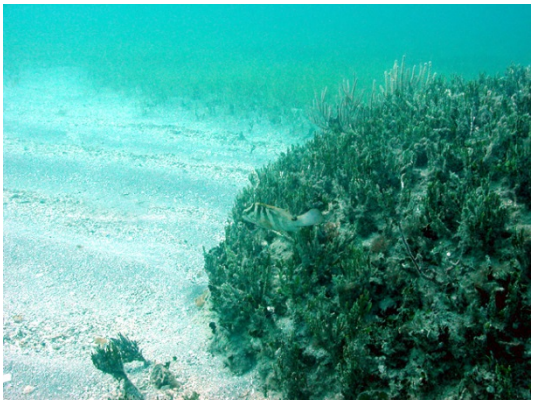
Martineau (7 m)



Martineau (7 m)

Martineau (7 m)

Martineau (6 m)



Martineau (6 m)

Martineau (6 m)

Martineau (6 m)

Martineau (6 m)

Martineau (6 m)

4. West of Rompeolas

Two seagrass stations located to the West of Rompeolas (Desembarcadero Mosquito) were surveyed at depths of 3.1 m and 6.4 m. Both stations were mixed stands of Turtle Grass (*Thalassia testudinum*) and Manatee Grass (*Syringodium filiforme*) with dense growth of calcareous, brown and red macroalgae. The main macroalgal assemblage included the calcareous species: *Udotea cyanthiformis, Valonia ventricosa, Penicillus capitatus, P. dumetosus, Avranvillea sp., Halimeda opuntia* and *H. monile. Padina* sp. and *Dictyosphaeria cavernosa* were the main brown algae present. *Jania* sp. was the red alga associated with the seagrass bed

Motile megabenthic invertebrates and fishes present within belt-transects at seagrass stations located West of Rompeloas (Desembarcadero Mosquito) are presented in Tables 61-62. The Cushion Sea Star (*Oreaster reticulatus*) was the most common megabenthic invertebrate present at both stations. One sea cucumber (*Holothuria* sp.) was also present at the shallow station (3.1m). Six megabenthic invertebrates were present within belt-transects at the deeper station (6.4 m) including the Cushion Sea Star (*Oreaster reticulatus*), Green Sea Urchin (*Lytechinus variegatus*), the Sand Dollar (*Clypeaster subdepressus*), the Rose Coral (*Manicina aereolata*) and Queen Conch (*Strombus gigas*).

The fish communities at seagrasses West of Rompeolas included a total of two species at the shallow (3.1 m) station and five species at the deeper (6.4 m) stations (Tables 61-62). Post recruitment juvenile grunts and juvenile Yellowtail Snappers were present within belt-transects at the deep station. The Black-ear and Clown Wrasses (*Halichoeres poeyi, H. maculipinna*) and the Bucktooth Parrotfish (*Sparisoma radians*) were common throughout both stations and appear to be resident species of the seagrass habitat.

Table 61. Seagrass bed North of Martineau . Taxonomic composition and abundance of motile mega-benthic invertebrates identified from belt transects

North of Punta Martineau
GPS Position: 18° 08.619' N; 065° 28.486' 'W
Depth: 6.1 m
Date: May 21, 2001

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Oreaster reticulatus	Cushion sea star	1	1	1				0.5
Strombus gigas	Queen conch			1				0.2
	Individuals/30m² =	**1**	**1**	**2**	**0**	**0**	**0**	**0.7**

Table 61. Continued.

Outside Transect:

Syringodium filiforme	Manatee grass
Amphiroa sp.	Twig alga
Udotea sp.	Mermaid's fans

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPECIES	**COMMON NAME**							
Haemulon sp.	Grunt	30	20	55	100	40	50	49.2
Halichoeres pictus	Painted wrasse				1	1		0.3
Halichoeres bivittatus	Slippery dick					1		0.2
Haemulon sciurus	Bluestripped grunt						1	0.2
	Ind./30 m² =	**30**	**20**	**55**	**101**	**42**	**51**	**49.8**
	Num. Species =	**1**	**1**	**1**	**2**	**3**	**2**	

Outside Transect:

Ocyurus chrysurus	Yellowtail snapper
Epinephelus striatus	Nassau grouper
Hypoplectrus puella	Barred hamlet
Holacanthus ciliaris	Queen angelfish
Acanthurus bahianus	Ocean surgeon
Stegastes dorsopunicans	Dushy damselfish
Pseudupeneus maculatus	Spotted goatfish
Stegastes variabilis	Cocoa damselfish
Stegastes rubripinne	Yellowtail parrotfish

Table 62. Seagrass bed North of Martineau . Taxonomic composition and abundance of motile mega-benthic invertebrates identified from belt transects

North of Punta Martineau
GPS Position: 18° 08.685' N; 065° 28.329' 'W
Depth: 7 m
Date: May 21, 2001

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
INVERTEBRATE SPECIES	**COMMON NAME**							
Oreaster reticulatus	Cushion sea star					2	1	0.5
Strombus gigas	Queen conch			1				0.1
Holothuria mexicana	Sea cucumber					1	1	0.3

	Individuals/30m² =		**1**		**3**	**2**	**0.9**

Table 62. Continued

Outside Transect:

Halimeda sp	Watercress alga
Penicillus sp.	Brush alga
Halimeda discoidea	Watercress alga
Udotea sp.	Mermaid's fans

		ABUNDANCE (Ind/30m²)						**MEAN ABUNDANCE (Ind/30m²)**
		TRANSECT						
		1	**2**	**3**	**4**	**5**	**6**	
FISH SPECIES	**COMMON NAME**							
Haemulon sp.	Grunt	30	70		50			25.0
Halichoeres poeyi	Painted wrasse				1	1		0.3
Ocyurus chrysurus	Yellowtail snaper	1		2		1		0.7
Haemulon sciurus	Bluestripped grunt				17		3	3.3
Acanthurus bahianus	Ocean surgeofish				1			0.2
Holocentrus rufus	Longspine squirrelfish				1			0.2
Carangoides ruber	Bar jack	1						0.2
Sparisoma radians	Bucktooth parrotfish				3			0.5
Hypoplectrus puella	Barred hamlet					1	1	0.3
	Ind./30 m² =	**32**	**70**	**2**	**73**	**3**	**4**	**30.7**
	Num. Species =	**3**	**1**	**1**	**6**	**3**	**2**	

Outside transects:

Equetus sp	Jack knife fish
Halichoeres poeyi	Black-ear wrasse

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Appendix 1. Canjilones Reef. Percent cover by sessile-benthic substrate categories. Video transect method. Feb, 2001.

Substrate Categories	Transects					Mean
	T-1	T-2	T-3	T-4	T-5	%
Stony Corals						
Montastrea annularis						
forma annularis	9.2	15.4	13.4	1.4	9.2	**9.72**
forma faveolata	2.0	9.6	2.4	14.0	17.0	**9.00**
forma franksi	3.6	4.0	1.2	3.6	4.0	**3.28**
M. cavernosa	2.6	3.4		2.8		**1.76**
Porites astreoides		0.6	1.8	1.0	0.2	**0.72**
P. porites	0.2		1.2	0.4	0.6	**0.48**
P. furcata		0.6				**0.12**
Dendrogyra cylindrus	0.6					**0.12**
Mycetophyllia sp		0.6		0.2		**0.16**
Siderastrea sp.	4.0					**0.80**
Agaricia sp	0.4			3.0	0.6	**0.80**
Madracis sp	1.4			0.8	0.6	**0.56**
Diploria labyrinthiformis	0.4				1.6	**0.40**
D. clivosa					0.2	**0.04**
D. strigosa	1.0	0.8			0.6	**0.48**
Total Stony Corals	**25.40**	**35.00**	**20.00**	**27.20**	**34.60**	**28.44**
Octocorals						
Pseudopterogorgia sp.	0.8	1.0	3.2		1.6	**1.32**
Gorgonia ventalina		0.4	1.8	2.8	2.0	**1.40**
Eunicea sp	2.2	2.0	3.0	1.8		**1.80**
Pterogorgia sp	0.4					**0.08**
Briareum asbestinum		0.8	0.2			**0.20**
Muricea sp	1.0		0.4			**0.28**
Erythropodium sp	0.4			0.2		**0.12**
Pseudoplexaura sp	2.0	2.2	0.6	1.8	1.8	**1.68**
unidentied						**0.00**
Total Octocorals	**6.80**	**6.40**	**9.20**	**6.60**	**5.40**	**6.88**
Sponges	2.0	2.0	1.0	2.8	2.2	**2.00**
Xethospongia muta		0.2				**0.04**
Callyspongia vaginalis						**0.00**
Aplysina sp						**0.00**
Hydrozoa						**0.00**
Zoanthids	0.6	2.2				**0.56**
Coralline algae						**0.00**
Calcareous algae						**0.00**
Fleshy Algae	19.4	16.6	22.4	18.4	7.0	**16.76**
Algal Turf	37.6	30.4	44.6	42.8	47.2	**40.52**

Unidentified		0.4				**0.08**
Abiotic	8.2	6.8	2.8	2.2	3.6	**4.72**

Appendix 2. Puerto Ferro Reef. Percent cover by sessile-benthic substrate categories. Video transect method. Feb, 2001.

Substrate Categories	**Transects**					**Mean**
	T-1	T-2	T-3	T-4	T-5	**%**
Stony Corals						
Montastraea annularis						
forma annularis				1.0		**0.20**
forma faveolata						**0.00**
forma franksi						**0.00**
M. cavernosa	0.2		1.0	0.2		**0.28**
Porites astreoides	1.0	0.2		0.4		**0.32**
P. porites	0.6					**0.12**
Colpophyllia sp				0.2		**0.04**
Mycetophyllia so						**0.00**
Madracis sp	0.2				0.2	**0.08**
Stephanocoenia sp				0.2		**0.04**
Meandrina meandrites		1.0	1.2			**0.44**
Total Stony Corals	**2.00**	**1.20**	**2.20**	**2.00**	**0.20**	**1.52**
Octocorals						
Pseudopterogorgia sp.	1.2	1.0	0.6	0.2		**0.60**
Gorgonia ventalina		3.8	1.4	1.2	1.2	**1.52**
Eunicea sp		2.6	3.2	0.2	5.8	**2.36**
Plexaurella sp	2.2			1.4	2.4	**1.20**
Briareum asbestinum		0.2				**0.04**
Pseudoplexaura sp	5.4	11.8	3.2	12.4	0.8	**6.72**
Muricea sp			1.0			**0.20**
Erythropodium caribaeorum						**0.00**
Unidentified		3.4	0.2	1.8	2.4	**1.56**
Total Octocorals	**8.80**	**22.80**	**9.60**	**17.20**	**12.60**	**14.20**
Sponges	2.2	1.4		2.0	0.4	**1.20**
Niphates sp						**0.00**
Callyspongia vaginalis						**0.00**
Xestospongia muta					0.2	**0.04**
Hydrozoa	0.2	0.4				**0.12**
Zoanthids	1.2					**0.24**
Coralline algae					2.0	**0.40**
Calcareous algae	1.6					**0.32**
Fleshy Algae	22.0	23.0	27.0	23.0	24.0	**23.80**
Algal Turf	55.8	47.8	60.0	51.6	58.2	**54.68**
Abiotic	6.2	3.4	1.2	4.2	2.4	**3.48**

Appendix 3. Monte Pirata Reef. Percent cover by sessile-benthic substrate categories. Video transect method. Feb, 2001.

Substrate Categories	Transects					Mean
	T-1	T-2	T-3	T-4	T-5	%
Stony Corals						
Montastrea annularis						
forma annularis	6.2	7.6	0.4	4.4	3.6	**4.44**
forma faveolata	2.4	3.8		7.4	10.4	**4.80**
forma franksi	3.6	1.8	10.0	1.4	2.0	**3.76**
M. cavernosa	1.6	0.4	1.8	0.8	1.0	**1.12**
Porites astreoides	0.6	2.8	0.8	0.6	0.4	**1.04**
P. porites	0.2				0.4	**0.12**
P. furcata		0.2				**0.04**
Colpophyllia natans			0.6		7.6	**1.64**
Mycetophyllia sp		0.2				**0.04**
Madracis decactis					0.6	**0.12**
Meandrina meandrites		0.2				**0.04**
Dendrogyra cylindrus			0.4		3.6	**0.80**
Acropora cervicornis					1.2	**0.24**
Agaricia sp	1.4	0.6			0.4	**0.48**
Siderastrea radians	2.6			1.6		**0.84**
S. siderea		0.4				**0.08**
Diplora labyrinthiformis					0.8	**0.16**
D. clivosa		2.2		0.4		**0.52**
D. strigosa	0.4				0.6	**0.20**
Total Stony Corals	**19.00**	**20.20**	**14.00**	**16.60**	**32.60**	**20.48**
Octocorals						
Pseudopterogorgia sp.	1.8	2.0	4.8	3.0	0.6	**2.44**
Gorgonia ventalina	0.6		0.2	5.2	2.8	**1.76**
Eunicea sp	3.6	2.2	5.0	5.4	4.6	**4.16**
Briareum asbestinum	0.2	0.2		0.2	0.2	**0.16**
Plexaura homomalla		0.6	2.8	1.8		**1.04**
Pseudoplexaura sp	3.6	2.6	8.2	4.6	3.4	**4.48**
Muricea sp	1.4	0.4	0.6	1.0	2.6	**1.20**
unidentified	0.4					**0.08**
Total Octocorals	**11.60**	**8.00**	**21.60**	**21.20**	**14.20**	**15.32**
Sponges	2.0	1.8	2.0	1.2	0.6	**1.52**
Niphates sp						**0.00**
Callyspongia vaginalis						**0.00**
Xestospongia muta	0.2					**0.04**
Hydrozoa	0.2				0.2	**0.08**
Zoanthids	1.4				3.6	**1.00**
Coralline algae	0.4	0.6	2.0	2.2	4.0	**1.84**
Calcareous algae	1.0	1.2				**0.44**

Fleshy Algae	17.2	20.8	20.6	21.0	10.2	**17.96**
Algal Turf	40.8	42.0	28.8	33.2	29.8	**34.92**
Abiotic	5.8	4.8	11.0	4.6	4.8	**6.20**

Appendix 4. Boya Esperanza Reef. Percent cover by sessile-benthic substrate Categories. Video transect method. Feb, 2001.

Substrate Categories	**Transects**					**Mean**
	T-1	T-2	T-3	T-4	T-5	**%**
Stony Corals						
Montastrea annularis						
forma annularis	34.4	20.0	59.2	26.6	10.2	**30.08**
forma faveolata					0.6	**0.12**
forma franksi	0.6	0.6		0.4	0.6	**0.44**
M. cavernosa	1.2	1.2			0.8	**0.64**
Porites astreoides	0.4	0.4		0.8	2.2	**0.76**
P. porites		0.4	1.2			**0.32**
Isophyllia sinuosa				0.6	0.4	**0.20**
Siderastrea sp.	1.0	2.4		2.2	1.6	**1.44**
Agaricia sp		0.2				**0.04**
Diploria strigosa	0.4	1.2		1.6	4.2	**1.48**
Total Stony Corals	**38.00**	**26.40**	**60.40**	**32.20**	**20.60**	**35.52**
Octocorals						
Pseudopterogorgia sp.	0.2	0.2				**0.08**
Gorgonia ventalina			0.2	0.2	0.2	**0.12**
Plexaura sp		0.2				**0.04**
Erythropodium sp		0.2	2.0	1.6	0.4	**0.84**
unidentified	1.8	4.0	0.6	2.4	3.8	**2.52**
Total Octocorals	**2.00**	**4.60**	**2.80**	**4.20**	**4.40**	**3.60**
Sponges	1.4	1.2		1.8	1.6	**1.20**
Niphates sp						**0.00**
Callyspongia vaginalis						**0.00**
Aplysina sp						**0.00**
Hydrozoa		0.2	2.2	0.6	1.6	**0.92**
Zoanthids		0.2	2.6	0.4	0.8	**0.80**
Coralline algae						**0.00**
Calcareous algae	0.8		1.6	0.6	0.2	**0.64**
Fleshy Algae	0.8	2.8			1.0	**0.92**
Algal Turf	31.4	57.2	29.4	56.0	61.4	**47.08**
Unidentified		0.2		0.8	0.2	**0.24**
Abiotic	25.6	7.2	1.0	3.4	8.2	**9.08**

Appendix 5. Caballo Blanco Reef Crest. Percent cover by sessile-benthic substrate categories. Video transect method. May, 2001.

Substrate Categories	Transects					Mean
	T-1	T-2	T-3	T-4	T-5	%
Stony Corals						
Montastrea annularis (forma annularis)					0.8	**0.16**
Porites astreoides	1	0.4		1.4		**0.56**
Diploria labyrinthiformis	0.4					**0.08**
D. clivosa		1.8				**0.36**
D. strigosa	1.2	7				**1.64**
Total Stony Corals	**2.60**	**9.20**	**0.00**	**1.40**	**0.80**	**2.80**
Octocorals						
Plexaura sp		0.4				**0.08**
Gorgonia ventalina	1	4.4		1.6	2.2	**1.84**
Eunicea sp	0.4				0.2	**0.12**
Plexaurella sp	0.6					**0.12**
Plexaura homomalla	0.8	0.8				**0.32**
Muricea sp						**0.00**
Erythropodium sp	0.4			3.2		**0.72**
Pterogorgia sp		0.6				**0.12**
Pseudoplexaura sp				1.8		**0.36**
Total Octocorals	**3.20**	**6.20**	**0.00**	**6.60**	**2.40**	**3.68**
Sponges	17.2	15.8		13.6	17.4	**12.80**
Hydrozoa	5.2			5.6	3.8	**2.92**
Zoanthids		3.2				**0.64**
Coralline algae		0.8		1.6	0.6	**0.60**
Calcareous algae		0.4				**0.08**
Fleshy Algae						**0.00**
Algal Turf	49	40.8		48	60.4	**39.64**
Abiotic	22.8	23.6		23.2	14.6	**16.84**
Algal Turf	49	40.8		48	60.4	**39.64**
Abiotic	22.8	23.6		23.2	14.6	**16.84**

Appendix 6. Caballo Blanco Reef Slope. Percent cover by sessile-benthic substrate Categories. Video transect method. May, 2001.

Substrate Categories	Transects T-1	T-2	T-3	T-4	T-5	Mean %
Stony Corals						
Montastrea annularis						
forma annularis	15.2	28.2	38.4	23.2	16.0	**24.20**
forma faveolata	16.6					**3.32**
forma franksi	4.6				1.2	**1.16**
M. cavernosa	0.6	0.2				**0.16**
Porites astreoides	1.0			0.6	3.0	**0.92**
P. porites	0.8		0.6		0.4	**0.36**
P. furcata	0.2					**0.04**
Agaricia sp					0.2	**0.04**
Siderastrea radians	2.4	4.2		0.8	1.0	**1.68**
Diploria labyrinthiformis		3.8				**0.76**
D.strigosa					2.6	**0.52**
D. clivosa	0.2					**0.04**
Total Stony Corals	**41.60**	**36.40**	**39.00**	**24.60**	**24.40**	**33.20**
Octocorals						
Pseudopterogorgia sp.	2.8	1.2	0.8	4.0	3.8	**2.52**
Gorgonia ventalina	3.2			1.0	2.0	**1.24**
Eunicea sp	2.2	1.0	0.6	2.4	1.0	**1.44**
Pterogorgia sp				0.0		**0.00**
Plexaura homomalla	0.4			0.4	0.6	**0.28**
Briareum asbestinum		0.2	0.2		0.6	**0.20**
Muricea sp			0.4		2.0	**0.48**
Erythropodium sp		0.6				**0.12**
Pseudoplexaura sp	0.2				0.8	**0.20**
Unidentified	0.4		0.8	0.4		**0.32**
Total Octocorals	**9.20**	**3.00**	**2.80**	**8.20**	**10.80**	**6.80**
Sponges	0.6					**0.12**
Niphates sp						**0.00**
Callyspongia vaginalis						**0.00**
Unidentified				0.6		**0.12**
Hydrozoa	0.4		0.4	0.4	0.2	**0.28**
Zoanthids						**0.00**
Coralline algae	0.2	0.4	0.6		0.2	**0.28**
Calcareous algae	1.4	6.2	8.4	7.6	10.4	**6.80**

Fleshy Algae	4.2	14.8	3.6	4.4	6.4	**6.68**
Algal Turf	35.4	38.8	42.0	52.6	43.6	**42.48**
Abiotic	7.0	0.4	3.2	1.6	4.0	**3.24**

Appendix 7. Mosquito Reef. Percent cover by sessile-benthic substrate categories. Video transect method. May, 2001.

Substrate Categories	**Transects**					**Mean**
	T-1	T-2	T-3	T-4	T-5	**%**
Stony Corals						
Montastrea annularis						
forma annularis	0.4	4.6	1.8	3.6	4.0	**2.88**
forma faveolata	11.4	13.6	23.6	9.0	7.0	**12.92**
forma franksi	4.0	4.4	1.6	1.4	5.4	**3.36**
M. cavernosa	1.0	0.6	0.2	10.2	1.6	**2.72**
Porites astreoides	7.6	5.0	4.4	2.6	3.0	**4.52**
P. porites	0.4	0.6				**0.20**
P. furcata		4.8	7.2	0.4	0.6	**2.60**
Colpophyllia natans	5.0	1.4	5.6		12.0	**4.80**
Mycetophyllia so		1.2	0.2	0.6		**0.40**
Madracis sp			0.4			**0.08**
Eusmilia fastigiata					0.2	**0.04**
Scolymia sp				0.2		**0.04**
Agaricia sp				0.2		**0.04**
Siderastrea radians	3.4					**0.68**
S. siderea		0.8	0.2		7.2	**1.64**
Diplora labyrinthiformis				1.0	0.2	**0.24**
D. clivosa	0.2				0.2	**0.08**
Total Stony Corals	**33.40**	**37.00**	**45.20**	**29.20**	**41.40**	**37.24**
Octocorals						
Pseudopterogorgia sp.				2.4	1.2	**0.72**
Gorgonia ventalina	1.0			0.2		**0.24**
Eunicea sp	1.6		0.8	2.4	1.6	**1.28**
Plexaurella sp		0.4		0.8		**0.24**
Briareum asbestinum	1.2		0.2			**0.28**
Plexaura homomalla		1.2				**0.24**
Pseudoplexaura sp		1.4	2.2			**0.72**
Muricea sp	4.0	0.6	1.6	1.6		**1.56**
Erythropodium caribaeorum	0.2	2.2	0.4	3.4	2.0	**1.64**
Total Octocorals	**8.00**	**5.80**	**5.20**	**10.80**	**4.80**	**6.92**
Sponges	1.0	3.2	2.8	5.2	6.0	**3.64**
Niphates sp						**0.00**
Callyspongia vaginalis						**0.00**
Aplysina sp						**0.00**
Hydrozoa	0.4	0.6		0.2	1.2	**0.48**
Zoanthids						**0.00**
Coralline algae	2.0	0.2	1.0	0.6	1.0	**0.96**

Calcareous algae	0.2					**0.04**
Fleshy Algae	10.0	6.0	16.0	13.4	7.0	**10.48**
Algal Turf	41.0	45.8	29.8	36.6	36.6	**37.96**
Abiotic	4.0	1.4		4.0	2.0	**2.28**

Appendix 8. Las Coronas. Percent cover by sessile-benthic substrate categories. Video transect method. May, 2001

Substrate Categories	**Transects**					**Mean**
	T-1	T-2	T-3	T-4	T-5	**%**
Stony Corals						
Montastrea annularis						
forma annularis	2.4	1.4	0.2	2.2	2.6	**1.76**
forma faveolata	3.6		2.4	5.8	6.8	**3.72**
forma franksi	1.8	2.8	0.2			**0.96**
M. cavernosa	3.8	3.0	0.8	10.6	4.6	**4.56**
Porites astreoides		0.4	0.2	1.4	1.6	**0.72**
Eusmilia fastigiata				0.6		**0.12**
Madracis sp	0.8					**0.16**
Agaricia sp	0.8			0.2		**0.20**
Siderastrea radians	1.6	4.0	0.4	1.4		**1.48**
S. siderea					0.2	**0.04**
Diploria strigosa		1.0		0.2		**0.24**
D. clivosa	0.4				0.4	**0.16**
Total Stony Corals	**15.20**	**12.60**	**4.20**	**22.40**	**16.20**	**14.12**
Octocorals						
Pseudopterogorgia sp.	2.6		6.2	0.6	6.4	**3.16**
Gorgonia ventalina	0.6		3.6		1.4	**1.12**
Eunicea sp	2.6	2.2	5.4	4.0	0.6	**2.96**
Plexaurella sp	0.4	0.8		1.2	0.2	**0.52**
Briareum asbestinum	0.6	1.4			0.2	**0.44**
Pseudoplexaura sp	3.2	1.6	6.8	3.6	5.6	**4.16**
Muricea sp	0.6	0.6			0.6	**0.36**
Erythropodium caribaeorum		1.8	3.0	1.2		**1.20**
Total Octocorals	**10.60**	**8.40**	**25.00**	**10.60**	**15.00**	**13.92**
Sponges	0.4	1.8	2.0	1.6	2.4	**1.64**
Niphates sp	0.4	0.8				**0.24**
Callyspongia vaginalis						**0.00**
Aplysina sp						**0.00**
Hydrozoa	0.2		0.2	0.4		**0.16**
Zoanthids	0.4					**0.08**
Coralline algae		0.4	0.8	1.4	1.0	**0.72**
Calcareous algae				0.6		**0.12**
Fleshy Algae	10.8	9.4	12.6	15.4	8.6	**11.36**
Algal Turf	48.8	59.8	49.6	44.4	49.8	**50.48**

Abiotic	13.2	6.8	5.6	3.2	7.0	**7.16**

Appendix 9. Comandante Reef. Percent cover by sessile-benthic substrate categories. Video transect method. May, 2001.

Substrate Categories	**Transects**					**Mean**
	T-1	T-2	T-3	T-4	T-5	**%**
Stony Corals						
Montastrea annularis						
forma annularis	2.0	9.4	0.4	21.4	1.4	**6.92**
forma faveolata	36.6	15.0	25.0	12.0	4.6	**18.64**
forma franksi		1.0	6.0	3.4	7.2	**3.52**
M. cavernosa			1.2		2.2	**0.68**
Porites astreoides	0.6	1.0		0.2	1.0	**0.56**
P. furcata			0.8		0.2	**0.20**
Agaricia sp					0.2	**0.04**
Colpophyllia natans		2.4	4.4		6.0	**2.56**
Acropora cervicornis		1.6				**0.32**
Diploria labyrinthiformis	0.2					**0.04**
D. strigosa		4.8			0.2	**1.00**
Total Stony Corals	**39.40**	**35.20**	**37.80**	**37.00**	**23.00**	**34.48**
Octocorals						
Pseudopterogorgia sp.	2.4		2.8	0.6	3.4	**1.84**
Gorgonia ventalina			0.6		0.4	**0.20**
Eunicea sp	1.2	1.8	1.4	3.2	6.2	**2.76**
Plexaurella sp		5.8	2.4	6.8	1.8	**3.36**
Briareum asbestinum	0.2	0.8	0.4	0.6	1.0	**0.60**
Pseudoplexaura sp		1.6				**0.32**
Muricea sp	1.6	0.8		1.0		**0.68**
Erythropodium caribaeorum	1.8		0.8		1.2	**0.76**
Unidentified	0.6	0.4	1.2		1.4	**0.72**
Total Octocorals	**7.80**	**11.20**	**9.60**	**12.20**	**15.40**	**11.24**
Sponges			1.4	1.2	0.8	**0.68**
Niphates sp						**0.00**
Callyspongia vaginalis						**0.00**
Aplysina sp						**0.00**
Hydrozoa	14.0	5.4	0.2	7.2	0.4	**5.44**
Zoanthids						**0.00**
Coralline algae	0.2					**0.04**
Calcareous algae	4.4	3.4	5.4	8.4	14.6	**7.24**
Fleshy Algae	4.6	7.4	6.0	2.0	5.4	**5.08**
Algal Turf	26.2	31.6	32.4	28.6	34.2	**30.60**

Abiotic	3.4	5.8	7.2	3.4	6.2	**5.20**

Appendix 10. Boya 6 Reef. Percent cover by sessile-benthic substrate categories. Video transect method. May, 2001

Substrate Categories	Transects					Mean
	T-1	T-2	T-3	T-4	T-5	%
Stony Corals						
Montastrea annularis						
forma annularis	6.0	1.4	8.2	1.2	3.6	**4.08**
forma faveolata	1.0	2.0	1.0			**0.80**
forma franksi			0.8			**0.16**
M. cavernosa		3.8	5.2	4.6	2.4	**3.20**
Porites astreoides	0.8	1.0	1.4	2.6	2.4	**1.64**
P. porites					1.0	**0.20**
P. furcata	0.8			1.2	1.0	**0.60**
Colpophyllia natans				1.6	0.4	**0.40**
Siderastrea sp.		1.0		0.0		**0.20**
Madracis sp			1.4	0.2		**0.32**
Diploria labyrinthiformis			0.0	1.2	0.4	**0.32**
D. clivosa			0.4			**0.08**
Total Stony Corals	**8.60**	**9.20**	**18.40**	**12.60**	**11.20**	**12.00**
Octocorals						
Pseudopterogorgia sp.	4.2	3.0	1.6	1.4	2.8	**2.60**
Gorgonia ventalina	3.4		0.4	2.2	0.4	**1.28**
Eunicea sp	1.2	6.2	3.2	4.6	4.0	**3.84**
Plexaurella sp	7.8	1.4	2.2	1.8	3.4	**3.32**
Briareum asbestinum		0.8	1.2		0.2	**0.44**
Muricea sp		0.8		1.2		**0.40**
Erythropodium sp			1.6	0.6	2.6	**0.96**
Psudoplexaura sp		6.6	5.0	3.6		**3.04**
Unidentified				0.4		**0.08**
Total Octocorals	**16.60**	**18.80**	**15.20**	**15.80**	**13.40**	**15.96**
Sponges	4.8	2.6	2.8	7.0	2.8	**4.00**
Niphates sp					0.4	**0.08**
Callyspongia vaginalis	1.2					**0.24**
Aplysina sp	1.4					**0.28**
Hydrozoa	0.4		0.2	0.6	0.4	**0.32**
Zoanthids				0.6		**0.12**
Coralline algae	1.6	10.0	7.8	0.6	4.4	**4.88**
Calcareous algae	4.2		3.6	0.2		**1.60**

Fleshy Algae	7.6	12.8	14.2	16.2	22.8	**14.72**
Algal Turf	51.2	44.8	33.4	44.4	41.6	**43.08**
Abiotic	2.4	1.8	4.4	2.0	3.0	**2.72**