Inventory and Atlas of Corals and Coral Reefs, with Emphasis on Deep-Water Coral Reefs from the U. S. Caribbean EEZ

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FINAL REPORT

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I. Executive Summary

Hermatypic coral reefs in deep terraces of the outer shelf, rocky outcrops and vertical wall features of the insular slope, submerged volcanic ridges and oceanic seamounts comprise the deep reef systems of Puerto Rico and the U. S. Virgin Islands (US Caribbean EEZ). Ahermatypic coral banks have not been reported, but at least 33 species of azooxanthellate (aposymbiotic) corals, including the deep water reef builder, *Lophelia pertusa* have been collected from deep reef habitats of the US Caribbean EEZ. The bathymetry of the northern and southern slope of PR and the USVI is characterized by an abrupt, almost vertical drop, without any large topographic features (platforms) where extensive deep (ahermatypic) reef banks could develop. There are two prominent ridge systems submerged along the west and southeast coasts that offer the best possibilities for existence of deep coral reefs. The most extensive is the great southern Puerto Rico fault zone, a submerged section of the Antillean ridge that extends across the entire Mona Passage, connecting Puerto Rico with La Hispaniola. On the southeast coast of Puerto Rico, the submerged seamounts, Bajo Investigador, Bajo Grappler and Bajo Whitting are the most prominent deep reef systems. These are seamount pinnacles of a submerged ridge that extends east, connecting the shelf platform of Puerto Rico with the Island of St. Croix, USVI. The ridge is separated from the mainland by oceanic depths of more than 1,000 meters. Bajo Grappler is the largest and taller of the seamounts, with its pinnacle reaching less than 60 meters from the surface. As with the west coast deep reef systems, the submerged seamounts of the south coast were sites of an intensive fishing effort for deep water snappers and groupers during the last three decades.

Most of the information regarding deep water habitats and associated communities in Puerto Rico and the U. S. Virgin Islands was produced more than 100 years ago, during the early ocean exploration surveys that included the Voyage of H. M. S. Challenger during 1873, dredging surveys by “Blake” during 1878-79, U. S. Fish Commission “Fish Hawk” in 1899, and the Johnson-Smithsonian Expedition aboard the Yacht Caroline in 1933. Extensive deep sea samplings of the southwestern Atlantic were performed during the period between 1950’s through and 1970’s by the exploratory fishing vessels R/V Oregon, R/V Silver Bay, R/V Combat, R/V Pelican, R/V Gerda, R/V Columbus-Iselin, and R/V John Elliot Pillsbury, but most of the survey effort was concentrated in the Florida Straits, Gulf of Mexico, western and southwestern Caribbean, Bahamas, and the Lesser Antilles. The US Caribbean EEZ received a relatively minor attention with respect to the sampling of deep sea habitats. After the 1970’s, most of the research attention on deep sea communities of Puerto Rico and the USVI was focused toward fishery resources. Assessment surveys of the deep sea snapper

and grouper fisheries potential were performed during the late 70's and throughout the 1980's by the National Marine Fishery Service in collaboration with the local governments of Puerto Rico, USVI, and the Caribbean Fishery Management Council. These surveys consisted of at least 11 cruises of the R/V Oregon II, R/V Delaware II and the Seward Johnson-Sea Link II submersible survey of the insular slope of PR and the USVI in 1985. The submersible survey provided an unprecedented and exceptional insight of our deep sea reef communities at depths between 100 – 1250 meters. Despite the generalized conclusion from these surveys that deep sea fish stocks were depauperate, deep sea snapper and grouper fisheries still represent the main fisheries resource in terms of catch and value in the U. S. Caribbean EEZ.

The first quantitative assessment of reef substrate cover by benthic communities from deep hermatypic reefs of the upper insular slope of PR was produced by Singh et al. (2004) using the SeaBED Autonomous Underwater Vehicle (AUV) off the La Parguera shelf-edge. The SeaBED AUV is an imaging platform designed for high resolution optical and acoustic sensing. Scleractinian corals were the dominant sessile-benthic invertebrate at depths down to 30 m, with maximum reef substrate cover (25 %) at the 24 – 30 m depth interval. Below 30 m, sponges were the dominant sessile-benthic invertebrate with a mean substrate cover of less than 10%. Benthic algae, sand and other abiotic substrates prevailed down the insular slope of La Parguera to a maximum depth of 125 m. Black corals (*Antipathes sp.* and *Cirrhipathes sp*.) were reported from the deepest section of the transect (90-100 m).

The SeaBED AUV imaging platform was used in June 2003 to survey the Hind Bank (MCD) benthic habitats south of St. Thomas, USVI, at depths between 32 to 54 m. Within the western side of the MCD, a well-developed deep hermatypic coral reef with 43 % mean living coral was found. The flattened growth form of boulder star coral, *Montastrea annularis-franksi* was the dominant taxonomic component of the sessile-benthos at all four sites surveyed in the MCD. Maximum coral cover found was 70 % at depths of 38 - 40 m. A similar deep hermatypic reef system, known as Black Jack Reef was studied off the south coast of Vieques, PR. The seamount rises from a depth of 51 m to a reef top at 30 m. A total of 25 species of scleractinian corals, two antipatharians and one hydrocoral were identified. Live coral cover averaged 28.8 % (range 25.0 – 40.4 %) within video-transect areas. Boulder star coral (*Montastrea annularis - franski*) was the dominant coral species in terms of substrate cover (mean: 21.9 %), representing 76 % of the total live coral cover at depths between 36 – 40 meters. Boulder star coral exhibited laminar, or flattened growth with closely spaced colonies of moderate size and low relief. Corals grow from a pedestal of unknown origin, creating a large protective habitat underneath the coral.

Deep hermatypic reefs have also been discovered at the southwest coast of Isla Desecheo. These include the SW Wall Reef, at depths between 30-40 m, and Agelas Reef, at depths between 45 – 70 m. Substrate cover at the SW Wall Reef was dominated by benthic macroalgae (mostly *Lobophora variegata*), sand, sponges, and massive corals. Sponges were highly prominent (mean surface cover: 17.3 %), growing mostly as large erect and branching forms that produced substantial topographic relief and protective habitat for fishes and invertebrates. In many instances, sponges were observed growing attached to stony corals, forming sponge-coral bioherms of considerable size. One of the most common associations involved the brown tube (*Agelas conifera, A. sceptrum*) and row pore sponges (*Aplysina spp*.) with star corals (*Montastrea cavernosa, M. annularis*). A total of 25 scleractinian corals, three hydrocorals and two antipatharian (black coral) species were present along the SW Wall Reef. Great star corals (*Montastrea cavernosa, M. annularis* complex) were the dominant species of scleractinian corals at the SW Wall Reef.

Agelas Reef (45 – 70 m) appears to be a crustose algal formation colonized by encrusting brown algae (*Lobophora variegata*), large erect and branching sponges (*Agelas conifera, Agelas spp., Aplysina spp*.) and lettuce corals (*Agaricia spp*). Sessile-benthic biota grows over a vast deposit of rhodolite nodules loosely anchored to the bottom. The reef has very low topographic relief as it lies over an essentially flat platform and massive corals do not contribute significantly to its rugosity. A total of 18 species of scleractinian corals, two hydrozoans (*Millepora alcicornis* and *Stylaster roseus*) and the antipatharian black wire coral (*Stichopathes lutkeni*) were identified from Agelas Reef. The combined mean substrate cover by the nine species of scleractinian corals within video-transects was 13.1 % (range: 7.4 – 36.4). Irregular sheets or laminar growth by lettuce corals (*Agaricia spp*.) prevailed at depths between 45 and 53 meters (148 – 175'), with a combined substrate cover of 8.9 %, representing 70 % of the total cover by scleractinian corals. Lamark's sheet coral (*Agaricia lamarki*) appeared to be the main species present.

A total of 70 fish species were identified from depths below 30 m at Isla Desecheo. The numerically dominant ichthyofauna within belt-transects surveyed was dominated by zooplanktivorous taxa, suggesting that planktonic food webs are most relevant on deep reefs Deep reefs studied at Isla Desecheo are the natural habitats of many exploited commercially important food fishes, such as large groupers (Nassau, Yellowfin, Red Hind) and snappers (Cubera) and target species of the aquarium trade (Blue Chromis, Royal Gramma, Pigmy Angelfishes, Butterflyfishes, Jawfishes). Densities of adult red hind (*Epinephelus guttatus*) from 40 m at the SW Wall are the highest recorded for Puerto Rico.

II. Introduction

This work is an effort towards characterization of deep reefs and associated marine communities from Puerto Rico (PR) and the U. S. Virgin Islands (USVI). It includes an assessment of their geographic distribution, bathymetric features, benthic habitat types, and a taxonomic inventory of species previously reported from deep reefs in this region, with particular emphasis on corals. Available geo-physical, hydrographic and biological information has been geo-referenced and included on a GIS map atlas of the U. S. Caribbean EEZ. A pilot field survey of marine communities associated with a deep hermatypic reef system in Isla Desecheo (west coast of PR) forms part of this investigation, and expands upon an ongoing program of coral reef community characterizations and monitoring sponsored by NOAA through the Department of Natural and Environmental Resources of Puerto Rico (DNER) (García-Sais et al., 2001 a, b, c, d) and the Division of Coastal Zone Management of the USVI (Nemeth et al., 2002, Jeffrey et al, 2005).

Deep reefs are hard ground structures that provide underwater topographic relief and serve as important habitats for marine communities, influencing ecosystem biodiversity and productivity beyond the shelf edge. The reef habitat at depths between 60 – 150 meters has been defined as the "twilight zone", the upper limit being the approximate maximum depths to which hermatypic corals dominate reef structure, and the lower limit the maximum depth to which the coral reef extends (Pyle, 2000). In Jamaica, and perhaps other islands of the northern Caribbean, hermatypic (reef building) corals occur down the insular slope to maximum depths of about 100 meters (Goreau and Wells, 1967), but are mostly present as isolated colonies without contributing significantly to the formation of reefs. Still, the deep hermatypic coral fauna represents an important genetic reservoir that may serve for replenishment of the declining shallow water scleractinian coral assemblage.

At depths below the range of hermatypic coral and algal growth, available hard primary substrate is the basis for attachment and growth of sponges, ahermatypic (azooxanthellate) corals, echinoderms, and other encrusting (sessile-benthic) biota. Ahermatypic corals are known to create true "coral reefs" in deep cool waters of the oceans in regions of strong currents and/or zones of upwelling. Reefs formed by ahermatypic corals are also called lithoherms, bioherms, or coral banks. The ivory tree coral, *Oculina varicosa* Leseur forms massive coral banks along the upper edge of the Florida-Hatteras slope at depths between 70 – 100 m, and water temperatures ranging between 7.5 – 26.5 °C (Reed, 1980). The geographic distribution of the *Oculina* banks appears to be confined to the Florida shelf.

Reyes et al. (2005) reported the occurrence of deep water azooxanthellate coral banks at three sites along the outer continental shelf and upper slope off Colombia, southern Caribbean. The most abundant coral at La Guajira (depth of 70 m) was *Cladocora debilis, whereas Madracis myriaster* was the dominat species off Santa Marta (depth of 200 m) and San Bernardo (depth of 150 m). In total, 290 invertebrates and 48 fish species were reported from these coral banks (Reyes et al., 2005).

At depths between 60 to 2,170 m, the deep sea coral, *Lophelia pertusa* forms massive reefs throughout the western Atlantic, from Nova Scotia to Brazil and the Gulf of Mexico, and also in the eastern Atlantic, Mediterranean, Indian, and eastern Pacific Oceans (Reed, 2002). The diversity of species associated with ahermatypic coral banks is much higher than that of the surrounding environment, suggesting that these reefs create biodiversity hot spots in deep water (Rogers, 1999; Reed et al.,1982; Reed and Mikkelsen, 1987; Reyes et al. 2005).

Since the edge of the insular shelf of PR and the USVI is typically found at depths between 20 to 30 meters, reef systems deeper than 30 meters are considered deep reefs for the purpose of this zonal review. Thus, coral reefs in deep terraces of the outer shelf, rocky outcrops and vertical wall features of the insular slope, submerged volcanic ridges, and oceanic seamounts comprise the deep reef systems of the US Caribbean EEZ.

A series of exploratory cruises have sampled the submerged ridges, seamounts and insular slope habitats of PR and the USVI producing highly valuable collections from which the taxonomic record of our deep reef communities has been constructed. This includes the pioneer expedition of the H. M. S. Challenger, which sampled the north coast of St. Thomas (USVI) at 390 fathoms (709 m) in 1873. Other major expeditions include the U. S. Coast Survey Steamer “Blake”, which sampled insular slope stations of the Lesser Antilles during 1878-79; the expedition by the U. S. Fish Commission “Fish Hawk”, which sampled 17 stations below 20 fathoms (36 m) off San Juan, Mayaguez, Aguadilla, Vieques and St. Thomas in 1899; and the Johnson-Smithsonian expedition to the Puertorrican Deep, which sampled 109 stations in Mona Passage, the north coast of Puerto Rico (including the Puertorrican Trench), and the USVI during 1933.

Extensive deep sea samplings of the southwestern Atlantic were performed during the 1956 – 60 by the exploratory fishing vessels R/V Oregon, R/V Silver Bay, R/V Combat, and R/V Pelican (Bullis and Thompson, 1965; Manning, 1969). Likewise, the Florida Straits, Gulf of Mexico, West Central and Southern Caribbean, Bahamas, and the Lesser Antilles were intensively sampled during the 1960’s - 1970’s by the R/V Gerda, R/V Pillsbury, Columbus-

Iselin, and R/V Oregon (Gore, 1974; Cairns, 1976; Cooper, 1977; Meyer et al. 1978). Interestingly, only very few stations in waters of the Hispaniola, Puerto Rico and the U S Virgin Islands were occupied by these sampling expeditions (R/V Oregon stations 644, 646, 6715; R/V Pillsbury stations P1386, P1397, P1401, P1402) (see Cooper, 1977). During the 1970's through the 1980's, the Caribbean Fisheries Management Council, with funding from the U. S. National Marine Fishery Service (NMFS) explored the deep sea fisheries potential of the insular slope of PR and the USVI. The fisheries effort included a series of at least 12 cruises of the R/V Oregon and R/V Delaware, with particular attention to the north coast of PR and the USVI (Nelson et al., 1984).

The taxonomic inference from all of these exploratory samplings is that the Caribbean Sea is a species rich region of deep reef biota that functions as a source of fish and invertebrate larvae to the Western North Atlantic (including the Gulf of Mexico) through an effective connectivity via inter-island passages (Rass, 1971; Cairns, 1979; Dawson, 2002). Aside from the relevance of deep reef systems for the general biodiversity of the region, commercial and recreational fisheries that include demersal (snapper/grouper) and pelagic species (billfish, tunas, mackerels) are associated with deep reef habitats of the insular slope and submerged seamounts of PR and the USVI (Nelson et al., 1984). The upper insular slope may also represent the last refuge habitat for highly valuable and overexploited coral reef fish populations, such as the Red Hind (*Epinephelus guttatus*), Nassau, Yellowfin and Tiger groupers (*Epinephelus guttatus, Mycteroperca venenosa, M. tigris*).

This study was sponsored by the Caribbean Fisheries Management Council (CFMC) and the National Oceanographic and Atmospheric Administration (NOAA). Mrs. Gabriela García-Moliner acted as the monitor of the study.

III. Study Objectives

I. Search, review and catalog the available historical (archival) information on deep reefs and associated communities around Puerto Rico and the U. S. Virgin Islands.

II. Construct a digitized and geo-referenced map of the deep benthic habitats of Puerto Rico and the U. S. Virgin Islands, incorporating geo-physical (bathymetric), hydrographic (CTD profiles) and biological (taxonomic, habitat type, photographic) information as gathered throughout the literature review process into a Geographical Information System (GIS) database available on a compact disk.

III. Provide a biological characterization of the sessile-benthic, motile-megabenthic and fish communities associated with the deep hermatypic reef system at Isla Desecheo using advanced (re-breather) diving technology. Specific objectives of the field program at Isla Desecheo included:

a. Taxonomic identifications, density of coral colonies, diversity indices, and quantitative determinations of percent reef substrate cover by sessile-benthic biota (corals, sponges, algae, etc.) and abiotic categories (sand, mud, holes, etc.) along transects encompassing a depth gradient between 30 – 50 meters
b. Taxonomic identifications and quantitative determinations (density, relative abundance and species richness) of fishes and motile megabenthic invertebrates across a depth gradient between 30 – 50 meters
c. Population assessments of commercially important fish species, including species for consumption, and target species for the aquarium trade
d. Characterization of benthic habitats and preparation of bathymetric map of the deep hermatypic reef system at Isla Desecheo
e. Digital still photographic album and DVD video of the deep reef system and associated reef community at Isla Desecheo.

IV. Methods

A. Recuperation of Historical Data

Most of the information regarding deep water habitats and associated communities in Puerto Rico and the U. S. Virgin Islands was produced more than 100 years ago, during the early ocean exploration surveys that included the Voyage of H. M. S. Challenger during the years 1872-76", dredging surveys in deep waters of the Caribbean Sea by the U. S. Coast Survey Steamer "Blake" during 1878-79, and the U. S. Fish Commission "Fish Hawk" Expedition of 1999. The Johnson-Smithsonian Expedition of 1933 sampled the marine communities associated with the insular slope of the west, north and east coasts of Puerto Rico, including the initial sounding and dredging surveys of the Puertorrican Trench. In order to recuperate the information on the taxonomy of species collected, as well as the geophysical and hydrographic information of deep benthic habitats from Puerto Rico and the USVI contained in these reports a detailed revision of the original 19th century and early 20th century publications was performed. The following libraries were visited in order to gather the historical information on deep sea communities of Puerto Rico and the U. S. Virgin Islands:

1. Smithsonian Museum of Natural History Library
2. Library of Congress, Washington, D. C.
3. Library of the Department of the Interior, Washington, D. C.
4. Rosenthiel School of Ocean and Atmospheric Sciences Library, U. Miami
5. Department of Marine Sciences Library, U. Puerto Rico, Mayaguez
6. General Library of the U. Puerto Rico, Mayaguez, Puertorrican Collection
7. Caribbean Fisheries Management Council Publications and Reports Collection

Table 1 presents an author's directory of taxonomic reports from species collected in deep sea habitats (> 30 m) during sampling expeditions within the U. S. Caribbean EEZ (Puerto Rico and the U. S. Virgin Islands).

Additional taxonomic records of sessile and motile megabenthic invertebrates and fishes reported for deep sea habitats from Puerto Rico and the U. S. Virgin Islands have been recuperated from a general search of scientific journals and other publications. Taxonomic megadata of echinoderms reported from Puerto Rico at depths below 30 m was obtained from the Smithsonian Museum of Natural History Library.

Table 1. Contributor authors of taxonomic reports on sessile and motile megabenthic invertebrates and fishes collected during sampling expeditions of deep sea habitats from Puerto Rico and the U. S. Virgin Islands

HMS Challenger Expedition (1873)

Sponges Monaxonida (Ridley and Dendy, 1887); Tetractinellida (Sollas, 1888), Hexactinellida (Schultze, 1887); Keratosa (Poléjaeff, 1884; Haeckel, 1889); Corals (Moseley, 1881); Crinoidea (Carpenter, 1884); Asteroidea (Sladen, 1889), Ophiuroidea (Clark, 1882); Echinoidea (Agassiz, 1881); Macrura (Spence Bate, 1888); Anomura (Henderson, 1888); Scaphopoda and Gasteropoda (Watson, 1886)

Blake Expedition (1878-79)

Crinoidea (Carpenter, 1882); Ophiuroidea (Lyman, 1882)

Fish Hawk Expedition (1899)

Sponges (Wilson, 1900); Corals (Vaughan, 1900); Echinoiderms (Clark, 1900); Anomurans (Benedict, 1900); Brachyura and Macrura (Rathbun, 1900), Mollusks (Dall and Simpson, 1900); Fishes (Evermann and Marsh, 1900)

Johnson-Smithsonian Expedition (1933)

Sponges (de Laubenfels, 1934); Echinoderms (Clark, 1934 a, b, c, d); Mollusks (Bartsch, 1934; Cooper, 1934; Corea, 1934); Crustaceans (Rathburn, 1934; Shoemaker, 1934; Wilson, 1935; Tattersall, 1937); Fishes (Myers, 1935; Schultz, 1937; Reid, 1934, 1940)

R/V Atlantis West Indies Expedition (1954)

Cephalopoda (Voss, 1958)

R/V Oregon and R/V Delaware Exploratory Fishery Cruises (1975-85)

Fishes (Nelson et al. 1984)

Mollusks (Cooper, 1977)

Seward Johnson Sea Link II Submersible Survey (1985)

Fishes (Nelson and Appeldoorn (1985)

Entire journal publications that were examined include:

1. Studies of the Fauna of Curacao and Other Caribbean Islands
2. Studies in Tropical Oceanography
3. Caribbean Journal of Science
4. Bulletin of Marine Science
5. Proceedings of the Gulf and Caribbean Fisheries Institute
6. Revista de Biología Tropical

A comprehensive taxonomic (historical) update of fishes and decapod crustacea reported from Puerto Rico and the U. S. Virgin Islands was recently prepared by Grana (2005 a, 2005 b) for the Caribbean Fisheries Management Council. The fish species update by Grana 2005) was analyzed and included with modifications to report fish species collected at/or below 30 m. Reference sources utilized by Grana (2005 a) to update the fish species record included Aguilar-Perera (2003, 2004), Anderson and Springer (2005a), Bacheler et al (2004), Bunkley-Williams and Williams (2004), Dennis et al (2004), Kenaley and Hartel (2005), Kiraly et al (2003), Mateo and Tobias (2004), Neal and Noble (2000), Nichols (1929), Siddiqi and Cable (1960) and Stella Mejía et al. (2001).

Electronic megadata sources examined in preparation of the fish list update by Grana (2005) included:

American Museum of Natural History. 2005. Department of Ichthyology. Ichthyology Specimens Database. http://research.amnh.org/ichthyology/specimens.html version (05/2004).

California Academy of Science. 2005. Ichthyology Collection Database. http://www.calacademy.org/research/ichthyology/collection/ version (08/2005).

Field Museum Collection Database Directory. 2005. http://www.fieldmuseum.org version (04/2004).

Florida Museum of Natural History. 2005. Ichthyology Collection Database. http://www.flmnh.ufl.edu/fish/collection/collectdata.htm version (08/2004).

Froese, R., & D. Pauly (Eds.). 2005. FishBase. World Wide Web electronic publication. www.fishbase.org. version (06/2005).

Global Biodiversity Information Facility (GBIF) Data Portal. 2005. http://www.gbif.org version (04/2005).

Harvard University Museum of Comparative Zoology (MCZ). 2005. MCZ Fish Collection Database. http://www.mcz.harvard.edu/Departments/Fish/ version (08/2005).

Integrated Taxonomic Information System (ITIS). 2005. http://www.itis.usda.gov version (11/2004).

ISSG Global Invasive Species Database. 2005. IUCN Invasive Species Specialist Group. http://www.issg.org/database .

Ocean Biogeographic Information System (OBIS), Census of Marine Life, State University of New Jersey, Rutgers. 2005. http://www.iobis.org/Welcome.htm version (05/2005).

Philadelphia Academy of Natural Sciences. 2005. Ichthyology Collection. http://data.acnatsci.org/biodiversity_databases/fish.php version (01/2004).

Reef Environmental Education Foundation (REEF). 2005. REEF Database. http://www.reef.org/data/database.htm versión (04/2004).

Smithsonian National Museum of Natural History (NMNH). 2005. NMNH Fish Collection, Division of Fishes, Department of Vertebrate Zoology. http://www.nmnh.si.edu/vert/fishes/fishcat/ version (11/2004)

Yale University Peabody Museum of Natural History. 2005. Fish Collection. http://george.peabody.yale.edu/ich/ version (05/2005).

Information on the taxonomic composition and fishing depths of species collected by the deep water snapper/grouper exploratory fishing program in PR and the USVI, sponsored by the National Marine Fishery Service (NMFS-NOAA) and the Caribbean Fishery Management Council (CFMC) were recuperated from cruise reports of the R/V Delaware and R/V Oregon (NOAA, 1979, 81, 82, 83, 84, 85, 87). Also, data on fish species composition, depths and habitat types at which species were observed during tthe Johnson Sea Link II submersible survey of the PR and USVI in 1985 was transcribed and re-organized from the cruise report prepared originaly by Nelson and Appeldoorn (1985). An updated list of echinoderms and decapod crustaceans reported for PR was obtained from a data base available at the Smithsonian Museum of Natural History, Invertebrate Collection, Division of Invertebrate Zoology.

B. Atlas of Deep Reefs around Puerto Rico and the U. S. Virgin Islands

A digital map with geo-referenced bathymetric, hydrographic and biological information on deep reefs around Puerto Rico and the U. S. Virgin Islands was developed in GIS format. Bathymetry data, prepared by Aurelio Mercado from the Puerto Rico Tsunami Warning and Mitigation Program was downloaded from the Poseidon server at (http://poseidon.uprm.edu). The data in x,y,z format was then used to create depth contours of the Puerto Rico and U. S. Virgin Islands insular shelf and slope. GIS shape files of the benthic habitat maps that include deep reef habitats of the Marine Conservation District

(MCD) in St. Thomas, USVI, the Mutton Snapper and Lang Banks, in St. Croix, USVI (Geophysics GPR International, 2003) were included as GIS layers on the deep reef atlas. A georeferenced TIFF file of side-scan sonar images of Bajo de Sico in Mona Passage, PR, available from DNER (2003), was incorporated into the map atlas. Georeferenced bathymetry data for Bajo de Sico and Isla Desecheo (García et al., this volume) were converted to Geo - TIF files and included in the general map. Hydrographic (CTD) data from profiles produced by the Johnson Sea Link submersible survey of the insular slope of PR and the USVI (Nelson and Appeldoorn, 1985) were graphed and included as GIF files into the map. Information from the deep water snapper/grouper exploratory fishing program in PR and the USVI (NMFS-NOAA) was also incorporated into the atlas. All stations were the catch of either ssnapper or grouper exceeded 20 pounds were plotted on the map. Results of the biological survey at Isla Desecheo (García et al., this volume) were also included in the map.

C. Field Survey at Isla Desecheo

1. Sessile-benthic communities

A quantitative and qualitative characterization of the upper slope reef communities at Isla Desecheo was performed. The survey area is located off the Puerto Canoas coast, southwest Isla Desecheo. Sets of six (6) permanent 10 m long transects were established at depths of 30 and 40 meters along the SE Wall Reef and a total of eight (8) non-permanent transects were surveyed at Agelas Reef, at a depth of 50 m. Transects were marked using steel rods drilled to the ocean floor and identified with (plastic) cable ties secured to the steel rods. Quantitative determinations of surface cover by sessile-benthic biota were obtained from video transects using a Sony VX 2100 video camera with a Gates underwater housing. A stainless steel rod with an extension of 76 cm (30 inches) beyond the camera housing lens plate was assembled to the housing to maintain a constant camera-subject distance during filming.

Continuous profiles of benthic communities along video transects were analyzed. Videos from each transect were saved as frozen frames (jpg files) in a computer. A random point template of 25 (x, y) points was superimposed on each frame, and substrate categories under the points were identified and recorded. For each transect, a total of 625 identifications of substrate categories were included.

Quantitative video data collected from each permanent transect was analyzed to determine percent coverage of the following substrate types and epibiota:

- **Live corals** – reported by species and total live coral cover. Includes scleractinian corals, hydrocorals and black (Antipatharian) corals (e.g. *Montastrea cavernosa*, *Stylaster roseus*, *Stichopathes sp.)*
- **Octocorals** – reported by species and total live coral cover (soft corals, includes sea fans, such as *Gorgonia ventalina*, sea whips, and encrusting forms, such as *Erythropodium* sp.)
- **Sponges** – reported as total sponges, or lowest possible taxon
- **Benthic Algae**
    - **Turf Algae** - reported as total turf algae (consisting of a mixed assemblage of short articulate coralline algae, intermixed with red, brown macroalgae and other small epibenthic biota forming a mat or carpet over hard substrate)
    - **Fleshy Algae** – vertically projected, mostly brown, red and green macroalgae. Identified to species in most cases (e.g. *Lobophora variegata*)
    - **Coralline Algae** – (red encrusting, crustose algae) reported as total coralline algae, or lowest possible taxon
    - **Abiotic Substrate** – includes unconsolidated sediment, bare rock, deep holes and gaps.

2. Fishes and Motile Megabenthic Invertebrates

Diurnal, non-criptic, predominantely demersal reef fish populations and motile megabenthic (> 10 cm) invertebrates were surveyed by belt-transects (10-meter long by 3m wide = 30m^2) centered along the reference line of transects used for sessile-benthic reef characterizations. Six (6) belt-transects were surveyed at the 30 and 40 m depths from the SW Wall Reef, and eight (8) transects were surveyed at 50 m in Agelas Reef. Transect width was marked with flagging tape stretched and tied to small weights on both ends. Each transect was surveyed during 15 minutes. The survey protocol for identification and enumeration of fishes and invertebrates within belt-trasects was the following: First minute- the diver remained still at one end of the transect in order to record any elusive, or transitory species within the transect that may not return (e.g. snappers, doctorfishes-acanthurids,

jacks, mackerels, large parrotfishes, etc.). Minutes 2-5 - the diver swam over the center of the transect to identify and enumerate opportunistic fishes that tend to be attracted to transect areas, presumably to feed upon mechanical disturbances created by the diver (e.g. wrasses, groupers, hamlets, caribbean puffer). Minutes 6-10 - the diver swam over each side of the transect to identify and count fishes that are either territorial (e.g. damselfishes) or that remain very close to their benthic microhabitat, without any evident concern of diver presence (gobies, grammas, squirelfishes, small parrotfishes, etc.). Minutes 10-12 – the diver swam over each side of the transect to search for fish species present in relatively low abundance (rare) and/or that may be either entering or exiting small reef microhabitats (e.g. cherubfish, basses). Minutes 13-15 the diver swam over each side of the transect to identify and enumerate non-criptic motile, megabenthic invertebrates present within belt-transect areas (e.g. cephalopods, gastropods, ophiuroids, urchins, holothurians, crabs, lobsters, shrimps, etc.). Fish surveys were performed during the summer of 2004 (June-August) at the 30 and 40 m depths in the SW Wall Reef, and during the summer of 2005 (June-August) at 50 m depth in Agelas Reef. A winter (January-March) survey was performed at the 30 and 40 m depths in the SW Wall Reef.

Large, elusive fish populations, which includes most of the commercially important and many recreationally valuable populations were evaluated using an Active Search Census (ASEC). This is a non-random, fixed-time method designed to optimize information of the numbers of fish individuals present at the main reef habitats, providing simultaneous information on size frequencies. At each depth (30, 40, 50 meters) the total number of individuals for each species observed within a fixed time frame of 30 min. was registered. Individuals were actively searched for within crevices, ledges and potentially important hiding places. For each individual sighted, a length estimate was recorded. Length (in cms) was visually estimated and aided by a measuring rod with adjustable width. Precision of length estimates allowed discrimination between small juveniles, juveniles, adult and large adult size classes. Two ASEC surveys were performed at 30 and 40 m depths, and one ASEC survey was performed at 50 m. All data was recorded in plastic paper.

Closed circuit Inspiration Rebreather units were used to conduct underwater survey operations at Isla Desecheo. We used mostly oxygen partial pressures of 1.3 ATA to survey depths between 30 – 50 m, with maximum decompression times of 30 minutes.

3. Statistical Analyses

Taxonomic structure similarity of sessile-benthic and fish communities between depths was analyzed from standardized data on relative abundances by each species at transects (6) surveyed from each depth. Dendrograms were constructed using the single linkage method (nearest neighbor), with distances calculated from the 1-Pearson correlation coefficient (Systat, 2000). Differences of fish abundance between winter and summer surveys were tested using a one-way analysis of variance (ANOVA).

V. Results and Discussion

A. Literature Review

1. Historical Overview

Investigations of marine communities associated with deep reefs in Puerto Rico and the U. S. Virgin Islands started with the dredge samplings of the H.M.S Challenger off the north (Atlantic) coast of St. Thomas, USVI during its pioneering oceanographic expedition in 1873 (Thompson and Murray, 1895). The H. M. S. Challenger sampled station 24, north of St. Thomas (USVI) at a depth of 390 fathoms (709 m). Over 350 specimens of invertebrates were obtained at this station (excluding protozoans), belonging to 245 species, of which 129 were new to science. One of the seven coral species collected included *Lophohelia prolifera*, which is a synonym of *Lophelia pertusa*, the main reef-building, deep-water coral. The first collections from the Caribbean Sea were produced by the United States Coast Survey Steamer “Blake” during its second dredging season in 1878-79 (Agassiz, 1888). A total of 30 stations were occupied by the “Blake” around Puerto Rico and the USVI, but due to the prevailing rough sea conditions of that winter season deep sea dredging operations were only possible at a few stations near St. Thomas and St. Croix, USVI (Agassiz, 1888). Nevertheless, rich collections of deep benthic habitats of the Lesser Antilles, including St. Kitts, Virgin Gorda, St. Vincent, St. Lucia, Guadalupe and Dominique were obtained by dredge samplings of the “Blake”. Given the close proximity of these sites to the USVI, taxonomic records of these samplings have been included in this report as species most likely to be distributed within the U. S. Caribbean EEZ.

During 1899, immediately after the United States gained political possession of Puerto Rico, the Commissioner of Fish and Fisheries launched an exploratory expedition of the island’s marine and terrestrial resources, with particular interest on its fisheries potential. The “Fish Hawk” expedition produced the first samplings of benthic habitats in the Puertorrican insular

slope down to depths of 230 fathoms (Bowers, 1900). Dredge samples were obtained from at a total of 50 stations, including 17 from depths below 20 fathoms (36 meters). Samplings of slope habitats below 20 fathoms were performed off San Juan and Mayaguez Bays, off Punta Borinquen in Aguadilla, off the north coast of St. Thomas, and between the islands of Vieques and Culebra. Species descriptions, bottom types and depths are available for each dredging station. Unfortunately, geographic coordinates of stations sampled by the Fish Hawk were not included in the report by the Commissioner (Bowers, 1900).

The Johnson–Smithsonian Expedition to the Puertorrican Deep in 1933 was a sampling cruise sponsored by Mr. Eldridge R. Johnson, who placed his motor yacht "Caroline" to the disposal of the Smithsonian Institution, and equipped her with instrumentation to sample the Puertorrican Trench, off the north coast of Puerto Rico. Most of the dredging effort however was performed in the Mona Passage, off the north coast of Rincon, Aguadilla, and throughout the north coast of PR and the USVI. The south coast of PR and the USVI were not sampled during this exploratory cruise. Bartsch (1933) published a general taxonomic record of organisms collected with trawling gear at the 109 stations occupied by the "Caroline" during this expedition (Table 2). The general information on the assemblages of organisms collected from each station provides inferences of the benthic habitat types that were sampled. Sampling stations where corals were dredged by the "Caroline" have been included in the map atlas of deep reefs (this volume).

Specific taxonomic reports from different authors on the collections from the Johnson-Smithsonian Expedition were published by the Smithsonian Institution between 1934 and 1940 (Smithsonian Miscellaneous Collections, Vol. 91) in a series of 31 articles describing new species and geographic records for Puerto Rico and the USVI. New species of sponges were reported by de Laubenfels (1934); hydroids were described by Fraser (1937); echinoderms were studied by Clark (1934 a, b, c, d); foraminiferans were examined by Cushman (1935) and Lalicker (1935); new mollusk records were reported by Bartsch (1934), Cooper (1934) and Corea (1934); crustaceans were described by Rathburn (1934), Shoemaker (1934), Wilson (1935) and Tattersall (1937); new fish species were reported and described by Myers (1935), Schultz (1937) and Reid (1934, 1940).

The R/V Atlantis from the Woods Hole Oceanographic Institution, based in Cuba sampled a total of three stations in waters of Puerto Rico and the USVI during its "West Indian Cruise" in 1954. The expedition appears to have been mostly directed to sample pelagic organisms, as the only reference that was found in our literature search is a paper by Voss (1958) that identifies species of cephalopods collected during the cruise. The sampling gear used for

collection of cephalopods was an Isaak-Kidd mid-water trawl. It is unlikely that benthic habitats were sampled with this type of gear.

Extensive deep sea samplings of the southwestern Atlantic were performed during the period between 1955 and 1965 by the exploratory fishing vessels R/V Oregon, R/V Silver Bay, R/V Combat, and R/V Pelican (Bullis and Thompson, 1965; Manning, 1969). From this period, taxonomic records of deep sea fauna were reported from at least 10 sampling stations occupied by the R/V Oregon and the R/V Silver Bay in the west coast of Puerto Rico. Also, during the 1960-70's the University of Miami launched its Deep Sea Expeditions Program, occupying more than one thousand sampling stations from the R/V Gerda, Columbus-Iselin, R/V Oregon, and R/V John Elliot Pillsbury in the Florida Straits, Gulf of Mexico, western and southwestern Caribbean, Bahamas, and the West Indies (Gore, 1974; Cairns, 1976; Cooper, 1977; Meyer et al. 1978). It seems that the US Caribbean EEZ was mostly excluded from the deep sea sampling expeditions of the U. Miami. Taxonomic records of deep sea fauna are reported from at least three stations occupied by the R/V John Elliot Pillsbury in waters off Vieques, and from the Puerto Rican Trench during sampling cruises of 1969 and 1971 (Cooper, 1977).

After the 1970's, most of the research attention on deep reef communities of Puerto Rico and the USVI was focused toward fishery resources. Assessment surveys of the deep sea snapper and grouper fisheries potential were performed during the late 70's and throughout the 1980's by the National Marine Fishery Service in collaboration with the local governments of Puerto Rico, USVI and the Caribbean Fishery Management Council (Juhl, 1972; Silvester and Dammann, 1974; Collazo, 1980; NOAA, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1987; Appledoorn, 1985; Nelson and Appledoorn, 1985; Rosario, 1986). These surveys consisted of at least 11 cruises of the R/V Oregon II, R/V Delaware II and the Seward Johnson-Sea Link II submersible survey of the insular slope of PR and the USVI in 1985. The submersible survey provided an unprecedented and exceptional insight of our deep sea reef communities at depths between 100 – 1250 meters. Whereas observations about a rich and highly complex reef community near the top of the insular shelf appear in the Seward Johnson-Sea Link II report (Nelson and Appledoorn, 1985), the upper slope reef communities were left mostly undescribed. Despite the generalized conclusion from these surveys that deep sea fish stocks were depauperate, deep sea snapper and grouper fisheries still represent the main fisheries resource in terms of catch and value in the U. S. Caribbean.

Table 2. General taxonomic record of organisms collected during the Johnson–Smithsonian Expedition to the Puertorrican Deep, 1933.

Station	Depth (fathoms)	Latitude (° North)	Longitude (° West)	General Locality	Biota
1	400-600	18° 33' 45"	66° 15' 00"	Off San Juan	small fishes, mollusks, brittle stars, 2 solitary corals
2	200-240	18° 31' 20"	66° 16' 20"	Off San Juan	glass sponges, 1 pennarian, brittlestars
3	260	18° 31' 20"	60° 21' 30"	Cerro Gordo	Water haul
4	140-260	18° 31' 45"	66° 31' 45"	Punta Pto. Nuevo	1 scallop
5	600	18° 37' 00"	66° 04' 30"		deep sea fishes, pteropods, small crustaceans, sagitta, medusae, fish eggs
6	100	18° 30' 45"	66° 04' 30"	Cabras Island	fish, pelagic mollusks, octopus, heteropods, pteropods, crustaceans and salpae
7	160-340	18° 30' 45"	66° 00' 50"	Pta Vacia Talega	1 umbellula
8	300	18° 31' 30"	66° 55' 30"	Pta Vacia Talega	Lost gear
9	240-280	18° 31' 30"	65° 55' 30"	Pta. Maldonado	brittlestars, worm tubes,1 hydroid, mollusks
10	120-160	18° 29' 20"	66° 05' 30"	Cabras Island	mollusks, brittlestars, crustaceans, crinoids, crallines, sponges, and algae
11	200	18° 32' 15"	66° 04' 10"	Pta Cangrejos	small fish, cephalopods, pelagic mollusks, crustaceans
12	200-300	18° 31' 00"	66° 00' 15"	Salinas island	mollusks, crustaceans, holothurians, brittlestars, small corals
13	200-300	18° 31' 05"	66° 02' 15"	Salinas island	fish, mollusks, echinoderms, hydroids, coral
14	240-340	18° 31' 00"	66° 04' 10"	N/D	fish, mollusks, echinoderms, rose-red holothurian, worms, crustacean
15	300	18° 31' 45"	66° 03' 00"	Salinas Island	deep-sea fish, crustaceans
16	38-95	18° 29' 40"	66° 08' 30"	Cabras Island	sponges, hydroids, corals, echinoderms, comatulid crinoids, mollusks
17	46-90	18° 31' 00"	66° 10' 30"	Pta. Salinas	hydroids, brittlestars, crinoids, worms
18	39-80	18° 30' 15"	66° 12' 45"	Pta Cerro Gordo	water haul
19	200-420	18° 31' 10"	66° 15' 45"	Pta. Cerro Gordo	deep-sea fish, young mackerel, small puffers, salpae, larval crustaceans
20	960-1000	18° 40' 30"	66° 19' 00"	Pta. Cerro Gordo	Carcharodon sharks
21	140-200	18° 30' 20"	66° 10' 30"	Salinas *I*sland	mollusks, brittlestars, worms, worm tubes, 1 hydroid
22	200-260	18° 30' 30"	66° 12' 45"	Pta. Cerro Gordo	ascidians, salpae, mollusks, crustaceans, brittlestars, worm tubes
23	260-360	18° 32' 15"	66° 17' 45"	Salinas island	deep-sea fish, coral, mollusks, crustaceans, shrimp
24	260-350	18° 32' 30"	66° 21' 15"	Pta. Cerro Gordo	pennarian, crustaceans, mollusks
25	240-300	18° 32' 15"	66° 22' 10"	Pta. Cerro Gordo	ascidians, mollusks, crustaceans, corals, foraminifera
26	33-40	18° 30' 20"	66° 22' 05"	Pta. Cerro Gordo	Corals, sponges, hydrozoa.
27	1100	18° 39' 50"	66° 21' 30"	Pta. Cerro Gordo	

Table 2. (Continued)

28	240-300	18° 31' 31"	66°12' 00"	Salinas island	octopus
29	1100	18° 40' 40"	66°20' 00"		Small fish, crustaceans
30	1200	18° 40' 30"	66°30' 00"		Small fish, mollusks, small crustaceans
31	280-300	18° 27' 20"	67°12' 50"	Borinquen Light	Water haul
32	200-280	18° 25' 50"	67°14' 55"	Borinquen Light	Small sponges, worm tubes, deep-sea fish, mollusks
33	180-360	18° 24' 15"	67°17' 50"	Borinquen Light	Pteropods, deep-sea fish
34	180	18° 26' 15"	67°12' 50"	Borinquen Light	eel, shrimp
35	80-180	18° 23' 40"	67°16' 45"	Borinquen Light	Deep-sea fish, mollusks, crustaceans, echinoderms, echinoids, brittlestars, crinoids, annelids, hydroids, glass sponges
36	220-440	18° 21' 50"	67°30' 15"	Desecheo Island	Ascidians, hydroids and corallines, crinoid arm, worm
37	160-200	18° 13' 50"	67°39' 20"	Desecheo Island	Sponges, corallines, corals, crinoid, gastropod, shipworm
38	240-260	18° 11' 55"	67°42' 50"	Mona Island	Brachiopods, brittlestars, crinoid, comatulid crinoids, hydroids, crustaceans, sponges, mollusks
39	220-240	18° 10' 00"	67°46' 00"	Mona Island	Deep-sea fish, shrimp, ascidian
40	50-120	18° 09' 30"	67°51' 30"	Monito Island	Water
41			7	Mona Island	Cerions, annularids, urocoptids, helicinas, subulimas
42	240-360	18° 01' 55"	76°55' 05"	Mona Island	
43	240-300	18° 02' 00"	76°51' 15"	Pta. Caigo no Caigo	Crinoids, comatulid crinoids, echinoids, brittlestars, astrophyton, corallines, hydroids, sponges, mollusks
44	120	18° 11' 00"	76°32' 45"	Desecheo Island	
45	20-40	18° 13' 10"	76°25' 30"	Desecheo Island	Shallow-water forms
46	30-289	18° 14' 40"	76°25' 20"	Desecheo Island	
47	280-340	18° 17' 20"	76°25' 00"	Desecheo Isalnd	Annelid worms, brittlestars, echinoids, corals, hydroids, sponges
48	400	18° 19' 40"	67°20' 30"	Desecheo Island	Water
49	180	18° 16' 12"	67°31' 20"	Desecheo Island	Glass sponges, hydrozoa, brittlestars, crinoids
50	300-320	18° 15' 35"	67°31' 35"	Samana Bay	Land shells, mollusks, crustaceans, small fish, Beroe, ctenophores
51	6-14	19° 10' 50"	69°20' 15"	Pta. Cerro Gordo	Hydroids, gorgonians, mollusks
52	14-22	19° 10' 25"	69°20' 55"	Cape Corozos z	Hydrozoan, gorgonians, sponges, bryozoa, foraminifera, crinoids, Brachiopods, crustaceans, mollusks
53	20	19° 10' 05"	69°21' 25"	Cape Corozos	Mollusks, coral
54	17	19° 10' 05"	69°26' 10"	Cape Corozos	Crustacean, mollusks
55	17	19° 10' 12"	69°27' 03"	Cape Corozos	Fish, mollusks, shipworms
56	17	19° 10' 15"	69°27' 20"	Cape Corozos	Mollusks
57	18	19° 10' 20"	69°28' 35"	Cape Corozos	Fish, crustaceans, mollusks

Table 2. (Continued)

58	18	19° 10' 20"	69°29' 15"	Cape Corozos	Fish, *Beroe*
59	18-19	19° 10' 25"	69°30' 05"	Cape Lorenzo	Fish, squids
60	500	19° 12' 55"	69°08' 35"	Cape Cabron	Deep-sea fish, crustaceans, pelagic mollusks
61	800	19° 24' 45"	69°09' 00"	Cape Cabron	
62	350	19° 25' 45"	69°09' 00"	Cape Cabron	Crustaceans, worms, salpae, heteropods, pteropods
63	80	19° 54' 00"	65°27' 00"	San Juan Bay	Sargassum, deep-sea fish, crustaceans
64	160-360	18° 28' 55"	65°45' 00"	Cape San Juan	
65	180-300	18° 28' 48"	65°45' 55"	Cape San Juan	Sponges hydroids, brittlestars, sea urchins, crustaceans, mollusks
66	180-280	18° 28' 48"	65°45' 54"	Cape San Juan	
67	180-280	18° 30' 12"	65°45' 54"	Cape San Juan	Mollusks, worms, crustaceans
68	10	18° 23' 00"	65°36' 48"	Cape San Juan	Sponges, hydroids, corals, bryozoans, mollusks
69	9	18° 23' 55"	65°37' 25"	Cape San Juan	Sponges, hydroids, corals, bryozoans, annulid worms, mollusks
70	350	18° 29' 25"	65°27' 00"	Cape San Juan	Deep-sea fish, shrimps
71	600	18° 38' 08"	65°47' 55"	Cape San Juan	
72		18° 38' 08"	65°50' 30''		
73		18°16' 50''	65°51' 00''	Cape San Juan	
74	360	18°36' 55''	65°51' 40''	Cape San Juan	Fish,crustaceans, worms, shark, mollusks
75	26	18°24' 40''	65°33' 40''	Cape San Juan	Sponges hydroids, corallines, bryozoans, echinoderms, mollusks
76	30-200	18°27' 35''	65°33' 35	Cape San Juan	Water haul
77	45	18°25' 30''	65°33' 36''	Cape San Juan	Batfish
78	100-300	18°27' 30''	65°32' 36	Cape San Juan	Gorgonian, crinoids, spider crab, mollusks
79	300	18°30' 30''	65°31' 00''	Cape San Juan	Pectin, isopod
80	9-10	18°19' 05''	65°19' 20''	Culebra Island	Corallines, bryozoans
81	200-400	18°29' 45''	65°25' 50''	Cape San Juan	Deep-sea, brittlestars, holothurians, crustaceans, mollusks
82	200-400	18°31' 15''	65°28' 10''	Cape San Juan	File fish
83	250-320	18°32' 54''	65°23'42''	Cape San Juan	Deep-sea fish
84	300-350	18°32' 30''	65°18' 30''		Deep-sea fish, mollusks, crinoids
85	400	18°39' 30''	65°16' 65''		Cephalopods, pteropods, heteropods, crustaceans
86	500	19°30' 30''	65°14' 00''		Sharks, pilotfish, deep-sea fish, crustaceans, mollusks
87		19°18' 30''	65°16' 00''		Fish, shrimp, squid
88	2,500	19°13' 00''	65°16' 00''		
89		19°13' 00''	65°16' 00''		Fish, crustaceans, mollusks
90	3,000	19°13' 00''	65°16' 00''		Sharks

Table 2. (Continued)

91	320-400	18°37’ 30’’	65°05’ 00’’	St. Thomas	fish, squid, crustaceans
92	310-350	18°39’ 00’’	65°05’ 30’’	St. Thomas	
93	350-400	18°38’ 00’’	65°09’ 30’’	St. Thomas	Mollusks, worms, foraminifera, echinoderms
94	300-470	18°37’ 45’’	65°05’ 00’’	St. Thomas	Pteropods, brittlestars
95	300-350	18°39’ 00’’	65°03’ 30’’	St. Thomas	
96	270-330	18°36’ 00’’	65°05’ 30’’	St. Thomas	Deep-sea fish, mollusks, worms, sea urchins, brittlestars, holothurians
97	310-400	18°37’ 30’’	65°02’ 15’’	St. Thomas	Deep-sea fish, heteropods, shrimp
98	290-340	18°33’ 30’’	65°00’ 00’’	St. Thomas	Deep-sea fish, pteropods, heteropods, shrimp
99	180-200	18°39’ 30’’	64°65’ 00’’	St. Thomas	Sea urchins, brittlestars, crinoids, crustaceans, deep-sea fish, mollusks
100	100-300	18°38’ 45’’	64°52’ 45’’	Tobago Island	Deep-sea fish, hydroids, echinoderms, sponges, crustaceans, mollusks
101	190-300	18°40’ 30’’	64°50’ 00’’	Tobago Island	Crinoids, comatulids, hydroids, deep-sea fish, mollusks, brachiopods, sponges, Crustaceans, anemones, worm tubes, parasites
102	90-500	18°50’ 30’’	64°43’ 00’’	Tobago Island	Hydroid
103	150-400	18°51’ 00’’	64°33’ 00’’	Tobago Island	Mollusks, crinoids, sponges
104	80-120	18°30’ 40’’	66°13’ 20’’	Chesapeak Bay	Fish, mollusks, crustaceans, echinoderms, worms, hydroids
105	150	18°30’ 50’’	66°13’ 20’’	Chesapeak Bay	Mollusks, brittlestars, anemones
106	150-195	18°31’ 20’’	66°16’ 30’’	Salinas Island	
107	250-260	18°32’ 15’’	66°17’ 45’’	Salinas Island	
108	2940	19°32’ 00’’	67°53’ 00’’		Pelagic organisms
109	3000	20°05’ 00’’	68°10’ 00’’		

2. Recent Investigations

2.1. La Parguera, southwest Puerto Rico

The first quantitative assessment of reef substrate cover by benthic communities from deep hermatypic reefs of the upper insular slope of PR was produced by Singh et al. (2004) using the SeaBED Autonomous Underwater Vehicle (AUV) off the La Parguera shelf-edge. The SeaBED AUV is a modern imaging platform designed for high resolution optical and acoustic sensing (Singh et al., 2004). The main purpose of the deployment was to perform engineering tests of the vehicle and to build initial photomosaics of shallow-water reef sites. However, one deep transect along the insular slope south of La Parguera starting at 20 m over the shelf-edge to 125 m depth was included in the scope of work. The UPRM Department of Marine Sciences 42' R/V Sultana was used as the support vessel.

Scleractinian corals were the dominant sessile-benthic invertebrate at depths down to 30 m, with maximum reef substrate cover (25 %) at the 24 – 30 m depth interval. Below 30 m sponges were the dominant sessile-benthic invertebrate with a substrate cover of less than 10% (Plates 1-2). Benthic algae, sand and other abiotic substrates prevailed down the insular slope of La Parguera to a maximum depth of 125 m. Black corals (*Antipathes sp.* and *Cirrhipathes sp*.) were reported from the deepest section of the transect (90-100 m).

This was a preliminary study designed primarily as an equipment test and not to provide a comprehensive biological characterization of the benthic communities. The single transect obtained constrains the analysis of variability associated with the vertical distribution of substrate categories. Identification of benthic organisms from the photography was impaired by the large, up to 4 m distance between the camera lens and the substrate, due in part to the high angle of the insular slope. Still, this work provided an unprecedented quantitative assessment of the benthic communities off southwestern Puerto Rico.

2.2. Hind Bank Marine Conservation District (USVI)

The Hind Bank Marine Conservation District (MCD) is located at the shelf-edge, 12 km south of St. Thomas, USVI (Figure 1). It is a known spawning aggregation site for the Red Hind (*Epinephelus guttatus*), and a closed fishing area since 1999 (Nemeth (2005). Beets and Friedlander (1997) described the spawning site and provided an assessment of the Red Hind population at the MCD. An evaluation of the effectiveness of the fishing closure as a

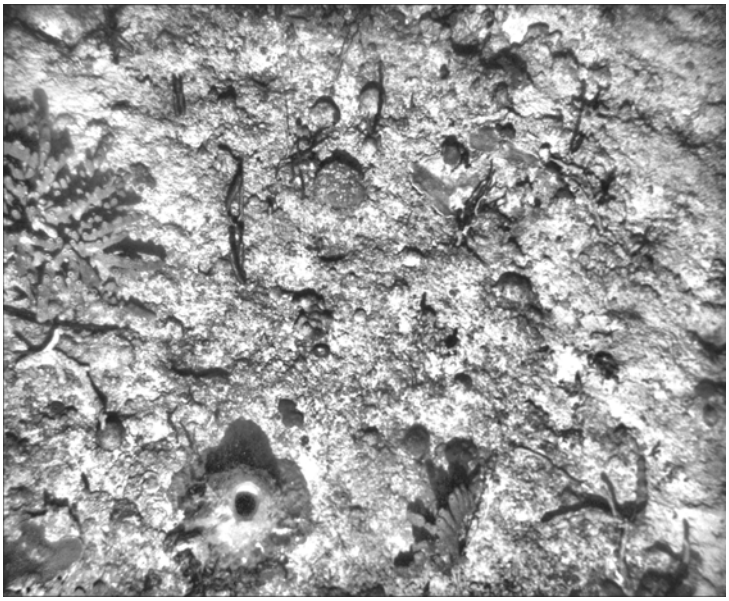


Plate 1. Image of the substrate at 40 m, La Parguera. Photo: courtesy of Roy Armstrong

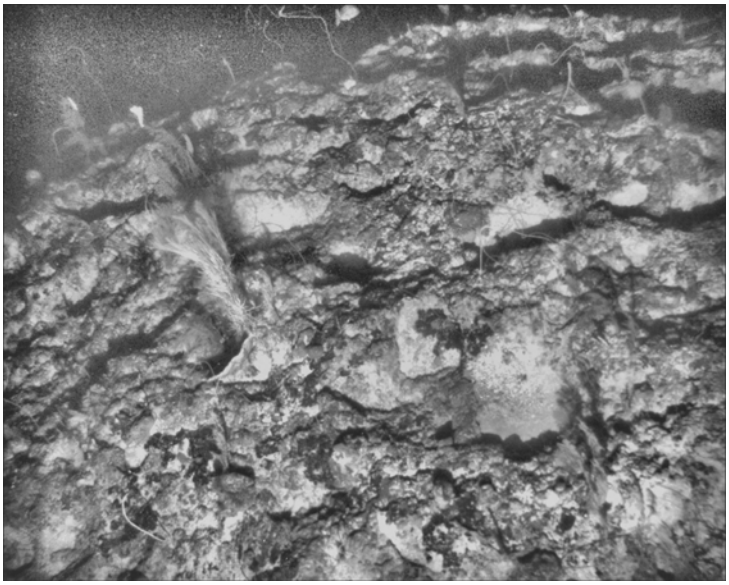


Plate 2. Image of the substrate at 100 m, La Parguera. Photo: courtesy of Roy Armstrong

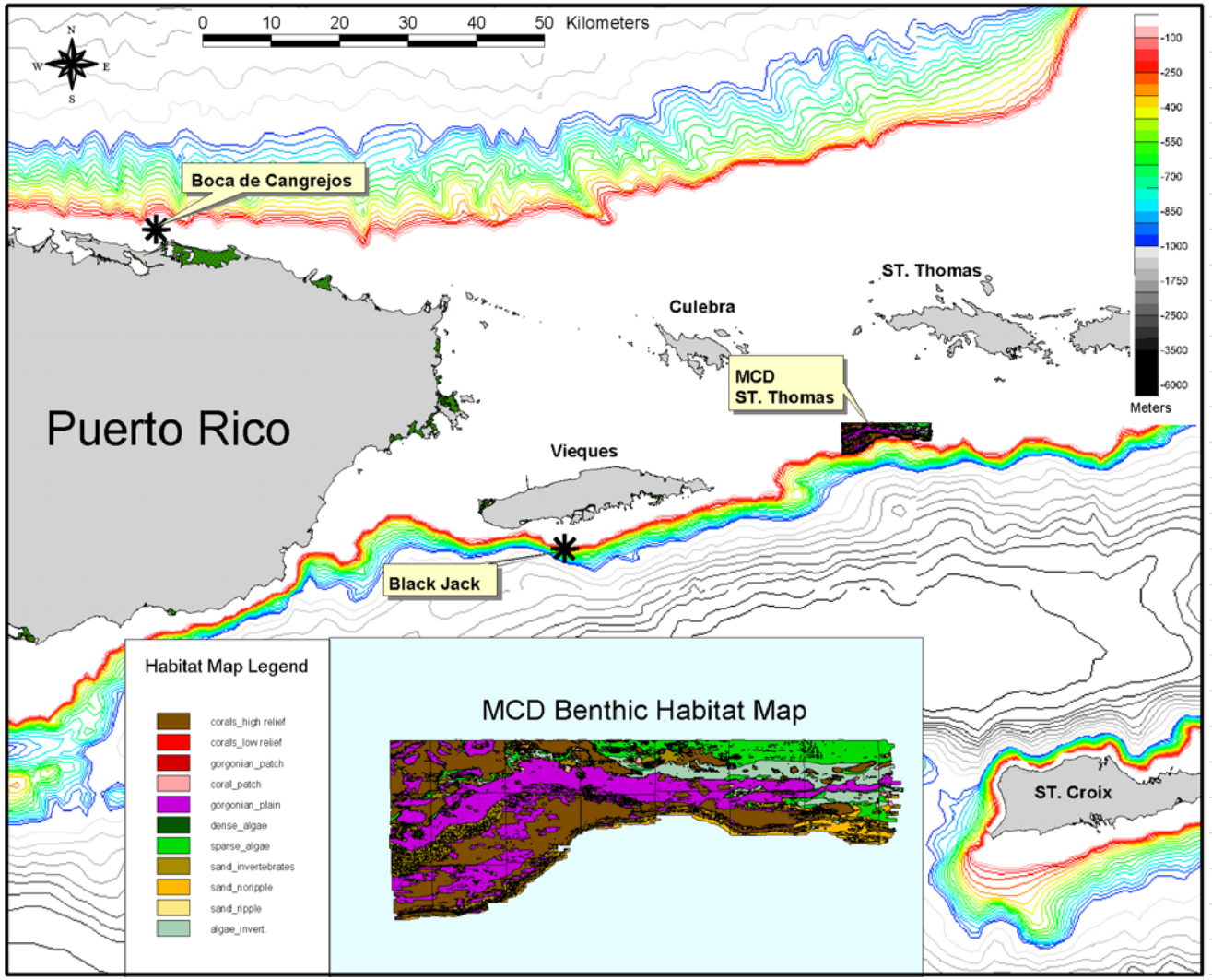


Figure 1. Location map of deep hermatypic reefs recently reported in P.R. and the USVI.

management strategy for protection of the Red Hind population was recently published by Nemeth (2005).

The SeaBED AUV imaging platform was used in June 2003 to survey the Hind Bank (MCD) benthic habitats at depths between 32 to 54 m. Four digital phototransects provided data on benthic species composition and percent cover of reef substrate. Within the western side of the MCD, a well-developed hermatypic coral reef with 43 % mean living coral was found (Armstrong et al., in press). The flattened growth form of boulder star coral, *Montastrea franksi* was the dominant taxonomic component of the sessile-benthos at all four sites surveyed in the MCD. Maximum coral cover found was 70 % at depths of 38 - 40 m (Plate 3). An additional 10 species of scleractinian corals, 10 gorgonians, one antipatharian, two hydrozoans, 17 sponges and several motile-megabenthic invertebrates and benthic algae within phototransects were identified (Armstrong et al., in press). Partial field validation of the SeaBED AUV results in characterization of benthic communities at the MCD were produced by Nemeth et al. (2004) and Herzlieb et al. (in press).

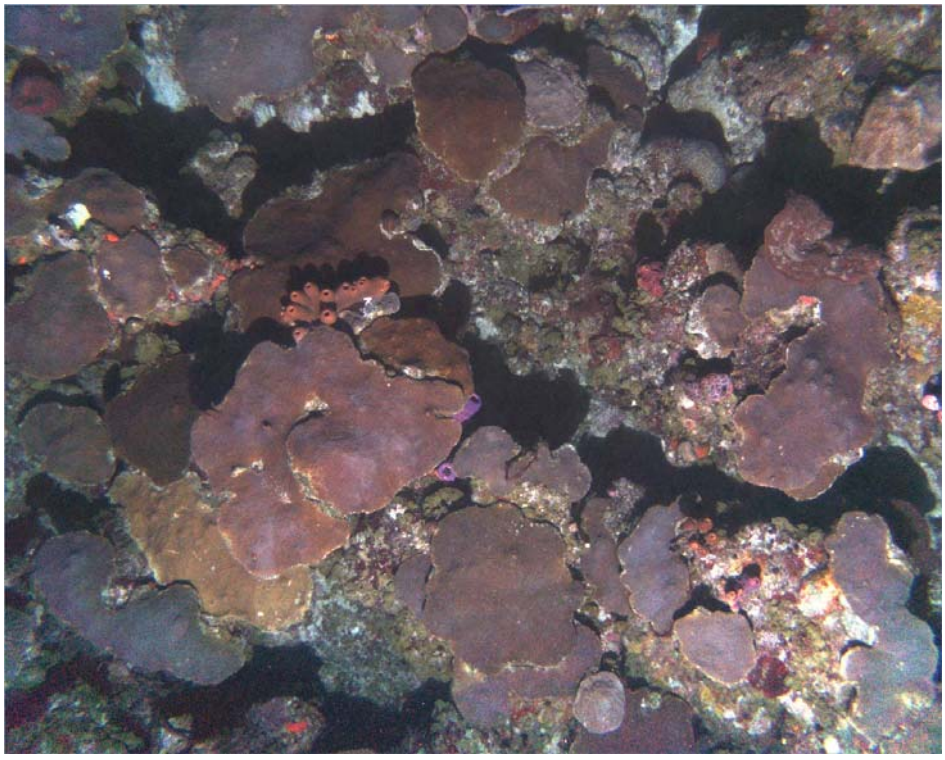


Plate 3. Image of the Hind Bank MCD Reef at a depth of 40 m, south of St. Thomas, USVI. Photo: courtesy of Roy Armstrong.

2.3 Black Jack Reef, south Vieques Island, PR

García et al. (2004) reported on the existence of a deep hermatypic reef, locally known as Black Jack, located south of Vieques Island, PR. Black Jack is an outer shelf promontory, or seamount that lies close to the shelf-edge, at about two nautical miles off from Ensenada Bay (Figure 2). The seamount rises from a depth of 51 m to a reef top at 30 m. At the seamount pinnacle, the reef exhibited moderate abundance of soft corals, including many large colonies. Stony corals were found mostly as encrusting and mound-shaped colonies interspersed among the reef top without providing much topographic relief. Great Star Coral (*Montastrea cavernosa*) was visibly the most abundant coral. Boulder Star Coral *M. annularis*) and Lettuce Coral (*Agaricia sp*.) were also part of the main stony coral assemblage at the reef top. The reef slopes down to a deeper terrace at depths of 36 - 40 meters where soft corals decline sharply in abundance and stony coral cover increases substantially. A digital photo album of Black Jack Reef is presented as Plates 4-9.

García et al. (2004) provided a quantitative assessment of the benthic community at Black Jack Reef based on five, 10 m long video-transects within a depth range of 36 – 40 meters (120 – 132 feet) on the deeper terrace. A total of 25 species of scleractinian corals, two antipatharians and one hydrocoral were identified, including 12 within video-transects. Live coral cover averaged 28.8 % (range 25.0 – 40.4 %) within video-transect areas. Boulder Star Coral (*Montastrea annularis- franksi*) was the dominant coral species in terms of substrate cover (mean: 21.9 %), representing 76 % of the total live coral cover at depths between 36 – 40 meters (Table 3). Boulder Star Coral exhibited laminar, or flattened growth with closely spaced colonies of moderate size and low relief. Corals grow from a pedestal of unknown origin, creating a large protective habitat underneath the coral. The laminar growth pattern appears to be an adaptation for optimum light utilization. Other coral species that presented substrate cover above 1% and that were present in at least four out of five transects surveyed include the Mustard Hill Coral (*Porites astreoides*), Graham's Sheet Coral (*Agaricia grahamae*) and Great Star Coral (*Montastrea cavernosa*). One large colony of the bushy black coral (*Antipathes caribbeana*) was present in the deep terrace of Black Jack Reef.

Turf algae was the dominant biological assemblage in terms of substrate cover with 57.4 %. Fleshy (*Lobophora variegata*) and calcareous algae (*Halimeda copiosa*) were also present within transect areas. The combined cover by benthic algae was 64.2 %. Encrusting sponges were present in all transect surveyed with a mean cover of 5.8 %. Erect gorgonians presented a mean abundance of 2 colonies per transect in the deep terrace and

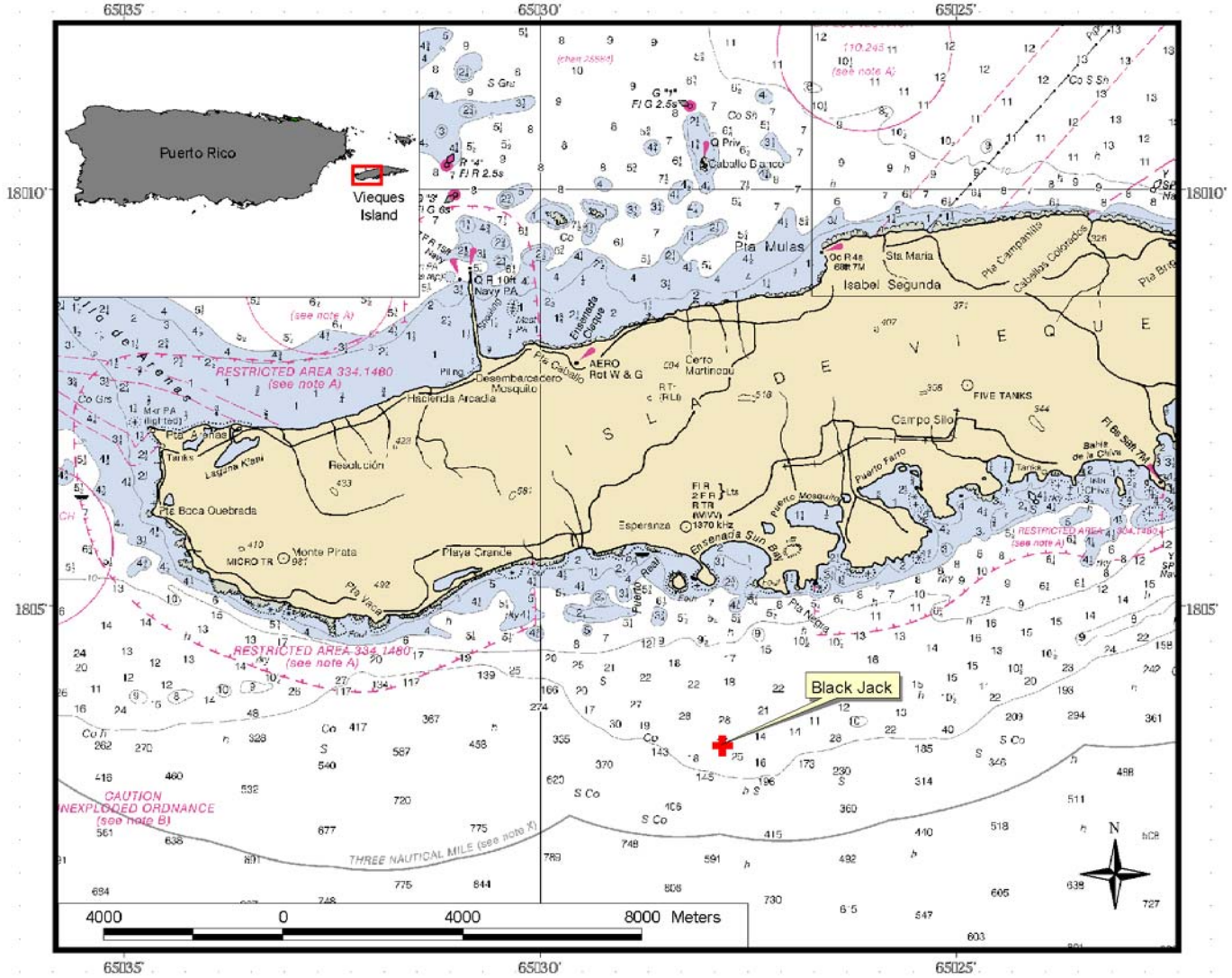


Figure 2. Location map of Black Jack Reef, Isla de Vieques P.R.

Table 3. Black Jack Reef. Percent substrate cover by sessile-benthic categories from video-transects at 35 -40 m depth. Modified from García-Sais et al. (2004)

SUBSTRATE CATEGORIES	TRANSECTS					
	1	2	3	4	5	MEAN
TURF ALGAE	58.00	56.40	60.60	61.00	51.20	**57.44**
LIVE CORAL	25.00	25.00	27.00	26.40	40.40	**28.76**
FLESHY ALGAE	7.40	10.20	7.00	5.20	2.80	**6.52**
SPONGES	7.40	6.40	4.80	5.40	4.80	**5.76**
ABIOTIC	1.20	1.80	0.60	2.00	0.60	**1.24**
CALCAREOUS ALGAE	1.00	0.20	0.00	0.00	0.20	**0.28**
GORGONIANS (# colonies)	1	2	1	2	2	**2**
CORAL SPECIES	1	2	3	4	5	MEAN
Montastrea annularis	18.20	19.20	21.00	17.00	34.00	**21.88**
Porites astreoides	1.40	1.60	1.20	0.60	4.20	**1.80**
Agaricia grahamae	2.00	1.00	1.20	4.60	0.00	**1.76**
Montastrea cavernosa	2.40	0.00	2.00	2.80	0.80	**1.60**
Agaricia sp.	0.20	0	0.60	0.80	1.20	**0.56**
Diploria strigosa	0.00	1.40	0.40	0.00	0.00	**0.36**
Mycetophyllia ferox	0.00	1.20	0.00	0.00	0.00	**0.24**
Siderastrea radians	0.00	0.40	0.40	0.00	0.20	**0.20**
Agaricia agaricites	0.60	0.00	0.00	0.20	0.00	**0.16**
Madracis decactis	0.20	0.20	0.00	0.00	0.00	**0.08**
Isophyllia sinuosa	0.00	0.00	0.20	0.20	0.00	**0.08**
Scolymia cubensis	0.00	0.00	0.00	0.20	0.00	**0.04**

Coral Species Outside Transects**:** *Agaricia grahame, Diploria strigosa, D. labyrinthyformis, Dichocoenia stockesii, Leptoseris cucullata, Meandrina meandrites, Mycetophyllia lamarkiana, M. aliciae, Eusmilia fastigiata, Siderastrea siderea, Colpophyllia natans, Stephanocoenia michilini, Millepora squamosa, M. alcicornis, Antipathes caribbeana, Stichopathes lutkeni*

were mostly represented by colonies of small size.

A total of 54 reef fishes were identified from Black Jack Reef, 33 of which were observed within belt-transect areas (Table 4). The mean abundance of fishes was 549.3 Ind/30 m^2 and the mean number of species per transect was 16. An assemblage of three species represented 95 % of the total fish abundance within belt-transects. The numerically dominant species was the Masked Goby (*Coryphopterus personatus*) with a mean abundance of 390 Ind/30 m^2. This is the highest density ever reported for a demersal fish within a belt-transect from a reef surveyed in Puerto Rico. Following in abundance were the Creole Wrasse (*Clepticus parrae*) with 93.0 Ind/30 m^2 and the Blue Chromis (*Chromis cyanea*) with 36.7 Ind/30 m^2. The fish trophic structure at Black Jack Reef appears to be strongly influenced by the plankton food web. The three most abundant fish species within belt-transects are zooplankton feeders. This assemblage plays a key ecological function as forage for an abundant and diverse pelagic reef fish community, including top predators,

Table 4. Taxonomic composition and abundance (Individuals/30 m^2) of fishes surveyed within belt-transects at Black Jack Reef, south Vieques 2004. Modified from García-Sais et al. (2004)

		TRANSECTS			
		1	2	3	MEAN
SPECIES	COMMON NAME				
Coryphopterus personatus	Masked Goby	420	450	300	**390.0**
Clepticus parrae	Creole Wrasse	29	250		**93.0**
Chromis cyanea	Blue Chromis	80	30		**36.7**
Coryphopterus lipernes	Peppermint Goby	9	11	9	**9.7**
Stegastes partitus	Bicolor Damselfish	1	7		**2.7**
Gobiosoma evelynae	Sharknose Goby	2	2	2	**2.0**
Haemulon flavolineatum	French Grunt			5	**1.7**
Halichoeres garnoti	Yellow-head Wrasse	1	4		**1.7**
Chaetodon capistratus	Foureye Butterflyfish	1	2	1	**1.3**
Sparisoma aurofrenatum	Redband Parrotifish	1	1	2	**1.3**
Thalassoma bifasciatum	Bluehead Wrasse	3			**1.0**
Canthigaster rostrata	Caribbean Puffer	1		1	**0.7**
Flammeo marianus	Longspine Squirrelfish		2		**0.7**
Stegastes leucostictus	Beaugregory	1	1		**0.7**
Acanthurus chirurgus	Doctorfish			1	**0.3**
Acanthurus coeruleus	BlueTang		1		**0.3**
Balistes vetula	Queen Triggerfish		1		**0.3**
Cephalopholis cruentatus	Graysby	1			**0.3**
Chaetodon ocellatus	Spotfin Butterflyfish	1			**0.3**
Chaetodon striatus	Banded Buttrflyfish			1	**0.3**
Coryphopterus glaucofreanum	Bridled Goby		1		**0.3**
Haemulon carbonarium	Caesar Grunt			1	**0.3**
Holacanthus tricolor	Rock Beauty		1		**0.3**
Holocanthus ciliaris	Queen Angelfish	1			**0.3**
Holocentrus rufus	Squirrelfish	1			**0.3**
Hypoplectrus nigricans	Black Hamlet		1		**0.3**
Hypoplectrus puella	Barred Hamlet			1	**0.3**
Hypoplectrus unicolor	Butter Hamlet		1		**0.3**
Lactophrys triqueter	Smooth Trunkfish	1			**0.3**
Melichthys niger	Black Durgon	1			**0.3**
Pomacanthus arcuatus	Gray Angelfish	1			**0.3**
Pseudupeneus maculatus	Spotted Goatfish	1			**0.3**
Serranus tigrinus	Harlequin Bass		1		**0.3**
	TOTAL INDIVIDUALS	557	767	324	549.3
	TOTAL SPECIES	20	18	11	16

such as the great barracuda (*Sphyraena barracu*da), rainbow runner (*Elagatis bipinnulatus*) and the king and cero mackerels (*Scomberomorus cavalla, S. regalis*).

The herbivorous fish assemblage was represented by several species of parrotfishes (*Scarus sp., Sparisoma spp*.), doctorfishes (*Acanthurus spp*.), damselfishes (*Stegastes spp.*) and some triggerfishes (e.g. *Melichthys niger*). Small epibenthic invertebrate feeders were represented by the yellowhead wrasse, squirrelfish, caribbean puffer, juvenile grunts, hamlets and gobies. Large benthic invertebrate feeders, such as hogfishes, red hind, coneys, and schoolmaster snappers were common. Top benthic predators included the mutton snapper and the tiger grouper. Table 5 presents a list of large pelagic and benthic fishes observed at Black Jack Reef.

Table 5. Size-frequency distribution of large and/or commercially important reef fishes identified during an ASEC survey at Black Jack Reef, south Vieques 2004. Modified from García-Sais et al. (2004).

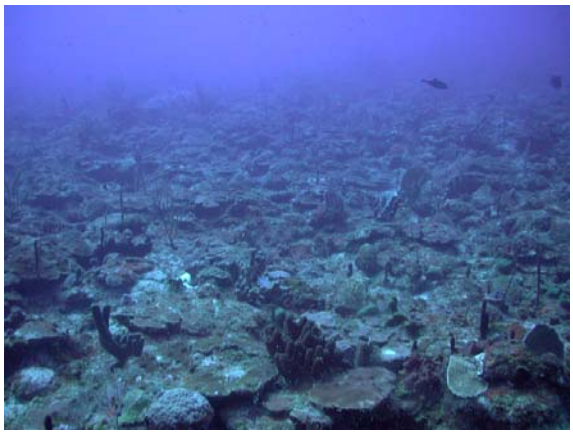
Depth range : 30 - 40 m Duration - 30 min.

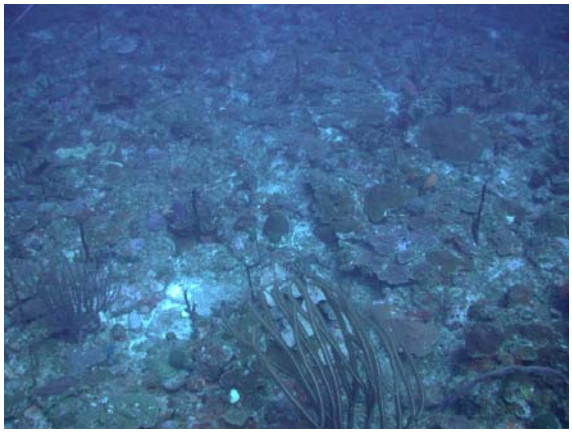
		SIZE – FREQUENCY (# - cm)		
SPECIES	**COMMON NAME**			
Epinephelus guttatus	Red Hind	1 - (30)		
Elagatis bipinnulatus	Rainbow Runner	5 – (50)	1 - (60)	1 - (70)
Lachnolaimus maximus	Hogfish	2 - (30)	1 - (60)	
Lutjanus analis	Mutton Snapper	1 - (40)	1 - (60)	2 - (75)
Lutjanus apodus	Schoolmaster	2 - (25)	1 - (30)	
Myctroperca tigris	Tiger Grouper	1 - (50)		
Ocyurus chrysurus	Yellowtail Snapper	3 - (20)	2 - (30)	1 - (35)
Scomberomorus regalis	Cero Mackerel	1 - (50)	1 - (60)	
Sphyraena barracuda	Great Barracuda	1 - (60)	1 - (80)	
Invertebrates				
Panulirus argus	Spiny Lobster	1 – (25)		

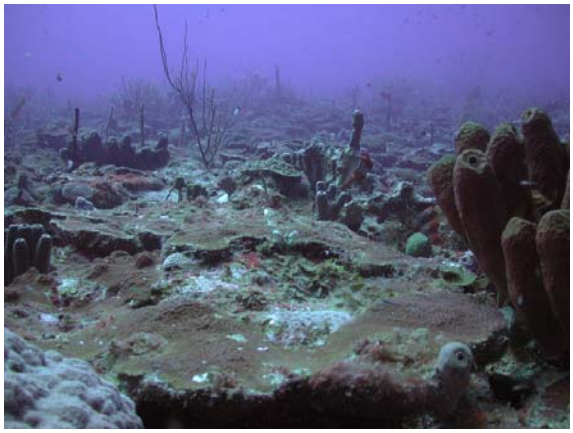
Other Fishes Present :
Gramma loreto, Haemulon macrostomum, Haemulon plumieri, Lactophrys quadricornis, Pomacanthus paru, Scaus chrysopterum, Serranus tabacarius, Synodus intermedius, Sparisoma viride, Scarus coeruleus, Xanthychihys ringens

Plates 4-9

Photo Album- Black Jack Reef







2.4. Boca de Cangrejos Reefs, Carolina, P. R.

During 2001, a biological survey of marine communities associated with benthic habitats along a proposed fiber optics cable route crossing the Carolina shelf, off from Boca de Cangrejos was prepared by García-Sais (2001). The work was part of the environmental research supporting permit applications for the cable crossing and landing. The outer shelf off from Boca de Cangrejos is defined by a steep slope that begins to break from a hard ground reef formation at a depth of 11 m, reaching a depth of 30 m at a distance of approximately 2.6 km from the coastline. The slope has an irregular substrate presenting mixed sandy bottom and low relief hard ground reef patches. At depths between 30 - 40 meters, the slope exhibits a more gentle drop, forming a deep terrace of sand with interspersed patch reefs of variable dimensions (Plates 10-11). The location of these deep patch reefs is shown in Figure 1.

The sandy substrate at the outer shelf was mostly colonized by cyanobacterial films, particularly at depths between 18 – 41 m. Also, dense patches of Paddle Grass, *Halophila decipiens* were growing over sandy substrate at a depth of 30.3 m. The Sea Feather, *Stylatula* sp. was observed on sand bottom at the deepest station surveyed (41.8 m).

Marine communities of the outer shelf were mostly concentrated on the submerged patch reefs interspersed among an otherwise unconsolidated sandy bottom. Reefs are submerged eolianite rocks almost completely colonized (> 90%) by a dense algal turf. Large erect sponges, such as the basket (*Xestospongia muta*), black-ball (*Ircinia strobilina*), brown tube (*Agelas spp*.) and pore sponges (*Aplysina* spp.) were common at outer shelf reefs.

Coral cover was less than 1 % in outer shelf reefs surveyed. The main stony coral assemblage at outer shelf stations was composed the great star coral (*Montastrea cavernosa*), symmetrical brain coral (*Diploria strigosa*), the mustard hill coral (*Porites astreoides*) and lettuce coral (*Agaricia spp*) (Table 6). Stony corals were mostly found as isolated encrusting colonies not contributing significantly to the reef topographic relief. Live scleractinian corals (*Agaricia spp., Scolymia lacera*) were observed at a maximum depth of 41.8 m.

Outer shelf reefs presented a diverse fish community that included 45 species (Table 7). The fish community corresponds to the typical Caribbean reef fish assemblage, including some species of commercial value, such as the mutton and yellowtail snappers (*Lutjanus analis, Ocyurus chrysurus*). Some of the most abundant taxa included the bicolor damselfish (*Stegastes partitus*), blue chromis (*Chromis cyanea*), bluehead wrasse (*Thalassoma bifasciatum*), coney (*Cephalopholis fulva*) and doctorfishes (*Acanthurus* spp.). The sand tilefish (*Malacanthus plumieri*) was common at the sandy habitat of the outer shelf.

Plate 10

Plate 11

Plates 10-11 . Low relief patch reefs at the outer shelf off from Boca de Cangrejos, PR

Table 6. Boca de Cangrejos Outer Shelf Reefs. Taxonomic composition and depth distribution of predominant benthic populations intercepted by linear transects, or present in the vicinity of survey stations, MACx cable landing survey. Modified from García-Sais (2001).

SPECIES	DEPTH (m) COMMON NAME	20	30	35	40
Scleractinian Corals					
Scolymia lacera	Atlantic Mushroom Coral		X	X	X
Agaricia agaricites	Lettuce Coral	X	X	X	X
Montastrea cavernosa	Great Star Coral		X		
Diploria labyrinthiformis	Grooved Brain Coral	X			
Stephanocoenia michilini	Blushing Star Coral	X			
Madracis decactis	Ten-Ray Star Coral	X			
Siderastrea siderea	Massive Starlet Coral	X			
Meandrina meandrites	Maze Coral	X	X		
Montastrea annularis	Boulder Star Coral	X			
Diploria strigosa	Symmetrical Brain Coral	X			
Dichocoenia stockesii	Elliptical Star Coral	X			
Leptoseris cucullata	Sunray Lettuce Coral	X			
Isophyllia sinuosa	Sinuous Cactus Coral	X			
Colpophyllia natans	Boulder Brain Coral	X			
Mycetophyllia sp.	Cactus Coral	X	X		
Porites astreoides	Mustard Hill Coral	X			
Hydrocorals					
Millepora squarrosa	Box Fire Coral	X			
Millepora alcicornis	Branching Fire Coral	X			
Stylaster roseus	Rose Lace Coral	X	X		
Antipatharians					
Stichopathes lutkeni	Wire Coral			X	X
Soft Corals					
Erythropodium caribaeorum	Encrusting Gorgonian	X			
Gorgonia sp.	Sea Fan	X			
Muricea sp.	Spiny Sea Fan	X			
Eunicea sp.	Knobby Sea Rod	X			
Muriceopsis sp.	Rough Sea Plume	X			
Pseudopterogorgia sp.	Sea Plume	X			
Stylatula sp.	Sea Feather				X
Telesto riseii			X		
Sponges					
Xestospongia muta		X	X	X	X
Ircinia sp			X	X	
Ircinia campana					
Aplysina sp.					
Neofibularia sp					
Agelas sp.					
Benthic Algae		X	X	X	X
Cyanobacterial Films				X	X

Table 7. Boca de Cangrejos Outer Shelf Reefs. Taxonomic composition and depth distribution of fishes observed, MACx cable landing survey. Modified from García-Sais (2001).

SPECIES	**DEPTH (m) COMMON NAME**	**20**	**30**	**35**	**40**
Acanthurus bahianus	Ocean Surgeon	X		X	X
Acanthurus chirurgus	Doctorfish	X	X	X	X
Acanthurus coeruleus	Blue Tang	X	X	X	X
Anisotremus virginicus	Porkfish	X	X	X	
Bodianus rufus	Spanish Hogfish	X		X	X
Calamus bajonao	Bajonao				X
Carangoides crysos	Blue Runner	X	X	X	
Carangoides ruber	Bar Jack		X		X
Cephalopholis cruentatus	Graysbe			X	
Cephalopholis fulva	Coney	X	X	X	X
Chaeaetodon capistratus	Four-eye Butterflyfish	X			
Chaetodon sedentarius	Reef Butterflyfish	X		X	X
Chaetodon striatus	Banded Butterflyfish		X		
Chromis cyanea	Blue Chromis	X	X	X	X
Chromis multilineata	Yellow-edge Chromis	X			
Equetus acuminatus	Cubbyu			X	
Equetus punctatus	Spotted Drum	X	X	X	
Gobiosoma evelynae	Sharknose Goby				
Haemulon aurolineatum	Tomtate	X	X		X
Haemulon flavolineatum	French Grunt	X	X	X	
Haemulon macrostomus	Spanish Grunt	X	X		
Haemulon plumieri	White Grunt	X			
Halichoeres cyanocephalus	Yellowcheek Wrasse	X	X	X	X
Halichoeres garnoti	Yellowhead Wrasse	X			
Holacanthus ciliaris	French Angelfish			X	X
Holacanthus tricolor	Rock Beauty	X	X	X	X
Holocentrus ascencionis	Long-spine Squirrelfish		X		X
Holocentrus rufus	Squirrelfish	X	X	X	
Lactophrys triqueter	Smooth Trunkfish	X		X	
Lutjanus analis	Mutton Snapper				X
Lutjanus synagris	Lane Snapper	X	X	X	
Malacanthus plumieri	Sand Tilefish			X	X
Melichthys niger	Black Durgon				X
Mulloides martinicus	Yellow-tail Goatfish				X
Myripristis jacobus	Black-bar Souldierfish	X		X	X
Ocyurus chrysurus	Yellowtail Snapper	X	X		X
Odontoscion dentex	Reef Croaker		X		
Paranthias furcifer	Creole Fish				X
Pareques acuminatus	Cubbyu		X		
Pomacanthus arcuatus	Grey Angelfish			X	X
Pomacanthus ciliaris	French Angelfish			X	

Table 7. continued					
	DEPTH (m)	**20**	**30**	**35**	**40**
SPECIES	**COMMON NAME**				
Priacanthus cruentatus	Glasseye	X		X	
Rypticus saponaceus	Soapfish				X
Pseudupeneus maculatus	Spotted Goatfish	X	X	X	
Scomberomorus regalis	Cero Mackerel		X		X
Scarus iserti	Striped Parrotfish	X		X	
Scarus vetula	Queen Parrotfish				X
Serranus baldwini	Lantern Bass		X		
Serranus tabacarius	Tobbaco Fish		X		
Sphyraena barracuda	Great Barracuda				X
Stegastes partitus	Bicolor Damselfish	X	X	X	X
Stegastes planifrons	Yelloweye Damselfish	X		X	
Thalassoma bifasciatum	Blue-head Wrasse	X	X	X	
Xanthychthys ringens	Sargassum Triggerfish			X	

B. Geographical Distribution and Physical Characteristics of Deep Reefs around Puerto Rico and the U. S. Virgin Islands

The regional bathymetry of the Puerto Rico and U. S. Virgin Islands insular slope reveals that both the northern and southern sections are characterized by an abrupt, almost vertical drop, without any large topographic features where extensive deep (ahermatypic) reef banks could develop (Figure 3). Located 50 kilometers off the north shoreline is the Puerto Rico Trench, the deepest part of the Atlantic Ocean, with depths exceeding 8.4 kilometers. The Puerto Rico trench is a deep trough where the North American plate slides past and underneath the Antilles and becomes deeper and wider north of Puerto Rico. In most sections of the south coast, depths of more than one kilometer are reached within horizontal distances of less than one kilometer from the shelf-edge (Figure 4). The slope of the north coast is more gradual, but essentially featureless in terms of large scale bathymetric discontinuities down to the maximum depths of ahermatypic coral reef formation (c.a. 1,500 m) (Figure 3). Still, the rocky substrate of the abrupt insular slopes represents a critical habitat for commercially important demersal snapper and grouper populations. The historical record of deep water snapper and grouper fisheries yields off the north-east coast between Fajardo, PR and St. Croix, USVI suggest that deep reefs, or reef benthic communities that support

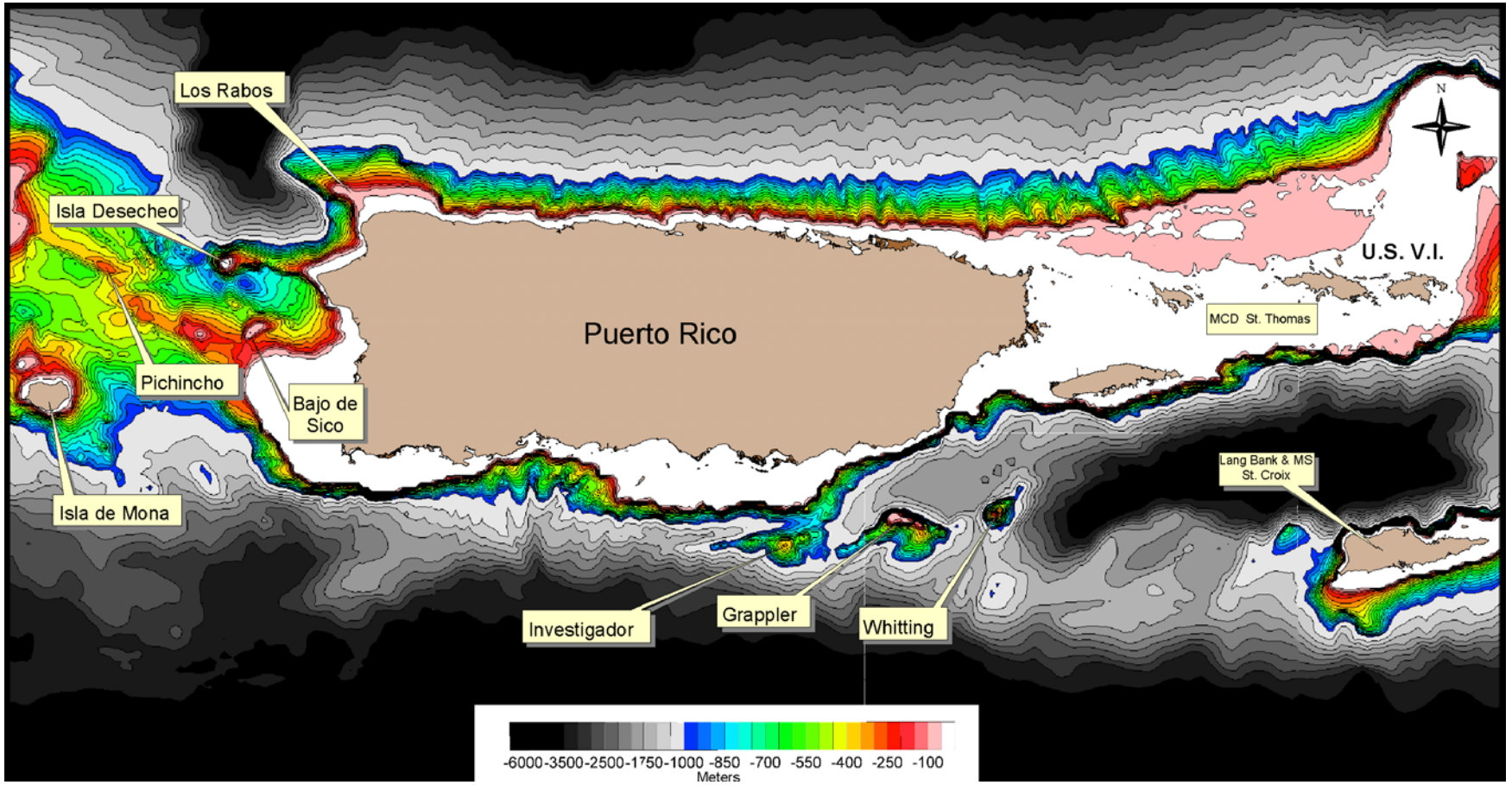


Figure 3. Bathymetric map of Puerto Rico and the U.S. Virgin Islands showing the geographical distribution of deep reefs.

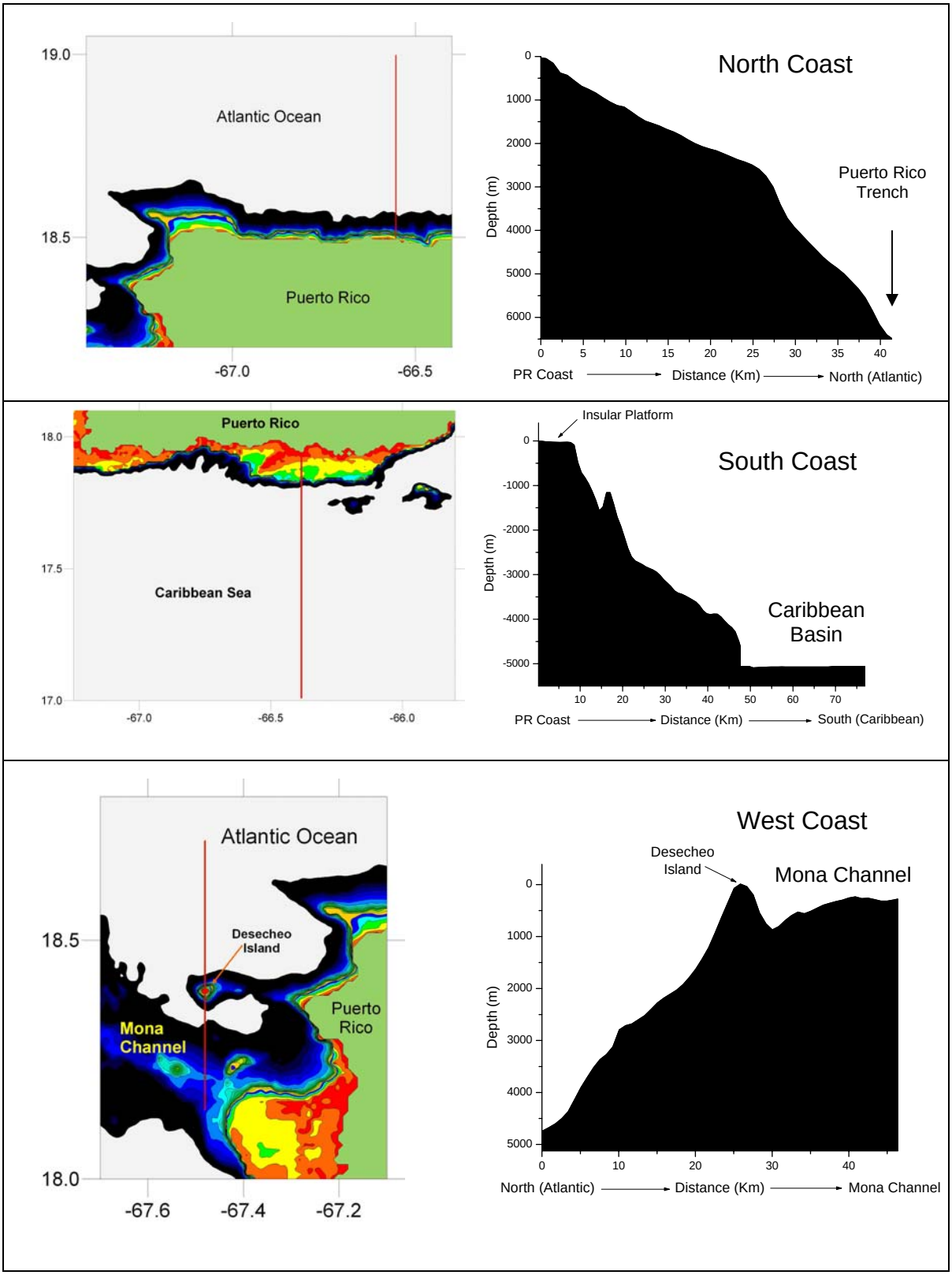


Figure 4. Transversal section of a typical slope on the north, south and west coasts of Puerto Rico.

these large fish populations are likely to exist along the insular slope at depths between 200 – 500 m.

There are two prominent ridge systems submerged along the west and southeast coasts (Figure 3). The most extensive is the great southern Puerto Rico fault zone (Glover, 1967; Garrison and Buell, 1971), a submerged section of the Antillean ridge that extends across the entire Mona Passage, connecting Puerto Rico with La Hispaniola. The ridge rises from a mean depth of 6,000 meters and includes the islands of Mona, Monito and Desecheo, as well as submerged seamounts that reach depths of less than 100 meters, such as Bajo de Sico, Bajo Esponjas and Bajo Pichincho in Puerto Rico, and Bajo Engaño within the Dominican Republic waters (Figure 5). The entire ridge was intensively fished for deep water snappers and groupers since the early 1970's by commercial fishermen from the west coast of Puerto Rico. "El Pichincho" is one of the most productive Blue Marlin (*Makaira nigricans*) fishing grounds of the world. A less extensive submerged ridge is found associated with the insular shelf off Aguadilla known as "Los Rabos". This area is well known for its pelagic fisheries, particularly Yellowfin Tuna (*Thunnus albaceres*), but deep sea snappers are also exploited on a regular basis by local artisanal fishermen.

On the southeast coast of Puerto Rico, the submerged seamounts, Bajo Investigador, Bajo Grappler and Bajo Whitting are the most prominent deep reef systems (Figure 6). These are seamount pinnacles of a submerged ridge that extends east, connecting the shelf platform of Puerto Rico with the Island of St. Croix, USVI. The ridge is separated from the mainland by oceanic depths of more than 1,000 meters. Bajo Grappler is the largest and taller of the seamounts, with its pinnacle reaching less than 60 meters from the surface. As with the west coast deep reef systems, the submerged seamounts of the south coast were sites of an intensive fishing effort for deep water snappers and groupers during the last three decades. At present, fishing effort has declined markedly with the reduction of its demersal fisheries yield. Large pelagic species, particularly Wahoo (*Acanthocibium solanderi*) are still targeted around the south coast seamounts.

The north coast does not show any prominent submerged structures that could be regarded as deep reef systems (Figure 5), but a series of small patch reefs are known to occur along the upper insular slope at depths of 30 – 40 meters off San Juan (García et al., 2001). These deep patch reefs appear to be eolianite (cemented sand dunes)

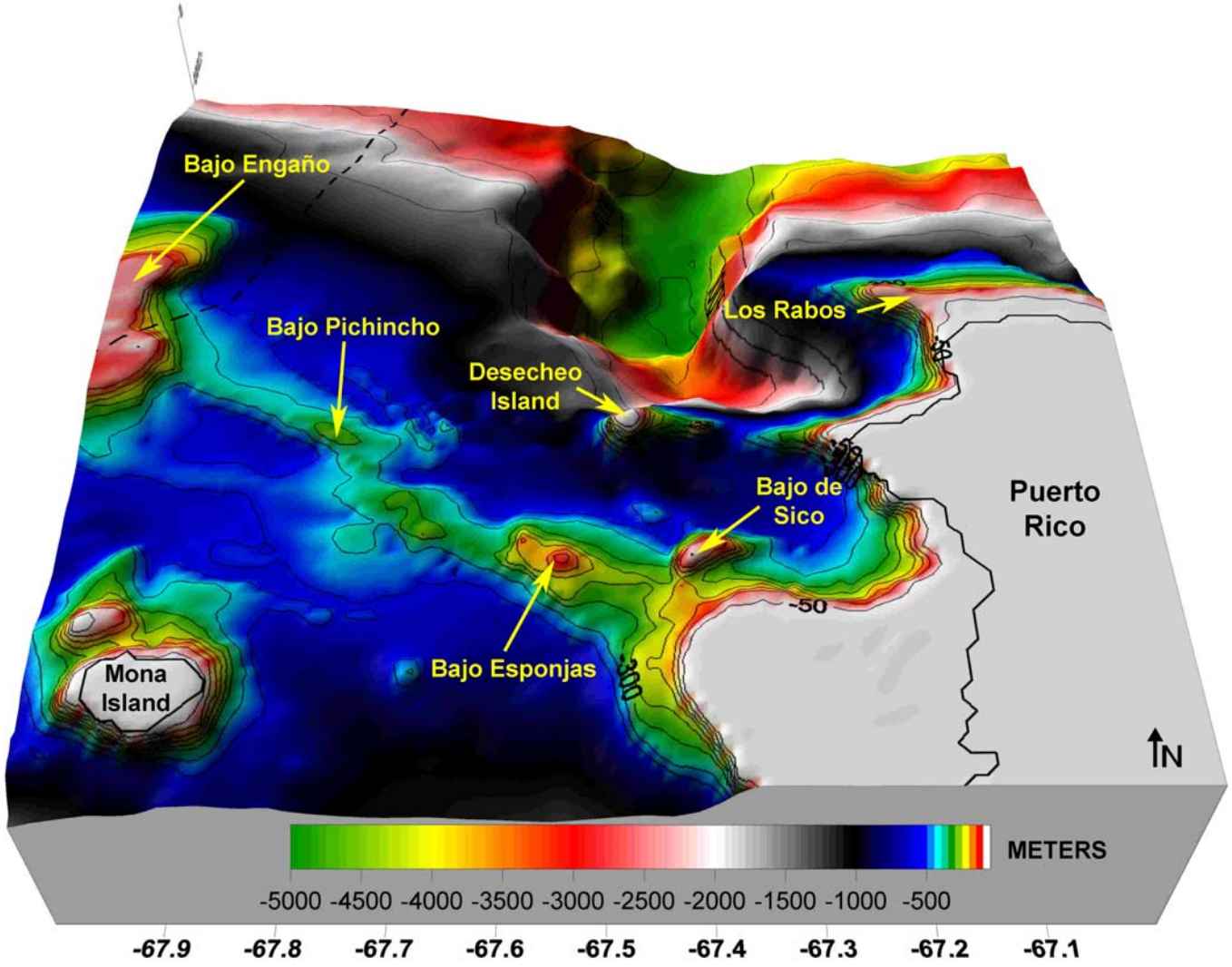


Figure 5. Three dimensional representation of the west coast of Puerto Rico

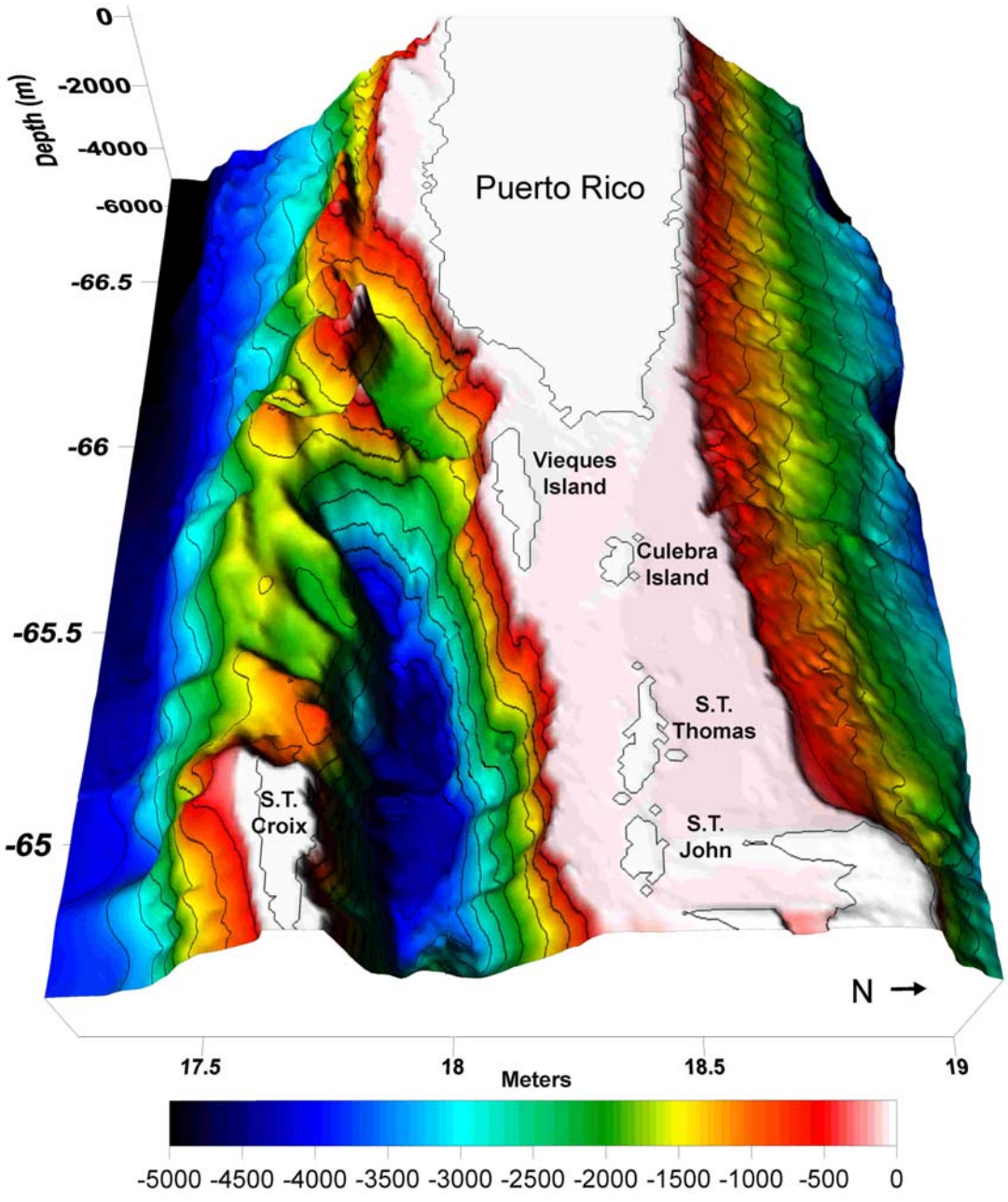


Figure 6. Three dimensional representation of the east coast of Puerto Rico and U.S. Virgin Islands.

structures that rise from a sandy substrate with a typical height of 3 – 5 meters. Anecdotal information from commercial divers of the north coast suggest that these patch reefs are also common off Aguadilla, Quebradillas, Isabela, Dorado, and perhaps other north coast locations.

The bathymetric characteristics of the U. S. Virgin Islands north and south insular shelf and slope (Figure 7) are similar to those described for Puerto Rico. An important difference is that the insular shelf break of the USVI, particularly north of St. Thomas, and also east of St. John, and southwest of St. Croix exhibits a series of deep terraces where, because of the availability of hard bottom and the clear waters coral reefs have the potential for development. It is along these outer shelf terraces where deep hermatypic reefs have been reported for the USVI (Nemeth et al., 2004; Herzlieb et al., in press; Armstrong et al., in press). The submerged ridge that connects the shelf of St. Croix with the southeast shelf of Puerto Rico represents a major hard bottom system, with pinnacles that reach depths between 100-700 m, where ahermatypic corals may be found, perhaps forming deep coral reef communities. The north shelf of St. Thomas exhibits a deep shelf with promontories rising from sill depths of 50 to 70 m. These topographic features of the shelf may be potentially favorable sites for development of deep hermatypic reefs. This may also apply for the north coast of Isla de Culebra and the south coast of Isla de Vieques, PR. At depths of 390 fathoms (709 m) north of St. Thomas, the H. M. S. Challenger dredged several species of azooxanthellate corals, including the reef forming species, *Lophelia pertusa*.

An early assessment of the frequency distribution of types of ocean bottoms in the Puerto Rico and the USVI geological platforms was prepared by Ruiz (1984), based on information compiled from nautical charts and other sources. The main types of ocean bottoms vary across the depth gradient of the insular slope profile and between the different coasts (Table 8). Corals are reported down to 300 fathoms (545 meters) in the west coast and constitute a common bottom type from depths between 100 – 300 fathoms (Ruiz, 1984). The north and south coasts present unconsolidated sediments (mud, clay) as the dominant bottom type at depths between 100 – 300 fathoms and rocky bottoms at shallower depths. According to Ruiz (1984), the east coast exhibits a mixed composition of hard ground and sandy bottoms at depths between 100 - 300 fathoms, with corals present at shallower depths.

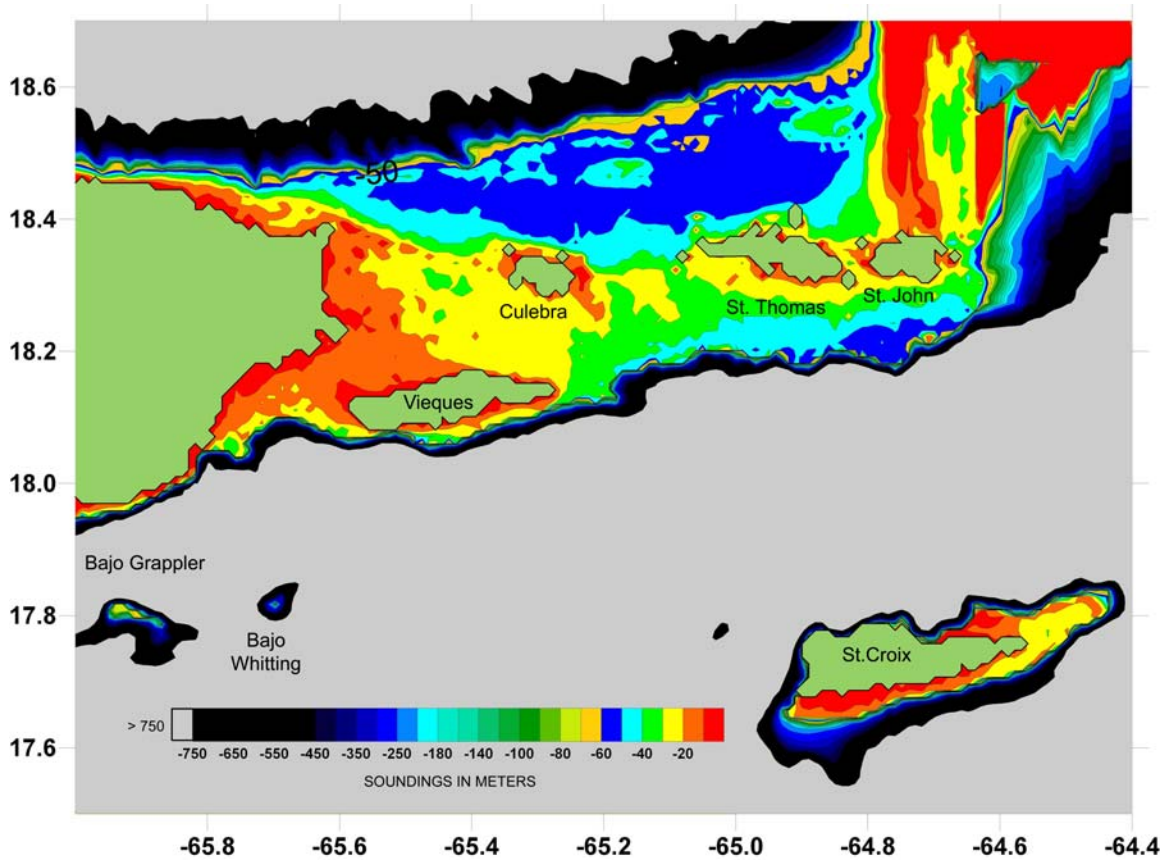


Figure 6. Bathymetric map of the east coast of Puerto Rico including the U.S. Virgin Islands

Observations of the physical features of deep reefs around Puerto Rico and the U. S. Virgin Islands are essentially limited to the video records of the Johnson Sea-Link submersible survey at several well known deep-sea snapper fishing areas (Nelson and Appledoorn, 1985) and the recent SeaBED platform imaging surveys of the Marine Conservation District Hind Bank near St. Thomas and the South Drop near St. John (USVI) (Singh, 2003; Armstrong et al., in press). The Johnson Sea-Link survey described benthic habitat types of the Puertorrican insular slope at depths between 100 – 450 meters, whereas the SeaBED surveyed depths between 33 – 90 meters.

Table 8. Summary of the most frequent ocean bottom types across the Puertorrican and U. S. Virgin Islands platforms. Data source: NOAA Nautical charts. Reproduced from Ruiz (1984)

Depth Range (meters)	Puerto Rico / U. S. Virgin Islands Geologic Platforms			
	North	**South**	**West**	**East**
0 - 16	Gravel - 40 % Hard - 33 % Rocky - 17 %	Reefs - 33 % Hard - 28 % Rocky - 26 %	Rocky - 43 % Reefs - 21% Hard - 15 %	Reefs - 41 % Corals - 19 % Hard - 17 %
17 - 35	Hard - 65 % Rocky - 9 % Corals - 7 %	Hard - 53% Rocky - 22% Soft - 8 %	Hard - 40 % Sticky - 20 % Rocky - 16 %	Hard - 27 % Corals - 15 % Rocky - 10 %
36 - 180	Hard - 35 % Sand - 21 % Rocky - 12%	Rocky - 32 % Hard - 16 % Corals - 11 %	Corals - 56 % Sand - 21 % Sand/Shells - 6 %	Sand - 23 % Corals/Hard - 23 % Corals - 12 %
181 - 544	Mud - 55% Hard - 19% Sand - 9 %	Mud - 47 % Hard - 13 %	Corals - 37 % Sand 31 %	Hard - 16 % Sand 22 %
> 545	Mud - 41 % Hard - 28 % Sand/Mud - 11 %	Clay - 30 % Rocky - 12 % Mud - 12 %	Corals - 34 % Sand - 22 % Mud - 4 %	Hard - 21 % Sand - 17 % Sand/Coral - 9 %

Table 9 summarizes benthic habitat observations from the Johnson Sea-Link survey at 15 locations around Puerto Rico and the U. S. Virgin Islands. Two distinct patterns of benthic habitat profiles down the insular slope were observed. Offshore sites surveyed at depths between 70 – 500 m in the Mona Passage (e.g. Bajo Esponjas and Isla Desecheo) exhibited an abrupt slope and highly rugged hard bottom with pilings of large rocks and boulders throughout the entire range (Nelson and Appledoorn, 1985). Sand pockets and channels were present in substrate depressions around rock boulders and cascaded down vertical walls. Primary substrate below 120 m (400 feet) was depauperate, with only a few small isolated coral colonies and sponges attached to the

bare rock faces (Nelson and Appledoorn, 1985). At Isla Desecheo, a rich marine life with abundant corals, sponges and colonial hydroids were reported above 120 m.

According to Nelson and Appledoorn (1985), a second type of benthic habitat profile which appears to be “typical” around mainland Puerto Rico and the U. S. Virgin Islands presents a sandy bottom composition at a depth of 450 m. Between 450 and 350 meters the slope is gentle (5 – 15 degrees) and the bottom habitat remains dominated by unconsolidated sand sediments, but with interspersed bare rock outcrops and slabs mostly devoid of attached biota. Above 350 meters, the slope increases to 25 – 30 degrees and there is an increased number of hard ground habitat, mostly rocky outcrops with some attached sponges, hydroids, soft and hard corals and crinoids. A predominantly slab rock rubble zone was generally encountered at a depth of approximately 300 meters, with relief and density of the rubble dependent on the particular site. In general, the rubble zone is mostly composed of slab rock on the southern section of Puerto Rico and the U. S. Virgin Islands, whereas large boulder outcrops are more typical of the northern insular slope, as well as for the slope section surveyed east of St. Croix, and both north and south of St. Thomas and St. John, USVI.

As in deeper slope sections, the sessile-benthic invertebrate biota associated with this deep rubble zone is depauperate (Nelson and Appledoorn, 1985). Above the rubble zone (300 – 200 m), the bottom is mostly sandy and even more unproductive, with almost no suitable areas for attachment of invertebrate biota until the interface of a vertical wall at about 180 meters. The deeper end of the vertical wall (180 – 140 m) exhibits few attached invertebrates and a depauperate fish fauna. Ambient light is noticeable above 140 meters, depth at which overall productivity increases markedly. Large numbers of reef fishes are associated with an increase in abundance and diversity of hard and soft corals, sponges and hydroids (Nelson and Appledoorn, 1985).

The wall on the southern insular slope is an almost vertical smooth rock, whereas on the northern section a slope of 50 – 70 degrees is more typical, with the wall ascending as a series of slabs or rock outcrop terraces up to a depth of about 90 meters. Above 90 meters, the slope decreases markedly to 20 – 30 degrees as the top of the wall is reached. The next 100 meters along the profile towards the surface is characterized by

Table 9. Benthic habitat characterizations by the Johnson Sea Link II on west coast site locations of PR during 1985. Modified from Nelson and Appeldoorn (1986).

Site	Dive #	Position Latitude (N)	Longitude (W)	Depth (meters)	Benthic Habitat Observations
Bajo Esponjas	1163	18° 13.66	67° 35.27	298 - 391	Hard bottom, scattered corals and sponges
Bajo Esponjas	1164	18° 14.29	67° 36.16	73 - 336	Hard bottom, wall, no info on benthic invertebrates
Abrir La Sierra	1165	17° 59.58	67° 23.49	82 - 402	Hard bottom shallow, sand-mud deep, sea whips
Abrir La Sierra	1166	17° 58.89	67° 23.80	46 - 292	Sandy silt, scattered rocks, coral rubble, sea fans
Guanica Drop-off	1167	17° 52.73	66° 54.55	541 - 670	Mud-sand, mounds, depressions, invertebrate trails
Guanica Drop-off	1168	17° 53.86	66° 54.58	242	Sandy silt, scattered rock outcrops, invert. mounds
Guanica Drop-off	1169	17° 53.65	66° 59.20	421 - 479	Silty sand, scattered rock outcrops, invert. mounds
Guanica Drop-off	1170	17° 53.59	66° 54.71	432 - 527	Silt-clay flat, depressions, burrows, mounds
Guanica Drop-off	1171	17° 52.82	66° 53.59	724 - 760	Sandy silt, invert. mounds
Guanica Drop-off	1174	17° 54.77	66° 53.21	70 - 120	Hard bottom, vertical wall, black coral, sponges
Guanica Drop-off	1175	17° 53.90	66° 54.71	90 - 220	Vertical wall at 100m with black coral and sponges
Guanica Drop-off	1176	17° 54.77	66° 53.21	30 - 120	Hard bottom, vertical wall, black coral, sponges
Guanica Drop-off	1177	17° 54.59	66° 53.52	21 - 212	Hard bottom, vertical wall, black coral max. at 54m
Guanica Drop-off	1178	17° 52.74	66° 54.32	727	Sandy silt, invert. mounds
Grappler Seamount	1179	17° 47.31	65° 54.54	61 - 482	Sandy at 270-482m; vertical wall, rock rubble shallower
St. John - South	1180	18° 10.65	64° 46.20	42 - 525	Rock rubble, wall, undercut terraces, corals, sponges
St. John - South	1181	18° 10.65	64° 46.20	61 - 523	Sandy with scattered rocks
St. John - East	1182	17° 49.88	64° 25.60	30 - 432	Sandy deep; rock wall shallower
St. John - West	1183	17° 43.42	64° 54.61	39 - 600	Sandy deep; rock wall shallower, corals above 50 m
Vieques - East	1184	18° 06.72	65° 11.75	45 - 495	Sandy deep; rock wall shallower with corals, sponges
St. Thomas - NE	1185	18° 23.76	64° 59.17	32 - 42	Sandy, mud with patch reefs shallow, gorgonians
San Juan	1186	18° 31.47	66° 10.56	288 - 508	Silty mud and sand
San Juan	1187	18° 30.55	66° 10.47	227 - 340	Silty mud deep, rocky shallower
Aguadilla	1188	18° 35.42	67°14.14	91 - 335	Hard bottom, rock rubble, holes, coral rubble
Aguadilla	1189	18° 26.82	67° 14.60	685 - 755	Sandy bottom
Aguadilla - West	1190	18° 32.79	67° 13.64	82 - 413	Sandy silt deep, slab rock shallower, fans/whip corals
Desecheo Island	1191	18° 22.28	67° 29.68	82 - 475	Rock boulders deep, rock wall, corals/sponges >120m
Fajardo - NE	1192	18° 29.50	65° 33.59	106 - 388	Sandy silt deep, rocky shallower
St. Thomas - NE Drop	1193	18° 35.27	65° 03.78	91 - 455	Rock outcrops, rock wall shallower

a band of mostly barren and unproductive rubble zone with few attached sponges and corals (Nelson and Appledoorn, 1985). Benthic habitats of the upper insular slope were not described in much detail in the Seward Johnson-Sea Link II survey. However, reference is made of a typical deep reef finfish and invertebrate fauna associated with the “reef top” habitat.

Data on the benthic habitat characteristics of the insular slope of Puerto Rico, including San Juan, Aguadilla, Mayaguez, Vieques, and St. Thomas (USVI) were contributed from dredge samplings of the Fish Hawk expedition in 1989 (Bowers, 1900). Sand and mud was reported as the prevailing bottom type below 30 fathoms (54 meters), except at station 6079, located approximately 5.5 miles off from Pta. Algarrobo, Mayaguez, where a predominantly “coral” bottom was reported at depths between 97 – 120 fathoms (176 - 218 m). Coral was also reported as the main bottom type off St. Thomas (Sta. 6079, 6080) and Vieques (Sta. 6088, 6089) at depths between 20 -23 fathoms (Table 10).

From the Johnson–Smithsonian Expedition to the Puertorrican Deep (Bartsch, 1933) insular slope areas where corals and/or associated “reef” benthic communities occurred were reported off San Juan Bay, off Pta. Salinas (San Juan), off Pta. Cerro Gordo and off Fajardo in the north coast, off Mona (Pta. Caigo no Caigo) and Desecheo Islands in the west coast, and off Culebra and Culebrita Islands, and west off Just Van Dyke in the east coast (Table 2).

Table 10. List of dredging stations occupied by the U. S. Commission steamer “Fish Hawk” about the island of Puerto Rico during 1899, with information of station depth and bottom types

Station #	General Locality	Depth (m)	Bottom Types
6050	Off San Juan Harbor	165	sand and mud
6051	Off San Juan Harbor	81	sand and mud
6052	Off San Juan Harbor	561	sand and mud
6055	Off Aguadilla	248	sand, mud, shells
6056	Off Aguadilla	87	sand, mud, shells
6060	Off Mayaguez Harbor	22	sticky mud
6061	Off Mayaguez Harbor	27	sand and mud
6062	Off Mayaguez Harbor	49	sand, mud, shells
6063	Off Mayaguez Harbor	136	rocky, sand, corals
5064	Off Mayaguez Harbor	50	sand and mud
6066	Off Mayaguez Harbor	304	sand and mud
6067	Off Mayaguez Harbor	200	coral
6068	Off Mayaguez Harbor	416	?
6069	Off Mayaguez Harbor	412	sand and mud
6070	Off Mayaguez Harbor	402	rocky
6071	Off Mayaguez Harbor	326	rocky
6073	Off Punta Melones	15	?
6074	Off Puerto Real	14	corals and sand
6075	Off Puerto Real	14	corals and sand
6076	Off Gallardo Bank	18	corals and sand
6077	Off Gallardo Bank	19	corals and sand
6078	Off Gallardo Bank	21	corals and sand
6079	Off St. Thomas	40	coral
6080	Off St. Thomas	36	coral
6081	Between Culebra and St. Thomas	31	coral
6082	Between Culebra and St. Thomas	33	rocky and corals
6083	Between Vieques and St. Thomas	42	?
6084	Between Vieques and St. Thomas	20	corals, sand, shells
6085	Off Vieques Island	25	corals and sand
6086	Off Culebra Island	27	corals and sand
6087	Off Culebra Island	27	corals and sand
6088	Off Vieques Island	44	coral
6089	Off Vieques Island	38	coral
6090	Off Culebra Island	29	coral
6091	Off Vieques Island	27	coral
6092	Off Vieques Island	16	coral
6093	Off Culebra Island	15	coral
6094	Off Vieques Island	12	coral
6095	Off Vieques Island	12 1/2	coral
6097	Off Humacao	10	coral
6098	Off Humacao	12 1/2	coral
6099	Off Humacao	9 1/2	coral

C. Taxonomic characterization of the sessile-benthic communities associated with deep reef habitats in Puerto Rico and the USVI

1. Benthic Algae

Benthic algae are perhaps the least known biological component of deep reef communities in Puerto Rico and the USVI. They were not reported from any of the early exploratory sampling expeditions, nor from any of the subsequent fishery related surveys, including the observations from the Johnson Sea-link submersible of the Puertorrican insular slope. A revised checklist of benthic marine algae known to Puerto Rico is available in Ballantine and Aponte (1997), but reference to the collection depths for each species is lacking. Most of the information regarding the taxonomic composition of benthic algae at depths below 30 meters was produced by Ballantine and Aponte (2003, 2005) for Lee Stocking Island, Bahamas. Collections were obtained by the submersible DSV Nekton-Gamma of NOAA's National Underwater Research Program (NURP) and by divers using SCUBA. A total of 102 benthic algal species were reported by Ballantine and Aponte (2003) for the deep reef at Lee Stocking Island, 73 of which had been previously reported for Puerto Rico (Ballantine and Aponte, 1997) (Table 11).

The encrusting fan leaf alga, *Lobophora variegata* was a major component of the hermatypic deep reef system at Isla Desecheo down to depths of at least 70 meters (García et al., this volume). It was found growing in patches over hard ground and accounted for a substantial percent of substrate cover in the reef at depths between 30 – 50 meters (García et al., this volume). This alga was also observed to be highly abundant on hard ground reef habitats at Bajo de Sico (Mona Passage) and La Parguera (SW Puerto Rico) at depths between 30 – 50 meters.

Crustose red algae appear to have played a fundamental role in the formation of Agelas Reef at Isla Desecheo (depth range: 50-70 m) and other recently discovered deep reefs at depths below 40 meters in Bajo de Sico. Crustose algae produce oval nodules, or rhodoliths of variable sizes that form extensive deposits over sloping deep terraces. Although these rhodoliths are unattached, they serve as the primary substrate for attachment of hermatypic corals, sponges and algae which consolidate the structure and

Table 11. List of benthic algae associated with a deep fore-reef at Lee-Stocking Island, Bahamas, with annotations on their distribution in Puerto Rico.

Legend to the locality codes:

1- Ponce	8- Rincon
2- Guayanilla	9- Aguadilla
3- Guanica	10- Arecibo
4- La Parguera	11-San Juan
5- Cabo Rojo	12-Fajardo
6- Mona and Desecheo Islands	13- Culebra and Vieques Islands
7- Mayaguez	14- Yabucoa
	15- Guayama

SPECIES	**Max. Depth Record in Bahamas (m)** (Ballantine and Aponte, 2003)	**Locality Records in PR** (Ballantine and Aponte, 1997)
Heterokontophyta		
Nereia tropica	27	4,9,10,11
Halopteris filicina	76	no record
Dictyopteris delicatula	61	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15
Dictyota cervicornis	77	1,3,4,5,6,7,9,11,12,14,15
Dictyota pulchella	76	1,2,3,4,5,6,7,8,9,10,11,13,14,15
Lobophora variegata	107	1,2,3,4,5,6,7,9,10,11,12,13,14,15
Stypopodium zonale	27	1,3,4,5,6,7,9,10,11,12,14,15
Sargassum polyceratium	76	1,3,4,5,6,7,9,10,11,12,13,14,15
Chlorophyta		
Pseudotetraspora marina	61	4
Verdigellas nektongammea	91	no record
Verdigellas peltata	122	6
Gayralia oxysperma	76	no record
Ulvella lens	85	3,4,9
Anadyomene linkiana	61	no record
Anadyomene saldanhae	107	6,7,14
Anadyomene stellata	46	3,4,5,6,7,8,9,10,11,12,14,15
Microdictyon boergesenii	77	3,4,9,10,14
Microdictyon marinum	27	no record
Phyllodictyon pulcherrimum	76	4,9
Struevea elegans	77	3,4,9
Cladophora coelothrix	76	9
Cladophora corallicola	91	no record
Cladophora vagabunda	46	1,2,3,4,5,8,9,10,11,13,14,15
Cladophoropsis macromeres	31	3,4,6,9,13,15
Cladophoropsis membranacea	27	1,2,3,4,5,6,9,10,11,12,13,14,15
Dictyosphaeria cavernosa	46	1,2,3,4,5,6,7,8,10,11,12,13,14,15

(**Table 11.** Continued)

Species	**Max. Depth Record in Bahamas (m)** (Ballantine and Aponte, 2003)	**Locality Record in PR** (Ballantine and Aponte, 1997)
Ventricaria ventricosa	46	2,3,4,7,9,10,11,13,14,15
Valonia macrophysa	107	4,6,7,9,13,14
Derbesia osterhoutii	61	no record
Pedobesia simplex	61	no record
Ostrebium quekettii	120	4
Caulerpa microphysa	30	2,3,4,5,7,9,10,11,12,14,15
Avranvillea cyathiformis	61	no record
Avranvillea longicaulis	31	1,2,3,4,6,7,9,10,11,12
Halimeda copiosa	107	4,7,14
Halimeda cryptica	61	4
Halimeda discoidea	61	2,3,4,5,7,8,9,10,11,12,13,14,15
Halimeda incrassata	61	1,2,4,5,6,11,12,13,14,15
Halimeda lacrimosa	61	no record
Halimeda simulans	31	2,3,4,5,7,13,14,15
Halimeda tuna	61	1,2,3,4,5,6,7,9,12,13,15
Penicillus dumetosus	31	1,2,3,4,10,12,13,14,15
Pseudocodium floridanum	61	no record
Rhipiliopsis stri	76	3,4,6
Rhipocephalus phoenix	31	6,9,10,14
Rhipocephalus oblongus	27	no record
Udotea dixonii	27	4,6,9,10
Udotea flabellum	31	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15
Udotea looensis	31	no record
Udotea unistrata	46	no record
Rhodophyta:		
Erythrotrotrichia carnea	32	3,4,5,13
Haliptilon cubense	46	1,3,4,5,7,8,9,10,11,13,15
Jania adhaerens	61	4,6,11
Tricleocarpa fragilis	76	
Hypnea spinella	30	1,2,3,4,5, 7,10,11,13,14,15
Platoma tenuis	76	
Peyssonnelia inamoena	113	
Peyssonnelia abyssica	107	
Cryptonemia crenulata	61	3,4,6,8,9,10,11,14
Champia parvula	61	1,2,3,4,5,8,9,11,12,15
Champia vieillardii	61	3,4,9,10,11
Lomentaria baileyana	61	3,4,15
Asteromenia peltata	107	3,4,6,9,11
Botryocladia bahamense	76	
Botryocladia spinulifera	61	3,4
Coelarthrum cliftonii	76	3,4,9
Gloiocladia atlantica	76	3,4,10,14
Acrothamnion butleriae	76	3
Anotrichium tenue	61	4,9,10,13

(**Table 11.** Continued)

Species	**Max. Depth Record in Bahamas (m)** (Ballantine and Aponte, 2003)	**Locality Record in PR** (Ballantine and Aponte, 1997)
Antithamnion antillanum	61	3,49,10,14
Antithamnion cf. decipiens	76	4
Centroceras clavulatum	46	1,2,3,4,5,6, 7,9,10,11,12,13,14,15
Ceramium comptum	46	
Ceramium flaccidum	61	1,2,3,4,7,8,11,13
Crouania attenuata	46	1,2,3,4,5,6, 7,9,10,11,13,15
Diplothamnion jolyi	46	
Gymnothamnion elegans	76	
Haloplegma duppereyi	61	3,5,6,10,11,12
Perikladosporon abaxiale	76	
Ptilothamnion speluncarum	27	
Rhododictyon bermudense	107	
Seirospora occidentalis	61	3,4,7,9,10,12
Spermothamnion investiens	61	3,4,5,10,11
Wrangelia penicillata	46	1,3,4,5,6,8,9,10,11
Dasya magnei	61	
Halydictyon mirabile	76	
Heterosiphonia crispella	29	
Frikkiella pseudoprostata	76	4,6
Frikkiella searlesii	76	
Hypoglossum anomalum	91	3,4,6,7,9,10,11
Hypoglossum caloglossoides	61	
Hypoglossum rhizophorum	92	3,4,610,14
Hypoglossum simulans	31	4,6,79,10,11
Nitophyllum adherens	61	4,9
Platysiphonia caribaea	92	4,6
Chondria curvilineata	46	
Herposiphonia secunda	31	1,4,9,11
Laurencia coelenterata	27	
Neosiphonia flaccidissima	46	
Polysiphonia havanensis	61	4,15
Wrightiella blodgettii	61	

create a continuous reef platform in deep reef zones of low wave energy. Crustose coralline algae are generally referred to as *Lithothamnion sp*. *Lithophyllum congestium* (Foslie), *Porolithon pachydermum* (Foslie) and species of *Neogonolithon* are known to be important ridge constructors in St. Croix and Panama (Colin, 1978).

2. Sponges (Phylum Porifera)

Wilson (1900) produced the first report on the taxonomy of sponges from deep reefs of PR and the USVI from specimens collected by the "Fish Hawk" expedition in 1899. This initial report included 31 species in the Class Demospongiae. M. W. de Laubenfels (1934) described another 24 new species from the collections by the Johnson-Smithsonian Expedition in 1933. Representative species in the Class Calcispongiae (*Leucosolenia canariensis*) and the Class Sclerospongiae (*Ceratoporella nicholsoni* and *Goreauiella auriculata*) were reported by Colin (1978) from personal observations while SCUBA diving in the oceanic islands of Mona and Desecheo. The most recent review of sponges from the Caribbean was produced by Van Soest (1978, 1980). Including several geographical and depth records contributed by Gaecía et al (this volume), a total of 96 species of sponges are presently reported for Puerto Rico and the U. S. Virgin Islands at depths below 30 m (Table 12). In the study by Van Soest (1978, 1980) it was evident that many species reported to occur on shallow reefs of the insular shelf, were found in deeper waters growing on sandy and muddy substrates.

Below depths of 30 meters, sponges represent the most prominent invertebrate taxa in terms of reef substrate cover at Isla Desecheo, and play a fundamental role as protective microhabitat for fishes and motile benthic invertebrates (García et al., this volume). The brown tube sponge (*Agelas conifera*) and row-pore sponges (*Aplysina spp.*) are the dominant species in terms of reef substrate cover and typically grow in association with scleractinian corals (*Montastrea annularis, M. cavernosa, Agaricia spp*.) forming sponge-coral bioherms that contribute substantially to the overall underwater reef topography or rugosity.

Sclerosponges are perhaps the largest sessile-benthic invertebrate contributing topographic relief in deep reefs of the West Indies. The species are mostly cavernicolous (cave-dwelling) at depths of less than 40 meters, but at depths of 70 m or more, they may be found on exposed faces, competing with deep-water stony corals for

Table 12. Sponges reported from depths below 30 meters in Puerto Rico and the USVI

SPECIES	Max. Depth (fathoms)	Locality	Bottom Type	Expedition/ Reference
Class Calcispongiae				
Leucosolenia canariensis	45	Mona Island	Rocky	Colin, 1978
Class Sclerospongiae				
Ceratoporella nicholsoni	72	Mona and Desecheo Is., PR	Hard bottom, caves	Colin, 1978
Goreauiella auriculata	127	Mona Island, PR	Reef caves	Colin, 1978
Class Demospongiae				
Agelas clathrodes	94	Desecheo Is., PR	Coral	This study
Agelas conifera	94	Desecheo Is., PR	Coral	This study
Agelas dispar	94	Desecheo Is., PR	Coral	This study
Agelas schmidtii	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Alcyospongia india	543	San Juan, PR	unknown	Caroline, 1933
Amphimedon compressa	83	La Parguera, PR/USVI	Coral	Van Soest, 1980
Anacanthaea rea	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Anchorina fenimorea	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Aplysina archeri	76	St. Thomas	Coral	Armstrong et al., in press
Aplysina cauliformis	94	Desecheo Is., PR	Coral	This study
Aplysina fenestrata	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Aplysina flagelliformis	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Aplysina hirsuta	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Aplysina lacunosa	91	Mayaguez, PR	muddy, sand	Van Soest, 1980
Axinella reticulata	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Axociella calla	54	Desecheo Is., PR	Hard bottom, Coral	Caroline, 1933
Cacospongia spongeliformis	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Chalinopsilla pilosa	36	St. Thomas, USVI	Coral	Fish Hawk, 1899
Callyspongia strongylophora	91	Puerto Rico	muddy, sand	Van Soest, 1980
Callyspongia vaginalis	63	La Parguera, PR	Coral	Van Soest, 1980
Chondrilla nucula	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Chondrilla nucula	76	St. Thomas	Coral	Armstrong et al., in press
Chrotella minuta	407	Mayaguez, PR	Rocky	Fish Hawk, 1899
Cinachyra sp.	83	St. Thomas	Coral	Armstrong et al., in press
Clathria clathrata	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Cliona sp.	76	St. Thomas	Coral	Armstrong et al., in press
Coelosphaerella johnsoni	543	San Juan, PR	unknown	Caroline, 1933
Coppatias solidissima	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Cribrochalina spiculosa	63	La Parguera, PR	Coral	Van Soest, 1980
Cribrochalina vasculum	94	Desecheo Is., PR	Coral	This study

Table 12. (cont.) Sponges reported from depths below 30 meters in Puerto Rico and the USVI

SPECIES	Max. Depth (meters)	Locality	Bottom Type	Expedition/ Reference
Dactylella rhaphoxea	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Dendrospongia crassa	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Densa araminta	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Diplastrella sp.	83	St. Thomas	Coral	Armstrong et al., in press
Erylus alleni	119	San Juan, PR	Hard bottom, Coral	Caroline, 1933
Foliolina peltata	217	Mayaguez, PR	Coral	Fish Hawk, 1899
Gelliodes leucosolenia	543	Jost Van Dyke, USVI	Hard bottom	Caroline, 1933
Geodia neptuni	94	Desecheo Is., PR	Coral	This study
Haliclona pellasarca	54	Desecheo Is., PR	Hard bottom, Coral	Caroline, 1933
Haliclona podatypa	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Hezekia demera	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Hippospongia intestinalis	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Hircinia acuta	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Hircinia ramosa	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Hirsinia foetida	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Hirsinia variabilis	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Hyattella intestinalis	91	Mayaguez, PR	muddy, sand	Van Soest, 1980
Inflatella bartschi	181	San Juan, PR	Hard bottom	Caroline, 1933
Ircinia dendroides	91	Mayaguez, PR	muddy, sand	Van Soest, 1980
Ircinia strobilina	91	Mayaguez, PR	muddy, sand	Van Soest, 1980
Kapnesolenia fisheri	344	Jost Van Dyke, USVI	Hard bottom	Caroline, 1933
Margaritella coeloptychioides	87	Aguadilla, PR	Sand, mud	Fish Hawk, 1899
Microciona spinosa	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Mycale laevis	83	St. Thomas	Coral	Armstrong et al., in press
Neofibularia nolitangere	83	St. Thomas	Coral	Armstrong et al., in press
Niphates alba	63	La Parguera, PR	Coral	Van Soest, 1980
Niphates amorpha	91	La Parguera, PR	Coral	Van Soest, 1980
Neothenea enae	326	Desecheo Is., PR	Hard bottom, Coral	Caroline, 1933
Oceanapia bartschi	91	Puerto Rico	muddy, sand	Van Soest, 1980
Oceanapia fistulosa	91	Cerro Gordo, PR	muddy, sand	Van Soest, 1980
Oceanapia oleracea	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Oligoceras violacea	54	St. Thomas, USVI	n/d	Van Soest, 1980
Pachastrella dilifera	489	Mona Island, PR	Hard bottom, Coral	Caroline, 1933
Pachychalina amaranthus	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Pachychalina areolata	42	Vieques, PR	Coral	Fish Hawk, 1899
Pachychalina aurantiaca	42	St. Thomas, USVI	Coral	Fish Hawk, 1899

Table 12. (cont.) Sponges reported from depths below 30 meters in Puerto Rico and the USVI

SPECIES	Max. Depth (fathoms)	Locality	Bottom Type	Expedition/ Reference
Pachychalina mollis	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Pachypellina podatypa	91	Mayaguez, PR	muddy, sand	Van Soest, 1980
Petrosia weingergi	63	La Parguera, PR	Coral	Van Soest, 1980
Petrosia halichondrioides	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Pilochrota fibrosa	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Pilochrota variabilis	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Polyfibrospongia echina	67	Cerro Gordo, PR	Hard bottom, Coral	Caroline, 1933
Pseudoceratina crassa	83	St. Thomas	Coral	Armstrong et al., in press
Ridleia dendiia	453	Mona Island, PR	Hard bottom, Coral	Caroline, 1933
Roosa zyggompha	127	San Juan, PR	Hard bottom	Caroline, 1933
Siphonochalina procumbens	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Siphonochalina spiculosa	42	St. Thomas, USVI	Coral	Fish Hawk, 1899
Spinosella sororia	138	Mayaguez, PR	Rocky, Coral	Fish Hawk, 1899
Strongylacidon sp.	83	St. Thomas	Coral	Armstrong et al., in press
Strongylophora rampa	181	San Juan, PR	Hard bottom	Caroline, 1933
Stylospira mona	453	Mona Island, PR	Hard bottom, Coral	Caroline, 1933
Tethycordyla thyris	344	Jost Van Dyke, USVI	Hard bottom	Caroline, 1933
Tribrachium schmidtii	217	Mayaguez, PR	Coral	Fish Hawk, 1899
Verongula gigantea	94	Desecheo Is., PR	Coral	This study
Viles ophiraphidites	54	Desecheo Is., PR	Hard bottom, Coral	Caroline, 1933
Xestospongia portorricensis	91	Mayaguez, PR	muddy, sand	Van Soest, 1980
Xestospongia muta	91	Rincon	muddy, sand	Van Soest, 1980

space (Colin, 1978). *Ceratoporella nicholsoni* is the largest and most abundant of the western Atlantic sclerosponges. The species is known to occur as deep as 200 m and capable of constructing reef frameworks in Jamaica (Hartman and Goreau, 1972; Lang et al., 1975). The ecological role or relevance of these sponges in the deep reef systems of Puerto Rico and the USVI is presently unknown.

3. Corals (Phylum Cnidaria; Class Anthozoa; Orders Scleractinia and Antipatharia)

3.1 Scleractinian Corals

The first report of deep sea corals from the U. S. Caribbean EEZ was produced by Moseley (1881) from dredge samplings of the H. M. S. Challenger in 1873 at station 24, off the north coast of St. Thomas from a depth of approximately 700 m. Six azooxanthellate species were collected, including *Lophohelia prolifera*, a synonym of *Lophelia pertusa*, which is one of the main reef-building cold-water azooxanthellate corals in the world. Vaughan (1900) provided the initial report on the Puerto Rican corals from the collection of the "Fish Hawk" during its sampling expedition of 1899. A total of 21 species were identified from the collection, including 11 azooxanthellate (deep-water) and 10 zooxanthellate (shallow-water) species. The "Johnson-Smithsonian Expedition to the Puerto Rican Deep" collected corals from several dredging stations (Bartsch, 1933), particularly off Pta. Santiago (San Juan), and in the vicinity of Mona and Desecheo Islands (west coast). Coral samples were deposited in the Smithsonian Museum of Natural History, identified by S. Cairns, and included in the regional (Caribbean) taxonomic review of the deep-water Scleractinia prepared by Cairns (1979). During the mid and late 20th century, a series of expeditions sampled deep habitats of the Puerto Rico and USVI outer shelf and slope. These included samplings by the R/V Oregon and R/V Silver Bay at several stations off the west coast of PR, including Mona Island. The R/V Pillsbury occupied a dredging station in Vieques, PR, and another very deep (>7,000 m) station in the PR Trench.

From the material provided by the aforementioned expeditions, Cairns (1979) prepared the first regional review of the taxonomic composition and geographic distribution of the deep water ahermatypic (azooxanthellate) scleractinian corals of the Caribbean Sea and adjacent waters. A total of 88 species were initially reported by Cairns (1979), including 18 deep water coral species collected from Puertorrican waters. In a subsequent taxonomic revision of the ahermatypic corals of the Caribbean (Dawson, 2002) updated the list to a total of 129 species, including a total of 85 for PR and the West Indies. Ahermatypic coral species reported for PR and the USVI are presented in Table 13. The complete list of ahermatypic corals reported from the Caribbean Sea has been included as Appendix 1.

Table 13. Taxonomic record opf ahermatypic (azooxanthellate) corals reported from Puerto Rico and the West Indies at depths below 30 m

Species	Depth (m)	Locality	Sampling Expedition	Source
Order Scleractinia				
Astrangia astreiformis	16	Culebra, PR	Fish Hawk, 1899	Vaughan, 1900
Astrangia poculata	n/d	Puerto Rico	n/d	Dawson, 2002
Astrangia solitaria	16	Culebra, PR	Fish Hawk, 1899	Vaughan, 1900
Astrangia solitaria	n/d	Puerto Rico	n/d	Dawson, 2002
Axhelia asperula	16	Culebra, PR	Fish Hawk, 1899	Vaughan, 1900
Axhelia mirabilis	43	San Juan, PR	Fish Hawk, 1899	Vaughan, 1900
Bathyactis symmetrica	390	St. Thomas, USVI	HMS Challenger, 1873	Moseley, 1881
Caryophyllia ambrosia	476-658	San Juan, PR	Caroline, 1933	Cairns, 1979
Caryophyllia berteriana	91	San Juan, PR	Fish Hawk, 1899	Vaughan, 1900
Caryophyllia paucipata	390	St. Thomas, USVI	HMS Challenger, 1873	Moseley, 1881
Cladocora arbuscula	n/d	n/d	Fish Hawk, 1899	Vaughan, 1900
Cladocora debilis	n/d	n/d	Fish Hawk, 1899	Vaughan, 1900
Coenocyathus goreaui	n/d	Puerto Rico	n/d	Dawson, 2002
Coenosmilia arbuscula	329	Isla Desecheo, PR	Caroline, 1933	Cairns, 1979
Colangia immersa	n/d	Puerto Rico	n/d	Dawson, 2002
Cyathoceras portoricensis	43	San Juan, PR	Fish Hawk, 1899	Vaughan, 1900
Deltocyathus calcar	200-300	San Juan, PR	Caroline, 1933	Cairns, 1979
Deltocyathus eccentricus	260-360	San Juan, PR	Caroline, 1933	Cairns, 1979
Deltocyathus italicus	390	St. Thomas, USVI	HMS Challenger, 1873	Moseley, 1881
Deltocyathus italicus	108	Mayaguez, PR	Fish Hawk, 1899	Vaughan, 1900
Desmophyllum cailleti	390	St. Thomas, USVI	HMS Challenger, 1873	Moseley, 1881
Diaseris crispa	223	Mayaguez, PR	Fish Hawk, 1899	Vaughan, 1900
Fungiacyathus symmetricus	240-300	San Juan, PR	Caroline, 1933	Cairns, 1979
Lophohelia prolifera	390	St. Thomas, USVI	HMS Challenger, 1873	Moseley, 1881
Madracis asperula	n/d	Puerto Rico	n/d	Dawson, 2002
Madracis myriaster	180	Isla Desecheo, PR	Caroline, 1933	Cairns, 1979
Madrepora oculata	n/d	Puerto Rico	n/d	Dawson, 2002
Odontocyathus coronatus	390	St. Thomas, USVI	HMS Challenger, 1873	Moseley, 1881
Oxysmilia rotundifolia	n/d	Puerto Rico	n/d	Dawson, 2002
Paracyathus de filippii	30	Mayaguez, PR	Fish Hawk, 1899	Vaughan, 1900
Paracyathus pulchellus	46-90	San Juan, PR	Caroline, 1933	Cairns, 1979
Phacelocyathus flos	n/d	Puerto Rico	n/d	Cairns, 1979
Phyllangia americana	n/d	Puerto Rico	n/d	Dawson, 2002
Portualocyathus hispidus	240-600	San Juan, PR	Caroline, 1933	Cairns, 1979
Rhizosmilia gerdae	n/d	Puerto Rico	n/d	Cairns, 1979
Rhizosmilia maculata	n/d	Puerto Rico	n/d	Dawson, 2002
Schizocyathus fissilis	200-300	San Juan, PR	Caroline, 1933	Cairns, 1979
Stephanocyathus coronatus	n/d	Puerto Rico	n/d	Dawson, 2002
Stephanocyathus diadema	n/d	Puerto Rico	n/d	Dawson, 2002
Tethocyathus variabilis	240-260	Isla Mona, PR	Caroline, 1933	Cairns, 1979
Trochocyathus rawsonii	240-260	Isla Mona, PR	Caroline, 1933	Cairns, 1979
Tubastrea coccinea	n/d	Puerto Rico	n/d	Dawson, 2002

The greatest number of ahermatypic coral species in the Caribbean and adjacent waters are from a depth range of 200 - 500 meters (Cairns, 1979). Although there are "thicket-like" banks of some of the branching ahermatypes, the isolated "shrub-like" growth forms are the most frequently encountered in the deep waters of the Atlantic Ocean (Squires, 1959). Deep "coral banks" have been reported for the southern Caribbean (Santodomingo et al., 2003; Reyes et al., 2005) during exploratory surveys of the Colombian upper shelf slope. The most abundant coral species reported were *Cladocora debilis, Anomocora fecunda, Madracis myriaster, Polymices fragilis, Coenosmillia arbuscula* and *Thalamophyllia riseii* (Santodomingo et al., 2003; Reyes et al., 2005). The findings from this deep sea expedition to the Colombian Caribbean suggest that extensive deep sea coral banks may be present off the Guajira Peninsula (70 m), off Santa Marta (200 m) and nearby the San Bernardo Archipielago (150 m) (Santodomingo et al., 2003; Reyes et al., 2005).

Biogeographic patterns of ahermatypic corals in the Caribbean show a definitive trend toward increase in endemism when the faunas are ordered from greater to lesser depths, supporting the theory that the deep Atlantic Ocean is an effective barrier for the dispersal of shallow water coral species. According to Cairns (1979), the Caribbean, and specifically the Antilles is the center of diversity of scleractinian corals in the tropical western Atlantic. Away from the Caribbean, both north and south, there is a sharp reduction in the number of species (Cairns, 1979). Dawson (2002) recognized two distribution provinces of ahermatypic corals in the Caribbean. One province has a tropical and primarily insular component, while the other has a sub-tropical and primarily continental component.

There are 65 hermatypic coral species reported for the Caribbean (Cairns 1999). The vertical distribution of the hermatypic corals in Jamaica was examined by Goreau and Wells (1967). Many hermatypic (zooxanthellate) species have ample vertical distribution ranges, with at least 37 species reported to occur at depths of 30 meters of deeper (Table 14). In Jamaica, a rich and diverse assemblage of reef-coral populations occurs down to 70 meters. The deep hermatypic coral fauna of Puerto Rico and the USVI has not been properly characterized. Table 15 shows species identified during recent surveys of outer shelf and upper slope reefs by García-Sais et al (this study) and Armstrong et al. (in press).

Table 14. Hermatypic (zooxanthellate) corals reported to occur deeper than 30 meters off the shelf-edge in Jamaican waters (from Goreau & Wells, 1967)

Order Scleractinia	Depth Range (m)		
	Max	Optimum	Min
Family Astrocoenidae			
Stephanocoenia michelini	95+	3 - 50	1
Stephanocoenia sp.	65	10 - 30	3
Family Pocilloporidae			
Madracis decactis	70	5 - 40	1
Madracis sp.	95	60 - 70	35
M. mirabilis	60	3 - 40	1
Family Acroporidae			
Acropora cervicornis	50	15 - 30	1
Family Agariciidae			
Agaricia agaricites			
forma agaricites	45	7 - 20	3
forma danae	30	5 - 25	1
forma carinata	40	8 - 30	1
forma purpurea	75	3 - 45	1
forma humilis	70+	10 - 40	1
A. undata	80	35 - 70	4
A. fragilis	40	7 - 30	3
Helioseris cucullata	90	8 - 50	3
Family Siderastreidae			
Siderastrea siderea	70	3 - 20	0.5
Siderastrea radians	33	2	0.5
Family Poritidae			
Porites astreoides	70+	5 - 20	0.2
P. divaricata	47	1	0.1
P. furcata	50	6 - 20	0.2
Family Faviidae			
Favia fragum	30	2 - 8	0.2
Diploria clivosa	35	1 - 3	0.2
Diploria labyrinthiformis	43	2 - 15	0.1
Diploria strigosa	40	3 - 10	0.1
Manicina aereolata			
forma areolata	43	2 - 25	0.1
forma mayori	65	7 - 28	0.5
Colpophyllia natans	55	2 - 20	0.5
Montastrea annularis	80	3 - 45	0.3
M. cavernosa	95	10 - 60	0.5
Family Meandrinidae			
Meandrina meandrites			
forma meandrites	70	8 - 30	0.5
forma danae	80	15 - 30	8
Dichocoenia stokesii	40+	3 - 20	2
Dichocoenia sp.	72	10 - 40	3
Family Mussidae			

Table 14. Continued

Order Scleractinia	Depth Range (m)		
	Max	Optimum	Min
Mussa angulosa	59	10 - 30	1.5
Scolymia lacera	80	30-50	15
Mycetophyllia lamarckana	75	5 - 40	1
Family Caryophyllidae			
Eusmilia fastigiata			
forma fastigiata	65	3 - 30	1
forma flabellata	30	25	10

3.2 Black Corals (Order Antipatharia)

Black corals (Order Antipatharia) are known to occur in deep reefs of Puerto Rico and the USVI (Goenaga, 1977; Colin, 1978; Nelson and Appeldoorn, 1985). These are colonial cnidarians with a black, spiny-axial structure which may be bush or whip shaped. Polyps have six non-retractile, un-branched tentacles exposed on the surface of the skeleton. Black corals are generally distributed at depths greater than 30 meters, but can be found at shallower depths in caves and other cryptic habitats (Colin, 1978). At present, there are 28 species of Antipatharians reported from the Western Atlantic, 26 of which have been identified by Cairns et al. (1993) from collections in the Gulf of Mexico. Black coral specimens were examined from the Johnson Sea Link I submersible cruise south of Louisiana in 1989, collections by the University of Alabama-Dauphin Island Sea Lab, exploratory sampling cruises by the R/V Oregon, R/V Pelican, R/V Silver Bay, R/V Verill, Continental Shelf Associates, and other miscellaneous collections. From these sources, a total of 18 species have been reported from the West Indies and are presumed to be distributed in Puerto Rico and the US Virgin Islands (Table 16).

The specific taxonomy of black corals from Puerto Rico and the USVI has not been well examined. Goenaga (1977) and Colin (1978) both reported the occurrence of the Sea Whip, *Stichopathes lutkeni* from the slope off La Parguera. Colin (1978) included in his book of “Caribbean Reef Invertebrates and Plants” reports and underwater photographs of black coral species from Puerto Rico, the USVI and Bermuda. The assemblage includes *Antipathes pennacea* from the Salt River Canyon in St. Croix, and also from

Table 15. Taxonomic composition and depths of zooxanthellate scleractinian corals and hydrocorals reported from depths of at least 30 m in reef systems of Puerto Rico and the USVI.

Species	**Depth (m)**	**Locations**	**Sources**
Acropora cervicornis	30	1	1
Agaricia agaricites	30	1	1
Agaricia grahamae	40	1	1
Agaricia lamarki		1	1
Colpophyllia natans	30	1, 2	1, 2
Dichocoenia stellaris	72	3	3
Dichocoenia stokesi	40	3	3
Diploria labyrinthiformis	30	1	1
Diploria strigosa	41-46	2	2
Eusmilia fastigiata	40	1	1
Isophyllastrea rigida	41	2	2
Leptoseris cucullata	42	2	2
Madracis decactis	40	1	1
Madracis sp.	40	1, 2	1, 2
Manicina areolata	40	1	1
Meandrina meandrites	40	1	1
Montastrea annularis	40	1, 2	1, 2
Montastrea cavernosa	40	1, 2	1, 2
Montastrea faveolata	30	1	1
Mussa angulosa	40	3	3
Mycetophyllia aliciae	75	3	3
Mycetophillia ferox	30	1, 4	1, 3
Mycetophyllia lamarkiana	50	1	1
Porites astreoides	40	1, 2	1, 2
Porites divaricata	30	1	1
Scolymia cubensis	20-80	3	3
Scolymia lacera	80	3	3
Scolymia sp.	30	1, 2	1, 2
Siderastrea siderea	40	1, 3	1, 3
S. bournoni	36-41	2	2
Hydrocorals			
Millepora squarrosa	33-42	2	2
Millepora alcicornis	36-41	2	2
Stylaster roseus	40	1	1

Sources:
1- Garcia-Sais et al. (this volume)
2- Armstrong et al. (in press)
3- Colin, 1978

Locations:
1- Isla Desecheo, P.R.
2- St. Thomas, USVI
3- Puerto Rico
4-La Parguera

Monito Island in Puerto Rico (Mona Passage); *Antipathes furcata, A. hirta* and *A. tanacetum* from Bermuda and *A. atlantica* from Jamaica (Colin 1978). An additional six species of *Anthipathes*, two species of *Aphanipathes, Parantipathes testrasticha and Leiopathes glaberrima* have been reported for the West Indies (Cairns et al.,1993; Opresko, 1974) (Table 16). Plates 12 and 13 show black corals from Bajo de Sico and Guanica

A bushy type black coral that was reported by Colin (1978) as an undescribed *Antipathes sp*. was later described by Opresko (1996) as *A. caribbeana*. This species has a mostly Caribbean distribution, from Colombia to the Bahamas, Jamaica, Puerto Rico, and throughout the Greater and Lesser Antilles, but has not yet been reported from the Gulf of Mexico (Opresko, 1996). Its depth range is known to span from 11m to more than 100 m (Opresko, 1996). Nelson and Appeldoorn (1985) reported the occurrence of *Antipathes* sp. from the slope wall off Guánica, on the southwest coast of Puerto Rico. Colonies of *A. caribbeana* have been observed from the upper slope reefs in Guánica, Bajo de Sico, Ponce, and Vieques (García, unpublished data).

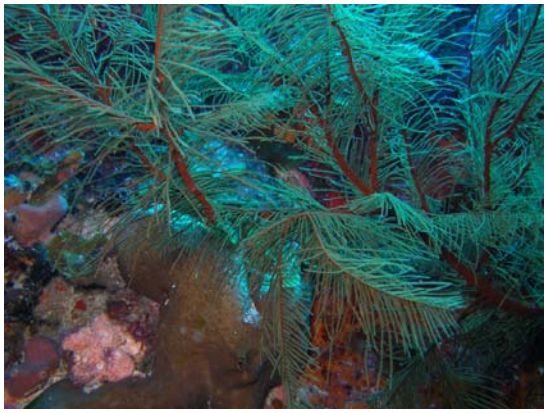


Plate 12.

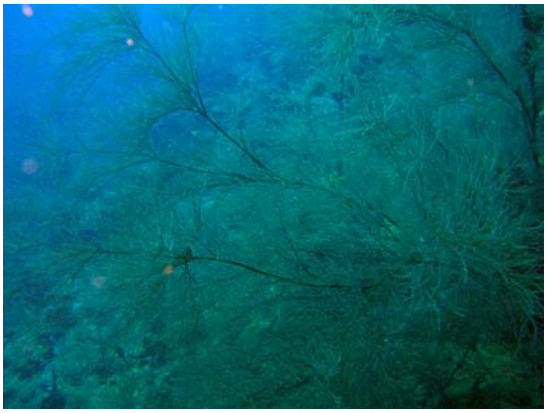


Plate 13.

Table 16. List of black corals (Anthozoa : Antipatharia) reported from the West Indies. Modified from Cairns et al. (1993).

Species	**Distribution**	**Depth Range**	**References**
Antipathes atlantica	West Indies and NW Gulf of Mexico	10 - 115 m	Brook, 1989; Warner 1981; Rezak et al.,1985
Antipathes columnaris	Dominican Republic, Lesser Antilles US Virgin Islands, Bahamas, NE South America, NW Caribbean	73 - 567 m	Opresco, 1974
Antipathes gracilis	West Indies, SW Florida	30 m	Brook, 1989; Warner 1981
Antipathes tanacetum	Lesser Antilles, Bahamas, Florida Brazil, Surinam, Venezuela, Colombia	46 - 915 m	Opresco, 1972
Antipathes hirta	Puerto Rico, NW Cuba, Guyana, Venezuela, Trinidad, Jamaica, Mexico	13 - 357 m	Opresco, 1972, Colin 1978; Warner 1981
Antipathes rigida	Lesser Antilles, Bahamas, NW Cuba	64 - 640 m	Opresco, 1972
Aphanipathes filix	Lesser Antilles, Bahamas, NW Cuba		Opresco, 1972
Antipathes furcata	throughout Caribbean, NW Cuba	30 - 72 m	Opresco, 1974
Antipathes caribbeana	Puerto Rico, US Virgin Islands, throughout Caribbean	13 – 92 m	Opresco, 1996
Antipathes pennacea	Puerto Rico, US Virgin Islands		Colin, 1978
Antipathes salix	Lesser Antilles, NW Cuba, W Florida	107 - 333 m	Opresco, 1972
Aphanipathes abietina	Lesser Antilles, Bahamas, NW Cuba, SE Louisiana	31 - 310 m	Opresco, 1972 Rezak et al., 1985
Aphanipathes humilis	Lesser Antilles, Dry Tortugas, NW Cuba, SE Louisiana	129 - 491 m	Opresco, 1972
Aphanipathes thyoides	NW Cuba, Yucatan-Mexico		Opresco, 1972
Stichopathes lutkeni	throughout Caribbean, SW Florida		Brook, 1989; Rezak et al.,1985
Bathypathes patula	Cosmopolitan	100 - 5000 m	Brook, 1989; Opresco, 1974
Parantipathes tetrasticha	Puerto Rico, Guyana, Yucatan-Mexico	175 - 428 m	Opresco, 1972
Leiopathes glaberrima	Bahamas, Florida, Yucatan-Mexico Mediterranean, NE Gulf of Mexico	176 - 549 m	Opresco, 1974

4. Alcyonarians or Gorgonians (Sub-Class Octocorallia)

The most comprehensive taxonomic review of the shallow-water Octocorallia of the West Indies was prepared by Bayer (1961) and includes several depth records below 30 m (Table 17). Among the islands of the West Indies, the Lesser Antilles (USVI to Granada) are the most thoroughly known and provide the greatest number of collecting localities (Bayer (1961). The "Fish Hawk" expedition of 1899 provided the first and still the main source of deep-water Octocorals (Alcyonarians) from Puerto Rican waters. The taxonomic report of the Alcyonaria from this expedition was produced by Hargitt and Rogers (1900). A total of 9 species of octocorals and one black coral (identified as *Antipathes tristis*) were collected from depths of at least 30 m. Unfortunately, the report by Hargitt and Rogers (1900) contains many species identifications of alcyonarians without reference to the station and/or depth of collection. The alcyonarian collection by the yatch Caroline from the Johnson-Smithsonian Expedition to the Puerto Rican Deep in 1933 was presumably examined by Dr. Bayer and included in his revision of the shallow-water Octocorallia of the West Indian Region. A regional taxonomic review of the deep-water Octocorallia is lacking at present.

The Sub-Class Octocorallia is divided into six Orders. The Order Telestacea includes the genus *Telesto*, with two species *T. riseii* and *T. corallina* reported for deep reefs of Puerto Rico (Bayer, 1961; Colin, 1978). The Order Gorgonacea includes sea fans, sea pens, sea rods, and sea plumes. This is a highly diverse and abundant taxonomic group, and a prominent structural component of many shallow-water Caribbean reefs. In Puerto Rico and the USVI there are at least 10 species distributed down to depths of at least 33 m in deep hermatypic reefs of the upper insular slope (Armstrong et al., in press). One of the most common species is the deepwater seafan, *Iciligorgia schrammi* which is abundant over hard (rocky) substate at depths between 30-40 meters in Bajo de Sico (Mona Passage) and at the shelf-edge in many localities of Puerto Rico (García-Sais-unpublished data). The devil's sea whip, *Ellisella barbadensis* is also common on deep hermatypic reefs of Puerto Rico and throughout the Caribbean down to depths of 250 m (Colin, 1978). The sea penn, *Stylatula diadema* was noted to be abundant in soft bottoms at depths between 20-30 m in turbid waters within Ponce Bay, south coast of PR (García-Sais, 2003), but has also been observed to occur in depths of more than 40 m in clear waters of the San Juan, PR outer shelf (García-Sais, 2001).

Table 17. Taxonomic record of octocorals (Alcyonarians) reported from depths of at least 30 m in Puerto Rico and the West Indies

Species	Depth (m)	Locations	Sources
Acabthogorgia aspera	407	Mayaguez, PR	Hargitt and Rogers, 1900
Callogorgia gracilis	164-1028	Hispaniola; Martinique, WI	Cairns and Bayer, 2002
C. americana americana	366-1464	Mona Passage, PR	Cairns and Bayer, 2002
Carijoa riisei	0-60	Florida, Bahamas, Caribbean	Humann, 1993
Chalcogorgia spp.	over 30	West Indies	Deichmann, 1936
Chrysogorgia desboni	407	Mayaguez, PR	Hargitt and Rogers, 1900
Chrysogorgia spp.	over 30	West Indies	Deichmann, 1936
Diodogorgia nodulifera	16-200	Florida, Bahamas, Caribbean	Humann, 1993
Ellisella barbadensis	41-46	St. Thomas, USVI	Armstrong et al. (in press)
E. elongata	16-240	Florida, Bahamas, Caribbean	Humann, 1993
Eunephthya nigra	310-880	So. Georgia to Fla. Keys	Bayer, 1961
Eunicea caliculata	2-36	Florida, Bahamas, Caribbean	Humann 1993
E. pinta	to 72	West Indies	Bayer, 1961
E. clavigera	to 140	West Indies	Bayer, 1961
E. claviculata	to 36	West Indies	Bayer, 1961
Gorgonia bipinnata	42	St. Thomas, USVI & Vieques, PR	Hargitt and Rogers, 1900
Gorgonia mariae	2-52	Caribbean	Humann, 1993
Heterogorgia uatumani	26-50	Norwest Caribbean	Humann, 1993
Iciligorgia schrammi	12-400	Florida, Bahamas, Caribbean	Humann, 1993
Iridogorgia spp.	over 30	West Indies	Deichmann, 1936
Leptogorgia virgulata	8-42	Florida, Caribbean	Humann, 1993
Leptogorgia sp.	54	Mayaguez, PR	Hargitt and Rogers, 1900
L. barbadensis	to 140	West Indies	Bayer, 1961
L. cardinalis	to 338	West Indies	Bayer, 1961
L. punicea	to 80	West Indies	Bayer, 1961
L. medusa	to 54	West Indies	Bayer, 1961
L. stheno	28-134	West Indies	Bayer, 1961
Lignella richardii	146-300	West Indies	Bayer, 1961
Metalogorgia spp.	over 30	West Indies	Deichmann, 1936
Muricea pinnata	12-40	Caribbean	Humann, 1993
M. laxa	20-140	Florida, Bahamas, Caribbean	Humann, 1993
Muriceopsis flavida	2-36	Florida, Bahamas, Caribbean	Humann, 1993
M. petila	78-588	West Indies	Bayer, 1961
Nicella goreaui	32-86	Florida, Bahamas, Caribbean	Humann, 1993
N. schmitti	22-72	Florida, Bahamas, Caribbean	Humann, 1993
Neospongodes portoricensis	76-556	Straits of Florida to Barbados	Bayer, 1961
Nidalia occidentalis	40-340	So. Carolina to Barbados	Bayer, 1961
Paramuricea hirta	217	Mayaguez, PR	Hargitt and Rogers, 1900
Pleurogorgia spp.	over 30	West Indies	Deichmann, 1936
Pseudopterogorgia sp.	2-60	Florida, Bahamas, Caribbean	Humann, 1993
P. albatrossae	to 66	Florida, Bahamas, Caribbean	Bayer, 1961
P. americana	2-50	Florida, Bahamas, Caribbean	Humann, 1993
P. bipinnata	16-60	Florida, Bahamas, Caribbean	Humann, 1993
P. hystrix	to 72	Florida, Bahamas, Caribbean	Bayer, 1961
P. flexuosa	2-50	Florida, Bahamas, Caribbean	Humann, 1993

Table 17. (Continued) Taxonomic record of octocorals …

P. macgravii	to 40	Florida, Bahamas, Caribbean	Bayer, 1961
P. nutans	10-52	Florida, Bahamas, Caribbean	Humann, 1993
P. elisabethae	4-60	Florida, Bahamas, Caribbean	Bayer, 1961
Plexaura homomalla	2-66	Florida, Bahamas, Caribbean	Humann, 1993
Plexaurella sp.	2-52	Florida, Bahamas, Caribbean	Humann, 1993
P. nutans	41-46	St. Thomas, USVI	Armstrong et al. (in press)
Pseudoplexaura porosa	to 310	West Indies	Bayer, 1961
Pseudoplexaura sp.	2-82	Florida, Bahamas, Caribbean	Humann, 1993
Renilla reniformis	over 30	Western Atlantic	Bayer, 1961
R. mulleri	over 30	Gulf coast to Brasil	Bayer, 1961
Radicipes spp.	over 30	West Indies	Deichmann, 1936
Solanderia crustata		Mayaguez, PR	Hargitt and Rogers, 1900
Solanderia nodulifera	60	St. Thomas, USVI	Hargitt and Rogers, 1900
Spongodes portoricensis	138	Mayaguez, PR	Hargitt and Rogers, 1900
Stylatula diadema	over 30	Western Atlantic	Bayer, 1961
S. antillarum	over 30	Western Atlantic	Bayer, 1961
S. brasiliensis	over 30	Western Atlantic	Bayer, 1961
S. elegans	over 30	Western Atlantic	Bayer, 1961
Stereotelesto corallina	26-200	Bahamas, Eastern Caribbean	Humann, 1993
Swiftia exserta	14-86	Florida, Bahamas, Caribbean	Humann, 1993
Telesto corallina	76-140	Puerto Rico to Barbados	Bayer, 1961
T. riisei	30	Florida to Brazil; San Juan, PR	Colin, 1978
T. sanguinea	26-120	So. Carolina to Florida keys	Bayer, 1961
Thesea nivea	26-400	Eastern caribbean	Humann, 1993
Titanideum frauenfeldii	16-86	Florida	Humann, 1993
Trichogorgia spp.	over 30	West Indies	Deichmann, 1936
Virgularia presbytes	18-64	Southeast US to Surinam	Bayer, 1961

D. Taxonomic Characterization of the Motile Megabenthic Invertebrates from Deep Reef Habitats of PR and the USVI

1. Echinoderms (Phylum Echinodermata)

The Phylum Echinodermata includes four main classes of organisms that have been collected from deep reef habitats in waters of Puerto Rico and the USVI. The main sources of these collections include the initial dredge sampling from the H. M. S. Challenger in 1873 off St. Thomas, samplings of the "Fish Hawk" in the west, north and eastern shelf and slope of Puerto Rico, including the Islands of Vieques, Culebra and St. Thomas in 1899; and the samplings bt the Yatch Caroline of the Johnson-Smithsonian Expedition of 1933. Other minor collections include several stations dredged by the R/V Oregon in 1959 within the west coast of PR, and the R/V Pillsbury, which sampled Isla de Vieques and the Puertorrican Trench (north of PR) between 1969 and 1971. A total of 134 species of echinoderms have been reported. The brittlestars (Class Ophiuroidea) are the most specious taxonomic group collected in deep water habitats with 69 species (Table 18).

Table 18. Taxonomic record of echinoderms collected from depths of at least 30 m in waters of Puerto Rico and the U. S. Virgin Islands. Modified from the Smithsonian Museum of Natural History data base.

	Species	**Depth**	**Locality**	**Expedition**
Class Asteroidea				
	Anthenoides piercei	7956	Puerto Rico Trench	Pillsbury, 1971
	Astropecten cingulatus	457	Mayaguez, PR	Oregon, 1959
	Astropecten cingulatus	293	Mayaguez, PR	Oregon, 1959
	Cheiraster (Cheiraster) sepitus	1510	San Juan, PR	Pillsbury, 1971
	Henricia sp.	329	Boqueron, PR	Oregon, 1959
	Litonotaster intermedius	1510	San Juan, PR	Pillsbury, 1971
	Luidia ludwigi scotti	7956	Puerto Rico Trench	Pillsbury, 1971
	Nymphaster arenatus	1510	San Juan, PR	Pillsbury, 1971
	Odinia antillensis	622	Mayaguez, PR	Caroline, 1933
	Plutonaster efflorescens	1510	San Juan, PR	Pillsbury, 1971
	Pseudarchaster sp.	457	Mayaguez, PR	Oregon, 1959
	Tamaria halperni	329	Mayaguez, PR	Oregon, 1959
	Thoracaster cylindratus	4366	Vieques Island, PR	Pillsbury, 1971
	Zoroaster fulgens	229	Mayaguez, PR	Oregon, 1959
	Zoroaster fulgens	421	Mayaguez, PR	Oregon, 1959

Table 18. (Continued)

	Astropecten antillensis	137	Aguadilla, PR	Fish Hawk, 1899
	Brisisnga cricophora	390	St. Thomas, USVI	Challenger, 1873
	Luidia senegalensis	137	Aguadilla, PR	Fish Hawk, 1899
	Pontaceros reticulatus	137	Aguadilla, PR	Fish Hawk, 1899
Crinoidea				
	Coccometra nigrolineata	219	Mayaguez, PR	Fish Hawk, 1899
	Comactinia echinoptera	220	San Juan, PR	Caroline, 1933
	Comactinia echinoptera	139	Mayaguez, PR	Fish Hawk, 1899
	Comactinia echinoptera	315	Mayaguez, PR	Fish Hawk, 1899
	Comactinia echinoptera	956	Puerto Rico Trench	Pillsbury, 1971
	Crinometra brevipinna	549	Mona Passage, PR	Caroline, 1933
	Crinometra brevipinna	549	Mona Passage, PR	Caroline, 1933
	Crinometra brevipinna	549	Mona Passage, PR	Caroline, 1933
	Crinometra brevipinna	7956	Puerto Rico Trench	Pillsbury, 1971
	Crinometra brevipinna	229		Oregon, 1959
	Democrinus rawsoni	7956	Puerto Rico Trench	Pillsbury, 1971
	Diplocrinus carolinae	622	Punta Jiguero	Caroline, 1933
	Endoxocrinus parrae	549	Mona Passage, PR	Caroline, 1933
	Endoxocrinus parrae	402	Mona Passage, PR	Caroline, 1933
	Endoxocrinus parrae	475	Mona Passage, PR	Oregon, 1959
	Endoxocrinus parrae	384	Mona Passage, PR	Oregon, 1959
	Endoxocrinus parra	329		Oregon, 1959
	Horaeometra duplex	549	Mona Passage, PR	Caroline, 1933
	Horaeometra duplex	476	Mona Passage, PR	Caroline, 1933
	Leptonemaster venustus	329	Punta Jiguero	Caroline, 1933
	Leptonemaster venustus	220	San Juan, PR	Caroline, 1933
	Nemaster sp.	293	San Juan, PR	Caroline, 1933
	Neocomatella alata	549	Mona Passage, PR	Caroline, 1933
	Neocomatella alata	549	Mona Passage, PR	Caroline, 1933
	Neocrinus blakei	329	Cape Rojo	Oregon, 1959
	Neocrinus decorus	548	Mona Passage, PR	Caroline R/V
	Neocrinus decorus	229	Aguadilla Bay	Oregon, 1959
	Neocrinus decorus	549	Mona Passage, PR	Caroline, 1933
	Psathyrometra acuta	256		Caroline, 1933
	Psathyrometra acuta	256		Caroline, 1933
	Psathyrometra acuta	256		Caroline, 1933
	Stylometra spinifera	229		Oregon, 1959
Echinoidea				
	Agassizia excentrica	329		Caroline, 1933
	Araeosoma belli	411	Mayaguez, PR	Fish Hawk, 1899
	Araeosoma fenestratum	411	Mayaguez, PR	Fish Hawk, 1899

Table 18. Continued.

	Brissopsis atlantica Mortensen	439		Oregon, 1959
	Clypeaster chesheri	640	San Juan, PR	Caroline, 1933
	Conolampas sigsbei	274	Mona Passage, PR	Silver Bay R/V
	Dorocidaris rugosa	411	Mayaguez, PR	Fish Hawk, 1899
	Heterobrissus hystrix	411	Mayaguez, PR	Fish Hawk, 1899
	Lytechinus euerces	366		Silver Bay R/V
	Lytechinus euerces	274	Mona Passage, PR	Silver Bay R/V
	Stylocidaris lineata	549		Caroline, 1933
	Stylocidaris lineata	219	Mayaguez, PR	Fish Hawk, 1899
	Tretocidaris bartletti	7956	Puerto Rico Trench	Pillsbury R/V
Ophiuroidea				
	Amphiodia gyraspis	139	Mayaguez, PR	Fish Hawk, 1899
	Amphioplus abditus	315	Mayaguez, PR	Fish Hawk, 1899
	Amphioplus abditus	139	Mayaguez, PR	Fish Hawk, 1899
	Amphipholis goesi	251	Desecheo Is., PR	Fish Hawk, 1899
	Amphiura bihamula	166	San Juan, PR	Fish Hawk, 1899
	Amphiura otteri	146		Caroline, 1933
	Amphiura palmeri	256		Caroline, 1933
	Amphiura rathbuni	315	Mayaguez, PR	Fish Hawk, 1899
	Asteronyx loveni	402		Caroline, 1933
	Asteroporpa annulata	139	Mayaguez, PR	Fish Hawk, 1899
	Asteroschema laeve	256		Caroline, 1933
	Asteroschema oligactes	256		Caroline, 1933
	Asteroschema oligactes	219	Mayaguez, PR	Fish Hawk, 1899
	Ophiacantha fraterna	732		Caroline, 1933
	Ophiacantha fraterna	476		Caroline, 1933
	Ophiacantha fraterna	549		Caroline, 1933
	Ophiacantha pentacrinus	402		Caroline, 1933
	Ophiacantha pentacrinus	402		Caroline, 1933
	Ophiacantha permixta	549		Caroline, 1933
	Ophiacantha permixta	274		Caroline, 1933
	Ophiacantha sertata	274		Caroline, 1933
	Ophiacantha sp.	402		Caroline, 1933
	Ophialcaea glabra	166	San Juan, PR	Fish Hawk, 1899
	Ophiocamax austera	549		Caroline, 1933
	Ophiogeron supinus	402		Caroline, 1933
	Ophiogeron supinus	256		Caroline, 1933
	Ophiogeron supinus	402		Caroline, 1933
	Ophiogeron supinus	274		Caroline, 1933
	Ophioleuce depressa	274		Caroline, 1933
	Ophioleuce depressa	274		Caroline, 1933
	Ophiomitrella laevipellis	402		Caroline, 1933

Table 18. Continued.

Ophiomitrella laevipellis	439		Caroline, 1933
Ophiomitrella laevipellis	183		Caroline, 1933
Ophiomitrella laevipellis	549		Caroline, 1933
Ophiomitrella laevipellis	256		Caroline, 1933
Ophiomitrella laevipellis	549		Caroline, 1933
Ophiomitrella laevipellis	256		Caroline, 1933
Ophiomitrella laevipellis	256		Caroline, 1933
Ophiomitrella laevipellis	256		Caroline, 1933
Ophiomitrella laevipellis	402		Caroline, 1933
Ophiomusium eburneum	549		Caroline, 1933
Ophiomusium eburneum	256		Caroline, 1933
Ophiomusium eburneum	139	Mayaguez, PR	Fish Hawk, 1899
Ophiomusium regulare	549		Caroline, 1933
Ophiomusium rosaceum	256		Caroline, 1933
Ophiomusium rosaceum	402		Caroline, 1933
Ophiomusium sculptum	219	Mayaguez, PR	Fish Hawk, 1899
Ophioplax ljungmani Lyman	219	Mayaguez, PR	Fish Hawk, 1899
Ophioplinthaca spinissima	219	Mayaguez, PR	Fish Hawk, 1899
Ophiopristis hirsuta	256		Caroline, 1933
Ophiopsila fulva	219	Mayaguez, PR	Fish Hawk, 1899
Ophioscolex disacanthus	549		Caroline, 1933
Ophioscolex serratus	166	San Juan Harbor	Fish Hawk, 1899
Ophiothrix angulata	139	Mayaguez, PR	Fish Hawk, 1899
Ophiothrix angulata	219	Mayaguez, PR	Fish Hawk, 1899
Ophiothrix (Cheiraster) spiculata	1510	San Juan	Pillsbury, 1971
Ophiothrix suensoni	219	Mayaguez, PR	Fish Hawk, 1899
Ophiothyreus goesi	274		Caroline, 1933
Ophiothyreus goesi	219	Mayaguez, PR	Fish Hawk, 1899
Ophiozonella nivea compta	274		Caroline, 1933
Ophiozonella nivea compta	549		Caroline, 1933
Ophiozonella nivea	166	San Juan Harbor	Fish Hawk, 1899
Ophiozonella tessellata	549		Caroline, 1933
Ophiozonella tessellata	256		Caroline, 1933
Ophiozonella tessellata	256		Caroline, 1933
Ophiozonella tessellata	219	Mayaguez, PR	Fish Hawk, 1899
Ophiura ljungman	402		Caroline, 1933
Ophiura robusta	166	San Juan Harbor	Fish Hawk, 1899
Ophiura robusta	219	Mayaguez, PR	Fish Hawk, 1899

2. Decapod Crustaceans (Lobsters, Crabs, Shrimps)

According to the taxonomic update of decapod crustaceans prepared by Grana (2005 b), a total of 361 species, included in 65 families have been reported from Puerto Rico and the U. S. Virgin Islands at depths of at least 30 m (Table 19). Some of the most specious families include the Panopeidae (Mud crabs – 28 spp), Galatheidae (Squat lobsters – 25 spp), Mithacidae (Clinging crabs – 23 spp), Xanthidae (Rubble crabs – 20 spp), and Penaeidae (Penaeid shrimps - 16 spp). The actual species richness may be biased towards representative organisms of habitat (substrate) types more effectively sampled by dredging gear. Most of the species (209) have been collected from upper slope habitats, within a depth range of 30 - 200 m.

Specious rich families of decapod crustaceans from the upper slope include the Mithracidae (19 spp.), Alphidae (Snapping shrimps – 13 spp.), Pinnotheridae (Pea crabs – 10 spp), Paguridae (Right-handed hermit crabs – 9 spp), Diageneidae (Left-handed hermit crabs – 8 spp), and Penaeidae (8 spp). From the mid-slope, at depths between 201 – 500 m, a total of 81 species have been reported. The most specious families within this depth range include the Xanthidae and Paguridae with seven spp, Palicidae (Stilt crabs) with five spp, and the Panopeidae (Mud crabs), Calappidae (Box crabs), Leucosidae (Purse crabs) and Galatheidae with four species each. From the base of the insular slope, at (max) depths between 500 – 1200 m, the most specious families include the Galatheidae (11 spp), Pandalidae (Stretched shrimps - 7 spp.) and Penaidae (5 spp.). Below a depth of 1,200 m, a total of 19 species have been reported. Both the Galatheidae and the Polychelidae (Clawed shrimps) include four species reported below 1,200 m within their family group. The deepest record is from *Ethusina abyssicola* (Fam. Dorippidae – Sumo crabs), collected from a depth of 4, 026 m. Many decapod crustaceans from deep water habitats exhibit wide bathymetric ranges that may encompass 500 m or more. This includes a group of at least 80 species.

From our observations in deep hermatypic reefs of Puerto Rico, at depths between 30 and 50 m, the most abundant species of (megabenthic, non-criptic) decapod crustaceans include the Banded coral shrimp, *Stenopus hispidus*, and the Arrow crab, *Stenorhinchus seticornis*. The later was not included in the updated taxonomic review by Grana (2005 b).

Table 19. Taxonomic record of decapod crustacea (Brachyura, Macrura, Anomura) collected from Puerto Rico and/or the U. S. Virgin Islands at depths of at least 30 m. (modified from Grana, 2005b)

Filum Arthropoda

Class Malacostraca- Order Decapoda

Sub-Order Natantia - Shrimps and Prawns	**Depth Range (m)**
Species	
FAM. ARISTEIDAE (Gamba Prawns)	
Aristaemorpha foliacea	90-1300
FAM. PANAEIDAE (Penaeid Shrimps)	
Farfantepenaeus aztecus	0-180
Farfantepenaeus brasiliensis	0-1910
Farfantepenaus duorarum	0-400
Farfantepenaeus notialis	0-720
Farfantepenaeus subtilis	0-190
Litopenaeus schmitti	0-50
Litopenaeus setiferus	0-82
Metapenaeopsis goodei	0-360
Metapenaeopsis martinella	0-137
Parapenaeus americanus	54-450
Parapenaeus longirostris	30-822
Parapenaeus politus	3-752
Penaeopsis serrata	120-800
Rimapenaeus constrictus	0-130
Rimapenaeus similis	0-100
Xiphopenaeus kroyeri	0-70
FAM. SICYONIIDAE (Rock Shrimps)	
Sicyonia burkenroadi	33-136
Sicyonia dorsalis	0-460
Sicyonia laevigata	0-100
Sicyonia olgae	0-622
Sicyonia parri	0-90
Sicyonia stimpsoni	20-822
Sicyonia typica	0-101
FAM. SOLENOCERIDAE (Solenocerid Shrimps)	
Hymenopenaeus robustus	70-1000
Mesopenaeus tropicalis	6-400
Solenocera acuminata	31-622
Solenocera atlantidis	10-360
FAM. LUCIFERIDAE (Lamp Shrimps)	
Lucifer faxoni	0-55
FAM. SERGESTIDAE (Sergestid Shrimps)	
Acetes americanus	0-40

Species	**Depth Range (m)**
FAM. STENOPODIDAE (Coral Shrimps)	
Stenopus hispidus	0-210
Stenopus scutellatus	0-113
FAM. PASIPHAEIDAE (Glass Shrimps)	
Leptochela carinata	0-56
Leptochela serratorbita	0-110
FAM. OPLOPHORIDAE (Deepsea Shrimps)	
Oplophorus gracilirostris	100-2400
FAM. GNATHOPHYLLIDAE (Bumblebee Shrimps)	
Gnathophyllum americanum	0-50
FAM. PALAEMONIDAE (Prawns)	
Brachycarpus biunguiculatus	0-156
Leander tenuicornis	0-72
Periclimenaeus atlanticus	40-46
Periclimenes americanus	0-80
Periclimenes iridescens	160-200
Periclimenes longicaudatus	0-60
FAM. ALPHEIDAE (Snapping Shrimps)	
Alpheus amblionyx	0-67
Alpheus cristulifrons	0-40
Alpheus cylindricus	0-82
Alpheus floridanus	0-81
Alpheus formosus	0-42
Alpheus heterochaelis	0-30
Alpheus intrinsecus	0-30
Automate evermanni	24-274
Synalpheus brooksi	0-336
Synalpheus fritzmuelleri	0-56
Synalpheus longicarpus	0-56
Synalpheus minus	0-68
Synalpheus pectiniger	0-52
Synalpheus rathbunae	24-66
Synalpheus sanctithomae	40-46
Synalpheus townsendi	0-840

Table 19. (Continued)

Species	(m)
FAM. HIPPOLYTIDAE (Cock Shrimps)	
Lysmata grabhami	0-30
Lysmata wurdemanni	0-30
Thor paschalis	0-46
Trachycaris restricta	0-100
Trachycaris rugosa	0-780
FAM. PROCESSIDAE (Night Shrimps)	
Processa canaliculata	0-600
Processa profunda	185-348
Processa vicina	46-91
FAM. PANDALIDAE (Stretched Shrimps)	
Heterocarpus cutressi	320-780
Heterocarpus ensifer	146-885
Pantomus parvulus	100-496
Parapandalus narval	10-910
Plesionika acanthonotus	190-1350
Plesionika edwardsii	50-686
Plesionika ensis	100-1250
Plesionika laevis	270-600
Plesionika longicauda	196-450
Plesionika longipes	196-440
Plesionika macropoda	320-780
FAM. CRANGONIDAE (Sand Shrimps)	
Parapontocaris caribbaea	366-546
Parapontocaris vicina	366-549
FAM. GLYPHOCRANGONIDAE (Armored Shrimps)	
Glyphocrangon longleyi	366-837
Glyphocrangon nobilis	666-2262
FAM. CALLIANASSIDAE (Ghost Shrimps)	
Cheramus marginatus	44-274
Crosniera minima	50-60
Neocallichirus rathbunae	0-40
FAM. AXIIDAE (Lobster Shrimps)	
Axiopsis inaequalis	322-344
Axius caribbaeus	176-436
Metaxius microps	230
FAM. POLYCHELIDAE (Clawed Shrimps)	
Polycheles crucifer	900-2262
Polycheles typhlops	183-3412
Stereomastis sculpta	230-4000

Species	(m)
Sub-Order Macrura-Lobsters	
FAM. NEPHROPIDAE (Clawed Lobsters)	
Acanthacaris caeca	290-880
Metanephrops binghami	230-700
Nephropsis aculeata	130-830
Nephropsis agassizii	600-2867
FAM. PALINURIDAE (Spiny Lobsters)	
Justitia longimanus	0-456
Panulirus argus	0-90
FAM. SCYLLARIDAE (Slipper Lobsters)	
Parribacus antarcticus	0-150
Scyllarides aequinoctialis	10-180
Scyllarides nodifer	0-100
Scyllarus americanus	0-360
Scyllarus chacei	18-200
Scyllarus depressus	32-288
FAM. SYNAXIDAE (Furry Lobsters)	
Palinurellus gundlachi	20-43
FAM. GALATHEIDAE (Squat Lobsters)	
Agononida longipes	40-810
Munida affinis	236-1000
Munida angulata	42-46
Munida evermanni	271-520
Munida flinti	11-630
Munida forceps	80-950
Munida irrasa	42-520
Munida microphtalma	200-1366
Munida pusilla	34-146
Munida sculpta	112-116
Munida stimpsoni	146-2210
Munida striata	390-550
Munida valida	270-1152
Munidopsis alaminos	448-904
Munidopsis armata	740-1366
Munidopsis bradleyi	492-914
Munidopsis brevimana	480-600
Munidopsis erinacea	212-1574
Munidopsis longimanus	48-638
Munidopsis platirostris	101-842
Munidopsis reynoldsi	47-52
Munidopsis riveroi	270-720
Munidopsis sharreri	326-496
Munidopsis sigsbei)	740-1950
Munidopsis spinifer	214-2030

Table 19. (Continued)

Species	**(m)**
Sub-Order Brachyura - Crabs	
FAM. CHIROSTYLIDAE (Thinclaw Crabs)	
Uroptychus nitidus	176-2140
Uroptychus rugosus	520
Uroptychus uncifer	174-530
FAM. PORCELLANIDAE (Porcelain Crabs)	
Megalobrachium soriatum	0-50
Pachycheles ackleianus	0-74
Pachycheles rugimanus	24-158
Petrolisthes politus	0-220
Porcellana sayana	3-780
Porcellana sigsbeiana	16-430
FAM. ALBUNEIDAE (Mole Crabs)	
Albunea gibbesii	0-70
Albunea paretii	0-100
FAM. DIOGENIDAE (Left-handed Hermit Crabs)	
Calcinus tibicen	0-36
Cancellus ornatus	37-366
Dardanus fucosus	45-365
Dardanus insignis	19-500
Dardanus venosus	0-100
Paguristes cadenati	0-32
Paguristes erythrops	0-53
Paguristes oxyophthalmus	20-306
Paguristes puncticeps	0-102
Paguristes rectifrons	28-150
Paguristes sericeus	10-110
Petrochirus diogenes	0-128
FAM. PAGURIDAE (Right-handed Hermit Crabs)	
Agaricochirus alexandri	36-241
Agaricochirus gibbosimanus	200-800
Iridopagurus caribbensis	0-50
Iridopagurus dispar	0-36
Iridopagurus iris	64-713
Iridopagurus margaritensis	Nov-91
Iridopagurus reticulatus	0-38
Iridopagurus violaceus	18-256
Pagurus annulipes	0-46
Pagurus brevidactylus	0-50
Pagurus criniticornis	0-50
Pagurus provenzanoi	0-100
Phimochirus holthuisi	0-210
Phimochirus leurocarpus	38-202
Phimochirus occlusus	103-640

Species	**(m)**
FAM. PAGURIDAE (continued)	
Phimochirus randalli	15-91
Pylopaguropsis atlantica	95-204
Pylopagurus discoidalis	50-1860
Tomopagurus chacei	80-519
Tomopagurus cokeri	40-305
Tomopagurus cubensis	180-370
Tomopagurus rubropunctatus	80-360
Tomopagurus wassi	40-360
Xylopagurus rectus	150-292
FAM. PARAPAGURIDAE (Deep-water Hermit Crabs)	
Oncopagurus gracilis	146-634
Parapagurus pilimanus	36-2034
FAM. DROMIIDAE (Sponge Crabs)	
Cryptodromiopsis antillensis)	0-340
Dromia erythropus	0-360
Hypoconcha arcuata	0-66
Hypoconcha parasitica	0-98
FAM. HOMOLIDAE (Carrier Crabs)	
Homola barbata	55-746
FAM. RANINIDAE (Frog Crabs)	
Lyreidus bairdii	117-824
Ranilia muricata	15-112
Raninoides lamarcki	15-440
Raninoides loevis	0-200
FAM. SYMETHIDAE (Nymph Crabs)	
Symethis variolosa	18-120
FAM. CYCLODORIPPIDAE (Waxy Crabs)	
Cyclodorippe agassizii	229-643
Cyclodorippe antennaria	90-686
Cyclodorippe bouvieri	275-549
Clythroceros nitidus	13-531
Deilocerus perpusillus	27-180
FAM. CYMONOMIDAE (Swollen Crabs)	
Cymonomus quadratus	182-930
Cymopolus agassizi	126-549

Table 19. (Continued)

Species	**(m)**
FAM. DORIPPIDAE (Sumo Crabs)	
Ethusa mascarone americana	0-90
Ethusa microphtalma	108-822
Ethusa truncata	0-146
Ethusina abyssicola	860-4026
FAM. CALAPPIDAE (Box Crabs)	
Acanthocarpus alexandri	57-1034
Acanthocarpus bispinosus	270-394
Calappa gallus	0-220
Calappa ocellata	0-80
Calappa sulcata	0-200
Calappa tortugae	0-300
Cryptosoma balguerii	0-230
FAM. HEPATIDAE (Liver Crabs)	
Hepatus epheliticus	0-60
Hepatus pudibundus	0-160
Osachila antillensis	45-481
FAM. LEUCOSIIDAE (Purse Crabs)	
Acanthilia intermedia	10-360
Callidactylus asper	15-393
Ebalia cariosa	0-131
Ebalia stimpsonii	13-83
Iliacantha liodactylus	13-130
Iliacantha sparsa	20-150
Iliacantha subglobosa	27-430
Myropsis quinquespinosa	90-1030
Persephona lichtensteinii	20-70
Persephona mediterranea	0-60
Persephona punctata	0-41
Speloeophorus pontifer	0-228
FAM. EPIALTIDAE (Algae Crabs)	
Epialtus longirostris	0-54
Sphenocarcinus corrosus	165-365
FAM. INACHIDAE (Inachid Crabs)	
Aepinus semtemspinosus	15-160
Anomalothir furcilatus	50-773
Metoporhaphis calcarata	0-98
Podochela curvirostris	134-420
Podochela gracilipes	0-240
Podochela grossipes	18-76
Podochela riisei	0-140
Podochela sidneyi	0-204
Stenorhynchus seticornis	0-1628

Species	**(m)**
FAM. INACHOIDIDAE (Inachoidid Crabs)	
Anasimus fugax	60-330
Arachnopsis filipes	30-240
Batrachonotus fragosus	0-247
Collodes robustus	0-150
Euprognatha rastellifera acuta	27-682
Euprognatha rastellifera marthae	28-708
Euprognatha rastellifera rastellifera	81-502
Inachoides forceps	15-750
FAM. MAJIDAE (Spider Crabs)	
Trachymaia cornuta	150-619
FAM. MITHRACIDAE (Clinging Crabs)	
Hemus cristulipes	0-70
Leptopisa setirostris	0-80
Macrocoeloma concavum	30-215
Macrocoeloma eutheca	70-153
Macrocoeloma laevigatum	0-30
Macrocoeloma trispinosum	0-90
Microphrys antillensis	0-40
Microphrys bicornutus	0-70
Microphrys interruptus	0-50
Mithraculus coryphe	0-60
Mithraculus forceps	0-90
Mithraculus ruber	0-46
Mithraculus sculptus	0-60
Mithrax caribbaeus	0-56
Mithrax cornutus	20-458
Mithrax hemphilli	0-60
Mithrax hispidus	0-72
Mithrax pleuracanthus	0-56
Mithrax spinosissimus	0-179
Stenocionops furcata coelata	0-120
Stenocionops furcata furcata	0-556
Stenocionops spinosissima	48-600
Teleophrys ornatus	0-45
FAM. PISIDAE (Pea Crabs)	
Chorinus heros	0-50
Herbstia depressa	60-700
Pelia mutica	0-51
Rochinia hystrix	36-708
Rochinia umbonata	161-915
FAM. TYCHIDAE (Opportunistic Crabs)	
Picroceroides tubularis	20-90
Pitho ihermineri	0-200

Table 19. (Continued)

Species	**(m)**
FAM. ATELECYCLIDAE (Horse Crabs)	
Trichopeltarion nobile	270-739
FAM. PARTHENOPIDAE (Elbow Crabs)	
Celatopesia concava	0-110
Heterocrypta granulata	0-140
Heterocrypta lapidea	0-180
Leiolambrus nitidus	0-80
Mesorhoea sexpinosa	0-210
Mimilambrus wileyi	18-31
Parthenope agona	0-428
Platylambrus fraterculus	0-220
Platylambrus guerini	15-30
Platylambrus pourtalesii	18-380
Platylambrus serratus	0-200
Solenolambrus typicus	90-622
Thyrolambrus astroides	50-370
FAM. GERYONIDAE (Deepsea Crabs)	
Geryon quinquedens	366-1695
FAM. PORTUNIDAE (Swimming Crabs)	
Arenaeus cribarius	0-70
Callinectes danae	0-76
Callinectes ornatus	0-75
Callinectes sapidus	0-98
Cronius ruber	0-110
Cronius tumidulus	0-75
Laleonectes vocans	40-310
Lupella forceps	20-150
Portunus gibbesii	0-393
Portunus ordwayi	0-360
Portunus sebae	0-30
Portunus spinicarpus	0-600
Portunus spinimanus	0-900
Portunus ventralis	0-420
FAM. CARPILIIDAE (Coral Crabs)	
Carpilius corallinus	0-46
FAM. GONEPLACIDAE (Squareback Crabs)	
Bathyplax typhlus	400-1205
Chasmocarcinus cylindricus	15-2150
Chasmocarcinus typicus	15-200
Euryplax nitida	0-98
Frevillea barbata	54-201
Frevillea hirsuta	73-476
Goneplax sigsbei	168-299
FAM. MENIPPIDAE (Stone Crabs)	
Menippe mercenaria	0-50
FAM. PANOPEIDAE (Mud Crabs)	
Eucratopsis crassimanus	0-80
Hexapanopeus angustifrons	0-139
Hexapanopeus caribbaeus	0-55
Panopeus rugosus	0-50
Panoplax depressa	0-100
FAM. PILUMNIDAE (Hairy Crabs)	
Pilumnus caribaeus	0-36
Pilumnus dasypodus	0-32
Pilumnus diomedeae	40-340
Pilumnus gemmatus	0-42
Pilumnus reticulatus	0-75
Pilumnus sayi	0-98
FAM. PSEUDORHOMBILIDAE (False Squareback Crabs)	
Nanoplax xanthiformis	0-330
Pseudorhombila quadridentata	0-55
FAM. TRAPEZIIDAE (Guard Crabs)	
Domecia acanthophora	0-146
Garthiope barbadensis	0-30
FAM. XANTHIDAE (Rubble Crabs)	
Actaea bifrons	0-80
Allactaea lithostrota	50-640
Banareia palmeri	0-156
Cataleptodius floridanus	0-35
Chlorodiella longimana	0-154
Edwardsium spinimanus	15-55
Melybia thalamita	0-200
Micropanope lobifrons	36-310
Micropanope nuttingi	0-183
Micropanope pusilla	30-310
Micropanope scultipes	15-311
Micropanope urinator	150-460
Paractaea rufopunctata nodosa	0-220
Paraliomera dispar	0-154
Paraliomera longimana	0-154
Platypodiella spectabilis	0-185
Pseudomedaeus agassizi	0-220
Eucratodes agassizii	156-395
Speocarcinus carolinensis	0-150
Tetraxanthus rathbunae	20-622

Table 19. (Continued)

Species	**(m)**
FAM. PINNOTHERIDAE (Commensal Pea Crabs)	
Dissodactylus crinitichelis	0-80
Dissodactylus encopei	0-50
Dissodactylus primitivus	0-43
Parapinnixa bouvieri	0-75
Parapinnixa hendersoni	0-60
Pinnixa sayana	0-75
Tumidotheres maculatus	0-50
FAM. PALICIDAE (Stilt Crabs)	
Palicus affinis	20-215
Palicus alternatus	0-285
Palicus cursor	192-1852
Palicus dentatus	27-481
Palicus depressus	103-463
Palicus gracilipes	109-563
Palicus gracilis	180-504
FAM. GRAPSIDAE (Shore Crabs)	
Geograpsus lividus	0-150
FAM. PLAGUSIIDAE (Spray Crabs)	
Euchirograpsus americanus	30-509
Euchirograpsus antillensis	192-366

3. Mollusks

A rich collection of more than 650 species of mollusks has been reported from deep waters around Puerto Rico and the U. S. Virgin Islands (Bartsch, 1934). From the dredge sampling of the H. M. S. Challenger at station 24 (depth: 706 m), north of St. Thomas, Watson (1886) identified 153 species of mollusks (Scaphopoda and Gasteropoda). Mollusks were also reported from the dredge samplings of the "Fish Hawk" (Dall and Simpson, 1900), and from the Johnson-Smithsonian Expedition to the Puerto Rican Deep aboard the Yatch "Caroline" in 1933 (Bartsch, 1934; Cooper, 1934; Corea, 1934). A collection of seven cephalopods (Order Sepioidea) were reported from Voss (1958) from mid-water trawl samplings by the R/V Atlantis in waters of the north coast of Puerto Rico. Samplings of the R/V Oregon and R/V Pillbury also contributed to the taxonomic record of the deep water mollusks from the U. S. Caribbean EEZ. The Queen Conch (*Strombus gigas*) was recently reported from a depth of 40 m off the south coast of St. Thomas by Armstrong et al. (in press).

E. Fishes Associated with Deep Sea Habitats in Puerto Rico and the U. S. Virgin Islands

Taxonomic characterizations of fish communities from deep habitats in Puerto Rico and the U. S. Virgin Islands started during the late 19th century and are probably still incomplete due to the extreme sampling difficulties imposed by depth, visibility, and the high rugosity and abrupt insular slope around these islands. The study effort on deep sea communities continues at present with the aid of advanced photographic technology aboard automated and manned submersibles (Singh et al., 2004; Armstrong et al., in press), as well as with the utilization of mixed gases for deep water diving (Pyle, 2000).

Deep waters of the Caribbean Sea offer favorable life conditions for ichthyofaunal communities. Water masses below 1,500 meters are well supplied with oxygen, have a relatively high temperature (4 - 5 ° C) and salinities between 34 – 35 su (Svedrup et al., 1942). Although geographically separated from the Western Atlantic by chains of islands and submarine ridges, the Caribbean is physically connected to the Atlantic Ocean by island passages up to 1,600 meters deep. Such deep water pathways allow for an effective Caribbean - Atlantic connectivity of adult and larval deep sea fishes.

1. Early Collections and Records

The first collections of deep sea fishes from the Caribbean Sea were obtained by the Steamer Blake during its second dredging season of 1878-79, when more than 20 stations within the Lesser Antilles were sampled (Agassiz, 1888). The “Fish Hawk” expedition produced the first fish records for deep waters around Puerto Rico from dredge samplings at 50 stations, of which 17 were deeper than 30 m (Bowers, 1900). During the early 20th century (1920-1930’s), additional collections were procured by the R/V Dana, R/V Pawnee and the R/V Atlantis in the Western Atlantic, with most of the collection effort concentrated on the Gulf of Mexico and the Straits of Florida (Rass, 1971). The west, north and east coast of Puerto Rico were sampled by the Yatch “Caroline” during 1933, as part of a joint venture between Mr. Eldridge Johnson and the Smithsonian Natural History Museum to sample the “Puerto Rican Deep” (Bartch, 1933). This initiative involved sampling the deep waters of the insular slope, and the deep

system north of the island, known as the Puerto Rican Trench, one of the deepest zones of the ocean.

Extensive deep sea samplings of the southwestern Atlantic, including the Caribbean Sea were performed during the 1956 - 60 by the exploratory fishing vessels R/V Oregon, R/V Silver Bay, R/V Combat, R/V Pelican and the R/V Alexander Kovalevskii of the Soviet - Cuban expedition (Bullis and Thompson, 1965; Manning, 1969; Rass, 1971). Fishes were mostly collected using bottom and mid-water trawls. Likewise, the Florida Straits, Gulf of Mexico, West Central and Southern Caribbean, Bahamas, and the Lesser Antilles were intensively sampled during the 1960's - 1970's by the R/V Gerda, R/V Pillsbury, R/V Columbus-Iselin, and R/V Oregon (Gore, 1974; Cairns, 1976; Cooper, 1977; Meyer et al., 1978). Interestingly, only a few stations in waters around the Hispaniola, Puerto Rico, and the U. S. Virgin Islands (north central Caribbean) were sampled during these expeditions (e.g. R/V Oregon stations 644, 646, 6715; R/V Pillsbury stations P-1386, P-1397, P-1401, P-1402). The dates and sampling station coordinates from these cruises to the Western Atlantic region (that include the Caribbean Sea) are available in several taxonomic review papers (Gore, 1974; Cairns, 1976; Cooper, 1977; Meyer et al., 1978). During the 1970's through the 1980's, the Caribbean Fisheries Management Council, with funding from the U. S. National Marine Fishery Service (NMFS/NOAA) explored the deep sea fisheries potential of the insular slope of PR and the USVI. The fisheries effort included a series of at least 12 cruises of the R/V Oregon and R/V Delaware, with particular attention to the north coast of PR and the USVI.

Taxonomic records of deep water fishes collected in the earlier expeditions to the Caribbean Sea were included in the monographs by Goode and Bean (1895), Jordan and Evermann (1896 - 1900), Gray (1956), Springer and Bullis (1956) and Bullis and Thompson (1965). Bigelow et al. (1948) produced the first taxonomic compilation of fishes from the Western Atlantic, including collections of deep sea species from the Caribbean Sea. A total of 160 fish species associated with deep habitats of the Caribbean basin, including collections from the insular slope of Puerto Rico and other islands were initially reported by Rass (1971) (Table 20). Nine groups of deep sea fishes representing 31 families comprised 80 % of the total number of species collected

Table 20. List of deep water fishes collected during early expeditions from Caribbean waters. (from Rass, 1971)

Stomiatoidea

Fam. Stomiatidae

Stomias affinis
Fam. Astronesthidae
Astronesthes gemmifer
Astronesthes indicus
Astronesthes niger
Astronesthes richardsoni
Astronesthes similis
Astronesthes cynaeus
Borostomias elucens
Diplolychnus mononema
Heterophotus ophistonema

Fam. Chauliodontidae

Chauliodus danae
Chauliodus sloani

Fam. Melanostomatidae

Melanostomias biseriatus
Melanostomias melanopogon
Melanostomias tentaculatus
Melanostomias valdiviae
Pachystomias microdon
Eustomias bibulbosus
Eustomias binghami
Eustomias braueri
Eustomias brevibarbatus
Eustomias dendriticus
Eustomias dubius
Eustomias fissibarbis
Eustomias globulifer
Eustomias leptobolus
Eustomias lipochirus
Eustomias longibarba
Eustomias macrophthalmus
Eustomias melanostigma
Eustomias obscurus
Eustomias polyaster
Eustomias silvescens
Eustomias schmidti
Eustomias xenobolus
Flagellostromias boureei
Leptostomias gladiator
Leptostomias analis
Leptostomias leptobolus
Thysanactis dentex
Grammastostomias flagellibarba
Bathophilus longipes
Bathophilus nigerrimus

Gonostomoidea

Fam. Gonostomatidae

Triplophos hemingi
Polymetme corytheola
Pollichthys mauli
Vinciguerria nimbaria
Gonostoma bathyphilum
Margrethia obtusirostra
Argyripnus atlanticus
Sonoda megalophthalma
Maurolicus muelleri

Fam. Idiacanthidae

Idiacanthus fasciola

Fam. Malacosteidae

Photostomias guernei
Aristostomias grimaldii
Aristostomias polydactylus
Aristostomias xenostoma
Aristostomias lunifer
Aristostomias grimaldii
Malacosteus niger

Myctophoidea

Fam. Bathyclupeidae

Bathyclupea argentea

Fam. Chloraphthalmidae

Chlorophthalmus agassizi
Parasudis truculentus

Fam. Bathysauridae

Bathypterois viridensis
Bathypterois bigelowi
Bathypterois quadrifilis

Fam. Ipnopidae

Ipnopus murrayi
Bathytyphlops marionae

Fam. Neoscopitelidae

Neoscopelus macrolepidotus

Fam. Myctophidae

Myctophum nitidulum
Myctophum affine
Diaphus dumerili
Diaphus bertelseni
Diaphus lucidus
Diaphus effulgens
Diaphus problematicus

Table 20. Continued.

Fam. Melanostomatidae (cont.)

Bathophilus pawneei
Bathophilus schizochirus
Ecistoma barbatum
Photonectes coerulescens
Photonectes margarita
Photonectes phyllopogon
Photonectes achirus

Alepisauroidea

Fam. Paralepididae

Paralepis atlantica
Lestidium atlanticum
Lestidium affinis
Lestidium mirabilis
Lestrolepis intermedia
Stemonosudis gracile
Stemonosudis intermedia

Fam. Alepidauridae

Alepisaurus ferox

Brotuloidea

Fam. Brotulidae

Bassozetus normalis
Nixonus pectoralis
Monomitopus agassizi

Fam. Aphyonidae

Barathronus bicolor

Alepocephaloidea

Fam. Alepocephalidae

Alepocephalus agassizi
Conocara macroptera
Rinoctes nasutus
Binghamichthys antillarum

Fam. Searsidae

Searsia koefoedi

Fam. Bathylaconidae

Bathylaco nigricans

Fam. Argentinidae

Argentina striata
Glassanodon pygmaeus
Xenophthalmichthys danae

Ceratioidea

Fam. Oneirodidae

Oneroides eschrichti
Oneroides schmidti
Oneroides malanocauda
Microlophichthys andracanthus
Microlophichthys microlophus
Dolopichthys sp
Lasiognathus saccostoma
Thaumatichthys pagidostomus

Fam. Cerattidae

Ceratias holboelli
Cryptopsaras couesi

Fam. Gigantactinidae

Gigantactis gracilicauda
Gigantactis exodon
Rhynchactis leptonema

Fam. Linophrynidae

Linophryne macrorhinus
Edriolychnus schmidti

Fam. Melanocetidae

Melanocetus murrayi
Melanocetus johnsoni

Fam. Himantolopidae

Himantolopus groenlandicus

Fam. Aphyonidae

Barathronus bicolor

Gadoidea

Fam. Macrouridae

Gadomus arcuatus
Bathygadus favosus
Malacocephalus ocidentalis
Cetonorus globiceps
Trachonurus sulcatus
Coelorhynchus caribbaeus
Coelorhynchus carminatus
Grenurus grenadae

Fam. Moridae

Uraleptus maraldi
Physiculus fulvus
Laemonema barbatulum
Brosmiculus incognitus

Table 20. *Continued*

Other Families

Fam. Cetomimidae
Gyrinomimus myersi
Fam. Eutaeniophoridae
Eutaeniophorus festivus
Fam. Giganturidae
Gigantura vorax
Fam. Nettastomidae
Venefica procera
Fam. Synaphobranchidae
Synaphobraunchus kaupi
Fam. Holosauridae
Halosaurus oweni
Aldrovandia gracilis
Fam. Stylephoridae
Stylephorus chordatus
Fam. Stephanoberycidae
Stephanoberyx monae
Fam. Melamphaidae
Melamphaes polyepis
Melamphaes longivelis
Melamphaes pumilus
Scopelogadus mizolepis
Fam. Trachichthydae
Hoplostethus mediterraneous
Fam. Grammicolepis
Xenolepidichtys dalgleishi
Grammicolepis brachiusculus
Fam. Antiginiidae
Antigonia capros
Fam. Chiasmodontidae
Chiasmodon niger
Fam. Gempylidae
Epinnula magistralis
Diplospinus multistriatus

during early sampling expeditions to the Caribbean Sea. Stomiatoidea (Dragonfishes-56 spp.), Myctophoidea (Lanternfishes-15 spp), and Gonostomoidea (Bristlemouths-15 spp) were the fish groups with the highest numbers of species collected. Rass (1971) proposed that the Caribbean region is the center of origin of Melanostomiatidae in the Atlantic Ocean.

The taxonomic record of fishes from Puerto Rico and the U. S. Virgin Islands collected from depths of at least 30 m has been recently updated to 872 species, included in 173 families and 35 orders. The complete list with common names, and the depth range in which species have been collected is included as Appendix 2. Serranidae (groupers and sea basses) with 53 species, Stomidae, with 51 species, and Myctophidae, with 49 species are the most specious families (Table 21). Most perciform fishes are associated with upper slope habitats. Dragonfishes and barracudinas (Paralepididae) exhibited distributions mostly associated with deep slope habitats. The deepest record (8,370 m) is for *Abyssobrutula galatheae* (Ophididae). Another four cuskeels are reported from depths below 3,000 m (see Appendix 2).

Table 21. List of the most specious fish families collected from deep water habitats (> 30 m) in Puerto Rico and the USVI (from Grana, 2005 a)

Fish Families	Common Name	# Species	Depth (meters) 30 - 100	100 - 500	501 - 1000	> 1,000
Serranidae	Groupers/Sea Basses	52	24	25	3	
Stomidae	Dragonfishes	51	2	4	15	30
Myctophidae	Lanternfishes	49	0	3	42	4
Carangidae	Jacks	25	14	10	1	
Ophidiidae	Cusk Eels	20	3	3	6	8
Lutjanidae	Snappers	17	3	13	1	
Haemulidae	Grunts	17	17			
Apogonidae	Cardinalfishes	17	15	2		
Gobiidae	Gobies	16	15	1		
Muraenidae	Moray Eels	16	8	8		
Sciaenidae	Croakers	15	14	1		
Carcharhinidae	Requiem Sharks	15	5	9	1	0
Scorpaenidae	Scorpionfishes	14	7	6		1
Paralichthydae	Largetooth Flounders	13	5	7		1
Ophichthidae	Snake Eels	13	9	3		1
Congridae	Conger Eels	13	4	5	4	
Macrouridae	Grenadiers	13	0	2	6	5
Labridae	Wrasses	13	9	4		
Paralepididae	Barracudinas	12	0	0	1	11
Ogcocephalidae	Batfishes	11	1	6	3	1

2. Deep-sea Larval Fish Studies

Ramirez-Mella and García-Sais (2003) reported on the taxonomic composition, spatial distribution and abundance of coral reef and oceanic-type fish larvae across a neritic oceanic gradient off from the reefs of La Parguera, southwest coast of Puerto Rico. Fish larvae were collected using a Tucker Trawl with 308 um mesh nets. Samplings were obtained from the surface mixed layer of the water column, encompassing depths between the surface and 60 meters. Although some penetration of Myctophidae, Scombridae, Gonostomatidae, Photichthyidae and Coryphaenidae larvae into neritic shelf zones was detected, the abundance and taxonomic richness of oceanic-type fish larvae increased sharply at the shelf-edge and beyond (Table 22). Myctophidae was the numerically dominant oceanic-type fish larvae collected throughout the neritic-oceanic gradient as far as 46 kilometers offshore. Other commonly occurring fish families of larval fishes off the insular shelf from La Parguera included Nomeidae, Bregmacerotidae, Paralepididae, Melanostomidae and others (Ramirez-Mella and García-Sais, 2003).

Table 22. Distribution and mean abundance of "oceanic-type" larval fishes collected from the southwest coast of Puerto Rico. Modified from Ramirez-Mella and Garcia-Sais (2003).

		Mean Abundance (Ind/100 m3)						
		6	10	13	17	29	46	
Fish Family	**Common Name**	**Km**	**Km**	**Km**	**Km**	**Km**	**Km**	**MEAN**
Myctophidae		1.84	1.96	11.01	8.75	13.81	15.35	**8.79**
Scombridae	Tunnas and Mackerel	0.34	1.22	2.05	1.34	1.45	1.52	**1.32**
Gonostomatidae		0.03	0.03	1.11	0.45	0.59	1.42	**0.61**
Nomeidae		0	0.15	0.41	1.15	1.02	0.68	**0.57**
Photichthyidae		0.02	0	0.85	0.36	0.34	0.46	**0.34**
Bregmacerotidae		0	0	1.11	0.27	0.08	0	**0.24**
Paralepididae	Barracudinas	0	0	0.35	0.16	0.15	0.24	**0.15**
Coryphaenidae	Dolphinfish	0.03	0.18	0.17	0.13	0.23	0.09	**0.14**
Gempylidae		0	0.11	0.06	0.04	0.19	0.21	**0.10**
Bramidae		0	0	0.05	0.08	0	0.12	**0.04**
Stomiatidae		0	0	0.03	0.09	0.06	0.06	**0.04**
Lampriformes		0	0	0	0	0.17	0	**0.03**
Tetragonuridae		0	0.01	0.06	0.03	0.02	0.02	**0.02**
Evermannelidae		0	0	0.01	0.01	0.01	0.06	**0.02**
Antennariidae		0	0	0	0.01	0.04	0.02	**0.01**
Astronesthidae		0	0	0	0	0.03	0.03	**0.01**
Melanostomidae		0	0	0	0.01	0	0.05	**0.01**
Istiophoridae	Marlins	0	0	0.01	0	0.04	0	**0.01**
Scopelarchidae		0	0	0	0	0.03	0	**0.01**
Idiacanthidae		0	0	0	0.02	0	0	**0.003**
Chauliodontidae		0	0	0.01	0	0	0	**0.002**
Malacosteidae		0	0	0	0	0.01	0	**0.002**
Lophiiformes		0	0	0	0.01	0	0	**0.002**
Ceratiidae		0	0	0	0.01	0	0	**0.002**

3. Commercial Deep-sea Fisheries Surveys

Exploratory fishing surveys of commercially valuable fishes associated with deep reefs of the insular slope were launched during the 1970's and 1980's (Juhl, 1972; Nelson et al., 1984). The initial survey, coordinated by the Fisheries Development Program of the Commonwealth of Puerto Rico (Juhl, 1972) examined the efficiency of several types of fishing gear, such as fish traps, snapper reels, trolling lines and bottom gill nets for the collection of deep water fishes. A total of 40 fish species were reported, including some species from insular shelf habitats.

The National Marine Fishery Service (NMFS) Southeast Fisheries Center conducted annual bottom longline fishing surveys around Puerto Rico and the USVI from 1980 - 1984. Fishing effort was concentrated in the 90 - 450 m (300 -1,500 feet) depth range of the insular slope. The primary purpose of these surveys was to evaluate the abundance and spatial distribution of commercial fish resources, with particular interest on deep water snappers and groupers (Nelson et al. 1984).

Exploratory fishing cruises sailed aboard the NOAA ships Oregon II and Delaware II and targeted the north and west insular slopes of PR and the north and south coast of the USVI (Table 23). The commercially valuable fish assemblage identified by these surveys included 12 species of snappers (Lutjanidae) and seven species of groupers (Serranidae). The taxonomic composition of commercially important species and depth partitioning of the mean catch per unit effort (kg./100 hooks) from the NMFS-NOAA expeditions between 1980 – 1984 is summarized in Table 24. The Red hind (*Epinephelus guttatus*), Yellow-edge grouper (*E. flavolimbatus*), and Mutton snapper (*Lutjanus analis*) yielded the highest CPUE at upper slope depths between 90 – 180 m. Misty grouper (*E. mistacinus*), Queen snapper (*Etelis oculatus*), and Silk snapper (*Lutjanus vivanus*) dominated the mid-slope habitat between 181 – 270 m.

Table 23. National Marine Fishery Service (NMFS-NOAA) exploratory fishing cruises around Puerto Rico and the U. S. Virgin Islands between 1980 and 1984.

Vessel	Cruise	Date	Area	Longline (sets)	Fish Traps (numbers)	Handline (stations)
Oregon II	108	June - July, 1980	North & West Slope	104	12	23
Oregon II	119	July, 1981	West Slope	13	1	1
Oregon II	129	Aug - Sep, 1982	North & West Slope South of St. Thomas	222	16	4
Delaware II	83-06	May-July, 1983	North & West Slope	278	10	0
Delaware II	84-04	April - May, 1984	North & West Slope	180	1	1

Table 24. Summary statistics from the NMFS exploratory fishing around PR and the USVI between 1980 - 1984. Species composition and catch per unit effort (kgs/100 hooks) at the various depth zones fished.

Species	Common Name	Depth Zones (meters)			
		90 - 180	181 - 271	272 - 362	363 - 454
Apsilus dentatus	Black snapper				
Etelis oculatus	Queen snapper		1.38	1.93	1.03
Lutjanus analis	Mutton snapper	0.99			
L. apodus	Schoolmaster snapper				
L. buccanella	Blackfin snapper		0.17		
L. jocu	Dog snapper	0.57	0.03		
L. synagris	Lane snapper	0.04			
L. vivanus	Silk snapper	0.21	1.04	0.23	0.05
Ocyurus chrysusrus	Yellowfin snapper				
Pristipomoides aquilonaris	Wenchman		0.06	0.22	0.07
P. macropthalmus	Wenchman		0.29	0.88	0.82
Rhomboplites aurorubens	Vermilion snapper	0.06	0.03	0.03	
Epinephelus flavolimbatus	Yellowedge grouper	1	0.94	1.51	0.16
E. guttatus	Red Hind	1	0.01		
E. morio	Red grouper	0.14			
E. mystacinus	Misty grouper		1.87	4.54	3.68
E. niveatus	Snowy grouper			0.13	0.50
E. striatus	Nassau grouper	0.23			
Mycteroperca venenosa	Yellowfin grouper	0.28		0.03	
Cephalopholis cruentatus	Coney				
Sharks					
Mustelis canis	Smooth dogfish				
Hexanchus griseus	Sixgill shark				
Squalus cubensis	Cuban dogfish				
Centroscyllium fabricii	Black dogfish				
Carcharhinus falciformis	Silky shark				
Heptranchias perlo	Sevengill shark				
		2.80	9.28	15.82	17.88
Others					
Seriola dumerili	Great Amberjack				
Ophicthus ocellatus	Pale spotted eel				
Caranx lugubris	Black Jack				
Brotula barbata	Bearded brotula				
Haemulon album	Margate				
Gymnothorax moringa	Spotted moray				
Remora remora	Remora				
Holocentrus ascensionis	Squirrelfish				
Xyphias gladius	Swordfish				
		2.20	1.44	1.34	0.54
	Totals	**9.52**	**16.54**	**26.66**	**24.73**

The catch at the deeper end of the slope, between 271 – 454 meters was dominated by Misty and Yellow-edge groupers, and the Queen and Wenchman snappers (*Pristipomoides macropthalmus*) (Nelson et al. 1984). Although not considered of commercial value then, unidentified "sharks" and "others" comprised the largest catch at all depths from the NMFS-NOAA surveys. The Swordfish, *Xyphias gladius* has been captured by recreational fishermen at the deeper end of the insular slope, close to the bottom.

Figure 8 shows the locations on the insular slope where relatively high catches of commercially valuable snappers and groupers (> 20 pounds) were obtained during the NMFS-NOAA fishery survey. Station identifications, geographic coordinates and depths of these slope sections are included as Appendix 3. These areas represent important habitats of insular slope reef fishes in the north coast of Puerto Rico, Culebra and the U. S. Virgin Islands. In contrast to the abrupt and contracted slope features of the south coast, the north coast presents a gentler slope, with more surface area for deep reef communities. However, a much higher fishing effort was addressed to the north coast slope, due to the extreme difficulties for fishing the south slope.

4. Seward Johnson Sea-Link II Submersible Survey

The Seward Johnson-Sea Link II submersible survey provided an unprecedented and exceptional insight of our insular slope and oceanic seamount communities, including taxonomic accounts and density estimates of commercially valuable fish species. The purpose of the survey was to provide information on deep water habitats between 300 and 1,500 feet (ca. 100 – 500 m), and to document faunal assemblages and habitat associations of commercially important fish species around Puerto Rico and the USVI, as well as to provide an assessment of the fisheries potential of deep water resources (Nelson and Appeldoorn, 1985).

Vertical submersible transects were performed from the lower slopes and rock walls to the shelf-break at 15 sites around Puerto Rico and the USVI. Surveyed sites and benthic habitat codes are presented in Table 25. Dives were initiated at the offshore end of the transects and moved up the insular slope towards the surface. Water temperature

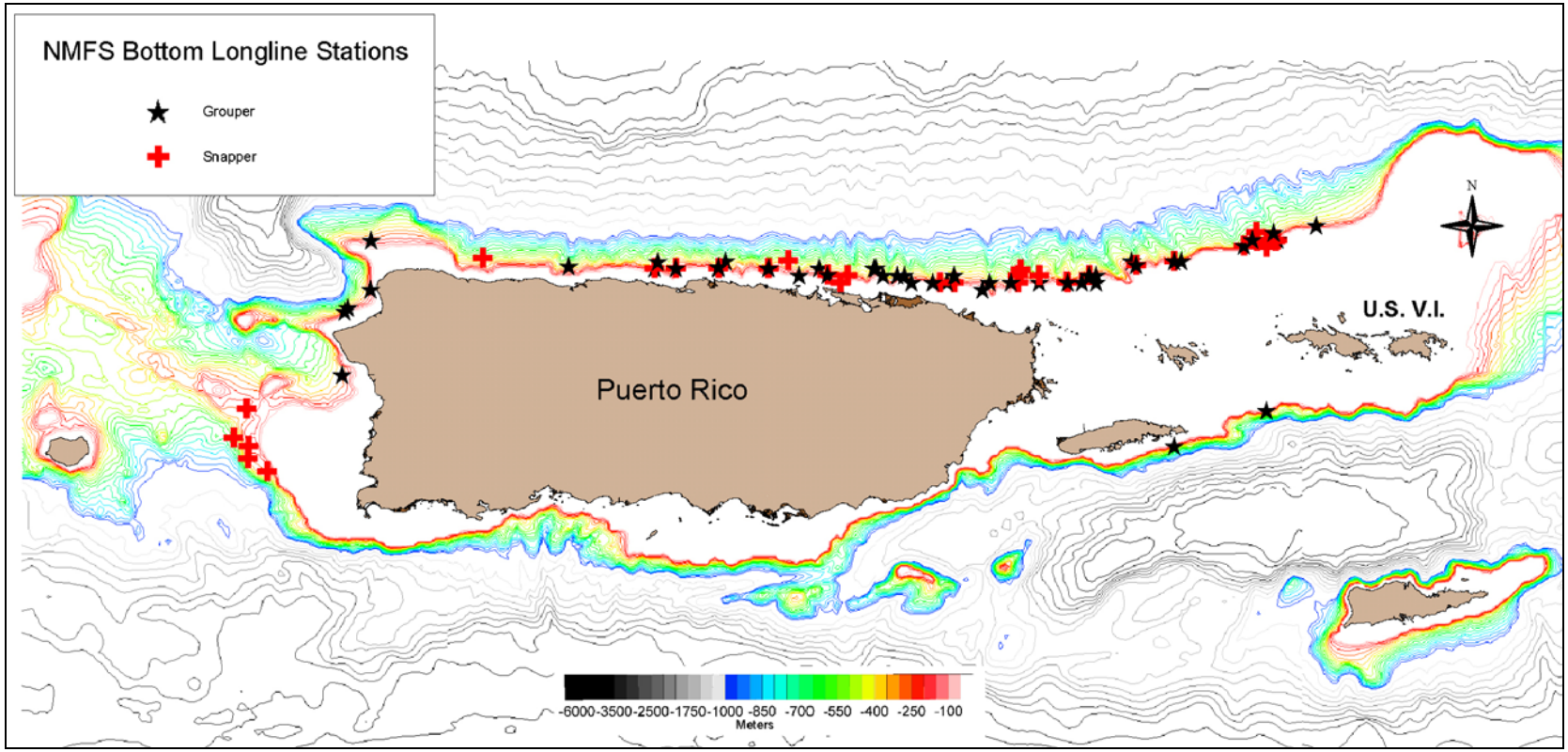


Figure 8. Location map of stations on the insular slope where relatively high catches of commercially valuable snappers and groupers were caught.

Table 25. List of sites and benthic habitats surveyed by the submersible Johnson Sea Link II around Puerto Rico and the USVI during 1985

Site Code	Site	Habitat Code	Habitat Code
1	West St. Croix-USVI	SS	Sand-Silt
2	Northwest St. Thomas - USVI	MS	Mud-Sand
3	Guánica - PR	MSS	Mud-Sand-Silt
4	Grappler Seamount - PR	RS	Rock-Sand
5	Northeast St. Croix - USVI	WC	Water Column
6	South St.John - USVI	RR	Rock Rubble
7	Southeast Vieques - PR	LW	Lower Wall
8	Northwest St. Thomas - USVI	RW	Rock Wall
9	Northeast Fajardo - PR	SR	Sand-Rubble
10	North San Juan Bay - PR	RRS	Rock-Rubble-Sand
11	North Dorado - PR	RWRT	Rock Wall-Reef Top
12	North Aguadilla - PR	W	Wall
13	Northwest Aguadilla - PR	WRT	Wall-Reef Top
14	Desecheo Island - PR	RT	Reef Top
15	Bajo de Sico - PR		

and conductivity profiles were obtained in every dive. The hydrographyc data from these profiles has been included as a layer in the GIS map atlas of deep reefs around PR and the USVI (this volume). Videos of the slope habitat and documentation of benthic habitats and predominant species were noted by scientists aboard the submersible. Most of the scientific personnel aboard were fish experts; therefore, the information regarding the invertebrate community is limited to general taxonomic inferences.

A total of 57 fish taxa were identified by scientists aboard the Johnson Sea Link II from depths of 750 to 300 meters (1000 - 2,500 feet), on the deepest section of the insular slope (Table 26). An assemblage of 31 species were only observed from depths beyond 300 meters, whereas 26 species were observed throughout a much more ample depth range, including species reaching the upper insular slope at depths of 120 meters. The typical habitat at the deep end of the insular slope consists of unconsolidated sand-silt and mud (e.g. SS, MS, MSS). Rock-sand, (RS), rock-rubble (RR), lower wall (LW), rock-wall (RW) and rock-rubble-sand (RRS) are found higher along the slope. An assemblage of demersal species associated with soft bottom and reef slope habitats was observed, along with a benthopelagic assemblage that appears to be widely distributed throughout the water column associated with the slope. The most common

Table 26. List of fishes observed at the deep insular slope habitats (below 300 m) during the Seward Johnson Sea Link II survey of the insular slope of Puerto Rico and the USVI during 1985.

Species	Common Name	Habitat	Depth (m)	Sites
Polymixia nobilis	Beard fish	MS,RR,MSS	300 - 670	3, 4, 5, 6, 8, 9, 10, 13, 14
Chlorophtalmus sp.	Benthic myctophid	SS,RR,RS,SSM	300 - 600	4, 6, 8, 10,14
Lutjanus vivanus	Silk snapper	RR,RRS,SR,RW,SSM	120 - 600	4, 6, 8, 13, 14
Ostichthys trachypoma	Deep sea squirrelfish	SR,RR,RS	240 - 600	4, 5, 6, 13, 14
Holanthias martinicensis		SR,RR,RRS,RW,RWR	90 - 330	4, 8, 13, 14
Gobiidae	Gobies	SR,RR,MSS,RWR	90 - 600	4, 6, 8, 10
Gempylidae		SS,WC,SSM	200 - 500	3, 8, 9, 13
Lutjanus buccanella	Blackfin snapper	RR,VRW,SR,RWR	90 - 600	3, 4, 6, 14
Pristipomoides sp.	Wenchman snapper	RR,SS,SR,MSS	100 - 600	4, 6, 9, 10
Etelis oculatus	Queen snapper	RR,LW,SSR,SSM	100 - 600	6, 8, 9
Seriola dumerili	Almaco Jack (CK)	WC,SMS,RW	100 - 300	3, 6, 8
Cyttopsis roseus		SS,SSM	200 - 500	3, 8, 13
Myctophidae	myctophid	MSS,RS	300 - 600	8, 10, 14
Antigonia capros	Zeiform fish	MSS,SSR	300 - 600	9, 10, 12
Benthodesmus sp.	Trichurid fish	SS,MSS	300 - 600	3, 10, 13
Argentinidae	Argentinoid fishes	SS,RR,MSS	300 - 600	2, 6, 10
Sternoptychids		RR,MSS	300 - 600	3, 6, 10
Peristeridae		SS,SSR	300 - 600	3, 5, 9
Chaunax sp.		SS	300 - 600	3, 10
Poecilopsetta albomarginata		SS,MSS	300 - 600	3, 10
	Halosaurid eel	MS	600 - 750	3, 14
Synodontidae	Lizardfishes	MSS,RW	100 - 600	8, 10
Mycteroperca intersticialis		RW	120 - 300	8, 14
Pristigenys alta		RRS,RW	100 - 300	4, 13
Parasudis truculenta		SS,SSM	200 - 600	8, 10
Caranx sp.	Jack	RR,LW,	100 - 300	6, 8
Plectrypops retrospinus		RRS,LW	210 - 300	4, 6
	cynoglossid	SSR	300 - 400	9
Apogonidae	Cardinalfishes	RR	300 - 600	6
Chauliodus sloanei		MSS	300 - 600	10
Chaunax pictus		RR	300 - 600	6
Gonostomatidae		MSS	300 - 600	10
Macrouridae		MSS	300 - 600	10
Paralepididae	Barracudinas	WC	383 - 694	3
Chaulodontidae		WC	383 - 760	3
	Trichurid fishes	SS	400	13
Epinnula magistralis		SS	421 - 479	3
Centrophorus sp.	Squalid shark	SS	705 - 750	3
Hexanchus griseus	Hexanchid shark	SS	705 - 750	3
	Bathyclupeid fish	SS	705 - 750	3
	Bathypteroid fish	SS	724 - 760	3
	Macrourid fish	SS	724 - 760	3

Table 26. Continued

Etmopterus hillianus	Deep sea shark	MS	670	3
	Ophioform fish	MS	670	3
Squalus sp.	shark	SS	703	3
	Chimaerid fish	SS	727	3
	Neoscopelid fish	SS	727	3
Bullisichthys caribbaeus		LW	100 - 300	6
Gonioplectrus hispanus		RW	120 - 300	14
Scorpaenidae	Scorpion fishes	RRS	200 - 300	13
Serranus notospilus		RRS	200 - 300	13
	Sea robins	RRS	200 - 300	13
	Batfish	RRS	200 - 300	13
Epinnula orientalis		SSM	200 - 600	8
Epinephelus mystacinus	Misty grouper	SR	248 - 330	4
Bembrops sp.			270 - 400	13
Parasudis sp.			270 - 400	13

benthic species, observed from at least five sites included the Beard fish, *Polymixia nobilis* (Lampriformes), and benthic myctophids (Lanternfishes), including *Chlorophtalmus* sp. Demersal snappers (Queen, Silk, Vermilion, Wenchman) and the Mysty grouper form part of the deep slope demersal fish assemblage reported by Nelson and Appeldoorn (1985). Yellowfin, yellow-edge, and snowy groupers had been previously reported from the deep slope habitat (see Table 26).

Benthopelagic species, such as *Antigona capros*, unidentified argentinoids, *Benthodesmus* sp. (Thichuridae), Sternoptychids (Stomiiformes) and Peristerids were observed from at least three sites. A total of 30 fish taxa were observed from only one site each at deep insular slope habitats surveyed, including the large predatory sharks, *Etmospterus hillianus*, *Centrophorus sp., Hexanchus griseus and Squalus sp.*

Mid-slope habitats surveyed by the Johnson Sea-Link submersible at depths between 120 - 300 m presented a taxonomic assemblage of 93 fish species (Table 27). From this total, 40 species were also reported from deep slope habitats (deeper than 300 m) and 61 species were observed to reach the upper slope and shelf-edge at depths of less than 120 m. Hard ground, rocky habitats, including rock rubble (RR), rock-rubble sand (RRS), rock walls (RW), wall (W) and lower wall (LW) were typical of the mid shelf. A diverse assemblage of demersal and pelagic fishes associated with reef habitats was

Table 27. List of fishes observed from mid-slope habitats (120 – 300 m) during the Seward Johnson Sea Link II survey of the insular slope of Puerto Rico and the USVI during 1985.

Species	Common Name	Habitat	Depth	Sites
Caranx lugubris	Black Jack	WC,SR,RRS,LW,RWR,RW	60 - 600	2, 3, 4, 6, 8, 14
Lutjanus vivanus	Silk snapper	RR,RRS,SR,RW,MSS	120 - 600	4, 6, 8, 13, 14
Ostichthys trachypoma	Deep sea squirrelfish	SR,RR,RS	240 - 600	4, 5, 6, 13, 14
Holacanthus tricolor	Rock Beauty	RWR	30 - 150	1, 2, 4, 6, 14
Stegastes partitus	Bicolor damselfish	LW,RWR	30 - 300	2, 4, 6, 8, 14
Chromis insolatus	Sunshine chromis	RR,LW,RWR	40 - 210	1, 3, 8, 13, 14
Chaetodon aculeatus	Longsnout butterflyfish	LW,RWR	40 - 300	1, 4, 6, 8, 14
Flammeo marianus	Longspine squirelfish	LW,RWR,SR,RRS	40 - 300	1, 3, 4, 6, 14
Chaetodon sedentarius	Reef butterflyfish	RWR	30 - 143	2, 4, 5, 14
Holocentrus rufus	Squirrelfish	RWR	30 - 330	2, 3, 4, 6
Centropyge argi		LW,RWR	60 - 300	4, 6, 8, 14
Serranus lucipercanus		RRS,LW,RWR	60 - 300	3, 6, 8, 14
Cephalopholis fulva	Coney	SR,RWR	60 - 330	4, 5, 6, 14
Pristipomoides sp.	Wenchman snapper	RR,SS,SR,MSS	120 - 600	4, 6, 9, 10
Gempylidae		SS,WC, MSS	200 - 500	3, 8, 9, 13
Holanthias martinicensis		SR,RR,RRS,RW,RWR	90 - 330	4, 8, 13, 14
Gobiidae	Gobies	SR,RR,MSS,RWR	90 - 600	4, 6, 8, 10
Lutjanus buccanella	Blackfin snapper	RR,VRW,SR,RWR	90 - 600	3, 4, 6, 14
Holocentrus ascensionis	Longjaw squirelfish	RRS,RWR	40 - 210	1, 4, 6, 14
Clepticus parrae	Creole wrasse	RRS,LW,RWR	40 - 240	1, 4, 6, 14
Paranthias furcifer	Creole fish	SR,RWR	60 - 330	4, 6, 8, 14
Etelis oculatus	Queen snapper	RR,LW,SSR, MSS	120 - 600	6, 8, 9
Seriola dumerili	Almaco Jack (CK)	WC,SMS,RW	120 - 300	3, 6, 8
Cyttopsis roseus		SS, MSS	200 - 500	3, 8, 13
Acanthurus coeruleus	Blue tang	RWR	30 - 143	2, 4, 6
Epinephelus guttatus	Red hind	RWR	30 - 143	2, 4, 6
Sparisoma viride	Stoplight parrotfish	RWR	30 - 150	2, 5, 6
Chaetodon capistratus	Four-eye butterflyfish	LW,RWR	30 - 300	2, 5, 6
Sphyraena barracuda	Great barracuda	RWR	60 - 120	3, 4, 5
Myripristis jacobus	Blackbar soldierfish	LW,RWR	40 - 143	1, 4, 6
Acanthurus bahianus	Ocean surgeon	RWR	40 - 150	1, 5, 6
Xanthichthys ringens	Sargassum Triggerfish	RRS,LW,RWR	40 - 177	1, 2, 13
Serranus tortugarum		LW,RWR	60 - 240	3, 6, 8
Synodontidae	Lizardfishes	MSS,RW	100 - 600	8, 10
Mycteroperca intersticialis		RW	120 - 300	8, 14
Pristigenys alta		RRS,RW	120 - 300	4, 13
Parasudis truculenta		SS, MSS	200 - 600	8, 10
Caranx sp.	Jack	RR,LW,	120 - 300	6, 8
Plectrypops retrospinus		RRS,LW	210 - 300	4, 6
Chromis enchrysurus		RWR	90 - 120	3, 14
Cephalopholis cruentatum	Graysbe	RWR	30 - 120	2, 3
Haemulon sciurus	Bluestripped Grunt	RWR	30 - 150	2, 5
Pseudupeneus maculatus	Stripped goatfish	RWR	30 - 150	1, 2
Scarus taeniopterus	Princess parrotfish	RWR	30 - 150	1, 2

Table 27. (Continued)

Sparisoma aurofrenatum	Red-band parrotfish	RWR	30 - 150	2, 5
Anisotremus virginicus	Porkfish	RWR	40 - 150	1, 6
Lioproma mawbrayi		RWR,RW	40 - 200	1, 8
Serranus tabacarius	Tobacco fish	RRS,LW,RWR	40 - 240	1, 3
Lutjanus jocu	Dog snapper	RWR	60 - 120	3, 6
Epinephelus striatus	Nassau grouper	RWR	60 - 143	4, 6
Holacanthus ciliaris	French angelfish	RWR	60 - 143	4, 14
Pomacanthus paru	Queen angelfish	RWR	60 - 143	4, 8
Bodianus rufus	Spanish hogfish	RWR	60 - 150	6, 14
Malacanthus plumieri	Sand tilefish	RWR	60 - 150	6, 8
Pomacanthus arcuatus	Gray Angelfish	RWR	60 - 150	5, 6
Balistes vetula	Queen triggerfish	LW,RWR	60 - 300	4, 6
Chaetodon aya		SR,RRS,LW,RWR	60 - 330	4, 6
Parasudis sp.			270 - 400	13
Chaetodon guayanensis		RW,RWR	90 - 200	8
Bullisichthys caribbaeus		LW	100 - 300	6
Gonioplectrus hispanus		RW	120 - 300	14
Serranus sp.		LW	140 - 210	4
Balistes sp.	Triggerfish	LW	143 - 210	4
Lactophrys bicaudalis	Spotted trunkfish	LW	143 - 210	4
Scorpaenidae	Scorpion fishes	RRS	200 - 300	13
Serranus notospilus		RRS	200 - 300	13
	Sea robins	RRS	200 - 300	13
	batfish	RRS	200 - 300	13
Epinnula orientalis		SSM	200 - 600	8
Lycodontis polygonius	Moray eel	RRS	248 - 264	4
Epinephelus mystacinus	Misty grouper	SR	248 - 330	4
Bembrops sp.			270 - 400	13
Chromis cyanea	Blue chromis	RWR	40 - 150	1
Chromis enchrysurus		RWR	40 - 150	1
Haemulon album	White grunt	RWR	40 - 150	1
Hypoplectrus nigricans	Black Hamlet	RWR	40 - 150	1
Hypoplectrus puella	Barred hamlet	RWR	40 - 150	1
Priacanthus cruentatus	Bigeye	RWR	60 - 143	4
Scomberomorus cavalla	King mackerel	RWR	60 - 143	4
Anisotremus surinamensiss	Black margate	RWR	60 - 150	6
Elagatis bipinnulata	Rainbow runner	RWR	60 - 150	5
Gramma linki		RWR	60 - 150	6
Holocentrus coruscus		RWR	60 - 150	6
Istiophoridae	Marlin	RWR	60 - 150	5
Kyphosidae	Chubs	RWR	60 - 150	8
Lutjanus apodus	Schoolmaster snapper	RWR	60 - 150	6
Mycteroperca tigris	Tiger grouper	RWR	60 - 150	6
Mycteroperca venenosa	Yellowfin grouper	RWR	60 - 150	6
Thalassoma bifasciatum	Blue-head wrasse	RWR	60 - 150	5
Chromis sp.	Chromis	LW,RWR	60 - 210	4
Stegastes variabilis	Cocoa damselfish	RRS,RWR	60 - 240	4
Chromis multilineatus	Brown chromis	LW,RWR	60 - 300	6
Microspathodon sp.		LW,RWR	60 - 300	6

found distributed throughout the mid-slope (Nelson and Appeldoorn, 1985). The Silk, Wenchman and Blackfin snappers (*Lutjanus vivanus, Pristipomoides spp., L. buccanella*), the Deep Sea Squirrelfish (*Ostichthys trachypoma*), unidentified gobies, and *Holanthias martinicensis* were some of the most common demersal species sighted at the deeper end of the mid-slope (> 120 m). A specious assemblage of coral reef fishes, such as butterflyfishes, angelfishes, damselfishes, hamlets, squirrelfishes, triggerfishes, wrasses, parrotfishes and small groupers were observed at the upper end of the mid shelf (> 120 m). Numerically dominant species of shallow reefs of the insular shelf (< 20 m), such as the bluehead wrasse (*Thalassoma bifasciatum*), bicolor damselfish (*Stegastes partitus*), stoplight and redband parrotfishes (*Sparisma viride, S. aurofrenatum*), doctorfishes (*Acanthurus spp*.) and squirrelfishes (*Myripristis jacobus, Holocentrus spp.*) were reported to occur at depths below 120 m. Pelagic species associated with mid-slope habitats reported by the Seward Johnson Sea-Link II submersible survey (Nelson and Appeldoorn, 1985) include Jacks (*Seriola spp., Caranx spp.*), mackerels (*Scomberomorus spp*.), Great barracuda (*Sphyraena barracuda*) and unidentified Gempilids. Most pelagic game fishes, including blue and white marlins (*Makaira nigricans*, *Tetrapturus albidus*), tunas (*Thunnus spp*), Wahoo *Acanthocibium solanderi*) and Cobia (*Rachycentron canadum*) in the vicinity of insular slope habitats (Randall, 1983).

Fishes identified from the upper insular slope (30 – 120 m) by the Seward Johnson Sea-Link II submersible survey (Nelson and Appeldoorn, 1985) are presented in Table 28. A total of 70 species were reported from depths between 30 – 120 m, of these 61 species were present also below depths of 120 m. The most frequently observed demersal fishes at the upper slope included an assemblage of well known coral reef fishes that are also common (some numerically dominant) from shallow reefs of the insular shelf and shelf-edge reefs, such as the bicolor damselfish (*Stegastes partitus*), blue chromis (*Chromis cyanea*), rock beauty (*Holacanthus tricolor*), coney (*Cephalopholis fulva*), squirrelfishes (*Holocentrus rufus, H. adsencionis, Flammeo marianus*) and butterflyfishes (*Chaetodon capistratus, C. sedentarius*), among others. There is another assemblage of fishes that are associated with deep reefs of the insular shelf and are not common at depths of less than 30 m. These include the cherubfish (*Centropyge argi*), sunshine chromis (*Chromis insolatus*), longsnout butterflyfish (*Chaetodon aculeatus*),

Table 28. List of fishes observed on upper insular slope and deep shelf habitats during the Seward Johnson Sea Link II survey of the insular slope of Puerto Rico and the USVI in 1985.

Species	Common Name	Habitat Type	Depth (m)	Sites
Caranx lugubris	Black Jack	WC,SR,RRS,LW,RWR,RW	60 - 600	2, 3, 4, 6, 8, 14
Holacanthus tricolor	Rock Beauty	RWR	30 - 150	1, 2, 4, 6, 14
Stegastes partitus	Bicolor damselfish	LW,RWR	30 - 300	2, 4, 6, 8, 14
Chromis insolatus	Sunshine chromis	RR,LW,RWR	40 - 210	1, 3, 8, 13, 14
Chaetodon aculeatus	Longsnout butterflyfish	LW,RWR	40 - 300	1, 4, 6, 8, 14
Flammeo marianus	Longspine squirelfish	LW,RWR,SR,RRS	40 - 300	1, 3, 4, 6, 14
Holocentrus ascensionis	Longjaw squirelfish	RRS,RWR	40 - 210	1, 4, 6, 14
Clepticus parrae	Creole wrasse	RRS,LW,RWR	40 - 240	1, 4, 6, 14
Centropyge argi	Cherubfish	LW,RWR	60 - 300	4, 6, 8, 14
Serranus lucipercanus		RRS,LW,RWR	60 - 300	3, 6, 8, 14
Cephalopholis fulva	Coney	SR,RWR	60 - 330	4, 5, 6, 14
Chaetodon sedentarius	Reef butterflyfish	RWR	30 - 143	2, 4, 5, 14
Holocentrus rufus	Squirrelfish	RWR	30 - 330	2, 3, 4, 6
Paranthias furcifer	Creole fish	SR,RWR	60 - 330	4, 6, 8, 14
Acanthurus coeruleus	Blue tang	RWR	30 - 143	2, 4, 6
Epinephelus guttatus	Red hind	RWR	30 - 143	2, 4, 6
Sparisoma viride	Stoplight parrotfish	RWR	30 - 150	2, 5, 6
Chaetodon capistratus	Four-eye butterflyfish	LW,RWR	30 - 300	2, 5, 6
Myripristis jacobus	Blackbar soldierfish	LW,RWR	40 - 143	1, 4, 6
Acanthurus bahianus	Ocean surgeon	RWR	40 - 150	1, 5, 6
Xanthichthys ringens	Sargassum Triggerfish	RRS,LW,RWR	40 - 177	1, 2, 13
Sphyraena barracuda	Great barracuda	RWR	60 - 120	3, 4, 5
Serranus tortugarum		LW,RWR	60 - 240	3, 6, 8
Cephalopholis cruentatum	Graysbe	RWR	30 - 120	2, 3
Haemulon sciurus	Bluestripped Grunt	RWR	30 - 150	2, 5
Pseudupeneus maculatus	Stripped goatfish	RWR	30 - 150	1, 2
Scarus taeniopterus	Princess parrotfish	RWR	30 - 150	1, 2
Sparisoma aurofrenatum	Red-band parrotfish	RWR	30 - 150	2, 5
Anisotremus virginicus	Porkfish	RWR	40 - 150	1, 6
Lioproma mawbrayi		RWR,RW	40 - 200	1, 8
Serranus tabacarius	Tobacco fish	RRS,LW,RWR	40 - 240	1, 3
Epinephelus striatus	Nassau grouper	RWR	60 - 143	4, 6
Holacanthus ciliaris	French angelfish	RWR	60 - 143	4, 14
Lutjanus jocu	Dog snapper	RWR	60 - 120	3, 6
Pomacanthus paru	Queen angelfish	RWR	60 - 143	4, 8
Bodianus rufus	Spanish hogfish	RWR	60 - 150	6, 14
Malacanthus plumieri	Sand tilefish	RWR	60 - 150	6, 8
Pomacanthus arcuatus	Gray Angelfish	RWR	60 - 150	5, 6
Balistes vetula	Queen triggerfish	LW,RWR	60 - 300	4, 6
Chaetodon aya		SR,RRS,LW,RWR	60 - 330	4, 6
Acanthurus chirurgus	Doctorfish	RWR	30 - 40	2
Archosargus rhomboidalis	Sea bream	RWR	30 - 40	2

Table 28. (Continued)

Canthigaster rostrata	Caribbean puffer	RWR	30 - 40	
Eucinostomus p.	Mojarra	RWR	30 - 40	2
Haemulon aurolineatum	Tomtate	RWR	30 - 40	2
Haemulon flavolineatum	French grunt	RWR	30 - 40	2
Hypoplectrus chlorurus	Yellowtail hamlet	RWR	30 - 40	2
Lacnolaimus mximus	Hogfish	RWR	30 - 40	2
Lutjanus analis	Mutton snapper	RWR	30 - 40	2
Chromis cyanea	Blue chromis	RWR	40 - 150	1
Chromis enchrysurus		RWR	40 - 150	1
Haemulon album	White grunt	RWR	40 - 150	1
Hypoplectrus nigricans	Black Hamlet	RWR	40 - 150	1
Hypoplectrus puella	Barred hamlet	RWR	40 - 150	1
Priacanthus cruentatus	Bigeye	RWR	60 - 143	4
Scomberomorus cavalla	King mackerel	RWR	60 - 143	4
Anisotremus surinamensiss	Black margate	RWR	60 - 150	6
Elagatis bipinnulata	Rainbow runner	RWR	60 - 150	5
Gramma linki		RWR	60 - 150	6
Holocentrus coruscus	Reef Squirrelfish	RWR	60 - 150	6
Istiophoridae	Marlin	RWR	60 - 150	5
Kyphosidae	Chubs	RWR	60 - 150	8
Lutjanus apodus	Schoolmaster snapper	RWR	60 - 150	6
Mycteroperca tigris	Tiger grouper	RWR	60 - 150	6
Mycteroperca venenosa	Yellowfin grouper	RWR	60 - 150	6
Thalassoma bifasciatum	Blue-head wrasse	RWR	60 - 150	5
Chromis sp.	Chromis	LW,RWR	60 - 210	4
Stegastes variabilis	Cocoa damselfish	RRS,RWR	60 - 240	4
Chromis multilineatus	Brown chromis	LW,RWR	60 - 300	6
Microspathodon chrysurus	Yellowtail Damselfish	LW,RWR	60 - 300	6

bright bass, chalk bass, (*Serranus lucipercanus, Serranus tortugarum*) and sargassum triggerfish (*Xanthychtys ringens*). Large groupers, such as the tiger, yellowfin, nassau and red hind (*Mycteroperca tigris, M. venenosa, Epinephelus striatus, E. guttatus*) were sighted. Although not reported by the submersible survey (Nelson and Appeldoorn, 1985), several other species of high commercial value, such as the dog, mutton and cubera snappers (*Lutjanus jocu, L. analis, L. cyanopterus*) are known to occur at upper-slope habitats.

Pelagic fishes associated with the upper-slope are those typical of shelf-edge reefs, many of which are large piscivorous predators. These include the mackerels (*Scomberomorus spp*.), jacks (*Caranx spp., Elagatis bipinnulatus*), great barracuda (*Sphyraena barracuda*), wahoo (*Acanthocibium solanderi*), marlins (*Makaira nigricans, Tetrapturus albidus, Istiophorus albicans*), tunnas (*Thunnus spp*.) and sharks

(*Carcharhinus spp., Sphyrna spp., Galeocerdo spp*). Schooling pelagic fishes that constitute forage species for the large pelagics at the upper slope include the Creole Fish (*Clepticus parrae*), Mackerel Scad (*Decapterus spp.*), Blue runner and Bar jacks (Carangoides spp.), and Chubs (*Kyphosus spp*.).

V. Field Survey at Isla Desecheo

1. Description of Study Area

Desecheo is an oceanic island located in Mona Passage, about 12 nautical miles off Rincon, northwest coast of Puerto Rico. The emergent section of the island is about 1.6 km long by 1.4 km wide. Its submerged insular shelf, down to a depth of 100 m along its most extensive northeast to southwest axis is approximately 5 km long. Surrounding depths range between 400-900 m, increasing abruptly to the north, where the southwestern edge of the Puertorrican Trench is found (Figure 9). The island, designated as a Natural Reserve in 1999, was used as a shooting range by the U. S. Navy during the Second World War.

Marine communities at Isla Desecheo are influenced by exceptionally clear waters, swift currents and seasonally strong wave action associated with North Atlantic winter swells. A rocky shoreline fringes the entire island, except for two small beach coves on the west and southwest coast (Puerto Botes and Puerto Canoas). A federally and locally enforced closure to fishing practices is in effect year-round. The protected area includes a fringe of 0.5 miles around the island.

The northwest shelf of Isla Desecheo consists of a series of massive lava rock promontories partially displaced from the main island. Hard substrate is mostly colonized by a dense algal turf with encrusting brown macroalgae. Scleractinian corals cover approximately 25.2 % of the substrate at a depth of 10.6 m on the North Reef of Isla Desecheo (García et al., 2001b). Due north, an isolated rock promontory known as the “Yellow Reef” rises from a depth of 38 m at its base to a pinnacle at approximately 6 m from the surface. This reef is extensively colonized by benthic algae (mostly encrusting fan-leaf alga, *Lobophora variegata*), colonial hydrozoans, hydrocorals and encrusting sponges and corals. To the northeast, the shelf is relatively wide and gradually slopes down along a flat, hard and mostly un-colonized bottom with sand channels and scattered small rock promontories encrusted by benthic algae, corals and sponges. The east coast features a narrow shelf with an abrupt slope. Rock promontories surge from narrow terraces down the slope at depths ranging from 30 to 50 meters. These rock reefs are relatively small (less than 30 m long) and are mostly covered by encrusting algae, sponges and isolated corals.

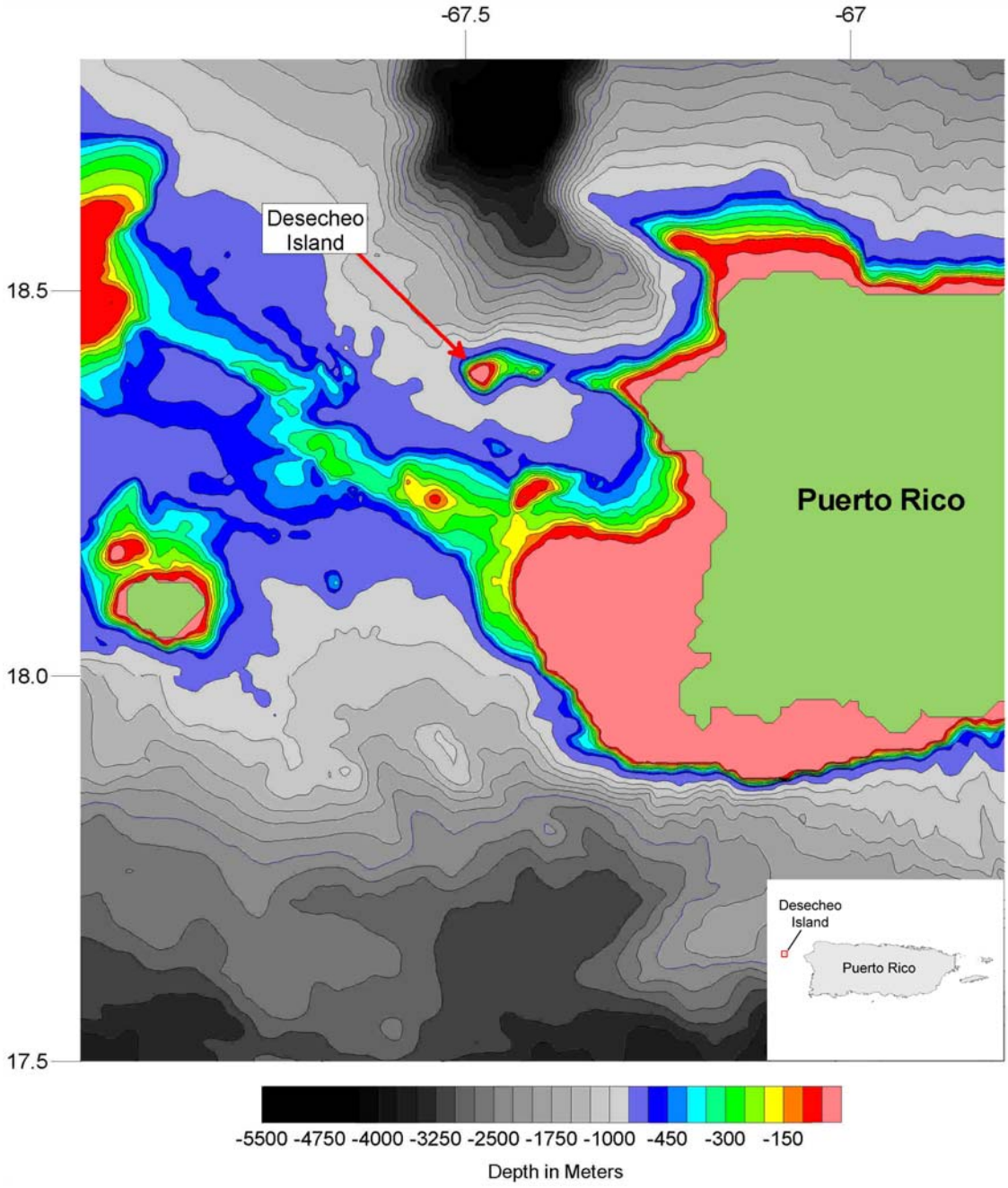


Figure 9. Location map of Isla Desecheo in the Mona Passage, western Puerto Rico.

Coral reefs have established along the west and southwest sections of the island shelf, extending offshore approximately 0.6 nautical miles, encompassing depths between 15 and (at least) 70 m. The area of most extensive hermatypic coral reef development is known as Puerto Canoas. This section of the shelf is identified as our study area and presented with its bathymetry as Figure 10. The coral reef system at the Puerto Canoas shelf is exuberant, with huge stony coral colonies growing together and forming large coral promontories that provide very high topographic relief (Plate 14). Coral outcrops are interspersed among a coralline sandy bottom. With a mean substrate cover of 52 %, scleractinian corals represent the dominant taxonomic component of the sessile-benthic community at Puerto Canoas (García-Sais et al., 2001b). A total of 21 species of

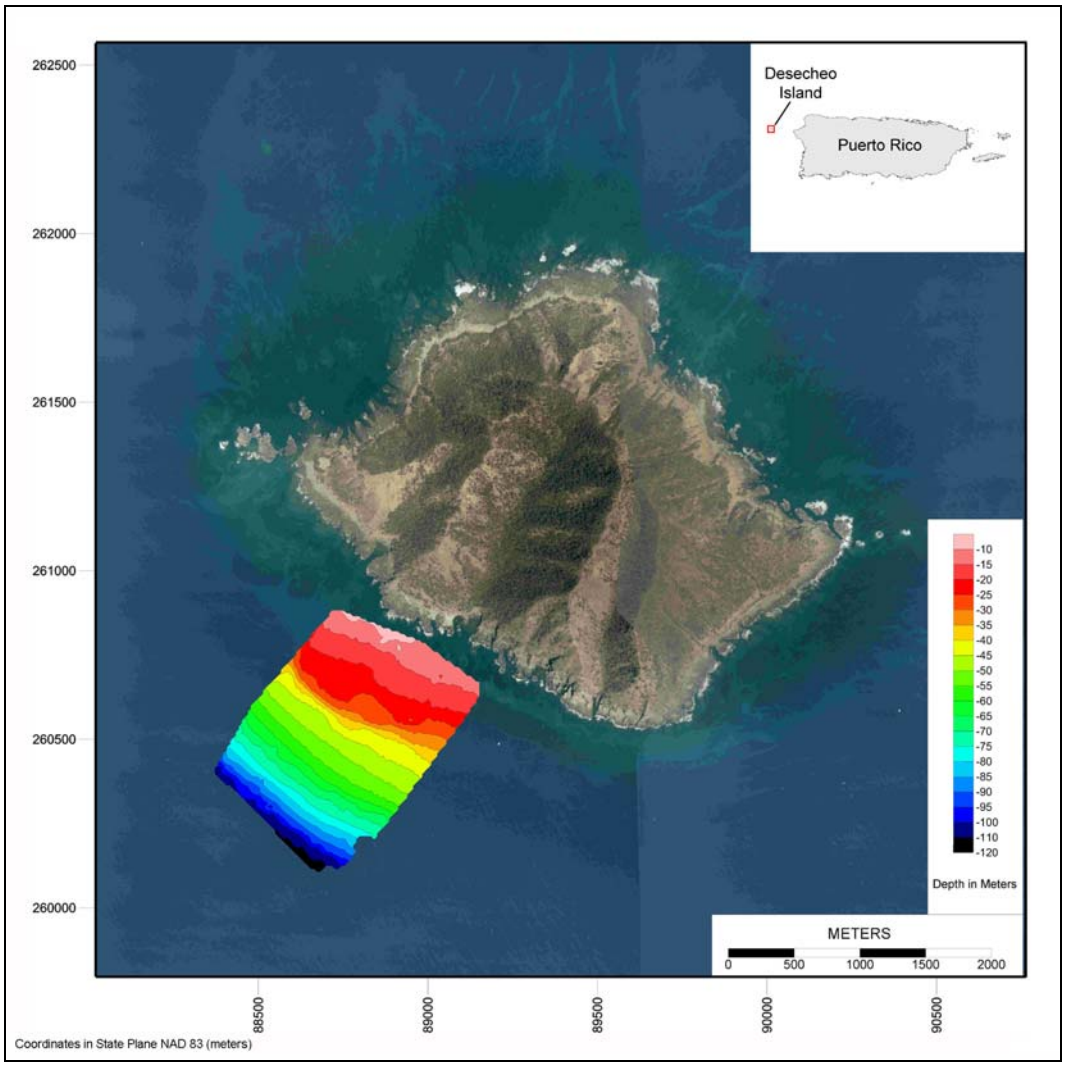


Figure 10. Study area at Isla Desecheo, Mona Passage, western Puerto Rico.

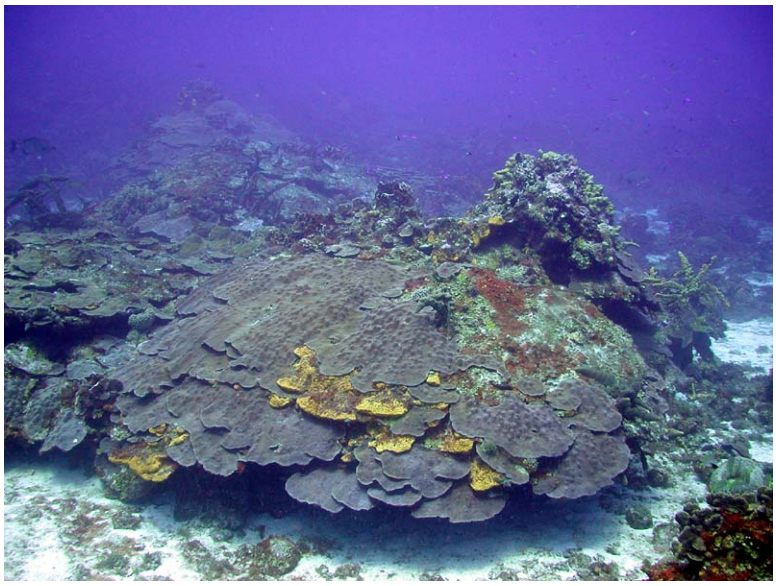


Plate 14.

scleractinian corals and two hydrocorals were identified during the baseline survey by García-Sais et al. (2001b). Boulder star coral, *Montastrea annularis* (*faveolata* morphotype) was the dominant coral species in terms of substrate cover with a mean of 32.0 %, representing 62% of the total cover by stony corals at a depth of 20 m.

The shelf-edge reef off Puerto Canoas is at the southwest end of a massive and impressive coral buildup that has developed as a series of patch reef promontories separated by coralline sand deposits. Coral promontories are typically comprised of several very large colonies of Boulder star coral (*Montastrea annularis*). There are colonies that rise from the bottom at least four meters and extend horizontally more than 5 meters, in some instances merging with other large colonies to form continuous laminar coral formations that are unique in Puerto Rico. There are many sections in this reef at depths between 23 – 27 m where coral cover along 10 meter long transects is between 80 – 100 %. In the baseline survey by García-Sais et al. (2004), stony corals dominated reef substrate cover along surveyed transects at the shelf-edge off Puerto Canoas with a mean of 48.4 %. Boulder star coral (*M. annularis*), with a mean cover of 36.1% represented almost 75 % of the total stony coral cover. Lettuce coral (*Agaricia agaricites*), mustard-hill coral (*Porites astreoides*) and flower coral (*Eusmilia fastigiata*) were among the species with highest percent substrate cover.

At the southern end, the reef platform ends in an extensive sand deposit that slopes down gently to a depth of about 50 meters. Towards the northern end, the shelf-edge reef platform leads to an almost vertical wall down to a depth of 40 meters known as the SW Wall Reef. Our permanent transects for characterization of the deep hermatypic coral reef communities were established along the 30 and 40 m depth contours in the central-south section of the SW Wall Reef (Figure 11 a-b). The total area of the SW Wall Reef was estimated as 7,000 m^2. It extends horizontally approximately 200 m along a north south axis and extends down approximately 15 m, from a depth of 27 m at the shelf-edge to a depth of 40 m at the base. The slope angle varies between 30 – 45°, being more abrupt at the northern section and increasing towards the south, where the coral reef ends in an extensive coralline sand deposit. Towards the west-southwest and down the slope, the SW Wall Reef ends in a gently sloping terrace of coralline sand with coral rubble. The sandy fringe extends offshore approximately 50 meters and merges with a deposit of coarse coral rubble and calcite rock formations that appear to be relict rhodoliths. These rhodolith structures of variable sizes are extensively colonized by encrusting biota, including benthic algae, erect and branching sponges and corals, forming a reef system, Agelas Reef.

Agelas is a live hermatypic reef established at depths between 45 – 70 meters (148 – 230') on the southwestern insular slope of Isla Desecheo (Figure 11 a-b). The reef extends offshore approximately 200 m along a gently sloping terrace and ends at a second drop-off rock wall at 70 meters. The north to south extension of this reef is still undetermined. The reef has very low topographic relief as it lies over an essentially flat platform and massive corals do not contribute significantly to its rugosity.

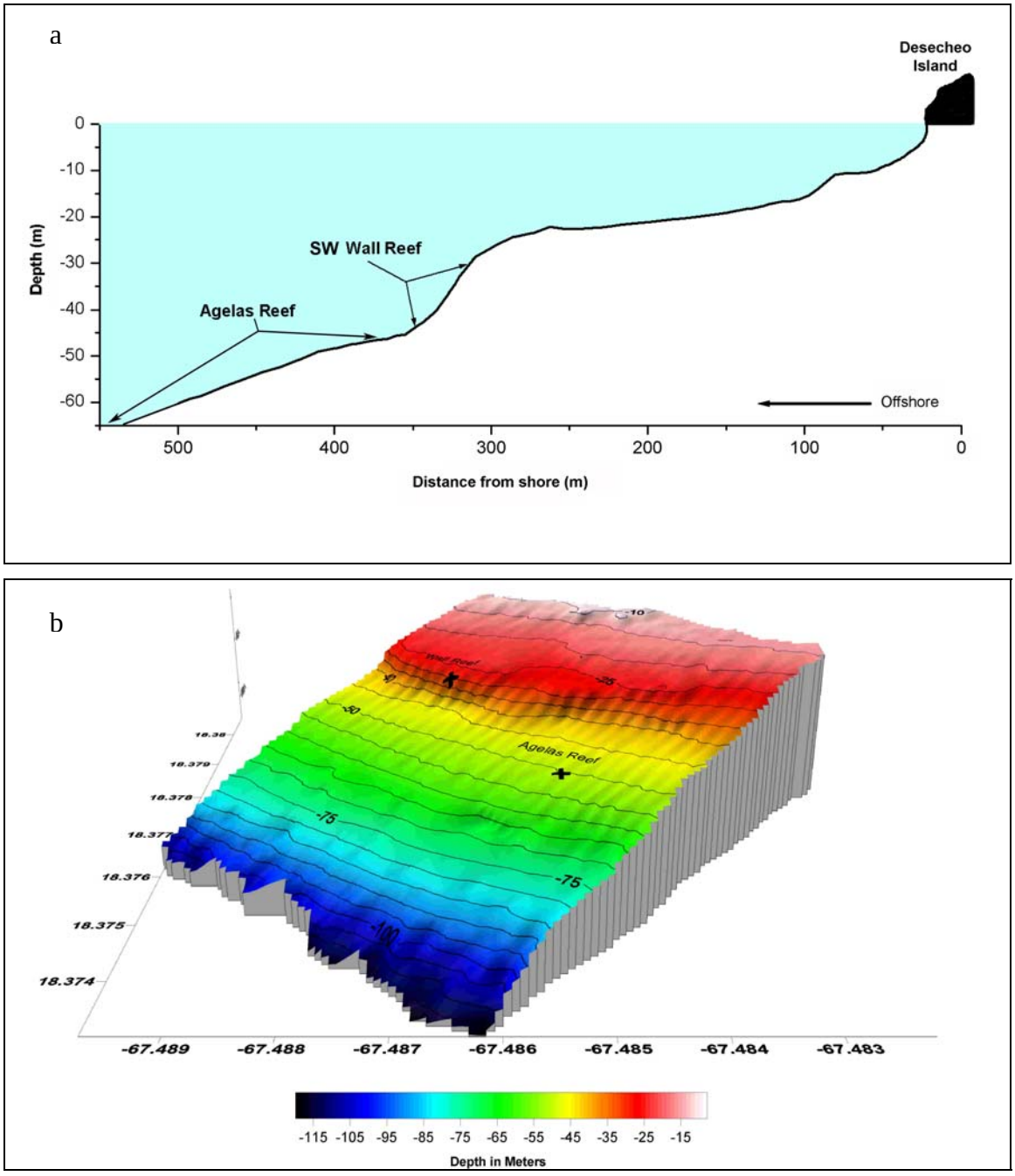


Figure 11 a) Transversal section of the southwestern shelf of Isla Desecheo.

b) Bathymetry of study area on the southwestern shelf of Isla Desecheo

1. Biological Characterization of Marine Communities
1.1 Sessile-benthic Reef Community

1.1.1 SW Wall Reef - 30 meters

Substrate cover at a depth of 30 meters on the SW Wall was dominated by benthic macroalgae, sand, sponges, and massive corals. A combination of brown (*Lobophora variegata, Dictyota sp., Padina sp.*), calcareous green (*Halimeda discoidea*), fleshy red (*Wrangelia bicuspidata*) and coralline red (*Amphiroa sp.*) macroalgae represented 48.6 % of the substrate cover along permanent transects surveyed (Table 29). The encrusting fan leaf alga (*L. variegata*) was the dominant species with a mean cover of 23.8 % (range 18.8 – 30.1 %). This alga was observed growing in patches or mats over the hard ground substrate, colonizing dead coral structures and stabilizing sandy sections of the reef (Plate 15).

Sponges were highly prominent in the reef benthos (mean surface cover: 17.3 %), growing mostly as large erect and branching forms that produced substantial topographic relief and protective habitat for fishes and invertebrates (Plate 16). In many instances, sponges were observed growing attached to stony corals, forming sponge-coral bioherms of considerable size (Plate 17). One of the most common associations involved the brown tube (*Agelas conifera*) and row pore sponges (*Aplysina spp*.) with star corals (*Montastrea cavernosa, M. annularis*). Large basket sponges (*Xestospongia muta*) were common in the reef and provided microhabitats for cleaning gobies (*Gobiosoma evelynae*), arrow crabs (*Stenorhynchus seticornis*), brittle stars (*Ophiocoma sp*) and pederson cleaner shrimps (*Periclimenes pedersoni*).

A total of 23 scleractinian corals, three hydrocorals and two antipatharian (black coral) species were present along the SW Wall Reef at a depth of 30 m. The branching and box fire corals (*Millepora alcicornis, M. squarrosa*) and the rose lace coral (*Stylaster roseus*) were the hydrocorals present. The latter was particularly common in crevices and other microhabitats. Wire (black) coral (*Stichopathes lutkeni*) was abundant on the SW Wall reef in shades of yellow-brown, red-brown and green. One colony of the feather black coral (*Antipathes pennacea*) was present. Twelve scleractinian coral species were observed within video-transect frames, with a combined mean substrate cover of 8.6 % (range: 3.2 – 19.2 %) (Table 30). Great star and boulder star corals,

Table 29. Percent substrate cover by sessile-benthic categories surveyed by video transects at a depth of 30 m on the SW Wall Reef, Isla Desecheo during 2004.

	Transects						MEAN
Substrate Categories	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**% Cover**
Scleractinian Corals							
Montastrea cavernosa	0.21	0.80	0.17	1.09	1.17	11.54	**2.50**
Montastrea faveolata	0.42	5.76	1.67	0.18		6.46	**2.42**
Siderastrea siderea	0.21		5.00		2.83		**1.34**
Agaricia spp.	1.47	0.48	0.50		0.17	0.46	**0.51**
Meandrina meandrites	0.21	1.60	0.17	0.55	0.50		**0.51**
Porites astreoides	0.21	1.12			0.83	0.31	**0.41**
Diploria strigosa				1.82			**0.30**
Diploria clivosa				1.64			**0.27**
Montastrea franksi	0.42					0.31	**0.12**
Madracis decactis		0.32	0.17			0.15	**0.11**
Eusmilia fastigiata		0.16	0.33				**0.08**
Colpophyllia natans		0.16					**0.03**
Total Scleractinian Corals	**3.15**	**10.40**	**8.01**	**5.28**	**5.50**	**19.23**	**8.60**
Sponges	13.89	8.32	11.83	10.73	14.00	7.23	**11.00**
Agelas conifera	2.74	5.92	3.33	8.00	2.33	2.92	**4.21**
Xestospongia muta			0.50	5.82	0.17		**1.08**
Esponja brown				2.55			**0.43**
Aplysina spp.		1.28			0.50		**0.30**
Aplysina cauliformis			0.83				**0.14**
Cribrochalina vasculum		0.64					**0.11**
Benthic Algae							
Lobophora variegata	30.11	22.56	20.50	21.09	18.83	29.54	**23.77**
Algal Turf	22.11	21.76	15.33	15.09	17.00	14.46	**17.63**
Coralline Algae	1.68	8.96	8.00	8.55	2.00	4.15	**5.56**
Fleshy Algae	0.42	2.40	1.83	3.45	1.50	0.46	**1.68**
Hydrozoans		0.16					**0.03**
Abiotic							
Sand	25.89	17.60	29.83	19.45	38.17	22.00	**25.49**

Corals and Hydrocorals Outside Transects: *Millepora alcicornis, M. squarrosa, Stylaster roseus, Stichopathes lutkeni, Antipathes pennacea, Isophyllia sinuosa, Dichocoenia stokesii, Diploria labyrinthiformis, Mycetophyllia lamarckiana, M. ferox, Leptoseris cucullata, Madracis sp.*

Plate 15

Plate 16

Plate 17

(*Montastrea cavernosa, M. annularis* complex) were the dominant species with a mean substrate cover of 2.5 and 2.4 %, respectively. Lettuce coral (*Agaricia spp*) and maze coral (*Meandrina meandrites*) were also common, with colonies present in at least four out of the six transects surveyed. The mean density of coral colonies within transects was 3.2 col/m^2 (range: 2.1 – 4.3 col/m^2) (Table 30). Again, the dominant species in terms of density of colonies were the great and boulder star corals (*M. cavernosa, M. annularis* complex) with 0.75 and 0.62 col/m^2, respectively. The Shannon-Weiner index of diversity for scleractinian corals within video-transects averaged 1.68 (range: 1.27 – 1.97) (Table 31). Transect 1 presented the highest diversity with a total of 11 colonies distributed in eight species, whereas transect 6 had the lowest diversity with 24 colonies distributed in six species. Coral species saturation reached an asymptotic trend at the fourth transect (Figure12). The variability of percent live coral cover associated with the number of replicate transects surveyed declined to 32 % by the fifth transect, but increased again with the sixth transect (up to 70 %) as a large coral head was present in the last transect (Figure13). The variability associated with other reef benthic categories declined consistently with the increasing number of transects, stabilizing at 33% or less by the sixth transect in all cases.

Soft corals, or gorgonians were rare at the SW Wall Reef. None were present within transect areas and only a few small colonies of sea plumes (*Pseudopterogorgia sp*.) were observed during random swim surveys.

Table 30. Density of scleractinian coral and hydrocoral colonies within video-transect areas at a depth of 30 meters, SW Wall Reef during 2004.

Coral and Hydrocoral Species	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Mean**
Agaricia sp	0.22	0.33	0.52		0.52	0.16	0.29
Montastrea cavernosa	0.44	0.17	0.52	0.76	0.87	1.76	0.75
Montastrea faveolata	0.22	1.33	0.52	0.19		1.44	0.62
Montastrea franksi	0.22					0.16	0.06
Diploria strigosa				0.38			0.06
Diploria clivosa				0.19			0.03
Porites astreoides	0.22	0.83		0.19	0.87	0.16	0.38
Meandrina meandrites	0.22	0.83	0.17	0.38	0.35		0.33
Colpophyllia natans		0.17					0.03
Eusmilia fastigiata	0.22	0.17	0.17				0.09
Siderastrea siderea	0.66		1.04		0.87		0.43
Madracis decactis		0.50	0.17		0.17	0.16	0.17
TOTAL (colonies/m2) =	**2.41**	**4.33**	**2.60**	**2.08**	**3.65**	**3.85**	**3.24**

Table 31. Shannon Weiner index of species diversity for scleractinian corals and hydrocorals surveyed within video transects at a depth of 30 m, SW Wall Reef, Isla Desecheo during 2004.

Station	Video Transect	No. of Species	No. Colonies	Species Diversity (H')
30 m	1	8	11	1.97
	2	8	26	1.82
	3	7	10	1.74
	4	6	11	1.64
	5	6	21	1.67
	6	6	24	1.26
MEAN		**6.8**	**17.1**	**1.68**

Abiotic categories, mostly comprised by fine and coarse coralline sand with some coral rubble presented an average substrate cover of 25.5 % (range: 17.6 – 38.2 %) at a depth of 30 meters on the SW Wall reef. Evidently, there is substantial transport of sand from the upper terrace of Puerto Canoas reef down this slope (Plate 18). A coralline sand deposit has accumulated at the base of the wall (40 – 45 m depth) separating the wall reef from a deep reef system established at depths between 46 – 70 meters. The relatively high substrate cover by sand is probably an important factor limiting the recruitment of coral colonies on the wall.

Plate 18

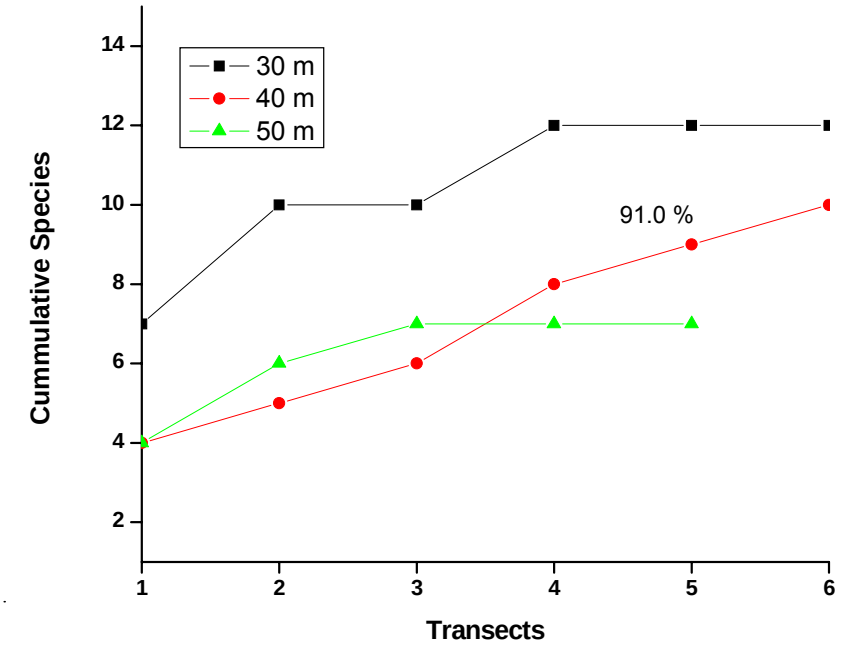


Figure 12. Coral species saturation curves from video-transects surveyed at depths of 30,40 and 50 m, Isla Desecheo, 2003-04

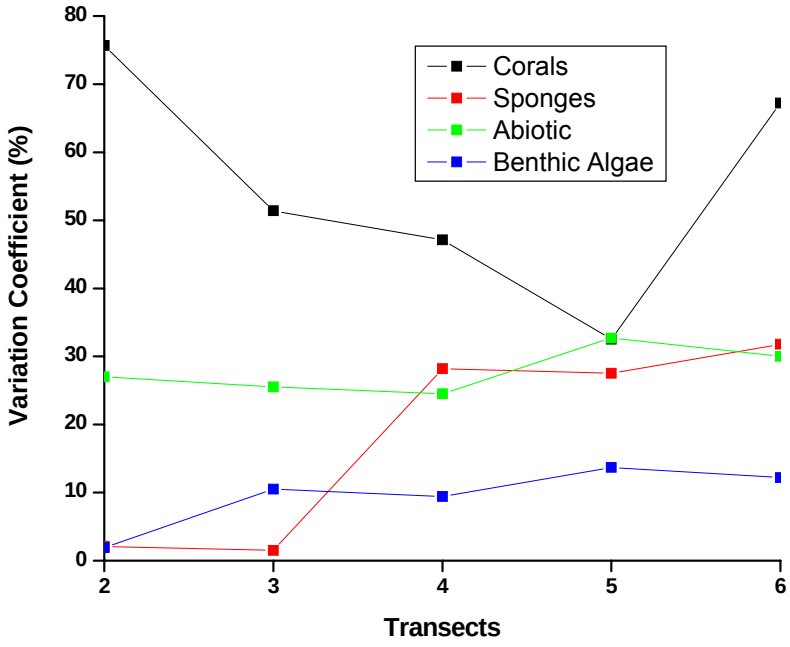


Figure 13. Effect of replicate transects in the variation coefficient of the mean substrate cover by reef sessile-benthic categories at a depth of 30 m, Isla Desecheo, 2003-04

1.1.2 SW Wall Reef - 40 meters

A series of large sponge-coral bioherms separated by sand patches lie at the base of the SW Wall Reef in Isla Desecheo (Plate 19). Most of the available hard substrate was colonized by benthic algae (combined mean cover: 46.0 %), particularly by the encrusting fan leaf alga, *Lobophora variegata* (mean: 25.8 %) (Table 32). The red coralline Y-twig alga (*Amphiroa* sp.), leafy flat-blade alga (*Stypopodium zonale*) and the Sea Pearl (*Ventricaria ventricosa*) were common within substrate depressions and crevices. Fleshy types, such as the fluorescent red bush alga (*Wrangelia bicuspidata*) grew as a carpet in large patches over the reef slope (Plate 20). Green pinecone alga (*Rhipocephalus phoenix f. longifolius*) was observed in sandy bottom sections at the base of the reef.

Sponges, mostly present as large erect and branching forms were the dominant sessile-benthic invertebrate taxa in terms of substrate cover at the base of the SW Wall Reef with a mean of 29.4 %. Sponges were observed growing attached to stony corals, forming sponge-coral bioherms of considerable size that produced substantial topographic relief. The most common associations involved the brown tube (*Agelas conifera, A. screptrum*) and row pore sponges (*Aplysina spp*.) with star corals (*mostly M. annularis*). The solid attachment surface provided by the coral structure allows brown tube sponges (*Agelas spp*.) to grow many large branches into the water column, creating a complex structure that was used as protective habitat by small schooling fishes, such as the blue and sunshine chromis (*Chromis cyanea, C.insolata*) and the masked goby (*Coryphopterus personatus*). Large basket sponges (*Xestospongia muta*) were observed at the base of the SW Wall and also represent important microhabitats for reef fishes and invertebrates. It was observed that when water currents were strong, red hinds (*Epinephelus guttatus*) swim into the cone of the basket sponge to avoid the force of the current. The base of the basket sponge appears to be one of the preferred microhabitats of the arrow crab (*Stenorhynchus seticornis*).

Scleractinian corals presented a mean substrate cover of 8.42 % (range:1.83 – 20.70 %). The high variability of substrate cover was mostly associated with the discontinuity of the reef habitat, and the presence of large massive corals interspersed within the sandy bottom at the base. A total of nine species of scleractinian corals were included

Table 32. Percent substrate cover by sessile-benthic categories surveyed by video transects at a depth of 40 m on the SW Wall Reef, Isla Desecheo during 2004.

Substrate Categories	Transects T1	T2	T3	T4	T5	T6	MEAN % Cover
Scleractinian Corals							
Montastrea annularis (faveolata)	4.17	5.12		0.57	13.33	12.00	**5.87**
Montastrea cavernosa		0.16		1.43		7.13	**1.45**
Agaricia spp	0.83		1.00		0.17	0.70	**0.45**
Meandrina meandrites	0.17	0.16				0.70	**0.17**
Montastrea annularis					1.00		**0.17**
Colpophyllia natans			0.83				**0.14**
Siderastrea siderea				0.43			**0.07**
Porites astreoides				0.29			**0.05**
Eusmilia fastigiata	0.17						**0.03**
Madracis decactis						0.17	**0.03**
Total Scleractinian Corals	**5.34**	**5.44**	**1.83**	**2.72**	**14.50**	**20.70**	**8.42**
Antipatharian Corals							
Stichopathes lutkeni		0.16					**0.03**
Sponges	21.83	21.44	18.3	18.57	10.83	16.17	**17.86**
Agelas conifera	10.00	1.12	0.17	5.71	6.67	5.39	**4.84**
Aplysina cauliformis		1.76	0.83				**0.43**
Aplysina sp.	3.00	1.44	11.67	6.29	5.83	1.91	**5.02**
Xestospongia muta		0.48	3.50	2.14	1.83		**1.33**
Benthic Algae							
Algal Turf	3.00	6.08	12.0	15.14	9.83	12.00	**9.68**
Fleshy Algae	0.67	0.48	0.83	0.29	0.67	0.87	**0.64**
Lobophora variegata	28.17	28.96	26.50	26.57	23.50	21.22	**25.82**
Coralline Algae	8.67	14.72	12.67	5.29	8.83	9.22	**9.90**
Abiotic							
Sand	19.33	17.92	11.67	17.3	17.50	12.52	**16.04**

Corals Outside Transects: *Agaricia grahame, A. agaricites, A. lamarki, Antipathes sp., Mycetophyllia aliciae, Stichopathes lutkeni, Stylaster roseus*

Plate 19

Plate 20

within video transect areas. Boulder star coral (*Montastrea annularis*), particularly the *faveolata* morphotype was the dominant species in terms of substrate cover (mean: 5.87 %). Great star coral (*Montastrea cavernosa*) ranked second in terms of substrate cover with a mean of 1.4 %.

Mean density of coral colonies within transects was 1.11 col/m^2 (range: 0.5 – 1.99 col/m^2) (Table 33), which reflects the influence of few, but large massive colonies in the

reef at 40 meters. The dominant species in terms of density of colonies were the boulder star, great star and maze corals (*Montastrea faveolata, M. cavernosa, Meandrina meandrites*) with 0.40, 0.20 and 0.20 col/m^2, respectively. Colonies of the three aforementioned coral species were present in at least four out of the six transects surveyed. The Shannon-Weiner index of diversity for scleractinian corals within video-transects averaged 1.24 (range: 1.04 – 1.56) (Table 34). Transect four presented the highest diversity with a total of five species distributed in six colonies, whereas transect two had the lowest diversity with three species distributed in four colonies. Transect six presented the highest number of colonies with 11, represented by five species.

Coral species saturation reached 91 % at the fifth transect, but the curve did not reach an asymptote by the sixth transect, which suggests that more species might be found with increasing number of transects (Figure 14). The variability of percent live coral cover associated with the number of replicate transects surveyed (expressed as the variation coefficient) presented an increasing pattern reflecting the high spatial heterogeneity of coral distribution at 40 m in the SW Wall Reef. The coefficient of variation associated with other reef benthic categories stabilized at 20 % or less by the fourth transect in all cases.

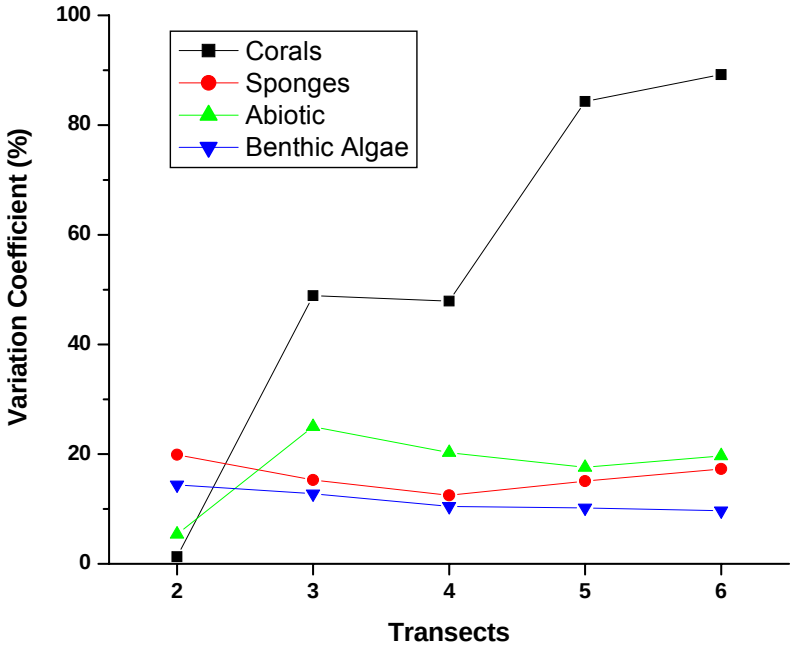


Figure 14. Effect of replicate transects in the variation coefficient of the mean substrate cover by reef sessile-benthic categories at a depth of 40 m, Isla Desecheo, 2003-04

Table 33. Density of scleractinian coral colonies within video transect areas at a depth of 40 meters, SW Wall Reef, Isla Desecheo during 2004.

Scleractinian Corals	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**Mean**
							(# col/m^2)
Montastrea faveolata	0.69	0.33		0.15	0.52	0.72	0.40
Montastrea cavernosa		0.17	0.17	0.15		0.72	0.20
Meandrina meandrites	0.52	0.17		0.15	0.17	0.18	0.20
Agaricia sp	0.17		0.17		0.17	0.18	0.12
Siderastrea siderea				0.30			0.05
Montastrea annularis					0.17		0.03
Colpophyllia natans			0.17				0.03
Eusmilia fastigiata	0.17						0.03
Madracis decactis						0.18	0.03
Porites astreoides				0.15			0.02
TOTALS (# col/m^2)	**1.56**	**0.67**	**0.52**	**0.89**	**1.04**	**1.99**	**1.11**

Table 34. Shannon Weiner index of species diversity for scleractinian corals surveyed within video transects at a depth of 40 m, SW Wall Reef, Isla Desecheo during 2004.

Station	**Video Transect**	**No. of Species**	**No. Colonies**	**Species Diversity (H')**
130	1	4	9	1.21
	2	3	4	1.04
	3	3	3	1.10
	4	5	6	1.56
	5	4	6	1.24
	6	5	11	1.39
Mean		**4**	**6**	**1.24**

Soft corals, or gorgonians were rare at the SW Wall Reef. None were present within transect areas and only a few small colonies of sea plumes (*Pseudopterogorgia sp*.) were observed during random swim surveys. Wire (black) coral (*Stichopathes lutkeni*) was common at 40 meters and throughout the reef wall habitat. Substrate cover by coralline sand and coral rubble averaged 16.0 % (range: 11.7 – 19.3 %) at a depth of 40 meters on the SW Wall.

1.1.3 Agelas Reef – 50 m

This is a live hermatypic reef found at depths between 45 – 70 meters (148 – 230') on the southwestern insular slope of Isla Desecheo. It is established across a gently sloping terrace separated from the SW Wall reef by a sand strip of approximately 40 meters (Figure 11). The reef extends offshore approximately 200 meters and ends at a second drop-off wall at 70 meters. Agelas Reef appears to be a crustose algal formation mostly colonized by encrusting brown algae, large erect and branching sponges and lettuce corals (*Agaricia spp*). Sessile-benthic biota grows over a vast deposit of rhodolite structures loosely anchored to the bottom. The reef has very low topographic relief as it lies over an essentially flat platform and massive corals do not contribute significantly to its rugosity.

Table 35 shows the percent substrate cover by sessile-benthic categories at Agelas Reef. Benthic algae dominated substrate cover by sessile biota with a combined mean of 57.6% (range: 54.2 – 66.4%). The benthic algal assemblage was comprised by encrusting and fleshy brown macroalgae, and a mixed stand of short filamentous (mostly microscopic) algae, forming an "algal turf". The encrusting fan leaf alga, *Lobophora variegata* was the main taxonomic component of the algal assemblage with a mean cover of 37.1 % (range (33.2 – 47 %). The leafy flat-blade alga, *Stypopodium zonale*, the pink bush alga (*Wrangelia* sp.), and the large leaf watercress alga (*Halimeda discoidea*) were also present at depths between 47 – 53 meters in Agelas Reef. Loose oval shaped structures of calcite (biogenic) origin, or rhodoliths were covered by what appears to be an assemblage of at least two or more species of (live) encrusting red crustose algae.

Sponges (Class Demospongiae) were the most important invertebrate component of the sessile-benthic community at Agela's reef with an assemblage of nine species within transects and a combined substrate cover of 28 % (range: 20.6 – 39.2 %) (Table 36). The Brown tube sponge (*Agelas conifera*) was the most prominent species within transects with a mean of 5.9 % substrate cover. *Agelas clathrodes* and *Aplysina cauliformis* ranked second and third in terms of substrate cover and were present in almost all transects surveyed. The basket sponge (*Xestospongia muta*) was present,

Table 35. Percent substrate cover by sessile-benthic categories surveyed by video transects at a depth of 50 m on Agelas Reef, Isla Desecheo during 2004.

Substrate Categories	TRANSECT								Mean
	1	2	3	4	5	6	7	8	
Scleractinian Corals									
Agaricia spp.	4.20	5.60	7.8	4.8	9.2	22.8	9.0	7.6	**8.88**
Porites astreoides	1.80	3.40	1.2	2.2	0.8	0.6	1.8	2.6	**1.80**
Montastrea annularis	2.40		0.4			8.8			**1.45**
Colpophyllia natans						4.2			**0.53**
Eusmilia fastigiata			0.4					1.0	**0.18**
Mycetophyllia lamarckiana	0.60	0.20		0.4					**0.15**
Montastrea cavernosa								0.6	**0.08**
Meandrina meandrites		0.20						0.2	**0.05**
Madracis sp.		0.20							**0.03**
Total scleractinian corals =	9.00	9.60	9.80	7.40	10.00	36.40	10.80	12.00	**13.13**
Benthic Algae									
Lobophora variegata	33.20	36.20	36.00	47.00	33.20	34.20	34.40	38.80	**36.63**
Fleshy algae	2.40	1.40	5.20	0.40	2.00	0.40	1.20	0.20	**1.65**
Turf algae	14.80	24.00	25.20	8.20	19.00	4.00	10.60	9.00	**14.35**
Total benthic algae =	50.4	61.6	66.4	55.6	54.2	38.6	46.2	48.0	**52.63**
Sponges									
Agelas conifera	16.8	8.4	4.6	7.8	1.0	1.6	4.6	2.6	**5.9**
Agelas clathrodes	1.0	0.2	0.8	5.6	1.4	0.6	1.0	1.2	**1.5**
Aplysina cauliformis	1.2	0	2.0	0.6	0.2	1.2	0.8	4.2	**1.3**
Aplysina lacunosa	0.2	0.2	0	0.2	1.2	0.6	0.6	0.4	**0.4**
Cribrochalina. vasculum	0.8	0.2	0	1.0	0.6	0	0	0	**0.3**
Xestospongia muta	0	2.8	0.6	0	0	0	0	0	**0.4**
Geodia neptuni	0	0	1.4	0	0	0	0	0	**0.2**
Agelas sp.	0	0	0	0	0.8	0.8	0	0.4	**0.3**
Agelas dispar	0	0	0	0	0	0	0	1.0	**0.1**
unidentified	19.2	15.4	11.6	19.0	27.8	15.8	13.6	18.4	**17.6**
Total sponges =	39.20	27.20	21.00	34.20	33.00	20.60	20.60	28.20	**28.00**
Abiotic	1.40	1.60	2.00	2.80	2.80	1.80	4.60	2.60	**2.45**
Antipatharians (# colonies/transect)	1								**0.13**

Corals outside transects: *Agaricia agaricites, A. lamarki, A. grahame, Isophyllia rigida,Leptoseris cucullata, L. cailleti, Madracis pharensis, Millepora alcicornis, Mycetophyllia aliciae, M. ferox, Porites sp. (colonensis ?), P. porites, Scolymia cubensis, Stylaster roseus, Stichopathes lutkeni*

but not as abundant as in the shallower SW Wall Reef. Brown tube sponges (*Agelas conifera*) exhibited large sizes, with branching arms reaching out to the water column and falling down to the bottom, creating "umbrella" structures that served as an important protective habitat for juvenile fishes (Plate 21). In many cases, sponges grew attached to corals at their base (mostly *Agaricia spp.* and *Montastrea cavernosa*), forming massive sponge-coral bioherms. It appears that the attachment to the coral serves to "anchor" the sponges, allowing them to grow to very large sizes in a mostly undisturbed physical environment. Sponge-coral bioherms represented the main biological structure contributing topographic relief in Agela's reef. Row-pore sponges (*Aplysina spp*.) typically attach also to the main sponge-coral bioherms, adding complexity and rugosity to the reef structure.

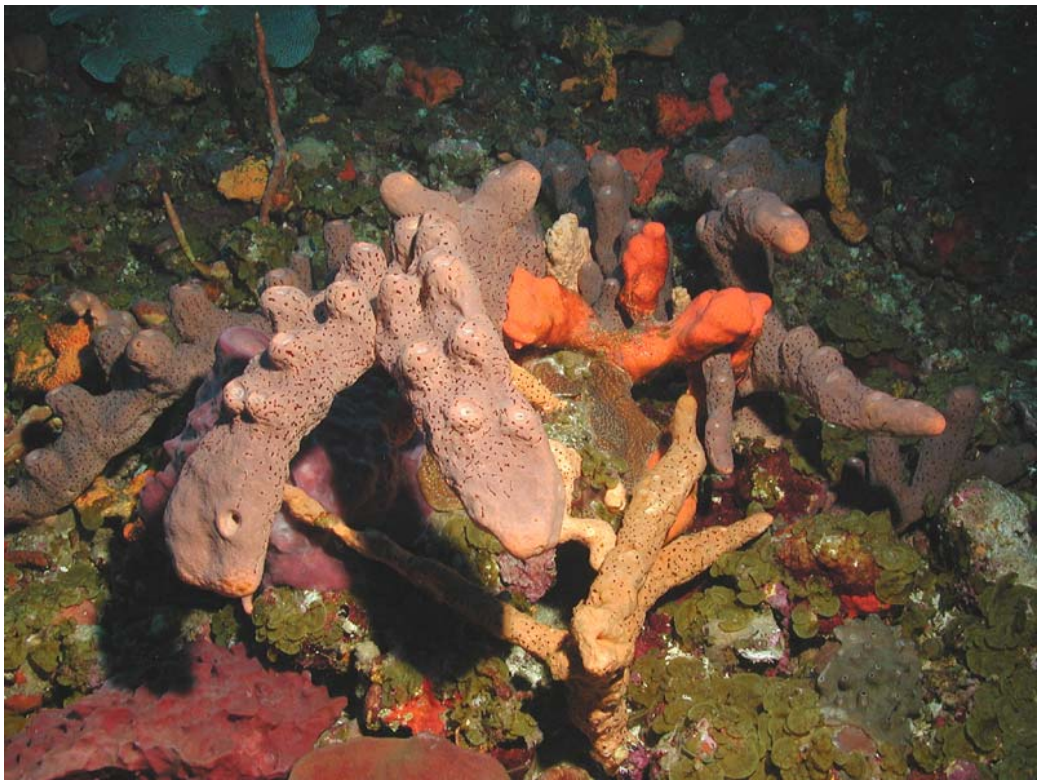


Plate 21

A total of 18 species of scleractinian corals, two hydrozoans (*Millepora alcicornis* and *Stylaster roseus*) and the antipatharian black wire coral (*Stichopathes lutkeni*) were identified from Agelas Reef. The combined mean substrate cover by the nine species of scleractinian corals within video-transects was 13.1 % (range: 7.4 – 36.4 %) (Table 35). Irregular sheets or laminar growth by lettuce corals (*Agaricia spp*.) prevailed at depths between 45 and 53 meters (148 – 175') with a combined substrate cover of 8.9 % (range: 4.2 – 22.8 %), representing 70 % of the total cover by scleractinian corals.

Lamark's sheet coral (*Agaricia lamarki*) appeared to be the main species present, as inferred by the presence of white star-like polyps and rounded ridges among the irregular arrangement of valleys in the coral structure. Graham's sheet coral (*Agaricia grahame*) was also observed, without the whitish polyp markings and a mostly parallel valley arrangement in the coral structure. The specific taxonomy of these corals is difficult to determine by divers at depths below 50 meters (165') due to the low light intensity at the bottom, and the phenotypic similarity between them. In many instances, the identification features that separate *Agaricia* species are not evident from videos either. Thus, the *Agaricia spp*. taxon (as reported in Table 35) is comprised by the Lamarki-Grahame species complex. The wire coral (*Stichopathes lutkeni*) was common at Agelas Reef, but other black coral (antipatharian) species were not observed. Also, the rose lace hydrocoral (*Stylaster roseus*) was common in small crevices and other criptic habitats of the reef.

Scleractinian corals, antipatharians and hydrocorals were observed growing attached to boulders of biogenic calcite origin at Agelas Reef. These appear to be red coralline algal nodules (rhodoliths) of variable dimensions. In fact, the entire reef appears to be constructed over these rhodolith structures, as previously described by Prager and Ginsburg (1989) for the Florida Keys outer shelf reefs, and by Jarret (2003) and Jarret et al. (2005) for the southern Pulley Ridge (SW Florida) deep hermatypic reef system.

Density of scleractinian coral colonies within video-transect areas averaged 6.88 col/ m^2 (range: 4.17 – 9.59 col/m^2). The higher density of coral colonies at Agelas Reef, as compared to the SW Wall reef at depths between 30 – 40 meters, is related to the typically smaller colony size exhibited by corals, and the higher homogeneity of the benthic habitat at Agelas Reef. The *Agaricia spp*. complex was numerically dominant in

terms of density of colonies with a mean of 5.05 col/m^2 (Table 36). Mustard-hill coral (*Porites astreoides*) ranked second with 1.04 col/m^2. Colonies of the two aforementioned species were present in all video-transects surveyed.

The Shannon-Weiner index of diversity for scleractinian corals within video-transects averaged 0.74 (range: 0.36 – 1.18) (Table 37). Scleractinian coral diversity was lower at Agelas, compared to the SW Wall, reflecting the relatively higher dominance of the *Agaricia spp*. complex at Agelas Reef. Transect one presented the highest diversity with a total of four species distributed in seventeen colonies, whereas transects five and six had the lowest diversity with two and tree species distributed in 17 and 23 colonies, respectively.

Abiotic substrate cover by coralline sand and coral rubble averaged only 2.4 % (range: 1.4 – 4.6 %), reflecting the remarkably high biogenic cover by algae, sponges and scleractinian corals at a depth of 48 - 53 meters on Agelas Reef.

Table 36. Density of scleractinian coral colonies within video-transect areas at Agelas Reef, Isla Desecheo, 2004

Scleractinian Corals	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**Mean**
Agaricia spp.	3.75	5.00	3.75	4.58	6.25	8.75	3.33	5.00	**5.05**
Porites astreoides	1.67	1.67	1.25	1.67	0.84	0.42	0.42	0.42	**1.04**
Mycetophyllia lamarkiana	0.84	0.42		0.42					**0.21**
Montastrea annularis	0.84		0.42			0.42			**0.21**
Montastrea cavernosa		0.42						0.42	**0.11**
Eusmilia fastigiata			0.42					0.42	**0.11**
Meandrina meandrites								0.42	**0.05**
Madracis sp.		0.42							**0.05**
Colpophyllia natans							0.42		**0.05**
TOTALS (# col/m^2)	**7.10**	**7.93**	**5.84**	**6.67**	**7.08**	**9.59**	**4.17**	**6.68**	**6.88**

Table 37. Shannon Weiner index of species diversity for scleractinian corals surveyed within video-transects at a depth of 50 m, Agelas Reef, Isla Desecheo, 2004.

Station	Video Transect	No. of Species	No. Colonies	Species Diversity (H')
150	1	4	17	1.18
	2	5	19	1.08
	3	4	14	0.99
	4	3	16	0.78
	5	2	17	0.36
	6	3	23	0.36
	7	3	10	0.64
	8	5	16	0.56
Mean		**3.6**	**16.5**	**0.74**

The saturation curve of coral species identified from video-transects reached an asymptote at the 3rd transect (Figure 15), reflecting the relatively low species richness of scleractinian corals at 50 m. The variability of percent live coral cover associated with the number of replicate transects surveyed (expressed as the variation coefficient) stabilized at less than 10 % by the fourth transect. Other reef benthic categories stabilized at 30 % or less by the fourth transect (Figure 15). This data is indicative of the relatively higher spatial homogeneity in the distribution of sessile-benthic biotic components at Agelas Reef (as compared to the SW Wall Reef).

The taxonomic structure of the reef sessile-benthic components at the depths studied evidenced major differences which separates them as two major clusters (Figure 16). One cluster joins all transects surveyed at the 30 m depth. The other major cluster joins the 40 and 50 m depths as two sub-clusters that keep their respective depth identity, but that are less dissimilar amongst them than compared to the 30 m transects. Benthic algae ranked first overall at all depths. The relative ranks of the percent substrate cover associated with sponges, abiotic cover and coral species composition provide the main elements of dissimilarities between depths. Sponges ranked second at 50 m and 40 m, whereas they ranked third overall at 30 m in the SW Wall Reef. Abiotic cover ranked as the second and third highest overall substrate category in terms of percent cover at the SW Wall Reef in the 30 and 40 m depths, respectively, whereas it ranked fourth at Agelas (50 m). Boulder star, great star, and massive starlet corals, *Montastrea cavernosa, Montastrea annularis* (*faveolata*) and *Siderastrea siderea* ranked as the first

three coral species in terms of percent substrate cover at depth of 30 m (ranks 4,5 and 6 overall). At 40 m, the highest ranking corals were *M. annularis (faveolata)*, *M. cavernosa* and *Agaricia spp* complex (ranks 4, 5, and 6 overall). The *Agaricia spp*. complex ranked first among corals at 50 m (rank 3 overall), followed by mustard-hill coral, *Porites astreoides,* and maze coral, *Meandrina meandrites* (ranks 5 and 6 overall).

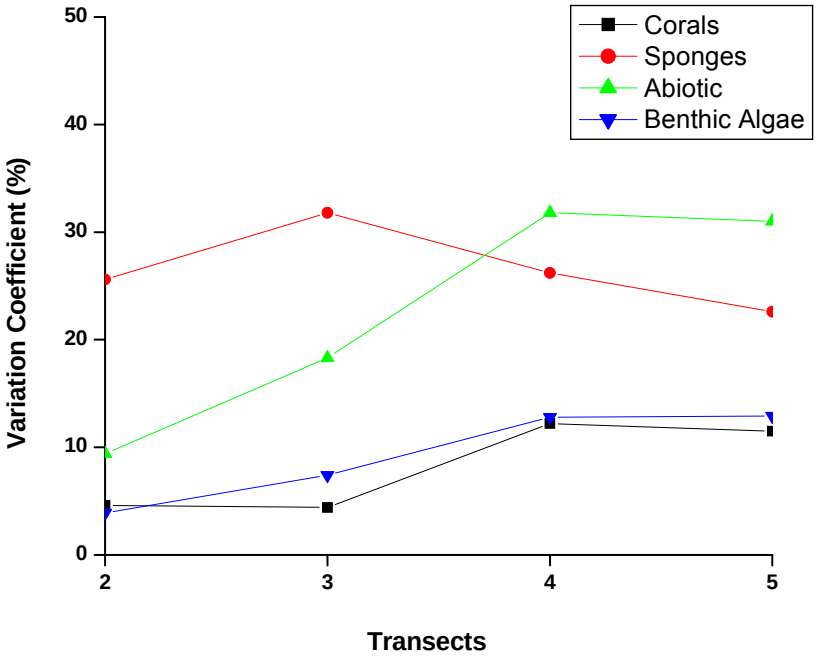


Figure 15. Effect of replicate transects in the variation coefficient of the mean substrate cover by reef sessile-benthic categories at a depth of 50 m, Agelas Reef, Isla Desecheo, 2003-04

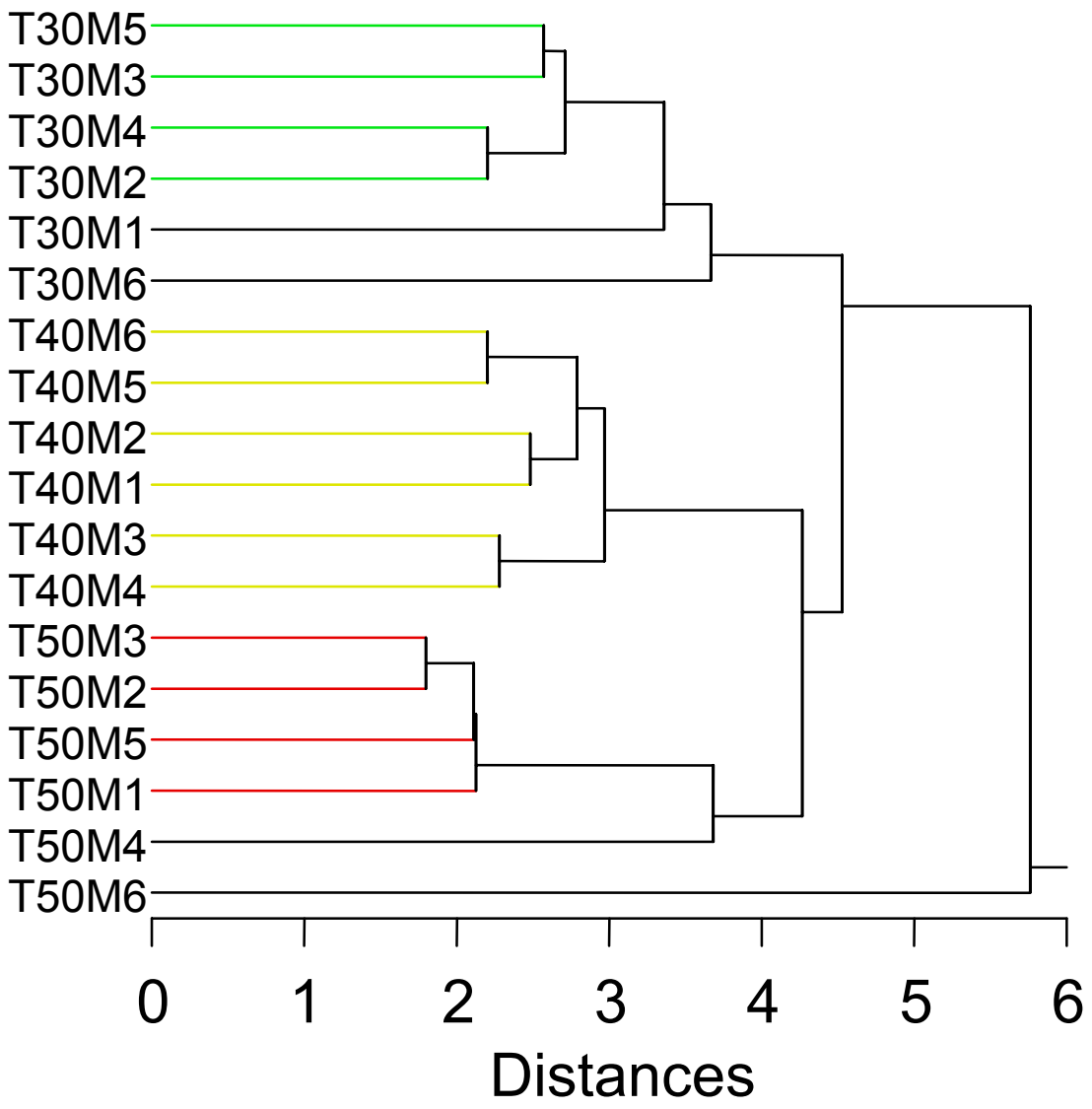


Figure 16. Cluster diagram analyzing the similarity of substrate cover by reef sessile-benthic categories in transects surveyed at 30, 40 and 50 m depths, Isla Desecheo. Distances are 1-Pearson correlation coefficient. Single linkage method (nearest neighbor).

1.2 Reef Fishes

1.2.1 SW Wall Reef 30 m

A total of 62 fish species, including 52 present within belt-transects were identified from a depth of 30 meters on the SW Wall Reef (Table 38). The mean number of species per transect was 24.1 (range: 19 - 31). The study mean abundance of fishes within belt-transects was 251.3 Ind/30 m^2. Total fish abundance during summer (mean: 293.2 Ind/30 m^2) was significantly higher (ANOVA; $p = 0.003$) than during winter (mean: 160.5 Ind/30 m^2). The temporal difference of total fish abundance was influenced by two of the numerically dominant species, the blue chromis (*Chromis cyanea*) and the masked goby (*Coryphopterus personatus*), which presented statistically significant higher summer abundances (ANOVA; $p < 0.001$). The fish species saturation curve from belt-transects surveyed reached 95 % by the fifth transect, but an asymptote was a not reached (Figure 17). It would be expected that new fish species would have been recorded with increased survey effort. Fish abundance data for belt-transects surveyed is presented as Appendix 4.

An assemblage of 10 species accounted for 85.4 % of the total fish abundance at 30 meters (Table 38). The blue chromis (*Chromis cyanea*) was the numerically dominant species with a study mean abundance of 79.2 Ind/30 m^2, representing 31.5 % of the total fish abundance within belt-transects. The creole wrasse, bicolor damselfish, fairy basslet, bridled, masked, peppermint and sharknose gobies, brown chromis and the blue-head and yellow-head wrasses comprised the rest of the numerically dominant fish assemblage at the SW Wall Reef at a depth of 30 meters. These are all common species of shallow coral reef systems (Randall, 1983; Human, 1989), perhaps with the exception of the creole wrasse, which is more typical of shelf-edge reefs.

Few individuals that are associated with deep reefs, such as the sunshine chromis (*Chromis insolata*), the Cherubfish (*Centropyge argi*) and the sargassum triggerfish (*Xanthychtys ringens*) were observed in relatively low abundance at a depth of 30 m on the SW Wall. The seasonal variation of abundance by blue chromis was strongly influenced by presence of large schools of newly recruited individuals during the summer (Table 40). Individuals less than 2 cm in total length formed swarms close to the reef, particularly around sponges and other protective microhabitats. This may be indicative

Table 38. Taxonomic composition, abundance and estimated stock size of fishes surveyed within belt-transects at the SW Wall Reef, Isla Desecheo during 2004. Depth: 30 meters

COMMON NAME	*SPECIES*	Mean Summer	Mean Winter	Study Mean	Var/X	Rel. Abu.(%)	Stock Size
		Ind/30 m2					Total Ind.
Blue Chromis	*Chromis cyanea*	114.2	25.2	79.2	36.0	34.9	9,502
Creole Wrasse	*Clepticus parrae*	46.0	12.7	33.2	34.3	14.6	3,980
Bicolor Damselfish	*Stegastes partitus*	23.5	32.0	29.7	1.9	13.1	3,565
Royal Gramma	*Gramma loreto*	15.2	11.0	14.3	7.3	6.3	1,722
Bridled Goby	*Coryphopterus glaucofraenum*	14.8	10.2	13.7	2.2	6.1	1,648
Masked Goby	*Coryphopterus personatus*	17.2	2.8	11.4	17.6	5.0	1,372
Brown Chromis	*Chromis multilineata*	5.2	12.5	9.3	15.3	4.1	1,112
Yellowhead Wrasse	*Halichoeres garnoti*	10.5	6.8	9.5	1.5	4.2	1,145
Blue-head Wrasse	*Thalassoma bifasciatum*	6.2	8.0	7.6	2.7	3.3	912
Sharknose Goby	*Gobiosoma evelynae*	4.7	8.2	6.8	3.8	3.0	817
Peppermint Goby	*Coryphopterus lipernes*	4.5	5.3	5.3	5.8	2.3	635
Coney	*Cephalopholis fulva*	3.2	4.2	3.9	0.7	1.7	472
Creole Fish	*Paranthias furcifer*	3.5	2.0	3.0	1.6	1.3	365
Red-band Parrotfish	*Sparisoma aurofrenatum*	1.2	2.0	1.7	0.5	0.7	202
Graysbe	*Cephalopholis cruentatus*	0.7	2.3	1.6	3.6	0.7	187
Harlequin Bass	*Serranus tigrinus*	1.3	1.5	1.5	0.7	0.7	183
Four-eye Butterflyfish	*Chaetodon capistratus*	1.7	1.0	1.5	1.1	0.6	177
Sunshine Chromis	*Chromis insolata*	2.7	0.0	1.6	2.7	0.7	187
Striped Parrotfish	*Scarus iserti*	0.7	2.0	1.4	2.1	0.6	167
Squirrelfish	*Holocentrus rufus*	1.2	1.3	1.3	0.9	0.6	162
Spotted Goatfish	*Pseudupeneus maculatus*	1.8	0.7	1.4	1.6	0.6	168
Black Durgon	*Melichthys niger*	0.7	1.2	1.0	0.8	0.4	117
Blue Tang	*Acanthurus coeruleus*	0.7	0.7	0.7	0.3	0.3	87
Red Hind	*Epinephelus guttatus*	0.7	0.7	0.7	0.8	0.3	87
Yellowhead Jawfish	*Opistognathus aurifrons*	1.0	0.3	0.8	3.9	0.3	90

Table 38. (Continued)

COMMON NAME	*SPECIES*	Mean Summer	Mean Winter	Study Mean	Var/X	Rel. Abu.(%)	Stock Size
		Ind/30 m2					Total Ind.
Bucktooth Parrotfish	*Sparisoma radians*	0.8	0.5	0.7	2.8	0.3	88
Rock Beauty	*Holacanthus tricolor*	0.7	0.5	0.6	0.6	0.3	77
Red-spotted Hawkfish	*Amblicirrhitos pinnos*	0.5	0.5	0.5	1.1	0.2	65
Spanish Hogfish	*Bodianus rufus*	0.3	0.7	0.5	0.8	0.2	63
Longsnout Butterflyfish	*Chaetodon aculeatus*	0.2	0.8	0.5	0.8	0.2	62
Mahogany Snapper	*Lutjanus mahogany*	1.0	0.0	0.6	4.7	0.3	70
Sargassum Triggerfish	*Xanthichthys ringens*	0.2	0.8	0.5	1.2	0.2	62
Sharpnose Puffer	*Canthigaster rostrata*	0.8	0.0	0.5	0.9	0.2	58
Clown Wrasse	*Halichoeres maculipinna*	0.5	0.3	0.5	0.5	0.2	55
Queen Angelfish	*Holacanthus ciliaris*	0.8	0.0	0.5	1.2	0.2	58
Smooth Trunkfish	*Lactophrys triqueter*	0.5	0.3	0.5	0.5	0.2	55
Cero	*Scomberomorus regalis*	0.8	0.0	0.5	1.9	0.2	58
Reef Butterflyfish	*Chaetodon sedentarius*	0.3	0.3	0.4	1.5	0.2	43
Honeycomb Trunkfish	*Acanthostrascion polygonus*	0.3	0.2	0.3	0.7	0.1	33
Horse-eye Jack	*Caranx hippos*	0.3	0.2	0.3	1.3	0.1	33
Banded Butterflyfish	*Chaetodon striatus*	0.5	0.0	0.3	1.2	0.1	35
Queen Parrotfish	*Scarus vetula*	0.3	0.2	0.3	0.7	0.1	33
Stoplight Parrotfish	*Sparisoma viride*	0.3	0.2	0.3	0.7	0.1	33
Black Jack	*Caranx lugubris*	0.2	0.2	0.2	0.8	0.1	22
Doctorfish	*Acanthurus chirurgus*	0.2	0.0	0.1	0.8	0.0	12
Queen Triggerfish	*Balistes vetula*	0.2	0.0	0.1	0.8	0.0	12
Bar Jack	*Carangoides ruber*	0.0	0.2	0.1	0.9	0.0	10
Cherubfish	*Centropyge argi*	0.2	0.0	0.1	0.8	0.0	12
Puddinwife	*Halichoeres radiatus*	0.0	0.2	0.1	0.9	0.0	10
Bermuda Chub	*Kyphosus sp.*	0.2	0.0	0.1	0.8	0.0	12
Yellowtail Damselfish	*Microspathodon chrysurus*	0.2	0.0	0.1	0.8	0.0	12
Moray Eel	*Muraena sp.*	0.2	0.0	0.1	0.8	0.0	12
	Mean Abundance =	**293.2**	**160.5**	**251.3**			
	Number of Species =	**50**	**40**	**52**			

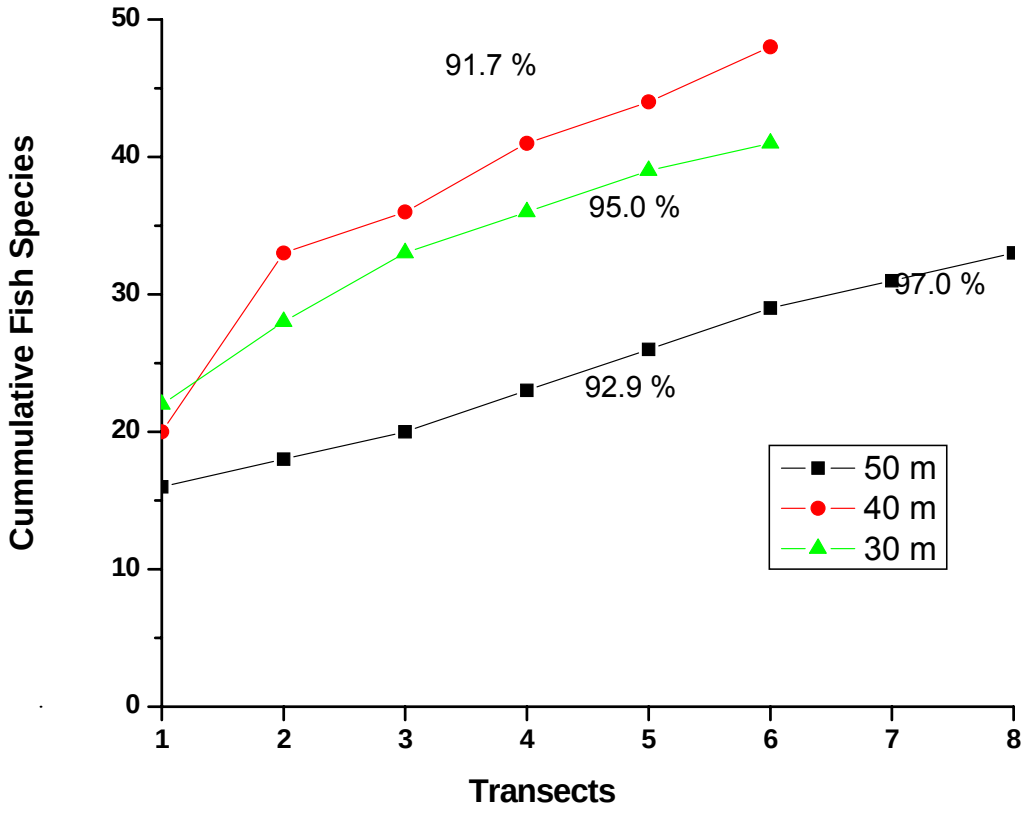


Figure 17. Fish species saturation curve from belt-transects surveyed at depths of 30, 40 and 50 m, Isla Desecheo, 2003-04

of a seasonal recruitment pattern, but additional observations are needed to test this hypothesis.

Blue and brown chromis formed loose aggregations over the reef, retreating toward the reef benthic microhabitats when approached by predators, or when the current was strong. The creole wrasse (*Clepticus parrae*) is another zooplanktivorous fish that was observed swimming in streaming schools over the reef, foraging larger reef spaces than the chromis species. Bicolor damselfish (*Stegastes partitus*) and fairy basslet (*Gramma loreto*) are demersal and territorial fishes that were present in all transects surveyed at 30 m. These are both carnivores that feed mostly upon reef zooplankton (Randall, 1967). The bridled goby (*Coryphopterus glaucofraenum*) was typically associated with

the sandy bottom, where it feeds upon small infaunal invertebrates. Its abundance in the reef was surely underestimated by this study due to its transparent appearance and relatively small size. Peppermint and sharknose gobies (*C. lipernes* and *Gobiosoma evelynae*) were typically observed perching over live coral heads, although sharknose gobies were also associated with basket sponges (*Xestospongia muta*). Both of these gobiid species are carnivores. The sharknose is a prominent cleaner of fish ectoparasites. Due to their small size and semi-criptic behavior, these species were most probably underestimated by our visual surveys. Yellow-head and blue-head wrasses (*Halichoeres garnoti* and *Thalassoma bifasciatum*) are opportunistic carnivores that forage for infaunal invertebrates that become exposed upon mechanical disturbances of the bottom.

In terms of trophic structure, the SW Wall Reef presented a fish community strongly associated with a plankton food web. The top four most abundant fishes within belt-transects (blue chromis, creole wrasse, bicolor damselfish, fairy basslet) and at least six out of the top ten (includes also masked goby and brown chromis) are also known to feed primarily on zooplankton (Randall, 1967). Thus, the combined zooplanktivorous assemblage represented approximately 77 % of the total fish community surveyed within belt-transects at 30 m. The fact that most of these fishes (except creole wrasse) live close to the benthic reef habitat, suggests that demersal zooplankton plays an important role in the trophic dynamics of this system. Dense swarms of mysid shrimps were present below ledges and on crevices in the reef (Plate 21). It was common to find swarms of masked gobies (*Coryphopterus personatus*) associated with swarms of mysid shrimps. Thus, these small shrimps appear to be important forage for zooplanktivorous fishes. Fish eggs (planktonic) are also known to be important food for zooplanktivorous fishes (Randall, 1967). A recent study by Rodriguez-Jeréz (2005) found very low abundance of crustacean macrozooplankton and high abundance of fish eggs associated with the water column over the reefs of Isla Desecheo. Given the high zooplanktivorous potential in the vicinity of the reef, the low zooplankton abundance reported by Rodriguez-Jeréz (2005) may be explained on the basis of predation. Nevertheless, the latter study did not sample close to the reef where demersal zooplankton may be important.

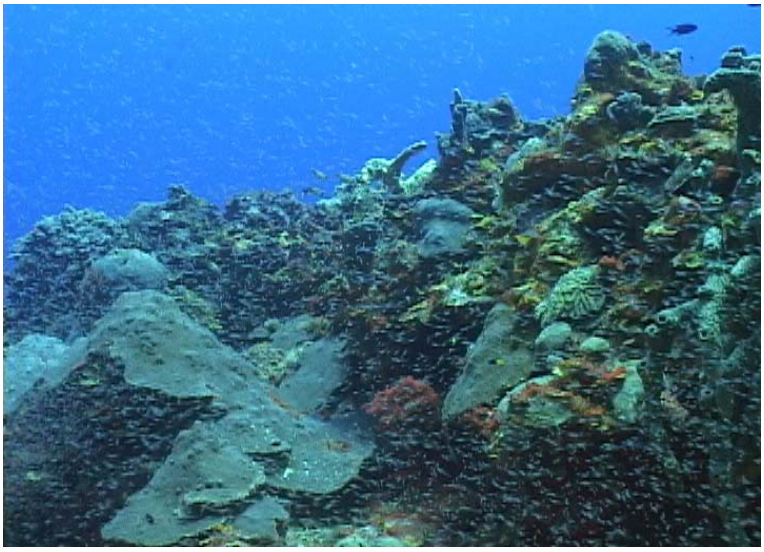


Plate 21

Zooplanktivorous fishes serve as forage for mid-size piscivores, such as the Yellowtail, Mahogany and Schoolmaster Snappers, Red Hind and Coney, as well as for large demersal and pelagic predators, such as Nassau and Yellowfin groupers, Cero Mackerels, Black and Horse-eye Jacks, Great Barracudas and Nurse and Caribbean Reef Sharks observed during ASEC surveys in this reef (Table 39). In contrast to shallow reef systems, herbivorous fishes comprised a minor taxonomic component of the SW Wall Reef community. Parrotfishes, doctorfishes and damselfishes, which represented the main herbivorous assemblage at 30 m, accounted for less than 3 % of the total fish abundance within belt-transects.

Commercially important species for the aquarium fish trade market, such as the fairy basslet (*Gramma loreto*), queen angelfish (*Holacanthus ciliaris*), rock beauty (*Holacanthus tricolor*), blue chromis (*Chromis cyanea*) and yellowhead jawfish (*Opistognathus aurifrons*) were present in the SW Wall reef at 30 m. Estimates of their stock size, based on the total area of reef habitat between 27 – 33 m depths and the species mean density (within belt-transects at 30 m), and/or their total abundance (estimated from ASEC surveys) are presented in Table 39. Fairy basslets and blue chromis were observed in their full size range, indicative that they are recruiting and spending their entire life cycle in this reef habitat. Queen angels and rock beauties were observed in their full adult sizes, suggesting that the SW Wall reef may function mostly as a foraging and/or reproductive (mating) habitat for these fish species. Yellowhead jawfishes were observed along a strip of coarse sand and coral rubble on the southwest

Table 39. Size-frequency distribution of large and/or commercially important reef fishes identified during ASEC surveys at the SW Wall Reef, Isla Desecheo during June, 2004 and January, 2005. Depth: 30 meters

Depth range : 27 - 33 m (90 – 109 feet)
Duration - 30 min.

		June, 2004			January, 2005	
SPECIES	**COMMON NAME**	# (cm)				
Balistes vetula	Queen Triggerfish				2 (35-40)	
Carangoides crysos	Blue Runner				3 (35 - 40)	
Caranx hippos	Horse-eye Jack	15(35 -40)	3(45-50)		5 (35-40)	2 (45-50)
Caranx lugubris	Black Jack	1(30)	1(60)		2 (50)	1 (60)
Carcharhinus perezi	Reef Shark				1 (120)	
Centropyge argi	Pigmy Angelfish	1(5)				
Chaetodon sedentarius	Reef Butterflyfish				2 (6-8)	
Chromis cyanea	Blue Chromis	34 (1-2)	85(3-4)	20 (5-6)	77(3-4)	60(5-6)
Chromis insolata	Sunshine Chromis	9 (2-3)				
Epinephelus guttatus	Red Hind	1(25)	3 (30)		2(30)	2 (35-40)
Epinephelus striatus	Nassau Grouper	1(30)	1 (65)		1 (45)	
Ginglymostoma cirratum	Nurse Shark				1 (150)	
Gramma loreto	Royal Gramma	16 (1)	55 (2-3)	21(4-6)	39 (2-3)	27 (4-6)
Holacanthus ciliaris	Queen Angelfish	1 (30)	2 (40-45)			
Holacanthus tricolor	Rock Beauty	1 (15)	2 (20)		1 (15)	1(20)
Kyphosus ap.	Bermuda Chub	2 (30)	4 (35-40)		6 (30)	7 (35-40)
Lutjanus apodus	Schoolmaster Snapper	2 (30)	5 (35 - 40)	1(45)		
Lutjanus mahogani	Mahogani Snapper	1(25)	2 (30)	50 (40)	3 (30)	30(35-40)
Mycteroperca venenosa	Yellowfin Grouper	1 (25)			1 (50)	
Ocyurus chrysurus	Yellowtail Snapper	1 (45)				
Opistognathus aurifrons	Yellowhead Jawfish	3 (6-8)			6 - (6-8)	
Pomacanthus paru	French Angelfish				2 - (30-35)	
Scomberomorus regalis	Cero Mackerel	2 (75)	2 (90)		2 (60)	
Sphyraena barracuda	Great Barracuda	1 (60)	1 (75)		1(50)	1(75)
Others						
Eretmochelys imbricata	Hawksbill Turtle	1 (60)	1 (90)			
Panulirus argus	Spiny Lobster	2 (25-30)				

corner of the reef. Only a few adult fishes were observed, but that sand strip habitat was not extensively surveyed. Since they are demersal spawners, it is most likely that yellowhead jawfishes spend their entire life cycle on this reef habitat. Other fish targets of the aquarium trade, such as the Cherubfish or pigmy angel (*Centropyge argi*) and the reef butterflyfish (*Chaetodon sedentarius*) were observed only in very low abundance.

Fish species of commercial value in the food market present at a depth of 30 m in the SW Wall reef included nassau, red hind, and yellowfin groupers (*Epinephelus striatus, E. guttatus, Mycteroperca venenosa*). Nassau groupers were represented by three individuals, ranging in adult sizes (TL) from 30 – 60 cms (Table 40). The sizes of the two yellowfin groupers were estimated as of 25 and 50 cms total length. Nassau and yellowfin groupers are believed to use the SW Wall reef mostly as a foraging ground, since there are no deep crevices, large coral overhangs, or other protective habitats for them to hide at the SW Wall reef. Their residential habitat appears to be the adjacent shelf reef, close to the edge at a depth of 20 – 25 m, where large coral heads and a complex array of sand channels, overhangs, crevices and other hideouts are available (García et al, 2004). Conversely, the red hind appears to be a resident of the SW Wall reef, but is more concentrated at the base of the wall, at a depth of approximately 40 m. Its mean density at 30 m (0.70 Ind/30 m^2, or 0.02 Ind/m^2) suggests that there was a population of about 70 individuals along the 27-33 m depth section on the SW Wall reef. All individuals surveyed were large adults, ranging in size between 24 – 40 cm (Table 39).

Mahogany snappers (*Lutjanus mahogany*) are also residents of the SW Wall reef. There was one major school of approximately 60 – 70 adult individuals at the edge of the wall on the southwest corner of the reef. More schools of mahogany snappers were observed on the shelf reef, close to the edge, which suggests that the population at the SW Wall is perhaps near their maximum depth distribution preference on this reef system. Schoolmaster snappers (*Lutjanus apodus*) were observed to swim occasionally down the wall, but their main population appears to reside on the shelf reef, above the wall. Large pelagic predators, such as cero mackerels, barracudas, black jacks and horse-eye jacks were common at the edge of the SW Wall reef, where some of their forage fishes, such as mackerel scad (*Decapterus macarellus*) and creole wrasse (*Clepticus parrae*) were observed to aggregate. One Caribbean reef shark (*Carcharhinus perezi*) was observed at the edge of the wall.

Photo Album 30 m

Plate 22

Plate 23

Plate 24

Plate 25

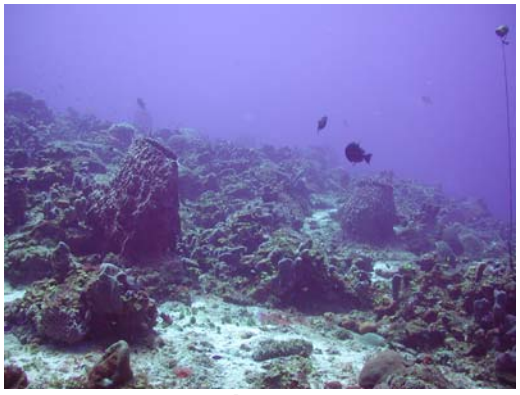


Plate 26

Plate 27

Plate 28

Plate 29

Plate 30

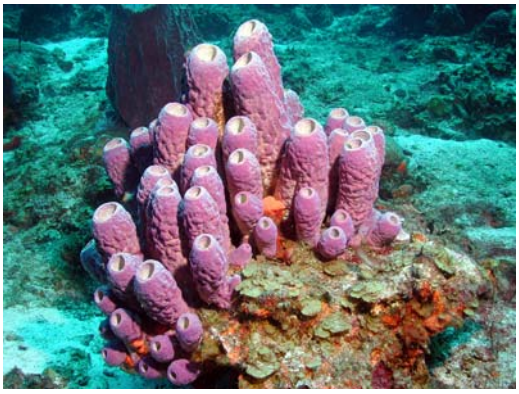


Plate 31

Plate 32

Plate 33

1.2.2 SW Wall Reef 40 m

A total of 60 fish species, including 57 present within belt-transects were identified from a depth of 40 meters on the SW Wall Reef. The study mean abundance of fishes within belt-transects was 342.2 Ind/30 m^2 (Table 40). Total fish abundance during summer (mean: 384.5 Ind/30 m^2) was not significantly different (ANOVA; $p = 0.519$) than during winter (mean: 202.2 Ind/30 m^2). The mean number of fish species per transect varied between18 – 33 (mean: 24.2). Differences of fish abundance and species richness between depths (30 vs. 40 m) at the SW Wall Reef were not statistically significant (ANOVA; $p > 0.05$). Fish species saturation reached 91.7 % by the fourth transect, but an asymptote in the curvwas not observed, suggesting that more species would have been recorded with increasing survey effort. Fish abundance data for belt-transects surveyed is presented as Appendix 5.

An assemblage of seven species accounted for 82.5 % of the total fish abundance at 40 meters (Table 40). The blue chromis (*Chromis cyanea*) was the numerically dominant species with a study mean abundance of 111.4 Ind/30 m^2, representing 32.6 % of the total fish abundance within belt-transects (Plate 34). The masked goby, creole wrasse, sunshine chromis, bridled goby, bicolor damselfish and fairy basslet comprised the rest of the numerically dominant fish assemblage at a depth of 40 meters. These are all common species of shallow coral reef systems (Randall, 1983; Human, 1989), perhaps with the exception of the creole wrasse, which is more typical of shelf-edge reefs, and the sunshine chromis (*Chromis insolata*) which is rare at depths over 25 m. Few individuals that are associated with deep reefs, such as the cherubfish (*Centropyge argi*), longsnout butterflyfish (*Chaetodon aculeatus*) and the sargassum triggerfish (*Xanthychtys ringens*) were common at a depth of 40 m on the SW Wall. The aforementioned species evidenced a sharp increment of abundance at 40m relative to the 30 m depth. The species that showed the largest increment in abundance with depth was the sunshine chromis, which increased (16 fold) from 1.5 (at 30 m) to 24.1 Ind/30 m^2 (at 40 m). The masked goby and the squirrelfish (*Holocentrus rufus*) also displayed marked increments of abundance (>4 fold) at 40 m, compared to their mean abundance at 30m.

Table 40. Taxonomic composition, abundance and estimated stock size of fishes surveyed within belt-transects at the SW Wall Reef, Isla Desecheo during 2004. Depth: 40 meters

COMMON NAME	*SPECIES*	Summer Mean	Winter Mean	Study Mean	Var/X	Rel. Abu (%)	Stock Size
Blue Chromis	*Chromis cyanea*	139.2	51.8	**111.4**	87.5	32.6	13,370
Masked Goby	*Coryphopterus personatus*	74.7	17.7	**53.9**	46.0	15.7	6,463
Creole Wrasse	*Clepticus parrae*	66.7	5.8	**42.3**	93.9	12.4	5,075
Sunshine Chromis	*Chromis insolata*	20.0	21.3	**24.1**	12.6	7.0	2,893
Goby	*Coryphopterus glaucofraenum*	16.7	13.8	**17.8**	1.7	5.2	2,135
Bicolor Damselfish	*Stegastes partitus*	11.5	18.5	**17.5**	2.3	5.1	2,100
Royal Gramma	*Gramma loreto*	14.2	12.3	**15.5**	4.5	4.5	1,855
Yellowhead Wrasse	*Halichoeres garnoti*	8.3	6.2	**8.5**	0.9	2.5	1,015
Squirerlfish	*Holocentrus rufus*	5.7	8.3	**8.2**	7.7	2.4	980
Peppermint Goby	*Coryphopterus lipernes*	3.0	7.0	**5.8**	6.7	1.7	700
Blue-head Wrasse	*Thalassoma bifasciatum*	3.5	4.0	**4.4**	3.1	1.3	525
Creole Fish	*Paranthias furcifer*	3.2	3.2	**3.7**	0.4	1.1	443
Coney	*Cephalopholis fulva*	2.7	2.7	**3.1**	0.9	0.9	373
Sharknose Goby	*Gobiosoma evelynae*	1.2	3.5	**2.7**	2.9	0.8	327
Sargassum Triggerfish	*Xanthichthys ringens*	2.0	2.2	**2.4**	0.7	0.7	292
Graysbe	*Cephalopholis cruentatus*	0.8	2.0	**1.7**	1.1	0.5	198
Red Hind	*Epinephelus guttatus*	0.7	2.0	**1.6**	0.8	0.5	187
Striped Parrotfish	*Scarus iserti*	0.7	1.8	**1.5**	1.5	0.4	175
Rock Beauty	*Holacanthus tricolor*	1.2	1.2	**1.4**	0.5	0.4	163
Harlequin Bass	*Serranus tigrinus*	1.5	0.7	**1.3**	0.8	0.4	152
Longsnout Butterflyfish	*Chaetodon aculeatus*	0.7	1.3	**1.2**	0.5	0.3	140
Four-eye Butterflyfish	*Chaetodon capistratus*	1.2	0.5	**1.0**	0.8	0.3	117
Red-band Parrotfish	*Sparisoma aurofrenatum*	0.7	1.0	**1.0**	0.5	0.3	117
Cardinalfish	*Apogon sp.*	0.0	1.5	**0.9**	1.9	0.3	105
Cherubfish	*Centropyge argi*	0.2	1.3	**0.9**	1.5	0.3	105
Yellow-edge Chromis	*Chromis multilineata*	0.2	1.3	**0.9**	3.9	0.3	105
Bucktooth Parrotfish	*Sparisoma radians*	0.0	1.5	**0.9**	2.1	0.3	105

Table 40. (Continued) Reef fishes 40 m…

COMMON NAME	*SPECIES*	Summer Mean	Winter Mean	Study Mean	Var/X	Rel. Abu (%)	Stock Size
Blue Tang	*Acanthurus coeruleus*	0.3	0.8	**0.7**	1.0	0.2	82
Reef Butterflyfish	*Chaetodon sedentarius*	0.5	0.5	**0.6**	0.9	0.2	70
Mahogany Snapper	*Lutjanus mahogany*	0.5	0.5	**0.6**	1.5	0.2	70
Horse-eye Jack	*Caranx hippos*	0.0	0.8	**0.5**	1.8	0.1	58
Clown Wrasse	*Halichoeres maculipinna*	0.0	0.8	**0.5**	1.8	0.1	58
Redspotted Hawkfish	*Amblicirrhitos pinnos*	0.2	0.5	**0.4**	0.5	0.1	47
Sharpnose Puffer	*Canthigaster rostrata*	0.3	0.3	**0.4**	0.5	0.1	47
Black Durgon	*Melichthys niger*	0.3	0.3	**0.4**	0.9	0.1	47
Spotted Goatfish	*Pseudupeneus maculatus*	0.0	0.7	**0.4**	0.6	0.1	47
Banded Butterflyfish	*Chaetodon striatus*	0.5	0.0	**0.3**	0.6	0.1	35
Queen Angelfish	*Holacanthus ciliaris*	0.5	0.0	**0.3**	1.2	0.1	35
Queen Triggerfish	*Balistes vetula*	0.2	0.2	**0.2**	0.7	0.1	23
Honeycomb Trunkfish	*Lactophrys trigonus*	0.0	0.3	**0.2**	0.7	0.1	23
Parrotfish	*Sparisoma sp.*	0.2	0.2	**0.2**	0.7	0.1	23
Honeycomb Trunkfish	*Acanthostrascion quadricornis*	0.2	0.0	**0.1**	0.7	0.0	12
Doctorfish	*Acanthurus chirurgus*	0.0	0.2	**0.1**	0.7	0.0	12
Whitespotted Filefish	*Cantherhines macrocerus*	0.2	0.0	**0.1**	0.7	0.0	12
Black Jack	*Caranx lugubris*	0.0	0.2	**0.1**	0.7	0.0	12
Porcupinefish	*Diodon histrix*	0.0	0.2	**0.1**	0.7	0.0	12
Longspine Squirrelfish	*Flammeo marianus*	0.2	0.0	**0.1**	0.7	0.0	12
Spotted Moray	*Gymnothorax moringa*	0.0	0.2	**0.1**	0.7	0.0	12
Puddinwife	*Halichoeres radiatus*	0.0	0.2	**0.1**	0.7	0.0	12
Longjaw Squirrelfish	*Holocentrus adscencionis*	0.2	0.0	**0.1**	0.7	0.0	12
Barred Hamlet	*Hypoplectrus puella*	0.0	0.2	**0.1**	0.7	0.0	12
Spotted Trunkfish	*Lactophrys bicaudalis*	0.0	0.2	**0.1**	0.7	0.0	12
French Angelfish	*Pomacanthus paru*	0.0	0.2	**0.1**	0.7	0.0	12
Soapfish	*Rypticus saponaceous*	0.0	0.2	**0.1**	0.7	0.0	12

Table 40. (Continued) Reef fishes 40 m.

COMMON NAME	*SPECIES*	Summer Mean	Winter Mean	Study Mean	Var/X	Rel. Abu (%)	Stock Size
Cero	*Scomberomorus regalis*	0.2	0.0	**0.1**	0.7	0.0	12
Stoplight Parrotfish	*Sparisoma viride*	0.0	0.2	**0.1**	0.7	0.0	12
Great Barracuda	*Sphyraena barracuda*	0.2	0.0	**0.1**	0.7	0.0	12
	Total Individuals =	**384.5**	**202.2**	**342.2**			
	Total Species =						

The base of the SW Wall Reef at 40 m appears to be the optimal residential habitat of the red hind (Plate 35), which exhibited the highest abundance (1.6 Ind/30 m^2) recorded within belt-transects from more than 50 reef sites surveyed in Puerto Rico (García et al., 2005). Based on its mean abundance within belt-transects, it is estimated that approximately 187 individuals were present within a depth range of 34 -40 m at the SW Wall during our survey. The estimated stock size for the entire SW Wall Reef is in the order of 374 fish individuals. All red hind individuals at 40m were present in adult sizes, no juveniles were observed (Table 41).

Plate 34

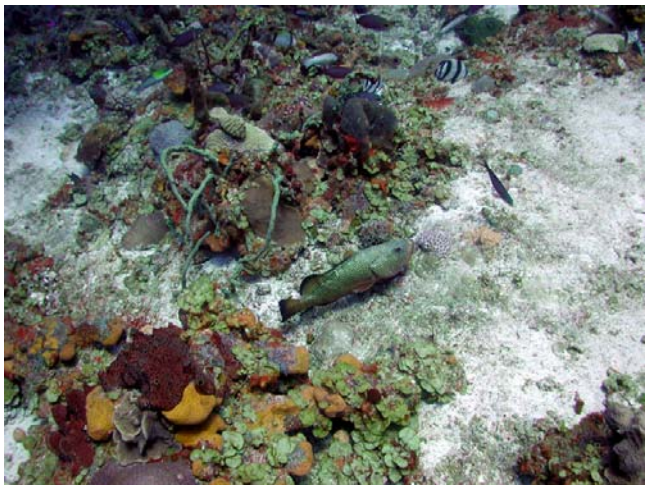


Plate 35

Table 41. Size-frequency distribution of large and/or commercially important reef fishes identified during an ASEC survey at the Wall Reef (40 meters), SW Isla Desecheo during June, 2004 and March, 2005

Depth range : 35 - 40 m (115 - 132 feet)
Duration - 30 min.

		June, 2004 # - (cm)			March, 2005		
SPECIES	**COMMON NAME**						
Balistes vetula	Queen Triggerfish	1(38)					
Caranx hippos	Horse-eye Jack				5(35-40)		
Caranx lugubris	Black Jack	2(50)	1(65)		2(40)	1(50)	
Centropyge argi	Pigmy Angelfish				1(1-2)	5(3-4)	
Chaetodon sedentarius	Reef Butterflyfish	2(10)					
Chromis cyanea	Blue Chromis	80(1-2)	125(3-4)	36(5-6)	97(2-4)	54(4-6)	
Chromis insolata	Sunshine chromis	26(1)	15(2-3)			(n/d)	
Dasyatis americana	Southern Stingray	1(75)					
Epinephelus guttatus	Red Hind	3(20-25)	17(33)	12(38)	10(25)	8(33)	5(40)
Gramma loreto	Royal Gramma	37(1)	22(2-3)	16(4-6)	23(2-3)	5(4-6)	
Holacanthus ciliaris	Queen Angelfish	2(40)					
Holacanthus tricolor	Rock Beauty				2(12)	1(20)	
Kyphosus bermudensis	Bermuda Chub	2(30)	4(35)				
Lactophrys bicaudalis	Spotted Trunkfish	1(28)					
Mycteroperca venenosa	Yellowfin Grouper	1(40)	3(60)	1(75)	1(40)		
Pomacanthus paru	French Angelfish				1(45)		
Scomberomorus regalis	Cero Mackerel				1(60)		
Sphyraena barracuda	Great Barracuda	2(90)	2(100)				

The fish community at 40 m presented a trophic structure strongly associated with a plankton food web, consistent with observations at 30 m. The top four most abundant fishes within belt-transects (blue and sunshine chromis, masked goby and creole wrasse) are known to feed mostly on zooplankton (Randall, 1967). The combined zooplanktivorous assemblage represented at least 80 % of the total fish individuals surveyed within belt-transects at 40 m. The fact that most of these fishes (except creole wrasse) live close to the benthic reef habitat, suggests that demersal zooplankton plays an important role in the trophic dynamics of this system.

As previously stated for the 30 m depth, zooplanktivorous fishes serve as forage for mid-size piscivores, such as the Yellowtail, Mahogany and Schoolmaster Snappers, Red Hind and Coney, as well as for large demersal and pelagic predators, such as Yellowfin grouper, Cero Mackerels, Black and Horse-eye Jacks and Great Barracudas observed during ASEC surveys in this reef (Table 41). In contrast to shallow reef systems, and consistent with observations at 30 m, herbivorous fishes comprised a minor taxonomic component of the SW Wall Reef community at 40 m. Parrotfishes, doctorfishes and damselfishes, which represented the main herbivorous assemblage, accounted for less than 1 % of the total fish abundance within belt-transects.

Commercially important species for the aquarium fish trade market, such as the fairy basslet (*Gramma loreto*), queen angelfish (*Holacanthus ciliaris*), rock beauty (*Holacanthus tricolor*), blue chromis (*Chromis cyanea*) and yellowhead jawfish (*Opistognathus aurifrons*) were present in the SW Wall reef at 40 m. Estimates of their stock size, based on the total area of reef habitat between 34 – 40 m depths and the species mean density (within belt-transects at 40 m), and/or their total abundance (estimated from ASEC surveys) are presented in Table 40. Fairy basslets and blue and sunshine chromis were observed in their full size range, indicative that they are recruiting and spending their entire life cycle in this reef habitat. Queen angels and rock beauties were observed in their full adult sizes, suggesting that the SW Wall reef may function mostly as a foraging and/or reproductive (mating) habitat for these fish species. Other fish targets of the aquarium trade, such as the Cherubfish or pigmy angel (*Centropyge argi*) and the longsnout butterflyfish (*Chaetodon aculeatus*) were observed in moderate abundance (0.9 – 1.2 Ind/m^2).

Fish species of commercial value in the food market present at a depth of 40 m in the SW Wall reef included red hind and yellowfin groupers (*Epinephelus guttatus, Mycteroperca venenosa*). The sizes of yellowfin groupers ranged between 40 – 75 cms total length which includes individuals from young adults through full adult sizes. Yellowfin groupers were only observed in transit over the reef at 40m. Thus, it is most likely that these large groupers use the SW Wall reef mostly as a foraging ground. The red hind appears to be a resident of the SW Wall reef and presented peak abundances at the base of the reef at 40 m.

Photo Album 40 m

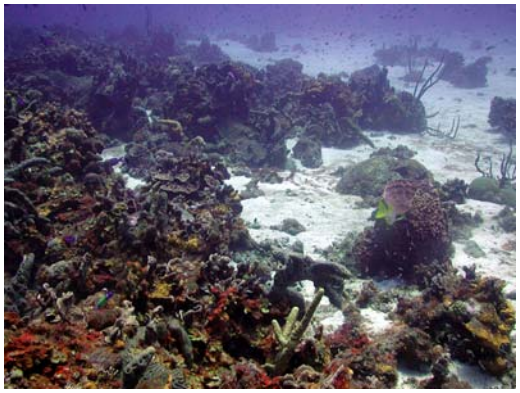


Plate 36

Plate 37

Plate 38

Plate 39

Plate 40

Plate 41

Plate 42

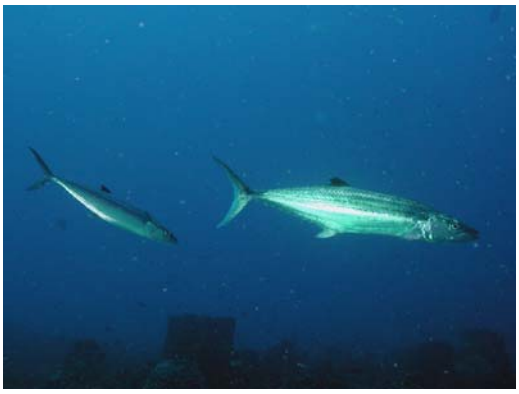


Plate 43

Plate 44

Plate 45

Plate 46

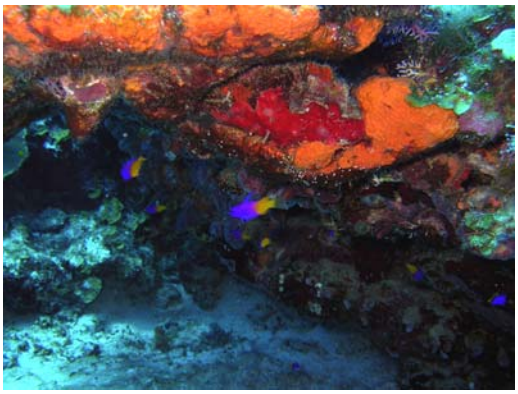


Plate 47

1.2.3 Agelas Reef 50 m

A total of 40 fish species, including 33 present within belt-transects were identified from a depth of 50 meters at Agelas Reef (Table 42). The study mean abundance of fishes within belt-transects was 82.0 Ind/30 m^2 (range: 60 – 104 Ind/30 m^2). This represents a decline of 468 % from the mean abundance at a depth of 40 m on the SW Wall Reef. A decline of fish species richness was also observed between Agelas Reef (14.2 spp/transect) and the SW Wall Reef (24.6 and 24.1 spp/transect) at 40 and 30 m depths. Differences of fish abundance and species richness from belt-transect surveys between Agelas Reef at 50 m, and the SW Wall Reef at depths of 30 and 40 m were statistically significant (ANOVA; $p < 0.001$).

An assemblage of five (5) species accounted for 78.8 % % of the total fish abundance within belt-transects at Agelas Reef (Table 42). The bicolor damselfish (*Stegastes partitus*) was the numerically dominant species with a study mean abundance of 27.2 Ind/30 m^2, representing 33.2 % of the total fish abundance within belt-transects. The blue chromis (*Chromis cyanea*), peppermint goby (*Coryphopterus lipernes*), sunshine chromis (*Chromis insolata*), and cherubfish (*Centropyge argi*) comprised the rest of the numerically dominant assemblage at a depth of 50 meters. The numerically dominant fish assemblage is composed by a combination of shallow and moderately deep coral reef species (Randall, 1983; Human, 1989). Both the sunshine chromis and cherubfish are rare at depths over 25 m (Randall, 1983). The cherubfish, also known in the aquarium trade market as the ”pigmy angel” presented a mean abundance of 6.8 Ind/30 m^2, which represents an increment of more than 750% (statistically significant; ANOVA, $p < 0.001$) over its abundance at depths of 30 and 40 meters on the SW Wall Reef.

The uniform, low-relief bathymetry of Agelas Reef, without large coral outcrops and overhangs, but with many small protective microhabitats created by branching sponges (*Agelas spp*.) and plate corals (*Agaricia spp*.) appear to favor a resident ichthyofauna dominated by small territorial species. The bicolor damselfish exhibited a variance to mean abundance ratio of 0.6, which is indicative of a highly uniform spatial distribution over the reef. The cherubfish presented a variance to mean ratio of 1.2, which is close to a random distribution. The peppermint goby and the blue and sunshine chromis displayed aggregated distributions, as suggested by the high variance to mean

Table 42. Taxonomic composition, abundance and estimated stock size of fishes surveyed within belt-transects at the SW Wall Reef, Isla Desecheo during 2004. Depth: 50 meters (Stock size estimates based on 100,000 m2 reef area).

Depth: 50 m

SPECIES	COMMON NAME	MEAN	Var/X	Rel. Abu.(%)	Stock Size
Stegastes partitus	Bicolor Damselfish	27.2	0.6	33.2	90667
Chromis cyanea	Blue Chromis	12.1	6.8	14.8	40333
Coryphopterus lipernes	Peppermint Goby	9.8	3	11.9	32667
Chromis insulata	Sunshine Chromis	8.7	3	10.6	29000
Centropyge argi	Cherubfish	6.8	1.2	8.3	22667
Coryphopterus personatus	Masked Goby	3.2	16.3	3.9	10667
Thalassoma bifasciatum	Bluehead Wrasse	2.3	1.6	2.8	7667
Chaetodon aculeatus	Longsnout Butterflyfish	2	0.4	2.4	6667
Cephalopholis fulva	Coney	1.7	0.8	2	5667
Halichoeres garnoti	Yellow-head Wrasse	1.2	1.2	1.5	4000
Amblycirrhitus pinnos	Redspotted Hawkfish	0.9	1	1.1	3000
Scarus iserti	Stripped Parrotfish	0.9	1.3	1.1	3000
Epinephelus guttatus	Red Hind	0.8	0.6	0.9	2667
Sparisoma sp.	Parrotfish	0.6	1.4	0.7	2000
Gramma loreto	Fairy Basslet	0.4	4	0.5	1333
Chromis multilineata	Brown Chromis	0.4	1.8	0.5	1333
Canthigaster rostrata	Caribbean Puffer	0.3	1.5	0.4	1000
Sparisoma aurofrenatum	Redband Parrotifish	0.3	0.8	0.4	1000
Gobiosoma sp.	Goby	0.3	0.8	0.4	1000
Cephalopholis cruentatus	Graysby	0.2	0.9	0.3	667
Sparisoma radians	Bucktooth Parrotfish	0.2	0.9	0.3	667
Holacanthus tricolor	Rock Beauty	0.2	0.9	0.3	667
Bodianus rufus	Spanish hogfish	0.2	0.9	0.3	667
Xanthychthys ringens	Sargassum Triggerfish	0.1	1	0.1	333
Balistes vetula	Queen Triggerfish	0.1	1	0.1	333
Holocentrus rufus	Squirrelfish	0.1	1	0.1	333
Hypoplectrus chlorurus	Yellowtail Hamlet	0.1	1	0.1	333
Hypoplectrus puella	Barred Hamlet	0.1	1	0.1	333
Serranus tigrinus	Harlequin Bass	0.1	1	0.1	333
Halichoeres cyanocephalus	Yellowcheek Wrasse	0.1	1	0.1	333
Chaetodon sedentarius	Reef Butterflyfish	0.1	1	0.1	333
Coryphopterus sp.	Goby sp.	0.1	1	0.1	333
Acanthurus coeruleus	Blue Tang	0.1	1	0.1	333
	Mean Abundance Ind/ 30m2 =	82			
	Mean # Species/transect =	14.2			
	Total species =	33			

abundance ratios (Table 42). This was expected, since the peppermint goby is only found over live corals and tends to aggregate in such limited habitats at 50 m. Both the blue and sunshine chromis species naturally exhibit schooling behavior, which is aggregated by definition. Large demersal predators, such as the yellowfin grouper were only observed in transit at Agelas Reef. There are no protective habitats large enough for adult yellowfin groupers, or any other top demersal predators in the 50 – 70 m depth range. Smaller groupers, such as the coney (*Cephalopholis fulva*) and the red hind (*Epinephelus guttatus*) were common on the reef, but declined in abundance relative to their mean abundances within belt-transects at 30 and 40 m on the SW Wall Reef.

The abundance of several fish species present at Agelas Reef was most likely underestimated by our survey because of their small size and criptic behavior. These include the cherubfish, peppermint goby, masked goby (*Coryphopterus personatus*), redspotted hawkfish (*Amblycirrhitus pinos*), cardinalfishes (*Apogon spp*.) and an unidentified goby (*Gobiosoma sp*.).

The fish community presented a trophic structure strongly associated with a plankton food web, consistent with observations at 30 and 40 m. Three of the top five most abundant fishes within belt-transects at 50 m are known to feed mostly on plankton. Planktonic copepods and other zooplankton, including tunicates, fish eggs, shrimp larvae, siphonophores and ostracods comprise most of the diet of juvenile and adult blue and sunshine chromis (Randall, 1967; Emery, 1973; Allen, 1991). The bicolor damselfish is omnivorous (Allen, 1991), but strongly associated with the plankton food web. Juveniles are known to feed on benthic algae, whereas adults feed on a combination of phyto and zooplankton (Emery, 1973; Fariña et al., 2005). Other well known zooplanktivores present at Agelas Reef include the brown chromis (*Chromis multilineata*), masked goby (*Coryphopterus personatus*), and fairy basslet *Gramma loreto*). The combined planktivorous assemblage represented at least 70 % of the total fish individuals surveyed within belt-transects. The fact that all of the aforementioned species live close to the benthic reef habitat suggests that demersal zooplankton plays an important role in the trophic dynamics of this system.

The cherubfish (*Centropyge argi*) was the main herbivorous species associated with Agelas Reef. Benthic algae (*Cladophora sp., Enteromorpha sp., Lyngbya spp*.) and

detritus have been reported as its main diet in Caribbean reefs (Randall, 1967). Other prominent herbivores include four species of parrotfishes (*Scarus iserti, Sparisoma spp*.), and the blue tang (*Acanthurus coeruleus*). The herbivorous fish assemblage presented a combined abundance of approximately 11 % of the total fish abundance within belt-transects. Opportunistic carnivores that feed on small infaunal and epibenthic invertebrates were represented by the bluehead, yellowhead and yellowcheek wrasses (*Thalassoma bifasciatum, Halichoeres garnoti, H. cyanocephalus*), caribbean puffer (*Canthigaster rostrata*), harlequin bass (*Serranus tigrinus*), queen triggerfish (*Balistes vetula*), spanish hogfish (*Bodianus rufus*), hamlets (*Hypoplectrus puella, H. chlorurus*) and the redspotted hawkfish (*Amblycirrhitus pinnos*), among others. All the aforementioned species that comprise the zooplanktivorous, herbivorous and carnivorous fish assemblages are small fishes that serve as forage for mid-size demersal piscivores, such as the red hind, graysbe, and the coney, as well as for large demersal and pelagic predators, such as yellowfin grouper, cero mackerels, black jacks and great barracudas, observed during ASEC surveys in this reef (Table 42).

Commercially important species for the aquarium fish trade market, such as the cherubfish, fairy basslet, rock beauty (*Holacanthus tricolor*), blue chromis (*Chromis cyanea*), redspotted hawkfish, spanish hogfish and longsnout butterflyfish (*Chaetodon aculeatus*) were present at 50 m in Agelas Reef. Estimates of their stock size, based on their mean density within belt-transects and the total area of reef habitat between 45 – 60 m depths are presented in Table 42. Fairy basslets, cherubfishes, and blue and sunshine chromis were observed in their full size range, indicative that they are recruiting and spending their entire life cycle in this reef habitat. Butterflyfishes and rock beauties (angelfish) were observed in their full adult sizes, suggesting that Agelas Reef may function mostly as a foraging and/or reproductive (mating) habitat for these fish species.

Fish species of commercial value in the food market included red hind and yellowfin groupers (*Epinephelus guttatus, Mycteroperca venenosa*). Yellowfin groupers were only observed in large adult sizes, whereas a couple of red hinds were observed in juvenile sizes of 6 – 8 cm (Table 43). These data suggests that large groupers use Agelas Reef mostly as a foraging ground. Red hinds appear to be adult residents, but may also be recruiting at this reef. Post-settlement and early juvenile red hinds have been observed

Table 43. Size-frequency distribution of large and/or commercially important reef fishes identified during an ASEC survey at Lechuga Reef (50 meters), SW Isla Desecheo during January,2005 and March, 2005

Depth range : 47 - 53 m (156 - 175 feet)
Duration - 30 min.

		January, 2005				March, 2005	
SPECIES	**COMMON NAME**	# (cm)					
Acanthosibium solanderi	Wahoo	1(120)					
Balistes vetula	Queen Triggerfish	2(40)	1(45)			2(40)	
Caranx lugubris	Black Jack	1(35)					
Centropyge argi	Pigmy Angelfish	(1-7)				(1- 7)	
Chaetodon aculeatus	Longsnout Butterflyfish	2(4-5)	10(6-7)			1(4-5)	8(6-7)
Chaetodon sedentarius	Reef Butterflyfish	2(10)	1(12)			2(10)	
Chromis cyanea	Blue Chromis	(1-6)				(1-6)	
Chromis insolata	Sunshine Chromis	(1-5)				(1-5)	
Epinephelus guttatus	Red Hind	2(6-8)	5(15-20)	3(25)	2(30-35)	1(20)	4(20-25)
Gramma loreto	Royal Gramma	(1-6)				(1-6)	
Holacanthus tricolor	Rock Beauty	1(15-20)				2(20-25)	
Mycteroperca venenosa	Yellowfin Grouper	2(40-45)					
Scomberomorus regalis	Cero Mackerel	1(50)					
Seriola rivoliana	Almaco Jack	2(35-40)					
Sphyraena barracuda	Great Barracuda	1(60)				1(75)	

in relatively high abundance at depths of 15 – 20 m over low relief colonized pavement habitats with abundant benthic algae in the north coast of Rincón, P. R. (García-Sais, unpublished data). Although there is a marked difference in depth between these habitats, the overall morphology of the reef system at Rincon is similar to the low relief, benthic algae dominated environment at Agelas.

A dendrogram analysis of fish taxonomic structure similarities between belt-transects surveyed at 30, 40 and 50 m depths in Isla Desecheo produced three distinct clusters of transects separated from each other by survey depth (Figure 18). At 50 m, the bicolor damselfish (*Stegastes partitus*) was the numerically dominant species in all transects surveyed, but ranked between third and eigth at 40m and between third and sixth at 30 m. Also, the peppermint goby (*Coryphopterus lipernes*) and sunshine chromis (*Chromis insolata*) occupied consistently higher ranks at 50 m than at 30. The Creole wrasse (*Clepticus parrae*), bridled goby (*C. glaucofraenum*) and the masked goby (*C.*

personatus) were among the top five ranks in terms of abundance at 40 m, but were not as prominent at 50m (particularly the bridled goby). The blue chromis ranked first in most transects at 30 and 40 m. The main difference between the 30 and 40 m transects was the higher rankings of masked gobies and sunshine chromis at 40 m, and the higher rankings of fairy basslet (*Gramma loreto*) at 30 m.

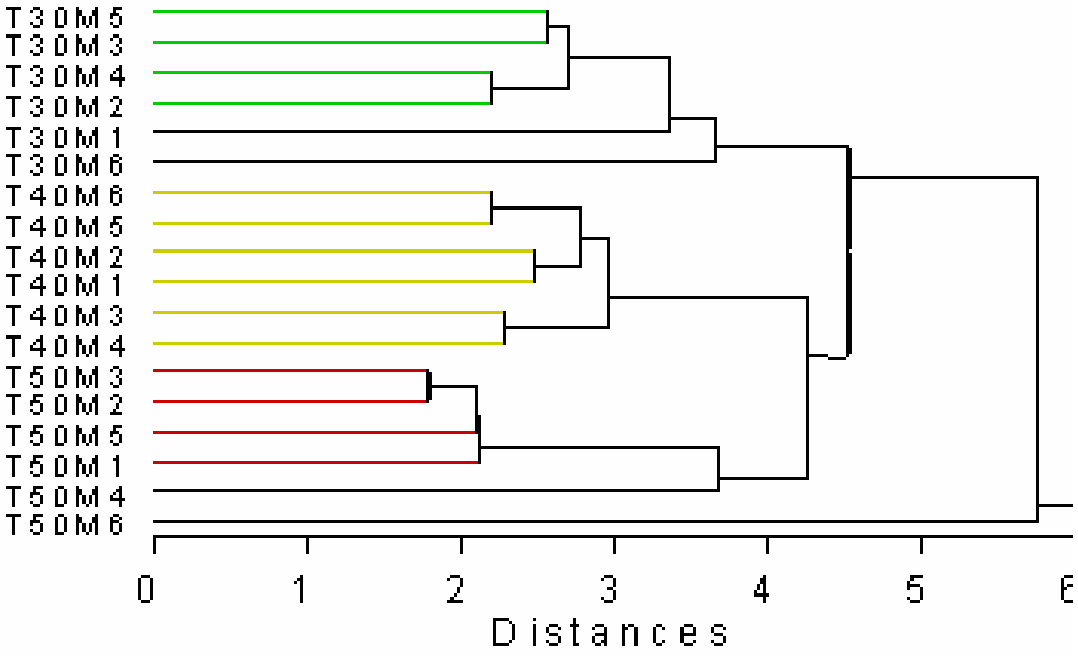


Figure 18. Cluster diagram analyzing the similarity of fish community structure in belt-transects surveyed at 30, 40 and 50 m depths, Isla Desecheo. Distances are 1-Pearson correlation coefficient. Single linkage method (nearest neighbor).

Photo Album 50 m

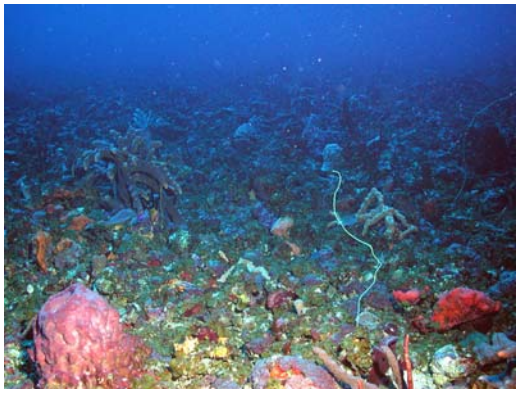


Plate 48

Plate 49

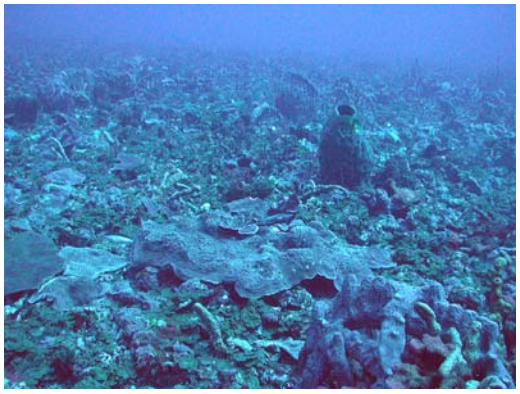


Plate 50

Plate 51

Plate 52

Plate 53

Plate 54

Plate 55

Plate 56

Plate 57

Plate 58

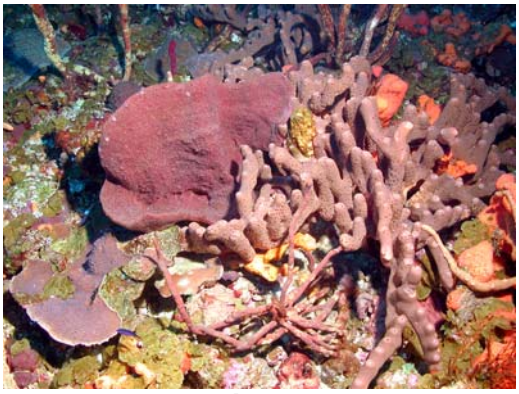


Plate 59

VI. Conclusions

1- Hermatypic coral reefs in deep terraces of the outer shelf, rocky outcrops and vertical wall features of the insular slope, submerged volcanic ridges, and oceanic seamounts comprise the deep reef systems of Puerto Rico and the U. S. Virgin Islands

2- Deep (30-70m) hermatypic “coral reefs” are known to occur along relatively flat, gently sloping terraces of the outer shelf and/or reef tops in oceanic islands and seamounts of PR (Vieques, Desecheo, Bajo de Sico) and associated with the shelf-edge north of St. Thomas, southwest of St. Croix and southeast and east of St. John

3- Exploratory surveys at the shelf-edge off south Vieques, north of Culebra, St. Thomas and St. John, and southwest of St. Croix, as well as in the islands of Mona and Monito are strongly recommended for assessment of the distribution of deep hermatypic coral reefs in the region

4- Ahermatypic coral banks have not been reported for the US Caribbean EEZ., but at least 33 species of azooxanthellate corals, including the deep water reef builder, *Lophelia pertusa* have been collected.

5- The bathymetry of the northern and southern slopes of PR and the USVI are characterized by an abrupt, almost vertical drop, without any large topographic features (platforms) where extensive deep (ahermatypic) reef banks could develop. There are two prominent ridge systems submerged along the west and southeast coasts that offer the best possibilities for existence of deep (ahermatypic) coral reefs.

6- Most of the information regarding deep water habitats and associated communities in Puerto Rico and the U. S. Virgin Islands was produced more than 100 years ago, during the early ocean exploration surveys that included the Voyage of H. M. S. Challenger during 1873, dredging surveys by “Blake” during 1878-79, U. S. Fish Commission “Fish Hawk” in 1899, and the Johnson-Smithsonian Expedition aboard the Yacht Caroline in 1933.

7- Biological characterizations of deep reef communities in P R and the USVI are mostly limited to “regional” assessments contributed by specialists (curators) of particular taxonomic groups

8- Limitations imposed by sampling gear (trawling nets), depth, time, cost, and the difficulty of sampling abrupt slope habitats suggest that the biological information available is incomplete

9- Inferences of community structure, ecosystem function and relevant oceanographic processes for particular deep reef sites within the US Caribbean EEZ are presently inexistent

10- The broad depth and benthic habitat plasticity exhibited by many of the fish and coral species reported from collection expeditions, experimental fishing programs and submarine surveys in the region suggest that the insular slope of PR and the USVI represents an integral ecological system

11- Despite intensive, unmanaged exploitation for more than 50 years, deep reef populations (snappers and groupers) still represent one of the most important fisheries in PR

12- The relatively high yields of pelagic game fishes (marlin, wahoo, mackerel, tuna, swordfish) near oceanic seamounts and insular slope habitats is indicative that deep reefs play an important role in the ecology of these commercially important populations

13- The field work at Isla Desecheo evidenced sharp variations in sessile-benthic community structure between the platform reef at 25 m, the Wall Reef at 30 -40 m and Agelas Reef at 50 + m.

14- Differences of benthic community structure appear to be related to effects of slope inclination on settlement and attachment dynamics, water currents, sediment deposition and abrasion, mechanical forces (e.g. storm induced disturbances), and differences of ambient light and temperature (internal waves)

15- Although sponges are the dominant sessile invertebrate taxa in terms of substrate cover at reefs below 25 m, they are commonly found in association with stony corals, creating large “sponge-coral bioherms” that function as (the most) important habitats for fishes and motile invertebrates

16- The numerically dominant ichthyofauna within belt-transects at reefs studied is dominated by zooplanktivorous taxa, suggesting that planktonic food webs are most relevant on deep reefs

17- Deep reefs studied at Isla Desecheo are the natural habitats of many exploited commercially important food fishes, such as large groupers (Nassau, Yellowfin, Red Hind) and snappers (Cubera) and target species of the aquarium trade (Blue Chromis, Royal Gramma, Pigmy Angelfishes, Butterflyfishes, Jawfishes, Hawkfishes)

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VIII. Appendices

Appendix 1. Ahermatypic coral species reported for the Caribbean region (Cairns, 1979)

Ahermatypic Coral Species	Cuba	Hispaniola	**Puerto Rico**	Jamaica	Winward Islands	Leeward Islands	N Coast South America	SW Caribbean	NW Caribbean	Trinidad/Tobago	Tropical Western Atlantic	**Bathimetric range (m)**
Madracis myriaster	X	X	X	X	X	X		X	X			37-308
Fungiacyanthus pusillus					X				X			285-439
F. symmetricus	X		X	X	X			X	X			183-1664
F. crispus					X				X			183-640
F.marenzelleri	X											2450-2745
Leptopenus discus	X											2842-3475
Madrepora oculata	X	X	X	X	X	X	X		X	X		144-1391
M. carolina	X	X		X				X	X			53-801
Anthemphyllia patera	X				X							500-700
Caryophyllia berteriana	X	X	X	X	X	X		X	X	X		100-1033
C. cornuformis	X			X	X				X			37-931
C. antillarum	X				X							150-1000
C. polygona	X			X	X							700-1817
C.paucipalata					X							714-843
C. a. caribbeana	X	X	X	X	X	X	X	X	X	X		183-1646
C.barbadensis					X							183-249
C. corrugata	X				X							183-380
C. parvula	X	X		X	X		X		X			97-399
C.zopyros	X			X	X							73-618
Concentrotheca laevigata									X			183-800
Cyatoceras sp. Cf. C cornu									X			220-241
C. squiresi												686-822
Labyrinthocyathus langae	X				X				X			695-810
Oxysmilia rotundifolia	X	X	X		X	X	X	X		X		46-640
Trochocyatus rawsonii	X	X	X		X	X	X	X	X	X		82-622
T. fossulus					X							205-380
T. fasciatus									X			238
Tethocyathus cylindraceus				X	X							155-649
T. recurvatus	X			X					X			320-488
T. variabilis	X		X		X				X			250-576
Paracyathus pulchellus	X	X	X	X	X	X	X	X	X			17-838
Deltocyathus agassizii	X				X							494-907
D. calcar	X	X	X	X	X		X	X	X	X		81-675
D. sp. Cf. D. italicus	X	X	X	X	X	X	X		X	X		403-2634
D. eccentricus	X		X	X	X		X	X	X	X		183-907

D.moseleyi	X				X				X			201-777
D. pourtalesi	X											311-567
Stephanocyathus diadema	X	X	X	X	X	X	X	X	X	X		795-2133
S. paliferus	X			X	X	X	X	X	X	X		229-715
S.laevifundus	X	X			X			X				300-1158
S. coronatus	X	X	X	X	X	X	X	X	X	X		543-1250
Trematotrochus corbicula	X											400-576
Peponocyathus folliculus	X				X							284-457
P. stimpsonii	X				X							110-553
Desmophyllum cristagalli	X				X							155-1939
D. striatum	X	X		X	X							130-823
Thalamophyllia riisei	X			X	X			X	X	X		18-1317
Lophelia prolifera			X	X	X		X					95-1000
Anomocora fecunda	X	X		X	X	X	X	X	X	X		73-567
Coenosmillia arbuscula	X		X		X	X	X	X	X			109-622
Dasmosmilia lymani						X						48-366
D. variegata							X					110-366
Solenosmilia variabilis	X			X	X	X				X		220-1383
Asterosmilia prolifera					X	X	X			X		32-311
A. marchadi							X					32-229
Rhizosmilia gerdae	X											123-355
Phacelocyathus flos	X	X		X	X			X		X		22-560
Flabellum mosleyi	X			X	X	X	X	X	X	X		216-1097
F. p. atlanticum	X											357-618
Placotrochides frusta					X							497-907
Javania cailleti	X	X		X	X	X	X	X	X	X		86-1682
J. pseudoalabastra				X								1089-1234
Polymyces fragilis	X				X	X		X	X			75-796
Gardineria paradoxa				X	X				X			91-700
G. minor	X	X		X	X	X	X	X	X			2-241
Guynia annulata	X	X		X	X			X	X			37-653
Schizocyanthus fissilis	X		X		X				X			88-640
Stenocyathus vermiformis	X				X							128-835
Pourtalocyathus hispidus	X		X	X	X							349-1200
Balanophyllia cyathoides	X				X				X			53-494
B. palifera	X				X				X			53-444
B. wellsi	X			X						X		412-505
B. hadros								X				238-274
B. bayeri									X			274-311
Dendrophyllia cornucopia	X				X							132-604
D. gaditana									X			146-505
D. alternata	X			X	X					X		276-900
Enallopsammia profunda	X				X							403-1748
E. rostrata	X	X		X	X			X				300-1646
Bathypsammia fallasocialis	X			X								244-805
Rhizopsammia manuelensis									X			76-366
Trochopsammia infundibulum	X				X							532-1372
Cylicia inflata	X											183-443
Madracis asperula											X	to 200 m

M. pharensis	X	to 200 m
M. brueggemanni	X	to 200 m
Agaricia cailleti	X	to 200 m
Cladocora debilis	X	to 200 m
Astrangia danae	X	to 200 m
A. rathbuni	X	to 200 m
A. solitaria	X	to 200 m
Phyllangia americana	X	to 200 m
Colangia inmersa	X	to 200 m
Oculina tenella	X	to 200 m
Caryophyllia horologium	X	to 200 m
Rhizosmilia maculata	X	to 200 m
Coenocyathus goreaui	X	to 200 m
Pourtalosmilia conferta	X	to 200 m
Trochocyathus halianthus	X	to 200 m
Polycyathus senegalensis	X	to 200 m
Sphenotrochus auritus	X	to 200 m
Gardineria simplex	X	to 200 m
Balanophyllia floridana	X	to 200 m
B. goesi	X	to 200 m
B. caribbeana	X	to 200 m
B. grandis	X	to 200 m
B. dineta	X	to 200 m
Rhizopsammia bermudensis	X	to 200 m
Tubastrea coccinea	X	to 200 m

Appendix 2. Taxonomic record of fishes reported for depths of at least 30m in Puerto Rico and U.S. Virgin Islands.

CLASE MYXINI	LAMPREAS GLUTINOSAS	HAGFISHES	
ORDEN MYXINIFORMES	LAMPREAS GLUTINOSAS	HAGFISHES	
FAMILIA MYXINIDAE	LAMPREAS GLUTINOSAS	HAGFISHES	
Eptatretus mendozai Hensley, 1985	lamprea glutinosa de Mendoza	Mendoza hagfish	720-1100
Myxine mcmillanae Hensley, 1991	pez bruja, lamprea glutinosa	Caribbean hagfish	30-1000
CLASE CEPHALASPIDOMORPHI	LAMPREAS	LAMPREYS	
ORDEN PETROMYZONTIFORMES	LAMPREAS	LAMPREYS	
FAMILIA PETROMYZONTIDAE	LAMPREAS	LAMPREYS	
Petromyzon marinus	lamprea	sea lamprey	0-1100
CLASE ELASMOBRANCHII	PECES CARTILAGINOSOS	CARTILAGINOUS FISHES	
ORDEN HEXANCHIFORMES	VILMAS	COW SHARKS	
FAMILIA HEXANCHIDAE	VILMAS	COW SHARKS	
Heptranchias perlo (Bonnaterre, 1788)	vilma siete-agallas	bigeye sevengill shark	3-500
Hexanchus griseus (Bonnaterre, 1788)	vilma seis-agallas	sixgill shark	30-3750
Hexanchus nakamurai Teng, 1962	vilma ojona	bigeye sixgill shark	16-600

ORDEN ORECTOLOBIFORMES	TIBURONES TIPICOS	CARPET SHARKS	
FAMILIA RHINCODONTIDAE	TIBURONES BALLENA	WHALE SHARKS	
Rhincodon typus Smith, 1828	tiburón ballena	whale shark	0-700
FAMILIA GINGLYMOSTOMATIDAE	GATAS	NURSE SHARKS	
Ginglymostoma cirratum (Bonnaterre, 1788)	gata, nodriza	nurse shark	0-130
ORDEN LAMNIFORMES	TIBURONES MACARELAS	MACKEREL SHARKS	
FAMILIA LAMNIDAE	TIBURONES MACARELAS	MACKEREL SHARKS	
Isurus oxyrinchus Rafinesque, 1810	tiburón carite, mako	shortfin mako	0-740
FAMILIA ALOPIIDAE	TIBURONES PELEADORES	THRESHER SHARKS	
Alopias vulpinus (Bonnaterre, 1788)	tiburón peleador, zorro	thresher shark	0-550
ORDEN CARCHARHINIFORMES	TINTORERAS	REQUIEM SHARKS	
FAMILIA SCYLIORHINIDAE	TIBURONES GATO	CAT SHARKS	
Apristurus canutus Springer & Heemstra, 1979	tiburón gato cano	hoary cat shark	687-840
Apristurus parvipinnis Springer & Heemstra, 1979	tiburón gato aletichico	smallfin cat shark	636-1115
Galeus antillensis Springer, 1979	tiburón gato manchado	Antillean marbled cat shark	150-700
Galeus arae (Nichols, 1927)[1]	tiburón gato veteado	marbled cat shark	280-800
Galeus springeri Konstantinov & Cozzi, 1998	tiburón gato coliaserrado	sawtail cat shark	457-699
Scyliorhinus boa Goode & Bean, 1895	tiburón culebrón	boa cat shark	329-676
Scyliorhinus hesperius Springer, 1966	tiburón gato ensillado	saddled cat shark	274-457
Scyliorhinus torrei Howell Rivero, 1936	tiburón gato enano	whitespotted cat shark	220-560

FAMILIA TRIAKIDAE	CAZONES	HOUNDSHARKS	
Mustelus canis (Mitchill, 1815)[2]	cazón, tiburón japonés	smooth dogfish	0-800
Mustelus norrisi Springer, 1940	cachorro, cazón, vilma	Florida smoothhound	0-100
FAMILIA CARCHARHINIDAE	TINTORERAS	REQUIEM SHARKS	
Carcharhinus brevipinna (Müller & Henle, 1841)	tintorera giradora	spinner shark	0-100
Carcharhinus falciformis (Bibron, 1841)	tiburón jaquetón, limón, cazón playero	silky shark	0-500
Carcharhinus galapagensis (Snodgrass & Heller,	tintorera de islas	insular shark	0-180
Carcharhinus leucas (Valenciennes, 1841)	sarda, toro	bull shark	0-152
Carcharhinus limbatus (Valeciennes, 1841)	caconeta punta prieta	blacktip shark	0-30
Carcharhinus longimanus (Poey, 1861)	tiburón galano	oceanic whitetip shark	0-150
Carcharhinus obscurus (Le Sueur, 1817)	tintorera oscura	dusky shark	0-400
Carcharhinus perezii (Poey, 1876)	tintorera de arrecifes, tintorera coralina,	reef shark	0-65
Carcharhinus plumbeus (Nardo, 1927)	tintorera de arenales	sandbar shark	0-1800
Carcharhinus porosus (Ranzani, 1840)	cazón playón, tiburoncito, caconeta,	smalltail shark	0-36
Galeocerdo cuvier (Peron & Le Sueur, 1822)	tiburón tigre, tintorera, tiburón cabrón	tiger shark	0-350
Negaprion brevirostris (Poey, 1868)	tiburón limón, caconeta, tintorera,	lemon shark	0-92
Prionace glauca (Linnaeus, 1758)	tiburón azul, cajaya	blue shark	0-350
Rhizoprionodon porosus (Poey, 1861)[3]	tintorera hocicuda caribeña	Caribbean sharpnose shark	0-500
Rhizoprionodon terraenovae (Richardson, 1836)	tintorera hocicuda	Atlantic sharpnose shark	10-280
FAMILIA SPHYRNIDAE	CORNUDAS	HAMMERHEAD SHARKS	
Sphyrna lewini (Griffith & Smith, 1834)	cornuda cortada, cornúa,	scalloped hammerhead	0-275
Sphyrna mokarran (Rüppell, 1837)	cornuda, tiburón martillo, cornúa	great hammerhead	1-300
Sphyrna tiburo (Linnaeus, 1758)	cornuda cabezona, cornúa,	bonnethead	10-80
Sphyrna zygaena (Linnaeus, 1758)	cornuda lisa, cornúa, tiburón martillo	smooth hammerhead	0-200
ORDEN SQUALIFORMES	GALLUDOS	DOGFISHES	

FAMILIA ETMOPTERIDAE	GALLUDOS LAMPARA	LANTERNSHARKS	
Etmopterus bullisi Bigelow & Schroeder, 1957	galludo rayado	lined lanternshark	0-375
Etmopterus hillianus (Poey, 1861)	galludo vientre negro	blackbelly dogfish	180-920
Etmopterus robinsi Schofield & Burgess, 1997	galludo oscuro	dark lantern shark	411-786
Etmopterus schultzi Bigelow, Schroeder & Springer, 1953	galludo aletirayado	fringefin lanternshark	384-732
Etmopterus virens Bigelow, Schroeder & Springer, 1953	galludo verde	green lanternshark	348-465
FAMILIA SOMNIOSIDAE	GALLUDOS DORMIDOS	SLEEPER SHARKS	
Scymnodon obscurus (Vaillant, 1888)[4]	galludo aterciopelado	smallmouth velvet dogfish	0-1450
FAMILIA DALATIIDAE	GALLUDOS ALETUDOS	KITEFIN SHARKS	
Dalatias licha (Bonaterre, 1788)	tiburón manatí	kitefin sharks	37-1800
Isistius brasiliensis (Quoy & Gaimard, 1824)	galludo collarino	collared dogfish	0-3500
Isistius plutodus Garrick & Springer, 1964[5]	galludo bocón	Gulf dogfish	0-1000
FAMILIA CENTROPHORIDAE	GALLUDOS TRAGONES	GULPER SHARKS	
Centrophorus acus Garman, 1906	galludo alargado	needle dogfish	200-915
Centrophorus granulosus (Bloch & Schneider, 1801)	galludo tragón manchado	gulper shark	100-1200
Centrophorus niaukang Teng, 1959[6]	galludo chino	Taiwan gulper shark	145-900
Centrophorus tessellatus Garman, 1906	galludo cuadriculado	mosaic gulper shark	20-750
Centrophorus uyato (Rafinesque, 1810)[7]	galludo tragón chico	little gulper shark	C, O, E, F,
Deania calcea (Lowe, 1839)	galludo picudo	birdbeak dogfish	60-1490
FAMILIA SQUALIDAE	ESCUALOS	DOGFISH SHARKS	

Cirrhigaleus asper (Merrett, 1973)	escualo áspero	roughskin dogfish	214-600
Squalus cubensis Howell Rivero, 1936	galludo cubano	Cuban dogfish	60-710
Squalus mitsukurii Jordan & Snyder, 1903[8]	escualo espinoso	shortspine spurdog	0-950
ORDEN TORPEDINIFORMES	RAYAS ELECTRICAS	ELECTRIC RAYS	
FAMILIA TORPEDINIDAE	RAYAS ELECTRICAS	ELECTRIC RAYS	
Torpedo nobiliana Bonaparte, 1835	raya torpedo	Atlantic torpedo	0-800
FAMILIA NARCINIDAE	RAYAS ENTUMECEDORAS	NUMBFISHES	
Heteronarce bentuviai Barnes & Randall, 1989	raya entumecedora	numbfish	0-160
Narcine brasiliensis (Olfers, 1831)	raya eléctrica	lesser electric ray	0-43
ORDEN RAJIFORMES	RAYAS	RAYS	
FAMILIA RHINOBATIDAE	PECES GUITARRA	GUITARFISHES	
Rhinobatos horkeli (Müller & Henle, 1841)	pez guitarra del Brasil	Brazilian guitarfish	C, O, E, F
Rhinobatos lentiginosus Garman, 1880	pez guitarra del Atlántico	Atlantic guitarfish	0-30
Rhinobatos percellens (Walbaum, 1792)	choler, pez guitarra del sur	southern guitarfish	0-110
FAMILIA RAJIDAE	RAYAS PATINETA	SKATES	
Dactylobatus clarkii (Bigelow & Schroeder, 1958)	raya garfio	hookskate	475-1000
Dipturus bullisi (Bigelow & Schroeder, 1962)	raya de Tortugas	Tortugas skate	200-600
Rajella bathyphila (Holt & Byrne, 1908)	raya de profundidades	abyssal skate	600-2400
FAMILIA ANACANTHOBATIDAE	RAYAS LISAS	LEG SKATES	

Anacanthobatis longirostris Bigelow & Schroeder, 1962	raya hocicuda	longnose leg skate	530-1052
Cruriraja cadenati Bigelow & Schroeder, 1962	raya ancha	broadfoot leg skate	458
Cruriraja rugosa Bigelow & Schroeder, 1958	raya áspera	rough leg skate	366-1007
FAMILIA DASYATIDAE	RAYAS	STINGRAYS	
Dasyatis americana Hildebrand & Schroeder, 1928	raya	southern stingray	0-53
Dasyatis centroura (Mitchill, 1815)	raya fuete	roughtail stingray	0-200
Dasyatis guttata (Bloch, 1801)	raya látigo	longnose stingray	0-36
FAMILIA MYLIOBATIDAE	CHUCHOS	EAGLE RAYS	
Aetobatus narinari (Euphrasen, 1790)	chucho, obispo	spotted eagle ray	0-80
Myliobatis freminvillii (Le Sueur, 1824)	raya narizona	bullnose ray	0-22
FAMILIA MOBULIDAE	MANTAS	MANTAS	
Manta birostris (Walbaum, 1792)	manta, mantarraya, vampiro	manta	0-24
FAMILIA UROLOPHIDAE	RAYAS REDONDAS	ROUND STINGRAYS	
Urobatis jamaicensis (Cuvier, 1816)	raya amarilla	yellow stingray	1-25
CLASE HOLOCEPHALI	QUIMERAS	CHIMAERAS	
ORDEN CHIMAERIFORMES	QUIMERAS	CHIMAERAS	
FAMILIA CHIMAERIDAE	QUIMERAS CARICHATAS	RATFISHES	
Chimaera cubana Howell Rivero, 1936	quimera antillana	tropical ratfish	180-1000
CLASE OSTEICHTHYES	PECES OSEOS	BONY FISHES	

ORDEN ELOPIFORMES	MACABIES	LADYFISHES	
FAMILIA ELOPIDAE	MACABIES	LADYFISHES	
Elops saurus Linnaeus, 1766	macabí, piojo, chiro, malacho,	ladyfish	0-50
FAMILIA MEGALOPIDAE	SABALOS	TARPONS	
Megalops atlanticus Valenciennes, 1847	sábalo, tarpón, saboga, sábalo real	tarpon	0-30
ORDEN ALBULIFORMES	MACACOS	BONEFISHES	
FAMILIA ALBULIDAE	MACACOS	BONEFISHES	
Albula nemoptera (Fowler, 1911)	macaco envarillado	shafted bonefish	0-50
Albula vulpes (Linnaeus, 1758)	macaco, conejo, piojo, ratón, macabí	bonefish	0-84
ORDEN NOTACANTHIFORMES	ANGUILAS ESPINOSAS	SPINY EELS	
FAMILIA HALOSAURIDAE	LAGARTOS DE ABISMOS	HALOSAURS	
Aldrovandia affinis (Günther, 1877)	lagarto hocicudo de abismos	rattail lizardfish	730-2560
Aldrovandia gracilis Goode & Bean, 1895	lagarto fino de abismos	thin halosaur	460-2860
Aldrovandia phalacra (Vaillant, 1888)	lagarto antorcha de abismos	firebrand halosaur	500-2540
Halosauropsis macrochir (Günther, 1878)	lagarto rayado de abismos	barred halosaur	1100-3300
Halosaurus guentheri Goode & Bean, 1895	lagarto cabeciescamoso de abismos	Atlantic halosaur	550-1600
Halosaurus ovenii Johnson, 1863	lagarto boquinegro de abismos	blackmouth halosaur	440-1760
FAMILIA NOTACANTHIDAE	ANGUILAS ESPINOSAS	SPINY EELS	
Polyacanthonothus merretti Sulak, Crabtree & Hureau, 1984	anguila espinosa occidental	western spiny eel	598-2000

ORDEN ANGUILLIFORMES	ANGUILAS	EELS	
FAMILIA ANGUILLIDAE	ANGUILAS	FRESHWATER EELS	
Anguilla rostrata (Le Sueur, 1817)	anguila	American eel	0-4000
FAMILIA HETERENCHELYIDAE	ANGUILAS PELLEJUAS	LOOSE-SKIN EELS	
Pythonichthys sanguineus Poey, 1868	anguila pellejúa	loose-skin eel	0-37
FAMILIA MORINGUIDAE	ANGUILAS FIDEILLO	SPAGHETTI EELS	
Moringua edwardsi (Jordan & Bollman, 1889)	anguila fideíllo	spaghetti eel	0-30
FAMILIA CHLOPSIDAE	ANGUILAS MORENAS	FALSE MORAYS	
Chilorhinus suensonii Lütken, 1852	anguila talasiera	seagrass eel	0-450
Kaupichthys hyoproroides (Stromann, 1896)	anguila morena	false moray	0-160
Kaupichthys nuchalis Bohlke, 1967	anguila collarina	collared eel	0-130
FAMILIA MURAENIDAE	MORENAS	MORAYS	
Anarchias similis (Lea, 1913)	morena pigmea	pygmy moray	0-180
Channomuraena vittata (Richardson, 1844)	morena franjeada	banded moray	5-100
Enchelycore carychroa Bölhke & Bölhke, 1976	morena parda	chestnut moray	0-30
Enchelycore nigricans (Bonnaterre, 1788)	víbora, morena negra	viper moray	0-30
Gymnothorax afer Bloch, 1795	morena oscura, congre	dark moray	10-45
Gymnothorax conspersus Poey, 1867	morena dorsomanchada	saddled moray	179-254
Gymnothorax funebris Ranzani, 1839	morena verde, congre	green moray	0-40
Gymnothorax maderensis (Johnson, 1862)	morena dientona	sharktooth moray	85-200
Gymnothorax miliaris (Kaup, 1856)	morena colidorada, morena brillante	goldentail moray	0-60
Gymnothorax moringa (Cuvier, 1829)	morena moteada, morena pintada,	spotted moray	0-200
Gymnothorax nigromarginatus (Girard, 1859)	chafiro, morena bordenegro	blackedge moray	10-20
Gymnothorax ocellatus Agassiz, 1828	morena de charcos, chafiro	white spotted moray	1-160

Gymnothorax polygonius Poey, 1875	morena cuadriculada	polygon moray	0-270
Gymnothorax vicinus (Castelnau, 1855)	morena boquilila, morena purpurina	purplemouth moray	0-145
Monopenchelys acuta (Parr, 1930)	morena caricolorada	redface moray	10-70
Uropterygius macularius (Le Sueur, 1825)	morena veteada	marbled moray	0-230
FAMILIA SYNAPHOBRANCHIDAE	ANGUILAS PECHICORTADAS	CUTTHROAT EELS	
Dysommina rugosa Ginsburg, 1951	anguila arrugada	rugose eel	0-525
Dysommina proboscideus (Lea, 1913)	anguila trompuda	trunk eel	0-150
FAMILIA OPHICHTHIDAE	TIESOS	SNAKE EELS	
Aplatophis chauliodus Bölhke, 1956	anguila dientona	tusky eel	33-91
Callechelys bilinearis Kanazawa, 1952	tieso birayado	twostripe snake eel	1-22
Callechelys guineensis (Osorio, 1894)	tieso colituco	shorttail snake eel	0-35
Echiophis intertinctus (Richardson, 1848)	tieso cuchareta	spotted spoon-nose eel	0-100
Gordiichthys irretitus Jordan & Davis, 1891	tieso fino	horsehair eel	90-200
Gordiichthys leibyi McCosker & Bölhke, 1984	tieso de Leiby	Leiby's eel	37-72
Ichthyapus ophioneus (Evermann & Marsh, 1900)	tieso de marullos	surf eel	0-35
Myrichthys ocellatus (Le Sueur, 1825)	tieso mancha dorada	goldspotted eel	0-150
Myrophis platyrhynchus Breder, 1927	gusano hocicudo	broadnose worm eel	0-20
Myrophis punctatus Lütken, 1851	gusano moteado	speckled worm eel	0-20
Ophichthus cruentifer (Goode & Bean, 1896)	tieso bordeado	margined snake eel	36-1350
Ophichthus gomesii (Castelnau, 1855)	tieso negro, congre	shrimp eel	0-180
Ophichthus ophis (Linnaeus, 1758)	tieso manchado, congre	spotted snake eel	21-50
FAMILIA COLOCONGRIDAE	CONGRES CABECICHICOS	SMALLHEAD CONGERS	
Coloconger meadi Kanazawa, 1957	congrio cabecicolorado	redhead conger	650-925
FAMILIA CONGRIDAE	CONGRES	CONGER EELS	
Acromycter atlanticus Smith, 1989	congre del Atlántico	Atlantic conger	503-640
Ariosoma anale (Poey, 1860)	congre hocicudo, congrio	longtrunk conger	10-63

Ariosoma balearicum (Delaroche, 1809)	congre dientijunto, congrio	bandtooth conger	0-732
Bathycongrus thysanochilus (Reid, 1934)	congre de abismos, congrio	abyssal conger	200-659
Conger esculentus Poey, 1860	congre, congrio	Antillean conger	0-100
Conger oceanicus (Mitchill, 1814)	congre de altura, congrio	oceanic conger eel	0-480
Conger triporiceps Kanazawa, 1958	congre dientón, congrio	manytooth conger	0-55
Heteroconger longissimus Günther 1870	congre jardinero, congrio	garden eel	10-60
Rhynchoconger flavus (Goode & Bean, 1896)	congre amarillo, congrio	yellow conger	20-183
Rhynchoconger guppyi (Norman, 1925)	congre gupi, congrio	guppy conger	320
Parabathymyrus oregoni Smith & Kanazawa, 1977	congre de profundidad, congrio	deepsea conger	320
Uroconger syringinus Ginsburg, 1954	congre colirayado, congrio	threadtail conger	44-384
Xenomystax congroides Smith & Kanazawa, 1989	congroide	eel-like conger	140-825
FAMILIA MURAENESOCIDAE	MORENOCIOS	PIKE CONGER EELS	
Cynoponticus savanna (Cuvier, 1829)	morenocio colorado	sapphire eel	0-100
FAMILIA NEMICHTHYIDAE	ANGUILAS DE CINTA	SNIPE EELS	
Nemichthys scolopaceus Richardson, 1848	anguila de cinta	slender snipe eel	91-2000
FAMILIA SERRIVOMERIDAE	ANGUILAS DENTISERRADAS	SAWTOOTH EELS	
Serrivomer beanii Gill & Ryder, 1883	anguila gorda	stout sawpalate	10-4550
Serrivomer lanceolatoides (Schmidt, 1916)	anguila dentichica	short-tooth sawpalate	150-1000
ORDEN SACCOPHARYNGIFORMES	ANGUILAS TRAGONAS	GULPERS	
FAMILIA EURYPHARYNGIDAE	ANGUILAS TRAGONAS	UMBRELLAMOUTH GULPERS	
Eurypharynx pelecanoides Vaillant, 1882	anguila tragona	pelican gulper	200-10000
ORDEN CLUPEIFORMES	ARENQUES	HERRINGS	
FAMILIA CLUPEIDAE	ARENQUES	HERRINGS	

Dorosoma cepedianum (Le Sueur, 1818)[9]	sardina americana	American gizzard shad	0-33
Etrumeus teres (De Kay, 1842)	arenque redondo	round herring	50-150
FAMILIA ENGRAULIDAE	ANCHOAS	ANCHOVIES	
Anchoa cubana (Poey, 1868)	anchoa cubana, bocona, bocúa,	Cuban anchovy	0-60
Anchoa lyolepis (Evermann & Marsh, 1900)	bocona prieta, bocúa	dusky anchovy	0-60
ORDEN OSMERIFORMES	ESPERINQUES	SMELTS	
FAMILIA ARGENTINIDAE	ARGENTINIOS	ARGENTINES	
Argentina brucei Cohen & Atsaides, 1969	argentinio de Bruce	Bruce's argentine	200-400
Argentina georgei Cohen & Atsaides, 1969	argentinio de George	George's argentine	220-457
Argentina stewarti Cohen & Atsaides, 1969	argentinio de Stewart	Stewart's argentine	366-567
Argentina striata Goode & Bean, 1896	argentinio rayado	striated argentine	95-500
Glossanodon pygmaeus Cohen, 1958	argentinio pigmeo	pigmy argentine	92-458
FAMILIA MICROSTOMATIDAE	ESPERINQUES FINOS	PENCILSMELTS	
Microstoma microstoma (Risso, 1910)	esperinque prieto	dusky pencilsmelt	0-600
FAMILIA OPISTHOPROCTIDAE	ESPANTAJOS	SPOOKFISHES	
Dolichopteryx binocularis Beebe, 1932	espantajo binocular	binocular spookfish	960-1200
Dolichopteryx longipes (Vaillant, 1888)	espantajo hocicoprieto	brownsnout spookfish	500-2000
FAMILIA ALEPOCEPHALIDAE	CABECILISOS	SMOOTHHEADS	

[9] Esta sardina ha sido reportada como introducida a Puerto Rico pero al momento no me constan reportes de que haya sido capturada aquí.

Bathylaco nigricans Goode & Bean, 1895	cabeciliso prieto	black warrior	450-7000
Bathytroctes macrolepis Günther, 1887	cabeciliso de Koefoed	Koefoed's smoothhead	2500-5850
Conocara murrayi (Koefoed, 1927)	cabeciliso de Murray	Murray's smoothhead	1200-2600
Xenodermichthys copei (Gill, 1884)	cabeciliso hocicudo	bluntsnout smoothhead	100-2650

ORDEN STOMIIFORMES — DRAGONES — DRAGONFISHES

FAMILIA GONOSTOMATIDAE — ESCOBILLONES — BRISTLEMOUTHS

Bonapartia pedaliota Goode & Bean, 1896	escobillón ventribrillante	ventral-light bristlemouth	150-3000
Cyclothone microdon (Günther, 1878)	escobillón velado	veiled bristlemouth	200-2700
Diplophos taenia Günther, 1873	escobillón portillo	portholefish	0-800
Gonostoma atlanticum Norman, 1930	escobillón del Atlántico	Atlantic fangjaw	200-2700
Gonostoma elongatum Günther, 1878	escobillón dientudo	longtooth bristlemouth	200-1200
Manducus maderensis (Jonson, 1890)	escobillón chico	minute bristlemouth	400-2000
Margrethia obtusirostra Jespersen & Tåning, 1919	escobillón carichato	bluntfaced bristlemouth	100-600
Triplophos hemingi (McArdle, 1901)	escobillón cabezón	bigheaded bristlemouth	400-2000

FAMILIA STERNOPTYCHIDAE — HACHITAS — SEA HATCHETFISHES

Argyripnus atlanticus Maul, 1952	hachita del Atlántico	Atlantic lightfish	300-500
Argyropelecus aculeatus Valenciennes, 1850	hachita plateada	silver hatchetfish	0-2000
Argyropelecus affinis Garman, 1879	hachita de abismos	deepsea hatchetfish	400-4000
Argyropelecus hemigymnus Cocco, 1829	hachita pelada	half-naked hatchetfish	310-3000
Maurolicus muelleri (Gmelin, 1788)	hachita manchada	pearlside	300-1600
Polyipnus asteroides Schultz, 1964	hachita de quilla	keeled hatchetfish	400-1200
Polyipnus laternatus Garman, 1899	hachita lámpara	lantern hatchetfish	480-2400
Sonoda paucilampa Grey, 1960	hachita colibrillante	lighttail hatchetfish	300-400
Sternoptyx diaphana Hermann, 1781	hachita transparente	transparent hatchetfish	0-3400
Valenciennellus tripunctulatus (Esmarck, 1871)	hachita pecosa	constellationfish	300-1000

FAMILIA PHOSICHTHYIDAE — LUCIERNAGAS — LIGHTFISHES

Ichthyococcus ovatus (Cocco, 1838)	luciérnaga ovalada	ovate lightish	400-1800

Pollichthys mauli (Poll, 1953)	luciérnaga ojona	stareye lightfish	100-600
Polymetme corythaeola (Alcock, 1898)	luciérnaga de lo hondo	deepsea lightfish	240-840
Vinciguerria nimbaria (Jordan & Williams, 1895)	luciérnaga oceánica	oceanic lightfish	20-5000

FAMILIA STOMIIDAE — DRAGONES — DRAGONFISHES

Aristostomias grimaldii Zugmayer, 1913	fauce barbudo	barbeled loosejaw	20-800
Aristostomias polydactylus Regan & Trewavas, 1930	fauce dactilar	fingered loosejaw	20-1000
Aristostomias xenostoma Regan & Trewavas, 1930	fauce torpedo	torpedo loosejaw	50-2000
Astronesthes atlanticus Parin & Borodulina, 1996	sobrediente del Atlántico	Atlantic snaggletooth	300-1200
Astronesthes cyanea (Brauer, 1902)	sobrediente cianótico	cyanotic snaggletooth	120-800
Astronesthes indicus Brauer, 1902	sobrediente cabecinegro	darkheaded snaggletooth	100-2000
Astronesthes macropogon Goodyear & Gibbs, 1970	sobrediente ojón	bigeye snagletooth	500-2000
Astronesthes richardsoni Poey, 1852	sobrediente barbiliso	smooth-barbeled snaggletooth	300-1000
Astronesthes similus Parr, 1927	sobrediente dos barbas	bibarbeled snaggletooth	200-500
Bathophilus digitatus (Welsh, 1923)	dragón digital	fingered dragonfish	
Bathophilus nigerrimus Giglioli, 1882	dragón oscuro	dusky dragonfish	
Bathophilus pawneei Parr, 1927	dragón bocón	largemouth dragonfish	100-3000
Borostomias mononema (Regan & Trewavas, 1929)	sobrediente colmilludo	fanged snaggletooth	640-658
Chauliodus danae Regan & Trewavas, 1929	dragón cabezón	bigheaded viperfish	
Chauliodus sloani Bloch & Schneider, 1801	dragón diente de sable	sabletooth viperfish	500-2800
Echiostoma barbatum Lowe, 1843	dragón barbudo	bearded dragonfish	
Eustomias bigelowi Welsh, 1923	dragón tres ramas	tribranched dragonfish	100-4800
Eustomias bimargaritatus Regan & Trewavas, 1930	dragón dos bulbos	twinbulb dragonfish	0-2600
Eustomias brevibarbatus Parr, 1927	dragón pelado	peeled dragonfish	20-2000
Eustomias dubius Parr, 1927	dragón tenedor	forkbarbel dragonfish	200-1300
Eustomias lipochirus Regan & Trewavas, 1930	dragón barbilargo	longbarbeled dragonfish	30-2600
Eustomias macrophtalmus Parr, 1927	dragón bulbigrande	bigbulb dragonfish	4000-10000
Eustomias macrurus Regan & Trewavas, 1930	dragón coletudo	bigtail dragonfish	20-50
Eustomias melanostigma Regan & Trewavas, 1930	dragón mancha negra	blackspot dragonfish	0-1000
Eustomias micraster Parr, 1927	dragón de estrellas	starry-barbeled dragonfish	0-1807
Eustomias monoclonus Regan & Trewavas, 1930	dragón barbiancho	branch-barbeled dragonfish	100-2000
Eustomias obscurus Vaillant, 1888	dragón colmilludo	fanged dragonfish	100-1700
Eustomias patulus Regan & Trewavas, 1930	dragón largo	long dragonfish	0-400
Eustomias polyaster Parr, 1927	dragón barbiespinoso	spinybarbel dragonfish	100-1660
Eustomias precarius Gomon & Gibbs, 1985	dragón precario	precarious dragonfish	
Eustomias pyrifer Regan & Trewavas, 1930	dragón encendido	flame dragonfish	0-50

Eustomias silvescens Regan & Trewavas, 1930	dragón barbifilamentoso	filamentous dragonfish	
Eustomias simplex Regan & Trewavas, 1930	dragón barbiliso	plainbarbel dragonfish	40-1200
Eustomias variabilis Regan & Trewavas, 1930	dragón bulbivariable	variable-barbel dragonfish	
Eustomias xenobolus Regan & Trewavas, 1930	dragón bulbiraro	strangebulb dragonfish	20-260
Grammatostomias circularis Morrow, 1959	dragón circular	circle dragonfish	0-450
Heterophotus ophistoma Regan & Trewavas, 1929	sobrediente iluminado	lighted snaggletooth	200-900
Idiacanthus fasciola Peters, 1877	dragón prieto	black dragonfish	0-1700
Leptostomias analis Regan & Trewavas, 1930	dragón bulbicurvo	bentbulb dragonfish	600
Leptostomias leptobolus Regan & Trewavas, 1930	dragón bulbizurdo	leftbulb dragonfish	300
Malacosteus niger Ayres, 1848	fauce prieto	stoplight loosejaw	1000-3900
Melanostomias biseriatus Regan & Trewavas, 1930	dragón bulbichato	flatbulb dragonfish	620-760
M. macrophotus Regan & Trewavas, 1930	dragón foco grande	brightbulb dragonfish	530-945
M. melanopogon Regan & Trewavas, 1930	dragón oscuro	dark dragonfish	
Melanostomias melanops Brauer, 1902	dragón ojinegro	blackeye dragonfish	300-1040
M. tentaculatus (Regan & Trewavas, 1930)	dragón tentaculado	tentacled dragonfish	30-1000
Melanostomias valdiviae Brauer, 1902	dragón iluminado	manylight dragonfish	40-1600
Photonectes caerulescens Regan & Trewavas, 1930	sobrediente azuloso	blue snaggletooth	
Photonectes margarita (Goode & Bean, 1896)	sobrediente multibarbado	polybulb snaggletooth	
Photostomias goodyeari Kenaley & Hartel, 2005	fauce de Goodyear	Goodyear's loosejaw	
Photostomias guernei Collett, 1889	fauce feroz	ferocious loosejaw	1120-2640
ORDEN AULOPIFORMES	AULOPIOS	AULOPUS	
FAMILIA CHLOROPHTHALMIDAE	OJIVERDES	GREENEYES	
Chlorophthalmus agassizi Bonaparte, 1840	ojiverde carichato	shortnose greeneye	0-1000
Chlorophthalmus brasiliensis Mead, 1958	ojiverde del sur	Brazilian greeneye	0-366
Parasudis truculenta (Goode & Bean, 1896)	ojiverde hocicudo	longnose greeneye	200-760
FAMILIA IPNOPIDAE	LAGARTOS CIEGOS	BLIND LIZARDFISHES	
Bathypterois bigelowi Mead, 1958	lagarto mancha negra	blackspot lizardfish	377-986
Bathypterois viridensis (Roule, 1916)	lagarto verde	green lizardfish	476-1477
FAMILIA SCOPELARCHIDAE	OJIBRILLANTES	PEARLEYES	

Rosenblattichthys hubbsi Johnson, 1974	ojibrillante pecoso	Hubb's pearleye	60-657
Scopelarchoides danae Johnson, 1974	ojibrillante rayado	striped pearleye	0-800
Scopelarchus analis (Brauer, 1902)	ojibrillante manchado	spotted pearleye	100-2600
Scopelarchus guentheri Alcock, 1896	ojibrillante velón	staring pearleye	100-500
Scopelarchus michaelsarsi Koefoed, 1955	ojibrillante aletudo	bigfin pearleye	200-500
FAMILIA NOTOSUDIDAE	PRECAVIDOS	WARYFISHES	
Scopelosaurus smithii Bean, 1925	precavido vientreblanco	palebelly waryfish	50-815
FAMILIA SYNODONTIDAE	LAGARTOS	LIZARDFISHES	
Saurida brasiliensis Norman, 1935	lagarto escamú	largescale lizardfish	10-450
Saurida caribbaea Breder, 1927	lagarto caribeño	smallscale lizardfish	0-500
Saurida normani Longley, 1935	lagarto carichato	shortjaw lizardfish	9-600
Saurida suspicio Breder, 1927	lagarto tímido	shy lizardfish	0-120
Synodus foetens (Linnaeus, 1766)	lagarto de orillas	inshore lizardfish	0-200
Synodus intermedius (Spix & Agassiz, 1829)	doncella, lagarto, guavina	sand diver	0-400
Synodus poeyi Jordan, 1887	lagarto de afuera	offshore lizardfish	20-350
Synodus saurus (Linnaeus, 1758)	lagarto franja azul	bluestriped lizardfish	0-400
Synodus synodus (Linnaeus, 1758	lagarto colorado	red lizardfish	0-100
Trachinocephalus myops (Forster, 1801)	culebra, lagarto	snakefish	40-430
FAMILIA PARALEPIDIDAE	BARRACUDINAS	BARRACUDINAS	
Lestidiops affinis (Ege, 1933)	barracudina incolora	camouflaged barracudina	0-2000
Lestidiops mirabilis (Ege, 1933)	barracudina maravillosa	strange pike smelt	0-1200
Lestidium atlanticum Borodin, 1928	barracudina del Atlántico	Atlantic barracudina	0-1200
Lestrolepis intermedia Poey, 1867	barracudina enmascarada	masked barracudina	10-1200
Macroparalepis brevis Ege, 1933	barracudina aleticorta	shortfin barracudina	0-1400
Magnisudis atlantica (Krøyer, 1891)	barracudina cuchareta	duckbill barracudina	50-10000
Paralepis speciosa Risso, 1820[10]	barracudina especiosa del Atlántico	Atlantic spicy barracudina	

Stemonosudis gracilis (Ege, 1933)	barracudina fina	slender barracudina	20-8000
Stemonosudis intermedia (Ege, 1933)	barracudina dorsomanchada	dorsal-spot barracudina	0-1000
Stemonosudis siliquiventer Post, 1970	barracudina barrigona	podbellied barracudina	40-2000
Sudis atrox Rofen, 1963	barracudina atroz	hideous barracudina	30-2250
Uncisudis advena (Rofen, 1963)	barracudina advenida	arriving barracudina	813-997
FAMILIA EVERMANNELLIDAE	COLMILLUDOS	SABERTOOTH FISHES	
Odontostomops normalops (Parr, 1928)	colmilludo indistinto	undistinguished sabertooth	400-2800
FAMILIA OMOSUDIDAE	LANCETAS BOCONAS	OMOSUDIDS	
Omosudis lowii Günther, 1887	boquimazo	hammerjaw	0-7000
FAMILIA ALEPISAURIDAE	PECES LANCETA	LANCETFISHES	
Alepisaurus brevirostris Gibbs, 1960	pez lanceta carichato	shortnose lancetfish	
Alepisaurus ferox Lowe,1833	pez lanceta hocicudo	longnose lancetfish	0-1830
ORDEN MYCTOPHIFORMES	PECES LAMPARA	LANTERNFISHES	
FAMILIA NEOSCOPELIDAE	QUIJADITAS	BLACKCHINS	
Neoscopelus macrolepidotus Johnson, 1863	quijadita escamuda	large-scale blackchin	300-800
Neoscopelus microchir Matsubara, 1943	quijadita aletichica	smallfin blackchin	250-1400
FAMILIA MYCTOPHIDAE	PECES LAMPARA	LANTERNFISHES	
Benthosema glaciale (Reinhardt, 1837)	pez lámpara glacial	glacier lanternfish	0-850
Benthosema suborbitale (Gilbert, 1913)	pez lámpara aletichico	smallfin lanternfish	10-700
Bolinichthys distofax Johnson, 1975	pez lámpara cabezón	widefaced lanternfish	100-690
Bolinichthys indicus (Nafpaktitis & Nafpaktitis, 1969)	escolariño	escolarinho	25-900
Bolinichthys photothorax (Parr, 1928)	pez lámpara pechibrillante	brightbreasted lanternfish	40-800
Bolinichthys supralateralis (Parr, 1928)	pez lámpara línea lateral	lateral-line lanternfish	40-850

Centrobranchus nigroocellatus (Günther, 1873)	pez lámpara hocicudo	pignosed lanternfish	0-800
Ceratoscopelus warmingii (Lütken, 1892)	pez lámpara escamudo	Warming's lanternfish	20-1500
Diaphus adenomus Gilbert, 1905	pez lámpara grande	Gilbert's large lanternfish	180-600
Diaphus bertelseni Nafpaktitis, 1966	pez lámpara garrote	club lanternfish	60-300
Diaphus brachycephalus Tåning, 1928	pez lámpara cabecichico	short headed lanternfish	0-350
Diaphus dumerilii (Bleeker, 1856)	pez lámpara maestro	master lanternfish	0-750
Diaphus effulgens (Goode & Bean, 1896)	pez farol	headlight fish	40-850
Diaphus fragilis Tåning, 1928	pez lámpara quebradizo	fragile lanternfish	40-750
Diaphus garmani Gilbert, 1906	pez lámpara carichato	bluntfaced lanternfish	40-750
Diaphus lucidus (Goode & Bean, 1896)	pez lámpara brillante	bright lanternfish	40-750
Diaphus luetkeni (Brauer, 1906)	pez lámpara boquibrillante	brightmouth lanternfish	40-750
Diaphus minax Nafpaktitis, 1968	pez almena	battlement lanternfish	476
Diaphus mollis (Tåning, 1928)	pez lámpara vago	lazy lanternfish	30-700
Diaphus perspicillatus (Ogilby, 1898)	pez lámpara transparente	transparent lanternfish	0-750
Diaphus problematicus Parr, 1928	pez lámpara problemático	troublesome lanternfish	40-750
Diaphus rafinesquii (Cocco, 1838)	pez lámpara mancha blanca	white-spotted lanternfish	40-1080
Diaphus roei Nafpaktitis, 1974	pez lámpara bocón	largemouth lanternfish	300-560
Diaphus splendidus (Brauer, 1904)	pez lámpara espléndido	splendid lanternfish	50-650
Diaphus subtilis Nafpaktitis, 1968	pez lámpara sutil	subtle lanternfish	40-750
Diaphus taaningi Norman, 1930	pez lámpara lateral	lateral lanternfish	40-480
Diaphus termophilus Tåning, 1928	pez lámpara termófilo	Taaning's lanternfish	40-500
Diogenichthys atlanticus (Tåning, 1928)	pez lámpara aletudo	longfin lanternfish	40-900
Gonichthys cocco (Cocco, 1829)	pez lámpara cotorro	parrot lanternfish	0-1000
Hygophum macrochir (Günther, 1864)	pez lámpara aletigrande	largefinned lanternfish	0-750
Hygophum reinhardtii (Lütken, 1892)	pez lámpara alargado	slender lanternfish	200-1100
Hygophum taaningi (Bekker, 1965)	pez lámpara caretón	longfaced lanternfish	20-1250
Lampadena luminosa (Garman, 1899)	pez lamparita	lampfish	50-850
Lampanyctus alatus Goode & Bean, 1896	pez lámpara aletilargo	winged lampfish	50-1000
Lampanyctus nobilis Tåning, 1928	pez lámpara noble	noble lampfish	40-900
Lampanyctus photonotus Parr, 1928	pez lámpara lomobrillante	brightback lampfish	40-1000
Lampanyctus tenuiformis (Brauer, 1906)	pez lámpara fino	thin lampfish	40-750
Lepidophanes gaussi (Brauer, 1906)	pez lámpara vientre brillante	brightbelly lanternfish	0-850
Lepidophanes guentheri (Goode & Bean, 1896)	pez lámpara pechiprieto	darkbreast lanternfish	40-950
Lobianchia gemellarii (Cocco, 1838)	pez dos-lámparas	Cocco's lanternfish	20-650
Myctophum affine (Lütken, 1892)	pez lámpara metálico	metallic lanternfish	200-650
Myctophum asperum Richardson, 1845	pez lámpara espinoso	prickly lanternfish	0-750
Myctophum nitidilum Garman, 1899	pez lámpara perlado	pearly lanternfish	200-950

Myctophum obtusirostre Tåning, 1928	pez lámpara obtuso	obtuse lanternfish	0-750
Myctophum selenops Tåning, 1928	pez lámpara ojón	Wisner's lanternfish	40-450
Nannobrachium cuprarium (Tåning, 1928)	pez lámpara cobrizo	cooper lampfish	40-1000
Nannobrachium lineatum (Tåning, 1928)	pez lámpara rayado	lined lampfish	60-1000
Notolychnus valdiviae (Brauer, 1904)	candelabro	topside lampfish	30-850
Notoscopelus caudispinosus (Johnson, 1863)	pez lámpara coliespinoso	lobisomem	0-1000
ORDEN LAMPRIFORMES	OPAS	OPAHS	
FAMILIA LAMPRIDAE	OPAS	OPAHS	
Lampris guttatus (Brunnich, 1788)	opa, opá, mariposa	opah	100-400
FAMILIA TRACHIPTERIDAE	PECES CINTA	RIBBONFISHES	
Zu cristatus (Bonelli, 1819)	pez cinta moñudo	scalloped ribbonfish	0-90
FAMILIA STYLEPHORIDAE	OJIBROTADOS	TUBE-EYES	
Stylephorus chordatus Shaw, 1791	ojibrotado	tube-eye	200-300
ORDEN POLYMIXIIFORMES	BARBUDOS	BEARDFISHES	
FAMILIA POLYMIXIIDAE	BARBUDOS	BEARDFISHES	
Polymia lowei Günther, 1859	barbudo	beardfish	50-720
Polymia nobilis Lowe, 1838	barbudo grueso	stout beardfish	100-770
ORDEN GADIFORMES	BACALAOS	CODFISHES	
FAMILIA BREGMACEROTIDAE	BACALAILLOS	CODLETS	
Bregmaceros atlanticus Goode & Bean, 1886	bacalaíllo de antena	antenna codlet	0-550

Bregmaceros cantori Milliken & Houde, 1984	bacalaíllo de Cantor	Cantor's codlet	450-475
Bregmaceros mcclellandii Thompson, 1840	bacalaíllo manchado	spotted codlet	0-2000
FAMILIA MACROURIDAE	PICOTAS	GRENADIERS	
Bathygadus favosus Goode & Bean, 1886	picota de abismos	deepsea grenadier	770-2750
Caelorinchus caribbaeus (Goode & Bean, 1885)	picota aletinegra	blackfin grenadier	100-400
Caelorinchus ventrilux Marshall & Iwamoto, 1973	picota vientrebrillante	firebelly grenadier	300-500
Gadomus arcuatus (Goode & Bean, 1886)	picota jorobada	doublethread grenadier	610-1370
Hymenocephalus billsam Marshall & Iwamoto, 1973	picota de Bill-y-Sam	Bill-and-Sam's grenadier	400-900
Hymenocephalus italicus (Giglioli, 1884)	picota cabecihueca	glasshead grenadier	300-800
Malacocephalus occidentalis Goode & Bean, 1885	picota occidental	western softhead grenadier	150-590
Nezumia aequalis (Günther, 1878)	picota lisa	smooth grenadier	200-1000
Sphagemacrurus grenadae (Parr, 1946)	picota hocicuda	pugnose grenadier	860-1220
Trachonurus sulcatus (Goode & Bean, 1885)	picota surcada	sulcate grenadier	700-1500
Trachonurus villosus (Günther, 1877)	picota velluda	bristly grenadier	510-1470
Ventrifossa macropogon Marshall, 1973	picota barbuda	longbeard grenadier	450-640
Ventrifossa mucocephalus Marshall, 1973	picota cabecibabosa	slimehead grenadier	550-660
FAMILIA MORIDAE	BACALAITOS	CODLINGS	
Gadella imberbis (Vaillant, 1888)	bacalaíto imberbe	beardless codling	200-800
FAMILIA MERLUCCIIDAE	MERLUZAS	MERLUCIID HAKES	
Merluccius albidus (Mitchill, 1818)	merluza de afuera	offshore hake	80-1170
Steindachneria argentea Goode & Bean, 1896	merluza luminosa	luminous hake	400-500
ORDEN OPHIDIIFORMES	ANGUILITAS	CUSKEELS	
FAMILIA OPHIDIIDAE	ANGUILITAS	CUSKEELS	
Abyssobrotula galatheae Nielsen, 1977	brotula de abismos	abyssal brotula	3110-8370
Brotula barbata (Bloch & Schneider, 1801)	anguilita barbuda, brotula	bearded brotula	0-650

Holomycteronus profundissimus (Roule, 1913)	brotula de lo hondo	deepwater brotula	5600-7160
Lamprogrammus brunswigi (Brauer, 1906)	anguilita de Brunswig	Brunswig's cuskeel	0-1600
Lepophidium brevibarbe (Cuvier, 1829)	anguilita bordenegro	blackedge cuskeel	0-90
Lepophidium kallion Robins, 1959	anguilita escamuda	scaly cuskeel	350-520
Lepophidium pheromystax Robins, 1960	anguilita upsilón	upsilon cuskeel	50-125
Lepophidium profundorum (Gill, 1863)	anguilita bordenegro	blackrim cuskeel	55-365
Monomitopus agassizii (Goode & Bean, 1896)	anguilita cabeciescamuda	scalyhead cuskeel	48-1125,
Neobythites elongatus Nielsen & Retzer, 1994	anguilita larga	elongated cuskeel	230-1270
Neobythites gilli Goode & Bean, 1885	anguilita blanca	white cuskeel	60-230
Neobythites marginatus Goode& Bean, 1886	anguilita bordeada	margined cuskeel	75-935
Neobythites ocellatus Günther, 1887	anguilita pecosa	ocellated cuskeel	45-640
Neobythites unicolor Nielsen & Retzer, 1994	anguilita lisa	unicolor cuskeel	185-935
Ophidion holbrooki (Putnam, 1874)	anguilita rayada	band cuskeel	0-80
Otophidium omostigmum (Jordan & Gilbert, 1882)	anguilita manchada	polka-dot cuskeel	10-50
Penopus microphtalmus (Vaillant, 1888)	anguilita de abismos	abyssal cuskeel	2000-3500
Porogadus catena (Goode & Bean, 1885)	anguilita catenulada	chain cuskeel	1180-3500
Porogadus miles Goode & Bean, 1885	anguilita fina	slender cuskeel	1000-5500
Sirembo marmoratum (Goode & Bean, 1885)	anguilita cabeciescamuda	scalyhead cuskeel	155-525

FAMILIA CARAPIDAE — PECES PERLA — PEARLFISHES

Carapus bermudensis (Jones, 1874)	pez perla	pearlfish	0-235
Echiodon dawsoni William & Shipp, 1982	pez perla eslabonado	chain pearlfish	20-180
Snyderidia canina Gilbert, 1905	pez perla ojón	bigeye pearlfish	110-1500

FAMILIA BYTHITIDAE — BROTULAS — VIVIPAROUS BROTULAS

Calamopteryx goslinei Böhlke & Cohen, 1966	brotula aletilarga	longarm brotula	10-40

FAMILIA APHYONIDAE — AFIONIDOS — APHYONIDS

Barathronus bicolor Goode & Bean, 1886	afiónido bicolor	bicolor aphyonid	549-1561

ORDEN BATRACHOIDIFORMES — SAPOS — TOADFISHES

FAMILIA BATRACHOIDIDAE	SAPOS	TOADFISHES	
Batrachoides surinamensis (Bloch & Schneider, 1801)[11]	sapo de Pacuma	Pacuma toadfish	0-36
ORDEN LOPHIIFORMES	PESCADORES	ANGLERFISHES	
FAMILIA LOPHIIDAE	RAPES	GOOSEFISHES	
Lophiodes beroe Caruso, 1981	rape de Beroe, ganso	Beroe's goosefish	347-860
Lophiodes reticulatus Caruso & Suttkus, 1979	rape manchado, ganso	reticulate goosefish	64-820
Lophius gastrophysus Miranda Ribeiro, 1915	rape aletinegro, ganso	blackfin goosefish	40-700
FAMILIA ANTENARIIDAE	PECES RANA	FROGFISHES	
Antennarius bermudensis Schultz, 1957	pez rana isleño, pescador, sapo	island frogfish	4-30
Antennarius multiocellatus (Valenciennes, 1837)	martín pescador, sapo, pez rana	longlure frogfish	0-66
Antennarius ocellatus (Bloch & Schneider, 1801)	pez rana manchado, sapo	ocellated frogfish	1-150
Antennarius pauciradiatus Schultz, 1957	sapito, pescador, pez rana	dwarf frogfish	6-80
Antennarius pictus (Shaw, 1794)	pez rana pintado, sapo	painted frogfish	0-75
Antennarius striatus (Shaw & Nodder, 1794)	pez rana rayado, sapo, murciélago	striated frogfish	10-219
FAMILIA CHAUNACIDAE	BOSTEZADORES	SEA TOADS	
Chaunax pictus Lowe, 1846	bostezador sonrojado	rosy frogmouth	200-760
Chaunax suttkusi Caruso, 1989	bostezador rosado	pink frogmouth	220-1060
FAMILIA OGCOCEPHALIDAE	DIABLOS	BATFISHES	
Dibranchus atlanticus Peters, 1876	diablo del Atlántico	Atlantic batfish	45-1260

Halieutichthys aculeatus (Mitchill, 1818)	diablo aplastado	pancake batfish	45-820
Halieutichthys caribbaeus Garman, 1896	diablo caribeño	Caribbean pancake batfish	
Malthopsis gnoma Bradbury, 1998	diablo hocicudo	pugnose batfish	91-475
Ogcocephalus corniger Bradbury, 1980	diablo cornudo, murciélago	longnose batfish	30-230
Ogcocephalus nasutus (Valenciennes, 1837)	diablo carichato, murciélago	shortnose batfish	0-280
Ogcocephalus parvus Longley & Hildebrand, 1940	diablo espinoso	roughback batfish	50-130
Ogcocephalus pumilus Bradbury, 1980	diablito	dwarf batfish	35-348
Ogcocephalus radiatus (Mitchill, 1818)	diablo moteado	polka-dot batfish	0-70
Ogcocephalus vespertilio (Linnaeus, 1758)	diablo hocicudo caribeño	Caribbean longnose batfish	
Zalieutes mcgintyi (Fowler, 1952)	diablo tricornio	tricorn batfish	90-180
FAMILIA MELANOCETIDAE	DIABLILLOS PRIETOS	BLACK SEADEVILS	
Melanocetus murrayi Günther, 1887	diablillo de Murray	Murray's abyssal anglerfish	
FAMILIA ONEIRODIDAE	SOŇADORES	DREAMERS	
Oneirodes macronema (Regan & Trewavas, 1932)	soñador	dreamer	350
FAMILIA CERATIIDAE	DIABLILLOS	SEADEVILS	
Ceratias uranoscopus Murray, 1877	diablillo mirón	stargazing seadevil	0-2091
FAMILIA LINOPHRYNIDAE	DEMONIOS DE MAR	LEFTVENTS	
Linophryne arborifera Regan 1925	demonio ramillete	branched leftvent	
ORDEN GOBIESOCIFORMES	RENACUAJOS	CLINGFISHES	
FAMILIA GOBIESOCIDAE	RENACUAJOS	CLINGFISHES	
Derilissus altifrons Smith-Vaniz, 1971	renacuajo cabezón	bighead clingfish	68-69

ORDEN STEPHANOBERYCIFORMES	ESPINOSOS	PRICKLEFISHES	
FAMILIA STEPHANOBERYCIDAE	ESPINOSOS	PRICKLEFISHES	
Achantochaenus luetkenii Gill, 1884	espinoso aletiblando	softfin pricklefish	2700-5320
Stephanoberyx monae Gill, 1883	espinoso de Mona	Mona pricklefish	945-4777
FAMILIA MELAMPHAIDAE	CABECIPLEGADOS	RIDGEHEADS	
Melamphaes longivelis Parr, 1933	cabeciplegado de vela	sailfin ridgehead	150-500
Melamphaes polylepis Ebeling, 1962	cabeciplegado multialetas	manyfinned ridgehead	200-2250
Melamphaes pumilus Ebeling, 1962	cabeciplegado pigmeo	pigmy ridgehead	50-400
Melamphaes suborbitalis (Gill, 1883)	cabeciplegado suborbital	suborbital ridgehead	150-500
Melamphaes typhlops (Lowe, 1843)	cabeciplegado ojimanchado	darkeye ridgehead	50-600
Scopelogadus mizolepis (Günther, 1878)	cabeciplegado ojón	bigeye ridgehead	50-500
FAMILIA GIBBERICHTHYIDAE	VERRUGOSOS	GIBBERFISHES	
Gibberichthys pumilus Parr, 1933	verrugoso	pigmy gibberfish	320-200
ORDEN BERYCIFORMES	ALFONSINOS	ALFONSINOS	
FAMILIA TRACHICTHYIDAE	CUERIDUROS	ROUGHIES	
Gephyroberyx darwinii (Johnson, 1866)	cueriduro grande	big roughy	9-1000
Hoplostethus atlanticus Collett, 1896	cueriduro naranja	orange roughy	480-1020
Hoplostethus mediterraneus Cuvier, 1829	cueriduro plateado	silver roughy	350-1040
FAMILIA ANOMALOPIDAE	PECES LINTERNA	FLASHLIGHTFISHES	
Kryptophanaron alfredi Silvester & Fowler, 1926	pez linterna	Atlantic flashlightfish	20-200

FAMILIA DIRETMIDAE	ALETIESPINOSOS	SPINYFINS	
Diretmichthys parini (Post & Quéro, 1981)	aletiespinoso prieto	black discfish	0-2000
Diretmoides pauciradiatus (Woods, 1973)	aletiespinoso aletilargo	longwing spinyfin	320-800
Diretmus argenteus Johnson, 1864	aletiespinoso plateado	silver spinyfin	0-2000
FAMILIA ANOPLOGASTERIDAE	COLMILLUDOS	FANGTOOTHS	
Anoplogaster brachycera Kotlyar, 1986	colmilludo cornudo	shorthorn fangtooth	1000-1500
Anoplogaster cornuta (Valenciennes, 1833)	colmilludo	common fangtooth	50-5360
FAMILIA BERYCIDAE	ALFONSINOS	ALFONSINOS	
Beryx decadactylus Cuvier, 1829	alfonsino colorado	red bream	150-800
Beryx splendens Lowe, 1834	alfonsino espléndido	splendid alfonsino	25-2000
FAMILIA HOLOCENTRIDAE	GALLOS	SQUIRRELFISHES	
Corniger spinosus Agassiz, 1829	gallo espinoso	spinycheek soldierfish	40-280
Holocentrus adscensionis (Osbeck, 1765)	gallo, candil, candelero, gallito,	squirrelfish	0-240
Holocentrus rufus (Walbaum, 1792)	candil, gallito, chillo de rocas	longspine squirrelfish	0-330
Myripristis jacobus (Cuvier, 1829)	toro, torito, cundeamor, gallito	blackbar soldierfish	0-210
Neoniphon marianus (Cuvier, 1829)	gallo bocón	longjaw squirrelfish	0-120
Ostichthys trachypoma (Günther, 1859)	gallo ojón	bigeye soldierfish	10-550
Plectrypops retrospinis (Guichenot, 1853)	gallo cardenal	cardinal soldierfish	2-240
Sargocentron bullisi (Woods, 1955)	gallo de altura	deepwater squirrelfish	30-120
Sargocentron coruscum (Poey, 1860)	gallo de arrecifes	reef squirrelfish	0-100
Sargocentron poco (Woods, 1965)	gallo ensillado	saddle squirrelfish	0-30
ORDEN CETOMIMIFORMES	BALLENATOS	WHALEFISHES	
FAMILIA CETOMIMIDAE	BALLENATOS	WHALEFISHES	
Ditropichthys storeri (Goode & Bean, 1895)	ballenato tropical	tropical whalefish	0-650

ORDEN ZEIFORMES	DORIOS	DORIES	
FAMILIA PARAZENIDAE	DORIOS FINOS	SLENDER DORIES	
Cyttopsis rosea (Goode & Bean, 1896)	dorio colorado	red dory	200-690
Parazen pacificus Kamohara, 1935	parazén	parazen	145-500
FAMILIA ZEIDAE	DORIOS	DORIES	
Zenion hololepis Goode & Bean, 1896	dorio envuelto	John dory	200-500
FAMILIA CAPROIDIDAE	MARRANOS	BOARFISHES	
Antigonia capros Lowe, 1843	cabrito	deepbody boarfish	60-400
Antigonia combatia Berry & Rathjen, 1959	marrano	shortspine boarfish	120-600
ORDEN SYNGNATHIFORMES	PECES FLAUTA	PIPEFISHES	
FAMILIA FISTULARIIDAE	CORNETAS	CORNETFISHES	
Fistularia petimba Lacepède, 1803	corneta colorada, trompetero	red cornetfish	10-200
Fistularia tabacaria Linnaeus, 1758	corneta verde, trompetero	bluespotted cornetfish	0-200
FAMILIA CENTRISCIDAE	PECES TIRADORES	SNIPEFISHES	
Macroramphosus scolopax (Linnaeus, 1758)	pez tirador	longspine snipefishes	60-280
FAMILIA SYNGNATHIDAE	PECES FLAUTA	PIPEFISHES	
Cosmocampus albirostris (Kaup, 1856)	pez flauta hocicoblanco	whitenose pipefish	C, B, 0-50
Cosmocampus profundus (Herald, 1965)	flautín de lo hondo	deepwater pipefish	180-270

ORDEN SCORPAENIFORMES	RASCANAS	SCORPIONFISHES	
FAMILIA SCORPAENIDAE	RASCANAS	SCORPIONFISHES	
Ectreposebastes imus Garman, 1899	rascana pelágica, rascacio	pelagic scorpionfish	150-2000
Neomerinthe beanorum (Evermann & Marsh, 1970)	rascana de lo hondo, rascacio	deepwater scorpionfish	92-375
Pontinus castor Poey, 1860	rascana hocicuda, rascacio	longsnout scorpionfish	32-549
Pontinus longispinis Goode & Bean, 1896	rascana de hebra, rascacio	longspine scorpionfish	70-440
Pontinus nematophthalmus (Günther, 1860)	rascana pechipuyúa, rascacio	spinythroat scorpionfish	80-410
Scorpaena agassizii Goode & Bean, 1896	rascana aletilarga, rascacio	longfin scorpionfish	40-280
Scorpaena albifimbria Evermann & Marsh, 1900	rascana coralina, rascacio	coral scorpionfish	0-40
Scorpaena bergii Evermann & Marsh, 1900	rascana cabezona, rascacio	goosehead scorpionfish	0-80
Scorpaena brasiliensis Cuvier, 1829	rascana barbuda, rascacio	barbfish	1-100
Scorpaena calcarata Goode & Bean, 1882	rascana calva, rascacio	smoothhead scorpionfish	0-90
Scorpaena elachys Eschmeyer, 1965	rascana enana, rascacio	dwarf scorpionfish	36-90
Scorpaena inermis Cuvier, 1829	rascana seta, rascacio	mushroom scorpionfish	1-73
Scorpaena isthmensis Meek & Hildebrand, 1928	rascana caretona, rascacio	smoothcheek scorpionfish	0-110
Scorpaena plumieri Bloch, 1789	rascana moteada, rascacio, rascaso,	spotted scorpionfish	1-60
FAMILIA TRIGLIDAE	GALLINAS DE MAR	SEAROBINS	
Bellator militaris (Goode & Bean, 1896)	gallina cornuda, rubio	horned searobin	40-110
FAMILIA PERISTEDIIDAE	RUBIOS ARMADOS	ARMORED GURNARDS	
Peristedion gracile Goode & Bean, 1896	rubio delgado	slender searobin	30-480
Peristedion imberbe (Poey, 1861)	rubio liso	smooth searobin	247-274
Peristedion longispatha (Goode & Bean, 1886)	rubio espátula	spatula searobin	
Peristedion platycephalum Goode & Bean, 1896	rubio cabecichato	flatheadsearobin	0-246
Prionotus ophryas Jordan & Swain, 1884	rubio colilistado	bandtail searobin	1-171
Prionotus punctatus (Bloch, 1797)	rubio moteado	bluewing searobin	0-190
ORDEN PERCIFORMES	PERCAS	PERCHES	
FAMILIA ACROPOMATIDAE	GUASETAS BARRIGONAS	LANTERNBELLIES	

Synagrops bellus (Goode & Bean, 1896)	guaseta boquinegra	blackmouth bass	60-1000
Synagrops pseudomicrolepis Schultz, 1940	guaseta aletichica	false smallfin bass	180-576
Synagrops trispinosus Mochizuki & Sana, 1984	guaseta triespinosa	threespine bass	36-550
Verilus sordidus Poey, 1860	berregüello	black virilus	100-600
FAMILIA SERRANIDAE	MEROS	SEA BASSES	
Alphestes afer (Bloch, 1793)	guaseta, aceituna, mantequilla	mutton hamlet	2-30
Anthias tenuis Nichols, 1920	guaseta hocicorayada	threadnose bass	
Bathyanthias cubensis (Schultz, 1958)	guaseta chillito	Cuban deepwater bass	366-412
Bathyanthias mexicana (Schultz, 1958)	guaseta coliamarilla	yellowtail bass	70-135
Bullisichthys caribbaeus Rivas, 1971	mero hocicudo	pugnose bass	0-300
Cephalopholis cruentata (Lacepède, 1802)	cherna enjambre, cabrilla	graysby	0-170
Cephalopholis fulva (Linnaeus, 1758)	mero mantequilla, cherna cabrilla,	coney	0-240
Dermatolepis inermis (Valenciennes, 1833)	boricua	marbled grouper	0-213
Diplectrum bivittatum (Valenciennes, 1828)	aguavinita	dwarf sand perch	0-100
Diplectrum formosum (Linnaeus, 1766)	aguavina arenera	sand perch	0-80
Epinephelus adscensionis (Osbeck, 1765)	cabra mora	rock hind	1-120
Epinephelus flavolimbatus Poey, 1865	guasa aletiamarilla	yellowedge grouper	64-275
Epinephelus guttatus (Linnaeus, 1758)	mero cabrilla, mero cherna,	red hind	0-200
Epinephelus itajara (Lichtenstein, 1822)	mero batata, mero grande, mero sapo,	jewfish	0-100
Epinephelus morio (Valenciennes, 1828)	mero guasa, cherna americana,	red grouper	5-300
Epinephelus mystacinus (Poey, 1852)	guasa, mero listado, cherna	misty grouper	30-400
Epinephelus niveatus (Valenciennes, 1828)	guasa blanca, cherna pintada	snowy grouper	30-525
Epinephelus striatus (Bloch, 1792)	cherna criolla, camaleón	Nassau grouper	0-140
Gonioplectrus hispanus (Cuvier, 1828)	pabellón, bandera española	Spanish flag	35-460
Hemanthias aurorubens (Longley, 1935)	guaseta timón	streamer bass	120-610
Hypoplectrus gummigutta (Poey, 1851)	vaca dorada	golden hamlet	1-45
Hypoplectrus guttavarius (Poey, 1852)	vaca tímida	shy hamlet	3-30
Hypoplectrus indigo (Poey, 1857)	vaca añil	indigo hamlet	3-45
Liopropoma carmabi (Randall, 1963)	guaseta listada, merito dulce	candy basslet	10-70
Liopropoma mowbrayi Woods & Kanazawa, 1951	guaseta jorobada	cave bass	30-110
Liopropoma rubre Poey, 1861	guaseta menta	peppermint bass	0-45
Mycteroperca acutirostris (Valenciennes, 1828)	guajil espinoso, gitano	western comb grouper	3-40
Mycteroperca bonaci (Poey, 1860)	guajil prieto, aguajil, bonací, bonasí	black grouper	6-33
Mycteroperca interstitialis (Poey, 1860)	guajil boquiamarillo, bacalao	yellowmouth grouper	0-450
Mycteroperca microlepis (Goode & Bean, 1879)[12]	guajil aletichico	gag	0-152

Mycteroperca phenax Jordan & Swain, 1884[13]	abadejo	scamp	0-100
Mycteroperca tigris (Valenciennes, 1833)	diente de sable, guajil pinto, mero pinto	tiger grouper	0-100
Mycteroperca venenosa (Linnaeus, 1758)	guajil colirrubio, mero pinto	yellowfin grouper	0-137
Paralabrax dewegeri (Metzelaar, 1919)	guaseta vieja	vieja	0-50
Paranthias furcifer (Valenciennes, 1828)	chilla rubia, rabirrubia de lo alto	creole-fish	8-240
Parasphyraenops incisus (Colin, 1978)	guaseta rayada	two-stripe bass	30-60
Pseudogramma gregoryi (Breder, 1927)	jaboncillo de arrecifes	reef bass	0-61
Rypticus saponaceus (Schneider, 1801)	jabón, jaboncillo	greater soapfish	0-60
Rypticus subbifrenatus (Gill, 1861)	jaboncillo manchado	spotted soapfish	0-30
Schultzea beta (Hildebrand, 1940)	guaseta de cardúmenes	school bass	10-120
Serraniculus pumilio Ginsburg, 1952	merito	pigmy sea bass	0-50
Serranus annularis (Günther, 1880)	guaseta lomonaranja	orangeback bass	10-80
Serranus atrobranchus (Cuvier, 1829)	guaseta raya negra	blackear bass	10-219
Serranus baldwini (Evermann & Marsh, 1900)	guaseta lámpara	lantern bass	0-80
Serranus chionaraia (Robins & Starck, 1961)	guaseta panza parda	snow bass	40-90
Serranus flaviventris (Cuvier, 1829)	guaseta colimanchada	twospot bass	2-402
Serranus luciopercanus Poey, 1852	guaseta brillante	bright bass	70-300
Serranus notospilus Longley, 1935	guaseta parda	saddle bass	70-270
Serranus phoebe Poey, 1852	guaseta blanca	tattler	15-400
Serranus tabacarius (Cuvier, 1829)	chilla negra, guaseta negra	tobaccofish	0-240
Serranus tigrinus (Bloch, 1790)	guaseta arlequín	harlequin bass	0-40
Serranus tortugarum Longley, 1935	guaseta terrosa	chalk bass	10-660
FAMILIA SYMPHYSANODONTIDAE	GUASETAS DE LO HONDO	SLOPE BASSES	
Symphysanodon berryi Anderson, 1970	guaseta de lo hondo	slope bass	220-476
Symphysanodon mona Anderson & Springer, 2005	guaseta de lo hondo de Mona	Akarnax's slopefish	
FAMILIA GRAMMATIDAE	CHERNITAS	BASSLETS	
Gramma linki Starck & Colin, 1978	chernita raya amarilla	yellowlined basslet	20-130
Gramma loreto Poey, 1868	gramma, chernita bicolor	royal gramma	0-70
Lipogramma evides Robins & Colin, 1979	chernita banda negra	banded basslet	45-370
Lipogramma klayi Randall, 1963	chernita bicolor	bicolor basslet	45-145
Lipogramma regium Robins & Colin, 1979	chernita real	royal basslet	45-95
Lipogramma roseum Gilbert, 1979	chernita rosada	rosy basslet	5-45
Lipogramma trilineatum Randall, 1963	chernita rayada	threelined basslet	5-95
FAMILIA OPISTOGNATHIDAE	QUIJADAS	JAWFISHES	

Lonchopistus lemur (Myers, 1935)	quijada ojona	lemur jawfish	0-200
Opistognathus aurifrons (Jordan & Thompson, 1905)	quijada cabecirrubia	yellowhead jawfish	3-40
Opistognathus leprocarus Smith-Vaniz, 1997	guijada verrugosa	roughcheek jawfish	165-308
FAMILIA PRIACANTHIDAE	OJOBUEYES	BIGEYES	
Cookeolus japonicus (Cuvier, 1829)	ojobuey	bulleye	40-400
Heteropriacanthus cruentatus (Lacepède, 1801)	toro, catalufa, payaso, cómico,	glasseye snapper	0-300
Priacanthus arenatus Cuvier, 1829	rey, sol, payaso, ojobuey, cómico,	bigeye	0-200
Pristigenys alta (Gill, 1862)	ojitobuey	short bigeye	0-630
FAMILIA APOGONIDAE	CARDENALES	CARDINALFISHES	
Apogon affinis (Poey, 1875)	cardenal dientudo	bigtooth cardinalfish	20-300
Apogon americanus Castelnau, 1855[14]	cardinal candela del sur	Brazilian flamefish	0-50
Apogon aurolineatus (Mowbray, 1927)	cardenal pardo	bridle cardinalfish	0-80
Apogon binotatus (Poey, 1867)	cardenal mancha negra	barred cardinalfish	0-60
Apogon evermanni Jordan & Schneider, 1904	cardenal escamudo	oddscale cardinalfish	3-69
Apogon lachneri (Böhlke, 1959)	cardenal mancha blanca	whitestar cardinalfish	5-70
Apogon maculatus (Poey, 1860)	cardenal candela	flamefish	0-128
Apogon phenax Böhlke & Randall, 1968	cardenal mimo	mimic cardinalfish	0-50
Apogon pillionatus Böhlke & Randall, 1968	cardenal rabinegro	broadsaddle cardinalfish	10-90
Apogon planifrons Longley & Hildebrand, 1940	cardenal claro	pale cardinalfish	0-30
Apogon pseudomaculatus Longley, 1932	cardenal dosmanchas	twospot cardinalfish	1-100
Apogon quadrisquamatus Longley, 1934	cardenal rayado	sawcheek cardinalfish	0-75
Apogon townsendi (Breder, 1927)	cardenal listado	belted cardinalfish	0-60
Astrapogon stellatus (Cope, 1869)	cardenal carruchero	conchfish	1-40
Phaeoptyx conklini (Silvester, 1916)	cardenal moteado	freckled cardinalfish	0-30
Phaeoptyx pigmentaria (Poey, 1860)	cardenal prieto	dusky cardinalfish	0-50
Phaeoptyx xenus (Böhlke & Randall, 1968)	cardenal de esponjas	sponge cardinalfish	0-60
FAMILIA EPIGONIDAE	CARDENALES DE LO HONDO	DEEPWATER CARDINALFISHES	
Brinkmannella elongata Parr, 1933	cardenal largo	elongated cardinalfish	
Sphyraenops bairdianus Poey, 1861	cardenal picúa	barracuda cardinalfish	200-1750
FAMILIA MALACANTHIDAE	JOLOCHOS	TILEFISHES	
Caulolatilus chrysops (Valenciennes, 1833)	jolocho caridorado	goldface tilefish	76-244
Caulolatilus cyanops Poey, 1866	domingo, limosnero, tremba, blanquillo	blackline tilefish	45-495
Malacanthus plumieri (Bloch, 1787)	jolocho, jorocho, matajuelo blanco	sand tilefish	0-153

[14] Esta especie sudamericana fue reportada en 1845 de St. Croix.

FAMILIA SCOMBROPIDAE	GNOMOS	GNOMEFISHES	
Scombrops boops (Houttuyn, 1782)[15]	gnomo	gnomefish	20-400
Scombrops oculatus (Poey, 1860)	gnomo ojón	Atlantic scombrops	200-610
FAMILIA RACHYCENTRIDAE	COBIAS	COBIAS	
Rachycentron canadum (Linnaeus, 1766)	bacalao, cobia	cobia	0-1200
FAMILIA ECHENEIDAE	PEGAS	REMORAS	
Echeneis naucrates Linnaeus, 1758	pegador, pega, rémora	sharksucker	20-50
FAMILIA CARANGIDAE	JURELES	JACKS	
Alectis ciliaris (Bloch, 1787)	corcobado de pluma, pámpano, sol,	African pompano	0-100
Carangoides bartholomaei (Cuvier, 1833)	guaymen amarillo, cojinúa amarilla,	yellow jack	0-50
Carangoides ruber (Bloch, 1793)	guaymen blanco, cojinúa blanca, chibí,	bar jack	0-100
Caranx crysos (Mitchill, 1815)	cojinúa, medregal, güira, chibí, cibí,	blue runner	0-100
Caranx hippos (Linnaeus, 1766)	jurel	crevalle jack	1-350
Caranx latus Agassiz, 1831	jurel ojón, cojobeo, ojobuey, tiñosa	horse-eye jack	0-140
Caranx lugubris Poey, 1860	jurel negrón, jurel negro	black jack	12-380
Caranx sexfasciatus Quoy & Gaimard, 1825	jurel ojicolorado	bigeye trevally	0-96
Chloroscombrus chrysurus (Linnaeus, 1766)	casabe, bagre, chicharra	Atlantic bumper	0-55
Decapterus macarellus (Cuvier, 1833)	caballa azul, chicharra	mackerel scad	0-200
Decapterus punctatus (Cuvier, 1829)	caballa amarilla, quía-quía, chicharra	round scad	0-100
Decapterus tabl Berry, 1968	caballa colicolorada	redtail scad	0-400
Elagatis bipinnulata (Quoy & Gaimard, 1824)	salmón	rainbow runner	0-150
Naucrates ductor (Linnaeus, 1758)	pez piloto	pilotfish	0-30
Pseudocaranx dentex (Bloch & Schneider, 1801)	jurel dientudo	white trevally	10-200
Selar crumenophthalmus (Bloch, 1793)	chicharro	bigeye scad	0-170
Selene dorsalis (Gill, 1863)[16]	corcobado africano	African moonfish	20-100
Selene setapinnis (Mitchill, 1815)	corcobado	Atlantic moonfish	0-55
Selene vomer (Linnaeus, 1758)	coronado, jorobado	lookdown	1-53
Seriola dumerili (Risso, 1810)	medregal	greater amberjack	0-750
Seriola fasciata (Bloch, 1797)	boquerón, medregal	lesser amberjack	55-349
Seriola rivoliana Valenciennes, 1833	escolar, medregal	almaco jack	0-245
Trachinotus carolinus (Linnaeus, 1766)	pámpano	Florida pompano	0-70

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[16] Esta especie del Atlántico oriental fue reportada en el siglo 19 de Islas Vírgenes y a principios del siglo 20 de Cuba y Puerto Rico. La especie se parece tanto a *Selene setapinnis* (Mitchill, 1815) que algunos investigadores sostienen que constituyen la misma especie y de ahí pudieran haber surgido reportes equivocados.

Trachinotus falcatus (Linnaeus, 1758)	pámpano jorobado	permit	0-36
Uraspis secunda (Poey, 1860)	carangue, jurel chiringa	cottonmouth jack	1-36
FAMILIA CORYPHAENIDAE	DORADOS	DOLPHINFISHES	
Coryphaena equiselis Linnaeus, 1758	doradito, tablita	pompano dolphin	
Coryphaena hippurus Linnaeus, 1758	dorado, tabla	dolphin	0-85
FAMILIA BRAMIDAE	PECHUGONES	POMFRETS	
Brama caribbea Mead, 1972	pechugón caribeño	Caribbean pomfret	0-800
Eumegistus brevorti (Poey, 1860)	pechugón de lo alto	tropical pomfret	190-1317
Pterycombus brama Fries, 1837	pechugón del Atlántico	Atlantic fanfish	25-400
FAMILIA LUTJANIDAE	PARGOS	SNAPPERS	
Apsilus dentatus Guichenot, 1853	chopa negra, pargo mulato, arnillo	black snapper	40-300
Etelis coruscans Valenciennes, 1862[17]	pargo encendido	flame snapper	90-400
Etelis oculatus (Valenciennes, 1828)	cachucho, cartucho	queen snapper	0-490
Lutjanus analis (Cuvier, 1828)	sama, pargo cebadal, pargo criollo	mutton snapper	25-95
Lutjanus apodus (Walbaum, 1892)	pargo amarillo, pargo rubio, cají,	schoolmaster	0-100
Lutjanus buccanella (Cuvier, 1828)	negra, alinegra, sesí	blackfin snapper	0-380
Lutjanus campechanus (Poey, 1860)	pargo colorado	red snapper	10-190
Lutjanus cyanopterus (Cuvier, 1828)	pargo mulato, pargo guacinuco,	cubera snapper	10-60
Lutjanus griseus (Linnaeus, 1758)	pargo prieto, pargo mulato,	gray snapper	1-180
Lutjanus mahogoni (Cuvier, 1828)	arrayado de yerbas, pargo ojón,	mahogany snapper	0-120
Lutjanus purpureus Poey, 1867[18]	chillo escamudo, pargo colorado,	Caribbean red snapper	26-340
Lutjanus synagris (Linnaeus, 1758)	arrayado, rayado, manchego,	lane snapper	10-400
Lutjanus vivanus (Cuvier, 1828)	chillo, pargo colorado, pargo de lo alto	silk snapper	90-380
Ocyurus chrysurus (Bloch, 1791)	colirrubia, rabirrubia	yellowtail snapper	0-180
Pristipomoides aquilonaris (Goode & Bean, 1896)	muniama de afuera	wenchman	24-370
P. macrophthalmus (Müller & Troschel,1848)	muniama ojona de afuera, voraz	cardinal snapper	110-550
Rhomboplites aurorubens (Cuvier, 1829)	besugo, buchona, chilla rubia,	vermillion snapper	40-300
FAMILIA LOBOTIDAE	VIAJACAS	TRIPLETAILS	
Lobotes surinamensis (Bloch, 1790)	viajaca, macurí, pez hoja, chopa,	Atlantic tripletail	
FAMILIA GERREIDAE	MOJARRAS	MOJARRAS	
Diapterus rhombeus (Cuvier, 1830)	mojarreta, mojarra	rhomboid mojarra	9-70
Eucinostomus gula (Quoy & Gaimard, 1824)	blanquilla	silver jenny	0-55
Eucinostomus havana (Nichols, 1912)	mojarra ojona, muniama	bigeye mojarra	0-45

FAMILIA HAEMULIDAE	RONCOS	GRUNTS	
Anisotremus surinamensis (Bloch, 1790)	vieja, pompón	black margate	0-100
Anisotremus virginicus (Linnaeus, 1758)	canario, catalineta, cicí, catalino,	porkfish	0-100
Conodon nobilis (Linnaeus, 1758)	berraco, bureteado	barred grunt	0-100
Haemulon album Cuvier, 1830	viuda, viejo blanco, vallao, vieja,	margate	0-110
Haemulon aurolineatum Cuvier, 1830	mulita, mula, jeniguana, saboga	tomtate	0-30
Haemulon bonariense Cuvier, 1830	ronco prieto, arrayado, ponce prieto,	black grunt	
Haemulon flavolineatum (Desmarest, 1823)	condenado, cachicata	French grunt	0-60
Haemulon macrostomum Günther, 1859	colombiano, muniama, corocoro,	Spanish grunt	5-25
Haemulon melanurum (Linnaeus, 1758)	jeniguana, jeniagua, jenigua, jeniguano	cottonwick	0-50
Haemulon parra (Desmarest, 1823)	roncador, arrayado, ronco blanco,	sailor's choice	3-30
Haemulon plumierii (Lacepède, 1801)	boquicolorado, cachicata, cicí, arará,	white grunt	0-40
Haemulon sciurus (Shaw, 1803)	ronco amarillo, cachicata,	bluestriped grunt	0-100
Haemulon steindachneri (Jordan & Gilbert, 1882)[19]	cherchere, ronco rayado	Latin grunt	0-50
Haemulon striatum (Linnaeus, 1758)	ronco listado	striped grunt	0-100
Orthopristis ruber (Cuvier & Valenciennes, 1830)	ronco manchado	spotted pigfish	1-70
Pomadasys corvinaeformis (Steindachner, 1868)	viejo espinoso, roncador	roughneck grunt	26-50
Pomadasys crocro (Cuvier, 1830)	viejo, ronco blanco, burro	burro grunt	0-120
FAMILIA INERMIIDAE	BOGAS	BONNETMOUTHS	
Emmelichthyops atlanticus Schultz, 1945	boguita	bonnetmouth	0-120
Inermia vittata Poey, 1861	boga	boga	0-50
FAMILIA SPARIDAE	PLUMAS	PORGIES	
Archosargus rhomboidalis (Linnaeus, 1758)	chopa amarilla, cagona	sea bream	0-50
Calamus bajonado (Schneider, 1801)	bajonado, bajonao, pluma, caricacha	jolthead porgy	0-200
Calamus calamus (Valenciennes, 1830)	pluma ojona	saucereye porgy	0-130
Calamus penna (Valenciennes, 1830)	pluma bocona	sheepshead porgy	0-130
Calamus pennatula Guichenot, 1868	pluma caribeña	West Indian porgy	0-140
Calamus proridens Jordan & Gilbert, 1884	pluma jorobada	littlehead porgy	0-85
Pagrus pagrus (Linnaeus, 1758)[20]	besugo	common seabream	0-250
FAMILIA SCIAENIDAE	CORVINAS	CROAKERS	
Bairdiella ronchus (Cuvier, 1830)	corvina tambor, ronco, corvino	ground croaker	16-40
Bairdiella sanctaeluciae (Jordan, 1890)	corvina rayada, corvino	striped croaker	0-35
Cynoscion microlepidotus (Cuvier, 1830)	guinea lisa, corvina, corvino	smallscale weakfish	0-30

Cynoscion jamaicensis (Vaillant & Boucourt, 1883)	guinea dientona, corvina, corvino,	southern weakfish	0-60
Equetus lanceolatus (Linnaeus, 1758)	verdugo, guapena, serrana	jackknife-fish	0-60
Equetus punctatus (Schneider, 1801)	verdugo moteado, guinea	spotted drum	0-30
Larimus breviceps (Cuvier, 1830)	corvina cabezona, corvino	shorthead drum	0-60
Leiostomus xanthurus Lacèpede, 1802	corvina amarilla, corvino	spot	0-60
Menticirrhus americanus (Linnaeus, 1758)	lambe de caletas	southern kingfish	0-40
Micropogonias furnieri (Desmarest, 1823)	burro, corvina boquiblanca, verrugato,	whitemouth croaker	0-60
Micropogonias undulatus (Linnaeus, 1766)	corvina ondulada, corvino, roncadina	Atlantic croaker	0-100
Odontoscion dentex (Cuvier, 1830)	corvina de arrecifes, corvino	reef croaker	1-30
Pareques umbrosus Jordan & Eigenmann, 1889	verdugo prieto	cubbyu	0-100
Protosciaena trewavasae (Chao & Miller, 1975)	corvina colombiana, corvino	New Granada's drum	70-394
Stellifer stellifer (Bloch, 1790)	guineíllla, corvina, corvino	small drum	0-35
FAMILIA POLYNEMIDAE	BARBUDOS DE HEBRA	THREADFINS	
Polydactylus virginicus (Linnaeus, 1758)	barbú, barbudo	barbu	0-55
FAMILIA MULLIDAE	SALMONETES	GOATFISHES	
Mulloidichthys martinicus (Cuvier, 1839)	salmonete amarillo, chopa	yellow goatfish	0-49
Mullus auratus Jordan & Gilbert, 1882	salmonete colorado	red goatfish	0-100
Pseudupeneus maculatus (Bloch, 1793)	salmonete moteado	spotted goatfish	0-110
Upeneus parvus Poey, 1853	salmonete enano	dwarf goatfish	10-112
FAMILIA PEMPHERIDAE	BARRIGONES	SWEEPERS	
Pempheris schomburgkii Müller & Troschel, 1848	barrigón clareado, barredor	glassy sweeper	0-30
FAMILIA BATHYCLUPEIDAE	ARENQUES DE LO HONDO	DEEPSEA HERRINGS	
Bathyclupea argentea Goode & Bean, 1896	arenque plateado	silver deepsea herring	0-668
Bathyclupea schroederi Dick, 1962	arenque de Schroeder	Schroeder's deepsea herring	512-513
FAMILIA KYPHOSIDAE	CHOPAS DE MAR	SEA CHUBS	
Kyphosus sectator (Linnaeus, 1758)	chopa blanca	Bermuda chub	0-30
FAMILIA CHAETODONTIDAE	MARIPOSAS	BUTTERFLYFISHES	
Chaetodon capistratus Linnaeus, 1758	mariposa, parché	foureye butterflyfish	0-100
Chaetodon ocellatus Bloch, 1787	mariposa manchada, parché	spotfin butterflyfish	0-200
Chaetodon sedentarius Poey, 1860	mariposa de arrecifes	reef butterflyfish	0-150
Chaetodon striatus Linnaeus, 1758	mariposa rayada	banded butterflyfish	0-200
Prognathodes aculeatus (Poey, 1860)	mariposa hocicuda	longsnout butterflyfish	0-380
Prognathodes guyanensis (Durand, 1960)	mariposa blanquinegra	French butterflyfish	0-380
FAMILIA POMACANTHIDAE	ISABELITAS	ANGELFISHES	

Centropyge argi Woods & Kanazawa, 1951	querubín, ángel, isabelita	cherubfish	0-300
Centropyge aurantonotus Burgess, 1974[21]	isabelita dorsoamarilla, ángel	flameback angelfish	12-200
Holacanthus bermudensis Goode, 1876	isabelita azul	blue angelfish	0-92
Holacanhus ciliaris (Linnaeus, 1758)	isabelita, angel reina, mariposa	queen angelfish	0-140
Holacanthus tricolor (Bloch, 1795)	isabelita medioluto, palometa,	rock beauty	0-140
Pomacanthus arcuatus (Linnaeus, 1758)	isabelita gris, chirivita, mariposa,	grey angelfish	0-100
Pomacanthus paru (Bloch, 1787)	isabelita negra, chirivita,	French angelfish	0-140
FAMILIA CIRRHITIDAE	HALCONCITOS	HAWKFISHES	
Amblycirrhitus pinos (Mowbray, 1927)	halconsito, halcón	redspotted hawkfish	2-46
FAMILIA POMACENTRIDAE	DAMISELAS	DAMSELFISHES	
Chromis cyanea (Poey, 1860)	burrito, jaqueta azul, cromis, chopita	blue chromis	0-110
Chromis enchrysura Jordan & Gilbert, 1882	damisela de arrecifes, cromis	yellowtail reeffish	0-170
Chromis insolata (Cuvier, 1830)	jaqueta gris, burrito, cromis, chopita	sunshinefish	0-300
Chromis multilineata (Guichenot,1853)	jaqueta parda, burrito, cromis, chopita	brown chromis	2-40
Chromis scotti Emery, 1968	jaqueta púrpura, cromis	purple reeffish	15-116
Microspathodon chrysurus (Cuvier, 1830)	damisela colirrubia, chopa	yellowtail damselfish	0-120
Stegastes fuscus (Cuvier, 1830)	leopoldito, maría molle, burrito,	dusky damselfish	0-200
Stegastes partitus Poey, 1868	damisela bicolor	bicolor damselfish	0-300
Stegastes planifrons Cuvier, 1830	damisela amarilla	threespot damselfish	1-30
Stegastes variabilis Castelnau, 1855	damisela chocolate	cocoa damselfish	0-240
FAMILIA LABRIDAE	DONCELLAS	WRASSES	
Bodianus pulchellus (Poey, 1860)	vieja lomonegro, capitán negro	spotfin hogfish	10-120
Bodianus rufus (Linnaeus, 1758)	loro capitán, pudiano, fino, oatilibí,	Spanish hogfish	0-100
Clepticus parrae (Bloch & Schneider, 1801)	doncella colilila	Creole wrasse	0-300
Decodon puellaris (Poey, 1860)	capitán colorado	red hogfish	10-280
Halichoeres bathyphilus (Beebe & Tee-Van, 1932)	doncella verde	greenband wrasse	20-190
Halichoeres caudalis (Poey, 1860)	doncella pintada	painted wrasse	10-100
Halichoeres cyanocephalus (Bloch, 1791)	doncella amarilla	yellowcheek wrasse	10-100
Halichoeres garnoti (Valenciennes, 1839)	doncella cabeciamarilla	yellowhead wrasse	0-80
Halichoeres radiatus (Linnaeus, 1758)	capitán de piedras	puddingwife	2-55
Lachnolaimus maximus (Walbaum, 1792)	capitán, doncella de pluma, peje perro	hogfish	0-50
Thalassoma bifasciatum (Bloch, 1791)	doncella cabeciazul, rabone	bluehead	0-100
Xirichthys martinicensis Valenciennes, 1840	navajón rosado	rosy razorfish	0-30
Xirichthys novacula (Linnaeus, 1758)	navajón perlado, doncellita	pearly razorfish	1-90

FAMILIA SCARIDAE	LOROS	PARROTFISHES	
Cryptotomus roseus Cope, 1871	loro boquiazul, cotorro	bluelip parrotfish	0-60
Nicholsina usta (Valenciennes, 1840)	loro esmeralda, cotorro	emerald parrotfish	1-73
Scarus coelestinus Valenciennes, 1839	judío, loro, cotorro	midnight parrotfish	5-75
Scarus taeniopterus Desmarest, 1831	princesa, loro, cotorro	princess parrotfish	0-110
Sparisoma atomarium (Poey, 1861)	loro parchoverde, cotorro	greenblotch parrotfish	20-55
Sparisoma aurofrenatum (Valencienns, 1839)	loro bandacolorada, cotorro	redband parrotfish	0-100
Sparisoma chrysopterum (Bloch & Schneider, 1801)	loro colirrojo, vieja, cotorro, loro verde	redtail parrotfish	1-15
Sparisoma radians (Valenciennes, 1839)	loro dientón, vieja, cotorro	bucktooth parrotfish	1-72
Sparisoma viride (Bonnaterre, 1788)	chaporra, loro verde, cotorro,	stoplight parrotfish	0-100
FAMILIA ZOARCIDAE	ANGUILETAS	EELPOUTS	
Pachycara sulaki Anderson, 1989	anguileta	Sulak's eelpout	2000-3510
FAMILIA CHIASMODONTIDAE	TRAGONES	SWALLOWERS	
Chiasmodon niger Johnson, 1864	tragón negro	black swallower	0-1500
Pseudoscopelus scriptus Lütken, 1892	tragón rayado	striped swallower	0-850
Pseudoscopelus scutatus Krefft, 1971	tragón escudado	shield swallower	
FAMILIA URANOSCOPIDAE	MIRONES	STARGAZERS	
Astroscopus y-graecum (Cuvier, 1829)	mirón moteado	southern stargazer	2-100
Gnathagnus egregius (Jordan & Thompson, 1905)	mirón pecoso	freckled stargazer	180-440
Kathetostoma cubana Barbour, 1941	mirón veteado	marbled stargazer	200-600
FAMILIA PERCOPHIDAE	CABECICHATOS	DUCKBILLS	
Bembrops anatirostris Ginsburg, 1955	cabecichato hocicudo	duckbill flathead	100-400
Bembrops gobioides (Goode, 1880)	cabecichato gobio	goby flathead	100-274
Bembrops macromma Ginsburg, 1955	cabecichato ojón	bigeye flathead	150-550
Bembrops magnisquamis Ginsburg, 1955	cabecichato áspero	largescale flathead	350-465
Bembrops ocellatus Thompson & Suttkus, 1998	cabecichato manchado	ocellate duckbill	394-579
Bembrops quadrisella Thompson & Suttkus, 1998	cabecichato ensillado	saddleback duckbill	347-914
Chrionema squamentum (Ginsburg, 1955)	cabecichato escamoso	scaly flathead	0-256
FAMILIA LABRISOMIDAE	BLENIOS LABRISOMIDIOS	LABRISOMIDS	
Labrisomus filamentosus Springer, 1960	blenio filamentoso, vieja, guavina	filamentous blenny	12-35
Malacoctenus boehlkei Springer, 1959	blenio de cristal, viejita	diamond blenny	5-70
Malacoctenus triangulatus (Springer, 1959)	blenio dorsomanchado, viejita	saddled blenny	0-40
Starksia hassi Klausewitz, 1958	blenio listablanca, viejita	ringed blenny	6-175
Starksia sluiteri (Metzelaar, 1919)	blenio cuadriculado, viejita	chessboard blenny	5-40
FAMILIA CHAENOPSIDAE	BLENIOS FINOS	PIKEBLENNIES	
Emblemaria piratula Ginsburg & Reid, 1942	blenio pirata, viejita	pirate blenny	0-30

Lucayablennius zingaro Böhlke, 1957	blenio puya, vieja	arrow blenny	13-106
FAMILIA CALLIONYMIDAE	DRAGONCITOS	DRAGONETS	
Foetorepus agassizii (Goode & Bean, 1888)	dragoncito aletimanchado	spotfin dragonet	90-700
Paradiplogrammus bairdi Jordan, 1888	dragoncito lancero	lancer dragonet	0-100
FAMILIA GOBIIDAE	GOBIOS	GOBIES	
Bollmannia boqueronensis Evermann & Marsh, 1899	gobio blanco, guaseta	white-eye goby	20-60
Coryphopterus eidolon Böhlke & Robins, 1960	gobio pálido, guaseta	pallid goby	6-30
Coryphopterus glaucofraenum Gill, 1863	gobio brida, guaseta	bridled goby	2-45
Coryphopterus hyalinus Böhlke & Robins, 1962	gobio vidrioso, guaseta	glass goby	0-52
C. personatus (Jordan & Thompson, 1904)	gobio máscara, guaseta	masked goby	3-46
Ctenogobius saepepallens Gilbert & Randall, 1968	gobio tasado, guaseta	dash goby	0-40
Ctenogobius stigmaturus (Goode & Bean, 1882)	gobio colimoteado, guaseta	spottail goby	0-60
Elacatinus chancei (Beebe & Hollister, 1933)	gobio raya chica, guaseta	shortstripe goby	10-30
Elacatinus evelynae (Böhlke & Robins, 1968)	gobio hocicudo, guaseta	sharknose goby	1-53
Elacatinus louisae (Böhlke & Robins, 1968)	gobio semáforo, guaseta	stoplight goby	13-45
Elacatinus oceanops Jordan, 1904	gobio de neón, guaseta	neon goby	0-45
Gnatholepis thompsoni Jordan, 1902	gobio dorado, guaseta	goldspot goby	0-50
Gobulus myersi Ginsburg, 1939	gobio lomoclaro, guaseta	slaty goby	0-50
Microgobius carri Fowler, 1945	gobio rayamarillo, guaseta	Seminole goby	0-30
Oxyurichthys stigmalophius (Mead & Böhlke, 1958)	gobio aletimanchado, guaseta	spotfin goby	0-60
Priolepis hipoliti (Metzelaar, 1922)	gobio mohoso, guaseta	rusty goby	0-130
FAMILIA MICRODESMIDAE	GUSANOS	WORMFISHES	
Cerdale floridana Longley, 1934	gusano quijada	pugjaw wormfish	0-30
Ptereleotris calliurus (Jordan & Gilbert, 1882)	gusano azul	blue wormfish	5-50
Ptereleotris helenae (Randall, 1968)	gusano flotador	hovering wormfish	3-60
FAMILIA EPHIPPIDAE	PAGUALAS	SPADEFISHES	
Chaetodipterus faber (Broussonet, 1782)	paguala, palaguala, isabelita,	Atlantic spadefish	3-35
Platax orbicularis (Forsskål, 1775)[22]	paguala aplastada	orbicular batfish	5-30
FAMILIA ACANTHURIDAE	MEDICOS	DOCTORFISHES	
Acanthurus bahianus Castelnau, 1855	cirujano, barbero, médico,	ocean surgeon	0-100
Acanthurus coeruleus Schneider, 1801	barbero, medico, navajón azul	blue tang	0-140
FAMILIA SCOMBROLABRACIDAE	MACARELAS DE ABISMOS	BLACK MACKERELS	
Scombrolabrax heterolepis Roule, 1922	macarela de abismos	longfin escolar	100-900

FAMILIA SPHYRAENIDAE	PICUAS	BARRACUDAS	
Sphyraena barracuda (Walbaum, 1792)	picúa, picúa brava, barracuda	great barracuda	0-120
Sphyraena picudilla Poey, 1860	picudilla, picuílla, picúa chin,	southern sennet	1-65
FAMILIA GEMPYLIDAE	ESCOLARES	SNAKE MACKERELS	
Diplospinus multistriatus Maul, 1948	escolar rayado	striped escolar	50-1000
Epinnula magistralis Poey, 1854	maestro	domine	400-500
Gempylus serpens Cuvier, 1829	macarela culebra	snake mackerel	0-600
Lepidocybium flavobrunneum (Smith, 1843)	escolar culebra	escolar	50-885
Nealotus tripes Johnson, 1865	macarela culebra negra	black snake mackerel	0-820
Neoepinnula orientalis (Gilchrist & von Bonde, 1924)	pez saco	sackfish	200-570
Nesiarchus nasutus Johnson, 1862	escolar negro	black gemfish	200-1200
Promethichthys prometheus (Cuvier, 1832)	conejo	roudi escolar	80-800
Ruvettus pretiosus Cocco, 1829	aceitero	oilfish	100-800
FAMILIA TRICHIURIDAE	MACHETES	CUTLASSFISHES	
Assurger anzac (Alexander, 1917)	machete lomoafilado	razorback scabbardfish	150-400
Benthodesmus simonyi (Steindachner, 1891)	machete de Simony	Simony's frostfish	200-900
Benthodesmus tenuis Günther, 1877	machete fino	slender frostfish	200-850
Evoxymetopon taeniatus Poey, 1863	tirano	tyrantfish	0-200
Trichiurus lepturus Linnaeus, 1758	machete, sable	Atlantic cutlassfish	0-400
FAMILIA XIPHIIDAE	PECES ESPADA	SWORDFISHES	
Xiphias gladius Linnaeus, 1758	pez espada, emperador	swordfish	0-800
FAMILIA ISTIOPHORIDAE	PECES DE PICO	BILLFISHES	
Istiophorus albicans (Latreille, 1804)[23]	pez vela, abanico	Atlantic sailfish	0-40
Makaira nigricans Lacepède, 1802	aguja azul	blue marlin	
Tetrapturus albidus Poey, 1860	aguja blanca	Atlantic white marlin	0-150
Tetrapturus pfluegeri Robins & de Sylva, 1963	aguja picuda	longbill spearfish	0-100
FAMILIA SCOMBRIDAE	ATUNES	TUNAS	
Acanthocybium solandri (Cuvier, 1832)	peto, carite tiburón	wahoo	
Auxis thazard (Lacepède, 1800)[24]	maduro, maúro, vaquita	frigate tuna	0-50
Euthynnus alletteratus (Rafinesque, 1810)	vaca, bonito, albacora, salmón	little tunny	1-150
Katsuwonus pelamis (Linnaeus, 1758)	bacora, albacore, bonito	skipjack tuna	0-260
Sarda sarda (Bloch, 1793)	bonito de afuera	Atlantic bonito	90-200
Scomberomorus brasiliensis Collette, Russo &	carite del Caribe, sierra	Atlantic sierra	

Scomberomorus cavalla (Cuvier, 1829)	carite, sierra, caballa, serrucho	king mackerel	0-140
Scomberomorus maculatus (Mitchill, 1815)	carite pintado, sierra	Spanish mackerel	10-35
Scomberomorus regalis (Bloch, 1793)	sierra, alasana, pintado, pintada,	cero	1-30
Thunnus alalunga (Bonnaterre, 1788)	albacora	albacore	0-600
Thunnus albacares (Bonnaterre, 1788)	atún aletiamarillo, albacore	yellowfin tuna	1-250
Thunnus atlanticus (Lesson, 1830)	atuncito, albacore, bonito	blackfin tuna	0-50
Thunnus obesus (Lowe, 1839)	atún ojón	bigeye tuna	0-250
Thunnus thynnus (Linnaeus, 1758)	atún aletiazul	bluefin tuna	0-100
FAMILIA CENTROLOPHIDAE	PECES DE AGUAVIVAS	MEDUSAFISHES	
Hyperoglyphe perciformis (Mitchill, 1818)	pez barril	barrelfish	60-130
FAMILIA NOMEIDAE	NAUFRAGOS	DRIFTFISHES	
Cubiceps pauciradiatus Günther, 1872	náufrago cabezón	longfin fathead	58-1000
Nomeus gronovii (Gmelin, 1788)	pastor	man-of-war fish	
Psenes cyanophrys Valenciennes, 1833	pecosa	freckled driftfish	0-550
Psenes maculates Lütken, 1880	naufrago plateado	silver driftfish	45-80
Ariomma bondi Fowler, 1930	arioma lucía	silver-rag	50-500
Ariomma melanum (Ginsburg, 1954)	arioma pardo	brown driftfish	180-600
Ariomma regulus (Poey, 1868)	arioma pintado	spotted driftfish	0-500
FAMILIA STROMATEIDAE	PALOMETAS	BUTTERFISHES	
Peprilus paru (Linnaeus, 1758)	papito, palometa	harvestfish	15-136
ORDEN PLEURONECTIFORMES	LENGUADOS	FLATFISHES	
FAMILIA PARALICHTHYIDAE	LENGUADOS DIENTUDOS	LARGETOOTH FLOUNDERS	
Ancylopsetta antillarum Gutherz, 1966	lenguado de tres ojos	Antillean three-eye flounder	412-458
Ancylopsetta dilecta (Goode & Bean, 1883)	lenguado lindo, tapaculo, arrevés	delightful three-eye flounder	
Citharichthys cornutus (Günther, 1880)	lenguado cornudo, tapaculo, arrevés	horned whiff	30-400
Citharichthys dinoceros Goode & Bean, 1886	lenguado largo, tapaculo, arrevés	elongated whiff	180-1800
C. gymnorhinos Gutherz & Blackman, 1970	lenguado aletivela, tapaculo, arrevés	anglefin whiff	30-200
Citharichthys macrops Dresel, 1885	lenguado pecoso, tapaculo, arrevés	spotted whiff	0-90
Citharichthys spilopterus Günther, 1862	lenguado de caletas, tapaculo, arrevés	bay whiff	0-80
Cyclopsetta fimbriata (Goode & Bean, 1885)	lenguado aletimoteado,	spotfin flounder	20-230
Etropus crossotus Jordan & Gilbert, 1882	lenguado listado, tapaculo, arrevés	fringed flounder	0-65
Paralichthys tropicus Ginsburg, 1933	lenguado tropical, tapaculo, arrevés	tropical flounder	0-185
Syacium gunteri Ginsburg, 1933	lenguado de bajos, tapaculo, arrevés	shoal flounder	0-95
Syacium micrurum Ranzani, 1840	lenguado de canales, tapaculo,	channel flounder	25-400

Syacium papillosum (Linnaeus, 1758)	lenguado prieto, tapaculo, arrevés	dusky flounder	10-140
FAMILIA BOTHIDAE	LENGUADOS OJISINIESTROS	LEFTEYE FLOUNDERS	
Bothus lunatus (Linnaeus, 1758)	lenguado lunado, tapaculo, arrevés	peacock flounder	0-100
Bothus ocellatus (Agassiz, 1831)	lenguado ocelado, tapaculo, arrevés	eyed flounder	0-360
Bothus robinsi Topp & Hoff, 1972	lenguado colimanchado, tapaculo,	spottail flounder	0-90
Chascanopsetta lugubris Alcock, 1894	lenguado lúgubre, tapaculo, arrevés	pelican flounder	60-977
Monolene atrimana Goode & Bean, 1886	lenguado del sur, tapaculo, arrevés	southern flounder	0-527
Trichopsetta ventralis (Goode & Bean, 1885)	lenguado bordeado, tapaculo, arrevés	sash flounder	30-110
FAMILIA PLEURONECTIDAE	LENGUADOS OJIDIESTROS	RIGHTEYE FLOUNDERS	
Poecilopsetta inermis (Breeder, 1927)	lenguado margenblanco, arrevés,	whitelined flounder	C, O, B,
Sinónimos menores:	tapaculo		182-793
Paralimanda inermis, Poecilopsetta albomarginata			
FAMILIA ACHIRIDAE	SUELAS AMERICANAS	AMERICAN SOLES	
Gymnachirus nudus Kaup, 1858	suela cebra, lenguado, arrevés,	zebra sole	37-100
Trinectes maculatus (Bloch & Schneider, 1801)	suela manchada, lenguado, arrevés,	hogchoker	0-75
FAMILIA CYNOGLOSSIDAE	LENGUADOS	TONGUEFISHES	
Symphurus arawak Robins & Randall, 1965	lenguado caribeño, lengua, arrevés	Caribbean tonguefish	3-39
Symphurus diomedeanus (Goode & Bean, 1886)	lenguado aletimanchado, lengua,	spottedfin tonguefish	6-183
Symphurus marginatus (Goode & Bean, 1886)	lenguado marginado, lengua, arrevés	margined tonguefish	37-750
Symphurus piger (Goode & Bean, 1888)	lenguado rayado de lo hondo, lengua,	deepwater tonguefish	70-549
Symphurus plagiusa (Linnaeus, 1766)	lenguado carinegro del Golfo, lengua,	blackcheek tonguefish	0-183
Symphurus plagusia (Bloch & Schneider, 1801)	lenguado carinegro del Caribe,	duskycheek tonguefish	1-75
Symphurus tessellatus (Quoy & Gaimard, 1824)	lenguado de lodazales, lengua,	mud tonguefish	1-275
ORDEN TETRAODONTIFORMES	TAMBORILES	PUFFERS	
FAMILIA TRIACANTHODIDAE	PECES PUA	SPIKEFISHES	
Hollardia hollardi Poey, 1861	pez púa cuadriculado	reticulate spikefish	200-920
Johnsonina eriomma Myers, 1934	pez púaojón	bullseye spikefish	
FAMILIA BALISTIDAE	PEJES PUERCO	LEATHERJACKETS	
Balistes capriscus Gmelin, 1789	peje puerco blanco	grey triggerfish	0-210
Balistes vetula Linnaeus, 1758	peje puerco, puerco, cochino,	queen triggerfish	0-380
Canthidermis maculata (Bloch, 1786)	turco manchado, lija	rough triggerfish	0-110
Canthidermis sufflamen (Mitchill, 1815)	turco, lija	ocean triggerfish	5-60

Melichthys niger (Bloch, 1786)	japonesa, tobi, galafate,	black durgon	0-75
Xanthichthys ringens (Linnaeus, 1758)	puerquito, cocuyo	sargassum triggerfish	0-240,
FAMILIA MONACANTHIDAE	LIJAS	FILEFISHES	
Aluterus heudelotii Hollard, 1855	lija pecosa, pereza	dotterel filefish	10-500
Aluterus monoceros (Linnaeus, 1758)	lija unicornio, pereza	unicorn filefish	1-50
Aluterus schoepfii (Walbaum, 1792)	lija naranja, pereza	orange filefish	3-900
Aluterus scriptus (Osbeck, 1765)	lija trompa, pereza	scrawled filefish	3-120
Cantherhines pullus (Ranzani, 1942)	lija motas naranja, pereza,	orangespotted filefish	3-50
Monacanthus ciliatus (Mitchill, 1818)	lija ribeteada, pereza, peje puerco	fringed filefish	0-50
Monacanthus tuckeri Bean, 1906	lija delgada, pereza	slender filefish	2-50
Stephanolepis hispidus (Linnaeus, 1766)	lija cabecichata, pereza	planehead filefish	0-80
Stephanolepis setifer (Bennett, 1831)	lija pigmea, pereza	pigmy filefish	0-80
FAMILIA OSTRACIIDAE	CHAPINES	BOXFISHES	
Acanthostracion polygonius Poey, 1876	chapín panal	honeycomb cowfish	3-80
Acanthostracion quadricornis (Linnaeus, 1758)	chapín veteado, toro	scrawled cowfish	0-80
Lactophrys bicaudalis (Linnaeus, 1758)	chapín moteado	spotted trunkfish	0-210
Lactophrys trigonus (LInnaeus, 1758)	chapín jorobado, gallina	buffalo trunkfish	2-50
Lactophrys triqueter (Linnaeus, 1758)	chapín liso	smooth trunkfish	0-50
FAMILIA TETRAODONTIDAE	TAMBORILES	PUFFERS	
Lagocephalus laevigatus (Linnaeus, 1766)	tambor liso, ratón, conejo, tamboril	smooth puffer	10-180
Lagocephalus lagocephalus (Linnaeus, 1758)	tambor oceánico, tamboril	oceanic puffer	10-476
Sphoeroides dorsalis Longley, 1934	tamboril veteado, tambor	marbled puffer	10-100
Sphoeroides marmoratus (Lowe, 1838)	tamboril lomoespinoso, tambor	Guinean puffer	0-100
Sphoeroides pachygaster (Müller & Troschel, 1848)	tamboril cabezón, tambor	blunthead puffer	50-480
Sphoeroides spengleri (Bloch, 1782)	tamboril colilistado, tambor	bandtail puffer	2-70
Sphoeroides testudineus (Linnaeus, 1758)	tamboril cuadriculado, tambor	checkered puffer	0-48
FAMILIA DIODONTIDAE	GUANABANOS	BURRFISHES	
Chilomycterus antillarum Jordan & Rutter, 1897	guanábano escamudo, puercoespín	web burrfish	1-44
Diodon holacanthus Linnaeus, 1758	guanábano moteado, puercoespín	balloonfish	2-100
Diodon hystrix Linnaeus, 1758	puercoespín, erizo, guanábano	porcupinefish	2-50
FAMILIA MOLIDAE	PECES SOL	MOLAS	
Masturus lanceolatus (Liénard, 1840)	pez sol colipuya, mola	sharptail mola	0-670
Mola mola (Linnaeus, 1758)	pez sol oceánico, mola	ocean sunfish	0-300

Appendix 3. Catch record of stations sampled during the NMFS-NOAA fishery survey where relatively high catches of commercially valuable snappers and groupers (> 20 pounds) were obtained.

Station	Latitude	Longitude	Depth (m)	Fish	# / Pounds	Cruise
37125	18.2666	-67.2500	380	G	1 / 33	R/V Delaware
37133	18.4666	-67.1833	265	G	1 / 31	R/V Delaware
37176	18.5166	-66.5166	362	G	1 / 26	R/V Delaware
37177	18.5166	-66.5166	362	S	2 / 23	R/V Delaware
37189	18.5166	-66.3666	329	G	2 / 54	R/V Delaware
37197	18.5333	-66.3500	432	G	1 / 58	R/V Delaware
37207	18.5166	-66.3666	316	S	2 / 39	R/V Delaware
37215	18.5166	-66.1333	329	G	2 / 83	R/V Delaware
37223	18.5000	-66.0666	342	S	3 / 22	R/V Delaware
37233	18.4833	-65.8166	294	S	5 / 20	R/V Delaware
37246	18.4833	-65.7333	289	G	1 / 32	R/V Delaware
37249	18.4833	-65.8666	256	G	2 / 61	R/V Delaware
37250	18.4833	-65.8333	276	G	1 / 35	R/V Delaware
37254	18.4833	-65.6666	274	S	5 / 24	R/V Delaware
37256	18.5000	-65.6666	411	S	5 / 29	R/V Delaware
37258	18.4833	-65.6166	296	G	1 / 65	R/V Delaware
37268	18.5333	-65.4000	293	G	1 / 46	R/V Delaware
37279	18.5333	-65.3000	369	S	3 / 9	R/V Delaware
37309	18.6166	-64.9666	336	G	1 / 40	R/V Delaware
37320	18.1833	-65.0833	313	G	1 / 31	R/V Delaware
37333	18.1000	-65.3000	384	G	1 / 44	R/V Delaware
31704	18.0416	-67.4250	274	S	40	R/V Delaware
31707	18.0633	-67.6383	282	S	70	R/V Delaware
31708	18.0716	-67.4700	282	S	52	R/V Delaware
31710	18.1010	-67.4683	207	S	20	R/V Delaware
31711	18.1200	-67.5033	282	S	70	R/V Delaware
31716	18.1883	-67.4733	252	S	82	R/V Delaware
31729	18.4250	-67.2366	355	G	117	R/V Delaware
31734	18.4150	-67.2433	304	G	33	R/V Delaware
31742	18.5816	-67.1816	285	G	26	R/V Delaware
31746	18.5416	-66.9200	485	S	31	R/V Delaware
31751	18.5216	-66.7183	443	G	120	R/V Delaware
31756	18.5316	-66.5100	410	G	53	R/V Delaware
31762	18.5200	-66.3666	249	G	20	R/V Delaware
31771	18.5350	-66.2050	611	S	21	R/V Delaware
31773	18.5000	-66.1800	450	G	75	R/V Delaware
31778	18.5016	-66.1133	379	S	35	R/V Delaware
31778	18.5016	-66.1133	379	G	50	R/V Delaware
31781	18.5166	-66.0033	355	G	44	R/V Delaware
31814	18.4850	-65.5533	346	S	20	R/V Delaware
31816	18.5133	-65.6600	443	S	20	R/V Delaware
31834	18.5250	-65.3900	331	S	43	R/V Delaware
31834	18.5250	-65.3900	331	G	68	R/V Delaware
31844	18.5700	-65.1366	267	S	46	R/V Delaware
31844	18.5700	-65.1366	267	G	39	R/V Delaware

31846	18.5800	-65.1066	161	S	36	R/V Delaware
31853	18.5833	-65.0583	291	S	51	R/V Delaware
31853	18.5833	-65.0583	291	G	253	R/V Delaware
31855	18.6016	-65.1083	479	S	91	R/V Delaware
31864	18.5800	-65.0616	174	S	59	R/V Delaware
2	18.5167	-66.4667	256 - 366	S	20	FRS Oregon II
2	18.5167	-66.4667	256 - 366	G	58	FRS Oregon II
3	18.5167	-66.4667	457 - 549	G	32	FRS Oregon II
5	18.5167	-66.2500	365	S	40	FRS Oregon II
5	18.5167	-66.2500	365	G	85	FRS Oregon II
6	18.4833	-66.0833	91 - 183	S	24	FRS Oregon II
8	18.5000	-65.9500	311 - 402	G	55	FRS Oregon II
10	18.4833	-65.9167	282 - 375	G	83	FRS Oregon II
12	18.5167	-66.0000	307 - 393	G	64	FRS Oregon II
13	18.5000	-65.9833	274 - 347	G	66	FRS Oregon II
15	18.4833	-65.8500	91 - 274	S	21	FRS Oregon II
16	18.5000	-65.8167	183 - 320	G	137	FRS Oregon II
17	18.5000	-65.9333	320 - 494	G	45	FRS Oregon II
18	18.4833	-65.8667	322 - 457	G	22	FRS Oregon II
20	18.4833	-65.6833	322 - 457	G	67	FRS Oregon II
21	18.5000	-65.6167	91 - 192	S	33	FRS Oregon II
23	18.4667	-65.7500	165 - 384	G	26	FRS Oregon II
24	18.5000	-65.5000	322 - 457	S	31	FRS Oregon II
24	18.5000	-65.5000	322 - 457	G	131	FRS Oregon II
25	18.4833	-65.4833	82 - 139	G	36	FRS Oregon II
28	18.5000	-65.4833	185 - 320	G	45	FRS Oregon II
29	18.5333	-65.3000	201 - 393	G	115	FRS Oregon II
31	18.5333	-65.2833	91 - 274	G	65	FRS Oregon II
33	18.4833	-65.5500	274 - 402	S	45	FRS Oregon II
33	18.4833	-65.5500	274 - 402	G	70	FRS Oregon II
34	18.4833	-65.5167	91 - 265	G	24	FRS Oregon II
36	18.5833	-65.0833	77 - 340	S	27	FRS Oregon II
38	18.4833	-65.4833	201 - 357	G	46	FRS Oregon II
39	18.5667	-65.0833	183 - 402	S	23	FRS Oregon II
40	18.6167	-65.9833	196 - 304	S	47	FRS Oregon II
41	18.5833	-65.1167	196 - 304	S	76	FRS Oregon II
41	18.5833	-65.1167	165 - 366	G	35	FRS Oregon II
42	18.5833	-65.0667	91 - 183	S	41	FRS Oregon II
43	18.6000	-65.0667	201 - 322	G	30	FRS Oregon II

Appendix 4. Taxonomic composition and abundance of fishes associated with the drop-off wall reef at a depth of 30 meters, Isla Desecheo 2004

	ABUNDANCE (Individuals/30m2)																			
DEPTH: 30 **m**																				
		TRANSECTS																		
TAXA	COMMON NAME	1	2	3	4	5	6	**Mean**							**Mean**	Study	Study	Var/X	Rel.
								Summer	1	2	3	4	5	6	**Winter**	Mean	Var		Abu.(%)
Chromis cyanea	Blue Chromis	75	150	150	105	75	130	**114.2**	1	32	1	26	63	28	**25.2**	79.18	2851.4	36.0	34.91
Clepticus parrae	Creole Wrasse	14	100	0	68	80	14	**46.0**	20	0	42	0	3	11	**12.7**	33.17	1136.8	34.3	14.62
Stegastes partitus	Bicolor Damselfish	24	26	22	26	30	13	**23.5**	26	41	27	39	36	23	**32.0**	29.71	57.4	1.9	13.10
Gramma loreto	Royal Gramma	31	30	2	21	3	4	**15.2**	13	12	1	4	17	19	**11.0**	14.35	105.1	7.3	6.33
Coryphopterus (glaucofraenum)	Bridled Goby	8	16	19	14	23	9	**14.8**	5	13	6	8	11	18	**10.2**	13.74	29.7	2.2	6.06
Coryphopterus personatus	Masked Goby	35	41	12	0	0	15	**17.2**	0	0	0	0	0	17	**2.8**	11.43	201.0	17.6	5.04
Chromis multilineata	Brown Chromis	0	0	0	16	14	1	**5.2**	42	12	0	0	15	6	**12.5**	9.26	141.5	15.3	4.08
Halichoeres garnoti	Yellowhead Wrasse	10	10	5	9	13	16	**10.5**	11	1	8	5	9	7	**6.8**	9.54	14.5	1.5	4.21
Thalassoma bifasciatum	Blue-head Wrasse	0	13	6	10	5	3	**6.2**	5	7	3	16	12	5	**8.0**	7.60	20.5	2.7	3.35
Gobiosoma evelynae	Sharknose Goby	2	5	3	1	7	10	**4.7**	4	3	11	4	7	20	**8.2**	6.81	25.6	3.8	3.00
Coryphopterus lipernes	Peppermint Goby	3	7	2	1	1	13	**4.5**	0	1	4	1	7	19	**5.3**	5.29	30.9	5.8	2.33
Cephalopholis fulva	Coney	3	3	4	3	4	2	**3.2**	8	2	4	5	2	4	**4.2**	3.93	2.6	0.7	1.73
Paranthias furcifer	Creole Fish	0	6	7	6	1	1	**3.5**	2	2	2	2	2	2	**2.0**	3.04	4.7	1.6	1.34
Sparisoma aurofrenatum	Red-band Parrotfish	0	2	3	0	1	1	**1.2**	2	3	2	2	2	1	**2.0**	1.68	0.9	0.5	0.74
Cephalopholis cruentatus	Graysbe	1	0	1	1	1	0	**0.7**	0	1	9	0	2	2	**2.3**	1.56	5.6	3.6	0.69
Serranus tigrinus	Harlequin Bass	0	0	2	1	4	1	**1.3**	2	2	2	1	1	1	**1.5**	1.53	1.1	0.7	0.67
Chaetodon capistratus	Four-eye Butterflyfish	4	2	2	0	0	2	**1.7**	2	0	0	2	2	0	**1.0**	1.47	1.6	1.1	0.65
Chromis insolatus	Sunshine Chromis	3	6	3	0	0	4	**2.7**	0	0	0	0	0	0	**0.0**	1.56	4.2	2.7	0.69
Scarus iserti	Striped Parrotfish	0	0	0	1	1	2	**0.7**	3	0	5	0	0	4	**2.0**	1.39	2.9	2.1	0.61
Holocentrus rufus	Squirrelfish	0	1	1	4	0	1	**1.2**	2	2	2	1	0	1	**1.3**	1.35	1.2	0.9	0.59
Pseudupeneus maculatus	Spotted Goatfish	3	1	0	0	3	4	**1.8**	3	1	0	0	0	0	**0.7**	1.40	2.2	1.6	0.62

Melichthys niger	Black Durgon	1	1	1	1	0	0	**0.7**	1	1	3	2	0	0	**1.2**	0.97	0.7	0.8	0.43
Acanthurus coeruleus	Blue Tang	0	0	1	1	1	1	**0.7**	1	1	1	0	0	1	**0.7**	0.72	0.2	0.3	0.32
Epinephelus guttatus	Red Hind	1	2	0	0	1	0	**0.7**	0	0	1	2	0	1	**0.7**	0.72	0.6	0.8	0.32
Opistognathus aurifrons	Yellowhead Jawfish	0	0	6	0	0	0	**1.0**	0	0	2	0	0	0	**0.3**	0.75	2.9	3.9	0.33
Sparisoma radians	Bucktooth Parrotfish	0	5	0	0	0	0	**0.8**	0	0	0	1	0	2	**0.5**	0.74	2.1	2.8	0.32
Holacanthus tricolor	Rock Beauty	0	0	0	2	1	1	**0.7**	0	1	1	0	0	1	**0.5**	0.64	0.4	0.6	0.28
Amblicirrhitos pinnos	Red-spotted Hawkfish	0	2	0	0	1	0	**0.5**	1	0	2	0	0	0	**0.5**	0.54	0.6	1.1	0.24
Bodianus rufus	Spanish Hogfish	0	1	0	0	0	1	**0.3**	1	0	0	0	1	2	**0.7**	0.53	0.4	0.8	0.23
Chaetodon aculeatus	Longsnout Butterflyfish	0	0	0	0	0	1	**0.2**	0	0	1	1	1	2	**0.8**	0.51	0.4	0.8	0.23
Lutjanus mahogany	Mahogany Snapper	0	0	0	0	0	6	**1.0**	0	0	0	0	0	0	**0.0**	0.58	2.8	4.7	0.26
Xanthichthys ringens	Sargassum Triggerfish	0	0	0	0	0	1	**0.2**	0	0	0	1	2	2	**0.8**	0.51	0.6	1.2	0.23
Canthigaster rostrata	Sharpnose Puffer	1	1	0	0	2	1	**0.8**	0	0	0	0	0	0	**0.0**	0.49	0.4	0.9	0.21
Halichoeres maculipinna	Clown Wrasse	0	0	0	1	1	1	**0.5**	0	0	1	1	0	0	**0.3**	0.46	0.2	0.5	0.20
Holacanthus ciliaris	Queen Angelfish	0	2	1	0	0	2	**0.8**	0	0	0	0	0	0	**0.0**	0.49	0.6	1.2	0.21
Lactophrys triqueter	Smooth Trunkfish	1	1	0	0	0	1	**0.5**	0	1	0	1	0	0	**0.3**	0.46	0.2	0.5	0.20
Scomberomorus regalis	Cero	0	3	0	2	0	0	**0.8**	0	0	0	0	0	0	**0.0**	0.49	0.9	1.9	0.21
Chaetodon sedentarius	Reef Butterflyfish	0	0	0	0	0	2	**0.3**	0	2	0	0	0	0	**0.3**	0.36	0.6	1.5	0.16
Acanthostrascion polygonus	Honeycomb Trunkfish	0	1	0	0	0	1	**0.3**	0	0	0	0	0	1	**0.2**	0.28	0.2	0.7	0.12
Caranx hippos	Horse-eye Jack	0	0	0	0	2	0	**0.3**	0	0	0	0	0	1	**0.2**	0.28	0.4	1.3	0.12
Chaetodon striatus	Banded Butterflyfish	0	2	0	0	0	1	**0.5**	0	0	0	0	0	0	**0.0**	0.29	0.4	1.2	0.13
Scarus vetula	Queen Parrotfish	1	0	0	1	0	0	**0.3**	0	1	0	0	0	0	**0.2**	0.28	0.2	0.7	0.12
Sparisoma viride	Stoplight Parrotfish	1	1	0	0	0	0	**0.3**	0	0	0	1	0	0	**0.2**	0.28	0.2	0.7	0.12
Caranx lugubris	Black Jack	0	1	0	0	0	0	**0.2**	0	0	1	0	0	0	**0.2**	0.18	0.1	0.8	0.08
Acanthurus chirurgus	Doctorfish	0	0	0	0	1	0	**0.2**	0	0	0	0	0	0	**0.0**	0.10	0.1	0.8	0.04
Balistes vetula	Queen Triggerfish	0	0	0	0	1	0	**0.2**	0	0	0	0	0	0	**0.0**	0.10	0.1	0.8	0.04
Carangoides ruber	Bar Jack	0	0	0	0	0	0	**0.0**	0	0	1	0	0	0	**0.2**	0.08	0.1	0.9	0.04
Centropyge argi	Cherubfish	0	1	0	0	0	0	**0.2**	0	0	0	0	0	0	**0.0**	0.10	0.1	0.8	0.04
Halichoeres radiatus	Puddinwife	0	0	0	0	0	0	**0.0**	1	0	0	0	0	0	**0.2**	0.08	0.1	0.9	0.04
Kyphosus sp.	Bermuda Chub	0	0	0	0	0	1	**0.2**	0	0	0	0	0	0	**0.0**	0.10	0.1	0.8	0.04
Microspathodon chrysurus	Yellowtail Damselfish	0	0	0	1	0	0	**0.2**	0	0	0	0	0	0	**0.0**	0.10	0.1	0.8	0.04
Muraena sp.	Moray Eel	0	0	0	0	0	1	**0.2**	0	0	0	0	0	0	**0.0**	0.10	0.1	0.8	0.04

	Ind./Transect	222	443	253	296	277	268	**293.2**	156	142	143	126	195	201	**160.5**	251.26			
	Species/Transect	20	31	21	23	26	31		21	22	26	22				48			
	New Species		13	3	5	3	4		1	0	1	0							
	Total Species	20	33	36	41	44	48		49	49	50	50							

Appendix 5. Taxonomic composition and abundance of fishes associated with the drop-off wall reef at a depth of 40 meters, Isla Desecheo 2004

ABUNDANCE
(Individuals/30m2)

DEPTH: 40 **m**

		TRANSECTS																
TAXA	**COMMON NAME**	**1**	**2**	**3**	**4**	**5**	**6**			**(October - March, 2005)**				**MEAN**	**STDEV**	**Var**	**Var/X**	**Rel. Abu**
		June-August, 2004						**1**	**2**	**3**	**4**	**5**	**6**					
Chromis cyanea	Blue Chromis	210	10	5	350	200	60	4	68	46	22	93	78	**95.50**	105.68	11168.6	116.9	42.7
Coryphopterus personatus	Masked Goby	130	23	25	175	40	55	7	15	37	15	1	31	**46.17**	52.71	2778.0	60.2	20.6
Clepticus parrae	Creole Wrasse	0	0	0	150	200	50	20	0	12	0	0	3	**36.25**	67.27	4525.8	124.9	16.2
Chromis insolatus	Sunshine Chromis	26	7	6	27	50	4	2	23	38	3	7	55	**20.67**	18.93	358.2	17.3	9.2
Coryphopterus sp.	Goby	18	30	16	10	15	11	12	9	14	23	12	13	**15.25**	6.02	36.2	2.4	6.8
Stegastes partitus	Bicolor Damselfish	5	9	17	11	9	18	14	14	10	22	25	26	**15.00**	6.73	45.3	3.0	6.7
Gramma loreto	Royal Gramma	8	16	18	25	17	1	5	8	5	8	16	32	**13.25**	9.10	82.8	6.2	5.9
Halichoeres garnoti	Yellowhead Wrasse	13	6	4	10	10	7	3	7	8	9	3	7	**7.25**	3.02	9.1	1.3	3.2
Holocentrus rufus	Squirerlfish	0	3	3	5	23	0	5	6	26	3	9	1	**7.00**	8.59	73.8	10.5	3.1
Coryphopterus lipernes	Peppermint Goby	1	1	0	0	12	4	0	1	5	3	11	22	**5.00**	6.76	45.6	9.1	2.2
Thalassoma bifasciatum	Blue-head Wrasse	2	15	1	1	1	1	1	6	4	4	3	6	**3.75**	4.03	16.2	4.3	1.7
Paranthias furcifer	Creole Fish	3	4	2	2	6	2	3	2	3	5	4	2	**3.17**	1.34	1.8	0.6	1.4
Cephalopholis fulva	Coney	2	2	5	2	2	3	7	3	0	2	2	2	**2.67**	1.78	3.2	1.2	1.2
Gobiosoma evelynae	Sharknose Goby	1	0	0	0	3	3	0	2	1	2	10	6	**2.33**	2.99	9.0	3.8	1.0
Xanthichthys ringens	Sargassum Triggerfish	1	5	1	2	1	2	1	1	3	1	4	3	**2.08**	1.38	1.9	0.9	0.93
Cephalopholis cruentatus	Graysbe	1	0	0	0	2	2	0	4	3	0	3	2	**1.42**	1.44	2.1	1.5	0.63
Epinephelus guttatus	Red Hind	1	1	0	0	2	0	1	4	2	2	2	1	**1.33**	1.15	1.3	1.0	0.60
Scarus iserti	Striped Parrotfish	0	0	0	3	1	0	0	0	1	4	2	4	**1.25**	1.60	2.6	2.1	0.56
Holacanthus tricolor	Rock Beauty	1	1	0	1	2	2	0	0	3	2	1	1	**1.17**	0.94	0.9	0.8	0.52
Serranus tigrinus	Harlequin Bass	1	2	1	4	0	1	1	0	1	1	0	1	**1.08**	1.08	1.2	1.1	0.48
Chaetodon aculeatus	Longsnout Butterflyfish	0	0	1	1	0	2	2	0	1	2	1	2	**1.00**	0.85	0.7	0.7	0.45
Chaetodon capistratus	Four-eye Butterflyfish	0	2	1	0	2	2	0	2	0	0	0	1	**0.83**	0.94	0.9	1.1	0.37
Sparisoma aurofrenatum	Red-band Parrotfish	0	1	2	0	1	0	1	1	1	0	2	1	**0.83**	0.72	0.5	0.6	0.37

Apogon sp.	Cardinalfish	0	0	0	0	0	0	0	3	0	0	3	3	**0.75**	1.36	1.8	2.5	0.34
Centropyge argi	Cherubfish	0	0	0	1	0	0	0	3	2	3	0	0	**0.75**	1.22	1.5	2.0	0.34
Chromis multilineata	Yellow-edge Chromis	0	0	0	0	0	1	0	1	0	0	7	0	**0.75**	2.01	4.0	5.4	0.34
Sparisoma radians	Bucktooth Parrotfish	0	0	0	0	0	0	0	3	0	0	4	2	**0.75**	1.42	2.0	2.7	0.34
Acanthurus coeruleus	Blue Tang	0	0	1	0	0	1	0	0	1	0	3	1	**0.58**	0.90	0.8	1.4	0.26
Chaetodon sedentarius	Reef Butterflyfish	1	0	0	0	0	2	1	0	0	0	2	0	**0.50**	0.80	0.6	1.3	0.22
Lutjanus mahogany	Mahogany Snapper	0	0	0	0	0	3	0	0	0	0	2	1	**0.50**	1.00	1.0	2.0	0.22
Caranx hippos	Horse-eye Jack	0	0	0	0	0	0	3	2	0	0	0	0	**0.42**	1.00	1.0	2.4	0.19
Halichoeres maculipinna	Clown Wrasse	0	0	0	0	0	0	0	0	2	0	0	3	**0.42**	1.00	1.0	2.4	0.19
Amblicirrhitos pinnos	Redspotted Hawkfish	1	0	0	0	0	0	0	1	0	1	1	0	**0.33**	0.49	0.2	0.7	0.15
Canthigaster rostrata	Sharpnose Puffer	0	1	1	0	0	0	0	1	0	0	1	0	**0.33**	0.49	0.2	0.7	0.15
Melichthys niger	Black Durgon	0	1	0	0	0	1	0	0	0	0	0	2	**0.33**	0.65	0.4	1.3	0.15
Pseudupeneus maculatus	Spotted Goatfish	0	0	0	0	0	0	1	0	0	1	1	1	**0.33**	0.49	0.2	0.7	0.15
Chaetodon striatus	Banded Butterflyfish	0	0	1	0	1	1	0	0	0	0	0	0	**0.25**	0.45	0.2	0.8	0.11
Holacanthus ciliaris	Queen Angelfish	1	0	2	0	0	0	0	0	0	0	0	0	**0.25**	0.62	0.4	1.5	0.11
Balistes vetula	Queen Triggerfish	1	0	0	0	0	0	0	0	0	0	0	1	**0.17**	0.39	0.2	0.9	0.07
Lactophrys trigonus	Honeycomb Trunkfish	0	0	0	0	0	0	0	1	1	0	0	0	**0.17**	0.39	0.2	0.9	0.07
Sparisoma sp.	Parrotfish	0	0	0	0	1	0	0	1	0	0	0	0	**0.17**	0.39	0.2	0.9	0.07
Acanthostrascion quadricornis	Honeycomb Trunkfish	0	0	0	0	1	0	0	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Acanthurus chirurgus	Doctorfish	0	0	0	0	0	0	1	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Cantherhines macrocerus	Whitespotted Filefish	0	1	0	0	0	0	0	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Caranx lugubris	Black Jack	0	0	0	0	0	0	0	1	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Diodon histrix	Porcupinefish	0	0	0	0	0	0	1	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Flammeo marianus	Longspine Squirrelfish	0	0	0	0	1	0	0	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Gymnothorax moringa	Spotted Moray	0	0	0	0	0	0	0	0	1	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Halichoeres radiatus	Puddinwife	0	0	0	0	0	0	0	0	0	0	0	1	**0.08**	0.29	0.1	1.0	0.04
Holocentrus adscencionis	Longjaw Squirrelfish	1	0	0	0	0	0	0	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Hypoplectrus puella	Barred Hamlet	0	0	0	0	0	0	0	0	0	0	0	1	**0.08**	0.29	0.1	1.0	0.04
Lactophrys bicaudalis	Spotted Trunkfish	0	0	0	0	0	0	0	1	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Pomacanthus paru	French Angelfish	0	0	0	0	0	0	1	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Rypticus saponaceous	Soapfish	0	0	0	0	0	0	0	0	0	1	0	0	**0.08**	0.29	0.1	1.0	0.04
Scomberomorus regalis	Cero	0	0	1	0	0	0	0	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Sparisoma viride	Stoplight Parrotfish	0	0	0	0	0	0	0	0	1	0	0	0	**0.08**	0.29	0.1	1.0	0.04
Sphyraena barracuda	Great Barracuda	0	0	1	0	0	0	0	0	0	0	0	0	**0.08**	0.29	0.1	1.0	0.04

	# Ind./Transect	219	131	110	430	403	179	97	194	232	139	235	316	**223.75**
	Species/Transect	22	21	22	18	25	25	23	29	27	23	28	33	**57**
Outside transects:	**New Species**		6	5	3	3	2	5	5	3	1	0	2	
	Total Species		28	33	36	39	41	46	51	54	55	55	57	